SOLUBILITY DATA SERIES

Volume 45/46

GASES IN MOLTEN SALTS
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Robert Maxwell
Publisher at Pergamon Press

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SOLUBILITY DATA SERIES

Volume 45/46

GASES IN MOLTEN SALTS

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The Solubility Data Series is a project of Commission V.8 (Solubility Data) of the International Union of Pure and Applied Chemistry (IUPAC). The project had its origins in 1973, when the analytical Chemistry Division of IUPAC set up a Subcommission on Solubility Data under the chairmanship of the late Prof. A.S. Kertes. When publication of the Solubility Data Series began in 1979, the Committee became a full commission of IUPAC, again under the chairmanship of Prof. Kertes, who also became Editor-In-Chief of the Series. The Series has as its goal the preparation of a comprehensive and critical compilation of data on solubilities in all physical systems, including gases, liquids and solids.

The motivation for the Series arose from the realization that, while solubility data are of importance in a wide range of fields in science and technology, the existing data had not been summarized in a form that was at the same time comprehensive and complete. Existing compilations of solubility data indeed existed, but they contained many errors, were in general uncritical, and were seriously out-of-date.

It was also realized that a new series of compilations of data gave educational opportunities, in that careful compilations of existing data could be used to demonstrate what constitutes data of high and lasting quality. As well, if the data were summarized in a sufficiently complete form, any individual could prepare his or her own evaluation, independently of the published evaluation. Thus, a special format was established for each volume, consisting of individual data sheets for each separate publication, and critical evaluations for each separate system, provided sufficient data from different sources were available for comparison. The compilations and, especially, the evaluations were to be prepared by active scientists who were either involved in producing new data, or were interested in using data of high quality. With minor modifications in format, this strategy has continued throughout the Series.

In the standard arrangement of each volume, the Critical Evaluation gives the following information:

(i) A text which discusses the numerical solubility information which has been abstracted from the primary sources in the form of compilation sheets. The text concerns primarily the quality of the data, after consideration of the purity of the materials and their characterization, the experimental method used, the uncertainties in the experimental values, the reproducibility, the agreement with accepted test values, and, finally, the fitting of the data to suitable functions, along with statistical tests of the fitted data.

(ii) A set of recommended data, whenever possible, including weighted averages and estimated standard deviations. If applicable, one or more smoothing equations which have been computed or verified by the evaluator are also given.

(iii) A graphical plot of the recommended data, in the form of phase diagrams where appropriate.

The Compilation part consists of data sheets which summarize the experimental data from the primary literature. Here much effort is put into obtaining complete coverage; many good data have appeared in publications from the late nineteenth and early twentieth centuries, or in obscure journals. Data of demonstrably low precision are not compiled, but are mentioned in the Critical Evaluation. Similarly, graphical data, given the uncertainty of accurate conversion to numerical values, are compiled only where no better data are available. The documentation of data of low precision can serve to alert researchers to areas where more work is needed.
A typical data sheet contains the following information:

(i) list of components: names, formulas, Chemical Abstracts Registry Numbers;
(ii) primary source of the data;
(iii) experimental variables;
(iv) compiler's name;
(v) experimental values as they appear in the primary source, in modern units with explanations if appropriate;
(vi) experimental methods used;
(vii) apparatus and procedure used;
(viii) source and purity of materials used;
(ix) estimated error, either from the primary source or estimated by the compiler;
(x) references relevant to the generation of the data cited in the primary source.

Each volume also contains a general introduction to the particular type of system, such as solubility of gases, of solids in liquids, etc., which contains a discussion of the nomenclature used, the principle of accurate determination of solubilities, and related thermodynamic principles. This general introduction is followed by a specific introduction to the subject matter of the volume itself.

The Series embodies a new approach to the presentation of numerical data, and the details continue to be influenced strongly by the perceived needs of prospective users. The approach used will, it is hoped, encourage attention to the quality of new published work, as authors become more aware that their work will attain permanence only if it meets the standards set out in these volumes. If the Series succeeds in this respect, even partially, the Solubility Data Commission will have justified the labour expended by many scientists throughout the world in its production.

January, 1989

J.W. Lorimer,
London, Canada
PREFACE

This volume in the Solubility Data Series contains tabulated collections and critical evaluations of original data for the solubility of gases in molten salts. Most of the solubilities were measured as a function of temperature above the melting point of the molten salt system. Some studies were made at different pressures. Where possible data are also reported in terms of a smoothing equation which represents the solubility or the Henry's law constant as a function of temperature. Heats of solution and entropies of solution are also reported where available.

Within the volume, material is arranged according to the individual gas. The gases include hydrogen halides, inert gases, oxygen, nitrogen, hydrogen, carbon dioxide, water vapor and halogens. The molten salt solvents consist of both single salts, binary mixtures and multicomponent systems. A special section on solubilities of gases in molten silicate systems is also included with the focus on slags and fluxes.

The data were gathered from a search of the chemical literature through the end of 1989, and make up a unique and valuable survey of the solubility of gases in molten salts.

The solubility of gases in molten salts has important implications in the various technological applications of molten salts. Some of these applications include high temperature molten salt batteries, extractive metallurgical processes such as the extraction of aluminum by electrolysis of fused chlorides, synthesis using molten salt systems, and energy storage in molten salts.

The editors would like to acknowledge the help and advice from several fellow members of the IUPAC commission on Solubility Data and in particular Professor Larry Clever (Emory University) and Dr. Peter Fogg (U.K.).

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September 1990.
INTRODUCTION TO THE SOLUBILITY OF GASES IN MOLTEN SALTS
R. P. T. TOMKINS and N. P. BANSAL

INTRODUCTION
The Solubility Data Project aims to make a comprehensive search of the literature for data on the solubility of gases, liquids and solids in liquids. Data of suitable accuracy are compiled on data sheets set out in a uniform format. The data for each system are evaluated and where data of sufficient accuracy are available, recommended values are advanced and in some cases a smoothing equation suggested to represent the variation of solubility with pressure and/or temperature. A text giving an evaluation and recommended values and the compiled data sheets are published on consecutive pages.

DEFINITION OF GAS SOLUBILITY
The distinction between vapor-liquid equilibria and solubility of gases in liquids is arbitrary. It is generally accepted that the equilibrium set up at 300K between a typical gas such as argon and a liquid such as water is gas liquid solubility, whereas the equilibrium set up between hexane and cyclohexane at 350K is an example of vapor-liquid equilibrium. However, the distinction between gas-liquid solubility and vapor-liquid equilibrium is often not so clear. The equilibria set up between methane and propane above the critical temperature of methane and below the critical temperature of propane may be classed as vapor-liquid equilibrium or as gas-liquid solubility depending on the particular range of pressure considered and the particular worker concerned.

The difficulty partly stems from our inability to rigorously distinguish between a gas, a vapor, and a liquid, which has been discussed in numerous textbooks. We have taken a fairly liberal view in these volumes and have included systems which may be regarded, by some workers, as vapor-liquid equilibria.

UNITS AND QUANTITIES
The solubility of gases in molten salts is of interest to a wide range of scientific and technological disciplines and not solely to chemistry. Therefore a variety of ways for reporting gas solubility have been used in the primary literature and inevitably sometimes, because of insufficient available information, it has been necessary to use several quantities in the compiled tables. Where possible, the gas solubility has been quoted as a mole fraction of the gaseous component in the liquid phase. The units of pressure used are bar, pascal, millimeters of mercury and atmosphere. Temperatures are reported in kelvins. Heats of solution data are given in KJ mol⁻¹.

EVALUATION AND COMPILATION
The solubility of comparatively few systems is known with sufficient accuracy to enable a set of recommended values to be presented. This is true both for measurement near atmospheric pressure and at high pressures. Although a considerable number of systems have been studied by at least two workers, the range of pressures and/or temperatures is often sufficiently different to make meaningful comparison impossible.

Occasionally, it is not clear why two groups of workers obtained very different sets of results at the same temperature and pressure, although both sets of results were obtained by reliable methods and are internally consistent. In such cases, sometimes an incorrect assessment has been given.

There are several examples where two or more sets of data have been classified as tentative although the sets are mutually inconsistent.

PURITY OF MATERIALS
The purity of materials has been quoted in the compiled tables where given in the original publication. The solubility is usually more sensitive to impurities in the gaseous component than to liquid...
impurities in the liquid component. However, the most important impurities are traces of a gas dissolved in the liquid. Inadequate degassing of absorbing liquid is probably the most often overlooked serious source of error in gas solubility measurements.

APPARATUS AND PROCEDURES
In the compiled tables some key points are made of the apparatus and procedure. There are several reviews on experimental methods of determining gas solubilities in molten salts and these are given in references 1 - 16.

METHODS OF EXPRESSING GAS SOLUBILITIES
Because gas solubilities are important for many different scientific and engineering problems, they have been expressed in a great many ways:

The mole fraction, $x(g)$

The mole fraction solubility for a binary system is given by:

$$x(g) = \frac{n(g)}{n(g) + n(l)} = \frac{W(g)/M(g)}{[W(g)/M(g)] + [W(l)/M(l)]}$$

where $n$ is the number of moles of a substance (an amount of substance) $W$ is the mass of a substance, and $M$ is the molecular mass. To be unambiguous, the partial pressure of the gas (or the total pressure) and the temperature of measurement must be specified.

The Mass Per Cent Solubility, 100W

For a binary system this is given by

$$\text{wt} \% = 100 \frac{W(g)}{[W(g) + W(l)]}$$

where $W$ is the weight of the substance. As in the case of mole fraction, the pressure (partial or total) and the temperature must be specified.

The Mass Solubility, $C_w$

The mass solubility is the number of moles of dissolved gas per unit mass of solvent when the partial pressure of gas is 1 atmosphere. The mass solubility is related to the mole fraction solubility at one atmosphere partial pressure by

$$x(g) \ (\text{partial pressure 1 atm}) = \frac{C_w M(l)}{1 + C_w M(l)}$$

where $M(l)$ is the molecular weight of the solvent.

The Amount concentration, $n$

Often for multicomponent systems the density of the liquid mixture is not known and the solubility is quoted as moles of gas per unit volume of liquid mixture. This is related to the mole fraction solubility by

$$x = \frac{n v^o(l)}{1 + n v^o(l)}$$

where $v^o(l)$ is the molar volume of the liquid component.
The Bunsen Coefficient, \( \alpha \)

The Bunsen coefficient is defined as the volume of gas reduced to 273.15 K and 1 atmosphere pressure which is absorbed by unit volume of solvent (at the temperature of measurement) under a partial pressure of 1 atmosphere. If ideal gas behaviour and Henry's law is assumed to be obeyed,

\[
\alpha = \frac{V(g)}{V(l)} \frac{T_o}{T}
\]

where \( V(g) \) is the volume of gas absorbed and \( V(l) \) is the original (starting) volume of absorbing solvent and \( T_o = 273.15 \) K. The mole fraction solubility is related to the Bunsen coefficient by

\[
x(g, 1 \text{ atm}) = \frac{\alpha}{\alpha + \frac{T_o}{T} \frac{\nu^o(g)}{\nu^o(l)}}
\]

where \( \nu^o(g) \) and \( \nu^o(l) \) are the molar volumes of gas and solvent at a pressure of one atmosphere. If the gas is ideal,

\[
x(g) = \frac{\alpha}{\alpha + \frac{T_o}{\nu^o(l)}}
\]

Real gases do not follow the ideal gas law and it is important to establish the real gas law used for calculating \( \alpha \) in the original publication and to make the necessary adjustments when calculating the mole fraction solubility.

The Kuenen Coefficient, \( S \)

This is the unit mass of gas, reduced to 273.15 K and 1 atmosphere pressure, dissolved at a partial pressure of gas of 1 atmosphere by unit mass of solvent.

The Ostwald Coefficient, \( L \)

The Ostwald coefficient, \( L \), is defined at the ratio of the volume of gas absorbed to the volume of the absorbing liquid, all measured at the same temperature:

\[
L = \frac{V(g)}{V(l)}
\]

If the gas is ideal and Henry's law is applicable, the Ostwald coefficient is independent of the partial pressure of the gas. It is necessary, in practice, to state the temperature and the total pressure for which the Ostwald coefficient is measured.

The mole fraction solubility, \( x \), is related to the Ostwald coefficient by

\[
x(g) = \left( \frac{RT}{P(g) L \nu^o(l)} + 1 \right)^{-1}
\]

where \( P \) is the partial pressure of gas. The mole fraction solubility will be at a partial pressure of \( P(g) \).
The Absorption Coefficient, $\beta$

There are several "absorption coefficients", the most commonly used one being defined as the volume of the gas, reduced to 273.15K and 1 atmosphere, absorbed per unit volume of the liquid when the total pressure is one atmosphere, $\beta$ is related to the Bunsen coefficient by

$$\beta = \alpha [1 - P(1)]$$

where $P(1)$ is the partial pressure of the liquid in atmospheres.

The Henry's Law Constant

A generally used formulation of Henry's law may be expressed as

$$P(g) = K_H x(g)$$

where $K_H$ is the Henry's law constant and $x$ the mole fraction solubility. The other formulations are

$$P(g) = K_2 C(1) \text{ or } C(g) = K_C C(1)$$

where $K_2$ and $K_C$ are constants, $C$ the concentration, and (1) and (g) refer to the liquid and the gas phases. Unfortunately, $K_H$, $K_2$, $K_C$ are all sometimes referred to as Henry's Law constants. Henry's law is a limiting law but can sometimes be used for converting solubility data from the experimental pressure to a partial gas pressure of 1 atmosphere, provided the mole fraction of the gas in the liquid is small, and that the difference in pressures is small. Great caution must be exercised in using Henry's law.

The Mole Ratio, $N$

The mole ratio, $N$, is defined by

$$N = \frac{n(g)}{n(1)}$$

Table 1 contains a presentation of the most commonly used interconversions not already discussed.

For gas solubilities greater than about 0.01 mole fraction at a partial pressure of 1 atmosphere there are several additional factors which must be taken into account to unambiguously report gas solubilities. Solution densities or the partial molar volume of gases must be known. Corrections should be made for the possible non-ideality of the gas or the non-applicability of Henry's law.

Table 1. Interconversion of parameters used for reporting solubility.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$L$</td>
<td>$L = \alpha (T/T_0)$, $T_0 = 273.15$ K</td>
</tr>
<tr>
<td>$C_W$</td>
<td>$C_W = \alpha / v_o P$</td>
</tr>
<tr>
<td>$K_H/\text{mm Hg}$</td>
<td>$17.033 \times 10^9 p(\text{soln}) + 760$</td>
</tr>
<tr>
<td>$v_o$</td>
<td>$\alpha M(1)$</td>
</tr>
<tr>
<td>$L$</td>
<td>$L = C_W V_{e,\text{gas}} P$</td>
</tr>
</tbody>
</table>

where $v_o$ is the molal volume of the gas in $\text{cm}^3\text{mol}^{-1}$ at 0°C, $P$ the density of the solvent at the temperature of the measurement, $P_{\text{soln}}$ the density of the solution at the temperature of the measurement, and $V_{e,\text{gas}}$ the molar volume of the gas at the temperature of the measurement.
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    Trans. Met. Soc. AIME. 1956, 206, 1568.

ACKNOWLEDGEMENTS

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Iguchi, Y.; Ban-Ya, S.; Fuwa, T.

- Figure. Solubility of H$_2$O in various CaO - SiO$_2$ melts at 1600°C. 465
- Figure. Solubility of water in CaO - Li$_2$O - SiO$_2$ as a function of CaO/SiO$_2$. 479
- Figure. Solubility of water in CaO - SiO$_2$ - SrO melts as a function of CaO/SiO$_2$. 499

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Shimoo, T.; Kimura, H.; Kawai, M.

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Uys, J. M.; King, T. B;
*Trans. Met. Soc. AIME. 1963, 227, 492 - 500

- Figure. Solubility of H$_2$O in Li$_2$O - SiO$_2$ melts. 451
- Figure. Solubility of H$_2$O in FeO - SiO$_2$ melts. 469
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Kurkjian, C. R.; Russel, L. E;
*J. Soc. Glass Tech. 1958. 42, 130T - 144T

- Figures 1-2. Solubility of H$_2$O in Li$_2$O - SiO$_2$ melts. 449, 450
- Figures 1-3. Solubility of H$_2$O in Na$_2$O - SiO$_2$ melts. 453 - 455
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*Can. Metallurgical Quart. 1976, 15, 103 - 110

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Wahlder, M.; Reichel, H. H.
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- Figure. The solubility of H$_2$O in various CaO - FeO - SiO$_2$ melts at 1873K. 518

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Figure. Solubility of water as hydrogen content in CaO - P$_2$O$_5$ - SiO$_2$ melts

Iguchi, Y.; Ban-Ya, S.; Fuwa, T.
Figure. Solubility of water in CaO - SiO$_2$ as a function of temperature
Figure. Solubility of H$_2$O in Al$_2$O$_3$ - SiO$_2$ melts
Figure. Solubility of H$_2$O in CaO - SiO$_2$ - TiO$_2$ melts
Figure. Iso-water vapor capacity lines in CaO - FeO - SiO$_2$ melts at 1450$^0$C
Figure. Iso-solubility lines of water in CaO - FeO - SiO$_2$ melts at 1550$^0$C

Iguchi, Y.; Fuwa, T.
Figures 1-3. Solubility of water in CaO - MgO - SiO$_2$ melts at 1550$^0$C

Ban-Ya, S.; Iguchi, Y.; Yamamoto, S.
*Tetsu to Hagane.* 1986, 72, 2210 - 2217
Figure. Iso-water vapor capacity lines in CaO - MgO - SiO$_2$ melts at 1400$^0$C

Ban-Ya, S.; Iguchi, Y.; Nagata, S.
*Tetsu to Hagane.* 1985, 71, 55 - 62
Figure. Iso-contours of water vapor capacity

Imai, M.; Ooi, H.; Emi, T.
*Tetsu to Hagane.* 1962, 48, 111 - 117
Figure. Solubility of water in CaO - Fe - SiO$_2$ melts at 1550$^0$C
COMPONENTS:

(1) Helium; He; [7440-59-7]
(2) Lithium nitrate; LiNO₃; [7790-69-4]

ORIGINAL MEASUREMENTS:

Cleaver, B.; Mather, D. E.

VARIABLES:

T/K = 543
P/kPa = 25000 - 10⁸

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

Solubilities of helium in the melt at only one temperature, 270°C, are presented in graphical form as a function of the gas pressure in the range 250 - 1000 bar. The value of Henry's law constant, $K_H$, is:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>$10^7 K_H$/mol ml⁻¹ bar⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>270</td>
<td>1.51 ± 0.4</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

High pressure elution method.

Diagram and details of the apparatus are given in the original paper. The melt was saturated by stirring it in contact with the gas at high pressure. A sample of the saturated melt was isolated and analyzed by the elution technique.

SOURCE AND PURITY OF MATERIALS:

Helium (99.8%) was used as received from the British Oxygen Company without further purification or drying.

LiNO₃ (99.9%) obtained from Johnson Matthey & Co. was recrystallized from distilled water and dried at 120°C. It was stored in an oven at 100°C.

ESTIMATED ERROR:

$δP$/bar = ± 10

REFERENCES:
COMPONENTS:

(1) Helium; He; [7440-59-7]
(2) Sodium nitrate; NaNO₃; [7631-99-4]

EVALUATOR:

N. P. Bansal
National Aeronautics and Space Administration.
Lewis Research Center.
Cleveland, Ohio, 44135, U.S.A.
December, 1989.

CRITICAL EVALUATION:

Only three studies (1 - 3) have been reported for the solubility of helium in molten sodium nitrate. Smoothed data from these studies, at different temperatures, are compared below:

<table>
<thead>
<tr>
<th>T/K</th>
<th>Field &amp; Green (1)</th>
<th>Cleaver &amp; Mather (2)</th>
<th>Copeland &amp; Zybko (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>590</td>
<td>0.87</td>
<td>(1.75)</td>
<td></td>
</tr>
<tr>
<td>600</td>
<td>0.91</td>
<td>(1.83)</td>
<td></td>
</tr>
<tr>
<td>620</td>
<td>0.99</td>
<td>1.99</td>
<td></td>
</tr>
<tr>
<td>640</td>
<td>1.07</td>
<td>2.17</td>
<td>22.7*</td>
</tr>
<tr>
<td>660</td>
<td>1.16</td>
<td>2.34</td>
<td></td>
</tr>
<tr>
<td>680</td>
<td>(1.25)</td>
<td>2.51</td>
<td></td>
</tr>
<tr>
<td>700</td>
<td>(1.33)</td>
<td>2.69</td>
<td></td>
</tr>
</tbody>
</table>

* At 642 K
Values in ( ) outside temperature interval of experimental measurement.

Copeland and Christie (4) have pointed out that solubility results reported earlier from their laboratory are not reliable. Therefore, the results of Copeland and Zybko (3) are rejected.

Solubility values of Cleaver and Mather (2) are two times larger than those of Field and Green. Although the heats of solution reported by the two groups are in excellent agreement, the entropy values are different. This is because the disagreement between the results lies in the magnitude rather than in the temperature dependence of the solubility.

Additional studies are required in order to evaluate and to advance recommended values for this system.

References:

COMPONENTS:
(1) Helium; He; [7440-59-7]
(2) Sodium nitrate; NaN0₃; [7631-99-4]

VARIABLES:
T/K = 588 - 675
P/kPa = 126.656 - 130.709

EXPERIMENTAL VALUES:

Henry's law is obeyed over the pressure range studied (1.25 - 1.29 atm). The values of Henry's law constant, $K_H$, for the solubility of He in molten NaN0₃ at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^7 K_H$ (mol cm⁻³ atm⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>588</td>
<td>0.856</td>
</tr>
<tr>
<td>618</td>
<td>0.980</td>
</tr>
<tr>
<td>643</td>
<td>1.068</td>
</tr>
<tr>
<td>675</td>
<td>1.223</td>
</tr>
</tbody>
</table>

Smoothed Data:

The temperature dependence of $K_H$ is expressed by the equation:

$$\log(K_H/(mol \ cm^{-3} \ atm^{-1})) = (-5.87 \pm 0.06) - (703.60 \pm 0.04)/(T/K)$$

std. dev. = 0.32%

The enthalpy of solution, $\Delta H$, and the entropy of solution, $\Delta S$, are:

$$\Delta H/(kcal \ mol^{-1}) = 3.22 \pm 0.18$$

$$\Delta S/(cal \ K^{-1} \ mol^{-1}) = -5.28 \pm 0.29 \ (at \ 637 \ K)$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution technique.

Diagram of the gas solubility apparatus is given in the original publication.

The experimental process consisted of three steps: saturation, elution and analysis. After saturating the melt with He gas, the gas phase was evacuated. Argon was introduced into the system as eluting gas to approx. 1 atm. pressure. The resultant gas mixture was analyzed with an Aerograph Model 90 - P gas chromatograph (Varian). The carrier gas used was also argon. Average of four measurements was used for calculation of the gas solubility.

SOURCE AND PURITY OF MATERIALS:
Helium and argon obtained from Airco were used directly from the cylinder.
Baker's reagent grade sodium nitrate was used without further purification.

ESTIMATED ERROR:
solubility = ± 5% (authors)

REFERENCES:
**COMPONENTS:**

1. Helium; He; [7440-59-7]
2. Sodium nitrate; NaN0₃; [7631-99-4]

**ORIGINAL MEASUREMENTS:**

Cleaver, B.; Mather, D. E.


**VARIABLES:**

<table>
<thead>
<tr>
<th>T/K</th>
<th>P/kPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>605 – 714</td>
<td>11000 – 10⁵</td>
</tr>
</tbody>
</table>

**PREPARED BY:**

N. P. Bansal

**EXPERIMENTAL VALUES:**

Solubilities of helium in the melt at three temperatures are presented only in the graphical form as a function of the gas pressure in the range 110 - 1000 bar. Values of Henry's law constant, $K_H$, are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>$10^7 K_H$/mol ml⁻¹ bar⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>332</td>
<td>1.86 ± 0.3</td>
</tr>
<tr>
<td>391</td>
<td>2.32 ± 0.3</td>
</tr>
<tr>
<td>441</td>
<td>2.80 ± 0.3</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of $K_H$ is expressed by the relation:

\[
\log(K_H/\text{mol ml}^{-1} \text{ bar}^{-1}) = -5.574 - 701.4/(T/K) \quad \text{(compiler)}
\]

std. dev. = 0.6% \quad \text{(compiler)}

$\Delta H$/kJ mol⁻¹ = 13.4

$\Delta S^°$/J K⁻¹ mol⁻¹ = -17.4

$\Delta H$ is the enthalpy of solution, and $\Delta S^°$ is the standard entropy of solution.

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

High pressure elution technique.

Diagram and details of the apparatus are given in the original paper. The melt was saturated by stirring it in contact with the gas at high pressure. A portion of the saturated melt was isolated and analyzed by the elution technique.

**SOURCE AND PURITY OF MATERIALS:**

Helium (99.8%) was used as received from British Oxygen Company without further purification or drying.

Sodium nitrate (> 99.5%) A. R. grade from B. D. H. was purified by filtration through Pyrex frits in the molten state. The melt was allowed to freeze and stored in vacuo.

**ESTIMATED ERROR:**

$\delta P$/bar = ± 10

**REFERENCES:**
COMPONENTS:
(1) Helium; He; [7440-59-7]
(2) Sodium nitrate; NaNO₃; [7631-99-4]

ORIGINAL MEASUREMENTS:
Copeland, J. L.; Zybko, W. C.

VARIABLES:
P/kPa = 11145.75 - 32525.33
one temperature: T/K = 642

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The solubility of helium in molten sodium nitrate at 369°C was determined up to a saturating gas pressure of 321 atm. Henry's law was obeyed. The value of Henry's law constant, $K_H$, is given as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>$10^7 K_H$/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>369</td>
<td>22.7 ± 0.7</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
The method used for the gas solubility measurements in the melt was the same as described elsewhere (1).

SOURCE AND PURITY OF MATERIALS:
Helium (99.99%) from the National Gas Co. was used.
Reagent grade sodium nitrate from Baker and Adamson was used without further purification other than drying.

ESTIMATED ERROR:
Nothing specified

REFERENCES:
1. Copeland, J. L.; Zybko, W. C.
**COMPONENTS:**

(1) Helium; He; [7440-59-7]
(2) Silver nitrate; AgNO₃; [7761-88-8]

**ORIGINAL MEASUREMENTS:**

Copeland, J. L.; Radak, S.

**VARIABLES:**

\[ \frac{P}{kPa} = 5167.58 - 25027.28 \]

One temperature: \( T/K = 523 \)

**PREPARED BY:**

N. P. Bansal

**EXPERIMENTAL VALUES:**

The solubility of helium in molten silver nitrate at 250°C was determined up to a saturating gas pressure of 247 atm. Henry's law was obeyed. The value of Henry's law constant, \( K_H \), is given as:

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>( 10^6 K_H ) (mol cm(^{-3}) atm(^{-1}) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>3.57 ± 0.48</td>
</tr>
</tbody>
</table>

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

The equipment and technique used for gas solubility were exactly the same as described elsewhere (1).

**SOURCE AND PURITY OF MATERIALS:**

Helium (99.98%) gas from National Cylinder Gas Co. was used.
Reagent grade silver nitrate obtained from Mallinckrodt, Fisher Scientific and Baker were used. Before each measurement, silver nitrate was fused, allowed to cool and solidify in a porcelain casserole placed in a desiccator and then finely pulverized.

**ESTIMATED ERROR:**

Nothing specified

**REFERENCES:**

1. Copeland, J. L.; Zybko, W. C.
COMPONENTS:

(1) Helium; He; [7440-59-7]
(2) Dilithium beryllium fluoride; Li₂BeF₄

ORIGINAL MEASUREMENTS:

Malinauskas, A. P.; Richardson, D. M.

VARIABLES:

T/K = 773 - 1073
P/kPa = 101.325 - 202.650

EXPERIMENTAL VALUES:

The values of Henry's law constant, K_H, and the Ostwald coefficient, L, for the solubility of helium in molten Li₂BeF₄ at various temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁸ K_H^a/mol cm⁻³ atm⁻¹</th>
<th>10³ L</th>
</tr>
</thead>
<tbody>
<tr>
<td>773</td>
<td>6.08 ± 0.39</td>
<td>3.86 ± 0.25</td>
</tr>
<tr>
<td>873</td>
<td>8.38 ± 0.15</td>
<td>6.01 ± 0.11</td>
</tr>
<tr>
<td>973</td>
<td>11.47 ± 0.23</td>
<td>9.16 ± 0.18</td>
</tr>
<tr>
<td>1073</td>
<td>16.47 ± 0.25</td>
<td>14.51 ± 0.22</td>
</tr>
</tbody>
</table>

^ Calculated by the compiler using the relation K_H = L/RT.

Smoothed Data:

Temperature dependence of K_H and L are expressed by the relations:

\[
\log(K_H/\text{mol cm}^{-3} \text{ atm}^{-1}) = -5.7095 - 1177/(T/K)
\]

\[
\log L = \log(T/K) - 1177/(T/K) - 3.7954
\]

The enthalpy of solution, ΔH, and the standard entropy of solution, ΔS^o, are:

\[
\Delta H/\text{kcal mol}^{-1} = 5.39 \pm 0.49
\]

\[
\Delta S^o/\text{eu} = -3.6 \pm 0.6 \quad (\text{at 1000 K})
\]

METHOD/APPARATUS/PROCEDURE:

Stripping method.

The diagram and details of the apparatus used and the experimental procedure followed have been described earlier (1). In brief, the melt was saturated with helium and a known volume of the saturated solution was transferred to the stripper. The dissolved helium was freed by flushing with xenon and analyzed by mass spectroscopy.

SOURCE AND PURITY OF MATERIALS:

Helium and xenon were 99.9% pure. Helium gas was purified by passing through liquid nitrogen cooled coils of copper tubing.

ESTIMATED ERROR:

Nothing specified

REFERENCES:

1. Malinauskas, A. P.; Richardson, D. M.; Savalainen, J. E.; Shaffer, J. H.
COMPONENTS:
(1) Helium; He; [7440-59-7]
(2) Sodium nitrate; NaN0₃; [7631-99-4]
(3) Potassium nitrate; KNO₃; [7757-79-1]

VARIABLES:
\[ T/K = 508 - 603 \]
\[ P/kPa = 10^2 \]

EXPERIMENTAL VALUES:

The solvent used was an equimolar molten mixture of sodium and potassium nitrates. The solubilities of helium in the melt at four temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10^0 ( K_H/\text{mol cm}^{-3} \text{ bar}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>508</td>
<td>2.9</td>
</tr>
<tr>
<td>533</td>
<td>3.5</td>
</tr>
<tr>
<td>573</td>
<td>4.5</td>
</tr>
<tr>
<td>603</td>
<td>5.4</td>
</tr>
</tbody>
</table>

Smoothed Data:

The temperature dependence of Henry's law constant, \( K_H \), is given by the relation:

\[
\log(\frac{K_H}{\text{mol cm}^{-3} \text{ bar}^{-1}}) = -5.834 - \frac{865.7}{T/K} \quad \text{(compiler)}
\]

std. dev. = 0.25% \quad \text{(compiler)}

The enthalpy of solution, \( \Delta H \), and the standard entropy of solution, \( \Delta S^\circ \), are:

\[ \Delta H/\text{kJ mol}^{-1} = 16.5 \]
\[ \Delta S^\circ/\text{J K}^{-1} \text{ mol}^{-1} = -23 \quad \text{(at 533 K)} \]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Manometric technique.

The details of the apparatus and procedure employed for solubility measurements are described elsewhere (1). Briefly, the melt was vacuum degassed degassed for a long time. The vacuum was disconnected and helium gas was introduced at about one bar pressure. The melt was vigorously stirred; pressure variations were noted with a manometer with time until the equilibrium was attained. The amount of gas dissolved was calculated from the final pressure variation after a suitable calibration.

SOURCE AND PURITY OF MATERIALS:

Helium (High Purity grade) was purified by keeping in contact with Ascarite for several hours to remove CO₂ and other acidic impurities and molecular sieve 5Å at - 80°C to remove water impurities.

Reagent grade sodium and potassium nitrates were used to prepare the solvent which was filtered in the molten state.

ESTIMATED ERROR:

Nothing specified

REFERENCES:

1. Desimoni, E.; Paniccia, F.; Zambonin, P. G.
Three experimental studies are available for the solubility of helium in molten lithium fluoride - beryllium fluoride mixture. One of these studies (1) reported only a single data point at one temperature and this has been included in the later study (2) by the same workers. Values of the Henry's law constant are compared below at different temperatures along with the thermodynamic parameters:

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^8 K_H$/mol cm$^{-3}$ atm$^{-1}$</th>
<th>Malinauskas et al. (1,2)</th>
<th>Watson et al. (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>773</td>
<td>6.08 ± 0.39</td>
<td>7.49 ± 0.07</td>
<td></td>
</tr>
<tr>
<td>873</td>
<td>8.38 ± 0.15</td>
<td>11.55 ± 0.39</td>
<td></td>
</tr>
<tr>
<td>973</td>
<td>11.47 ± 0.23</td>
<td>14.93 ± 0.42</td>
<td></td>
</tr>
<tr>
<td>1073</td>
<td>16.47 ± 0.25</td>
<td>19.48 ± 0.01</td>
<td></td>
</tr>
</tbody>
</table>

| ΔH/kJ mol$^{-1}$ | 22.55 ± 2.05 | 21.76 |
| ΔS/J K$^{-1}$ mol$^{-1}$ (at 1000 K) | -15.06 ± 2.5 | -14.2 |

The values of enthalpy of solution and entropy of solution reported by the two groups are in very good agreement, within experimental error. However, the solubility data of Watson et al. are 25 - 30% higher than those of Malinauskas et al.

Tentatively, the solubility values may be taken as the average of the two data sets. However, additional study is required in order to advance recommended values.

References:
<table>
<thead>
<tr>
<th>COMPONENTS:</th>
<th>ORIGINAL MEASUREMENTS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Helium; He; [7440-59-7]</td>
<td>Malinauskas, A. P.; Richardson, D. M.; Savolainen, J. E.; Shaffer, J. H.</td>
</tr>
<tr>
<td>(3) Beryllium fluoride; BeF₂; [7789-49-7]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VARIABLES:</th>
<th>PREPARED BY:</th>
</tr>
</thead>
<tbody>
<tr>
<td>one temperature: T/K = 873</td>
<td>N. P. Bansal</td>
</tr>
<tr>
<td>P/kPa = 101.325 - 202.650</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EXPERIMENTAL VALUES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>The value of Henry's law constant, Kₜ, for the solubility of helium in the molten LiF - BeF₂ eutectic is:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁸ Kₜ/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>8.40 ± 0.16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AUXILIARY INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>METHOD/APPARATUS/PROCEDURE:</td>
</tr>
<tr>
<td>Stripping method.</td>
</tr>
<tr>
<td>The diagram and details of the apparatus used and procedure followed are given in the original paper. In brief, the apparatus consisted of two parts, the saturation chamber and the stripper chamber. The main parts of the apparatus were constructed of Hastelloy, a nickel based alloy containing 7% Cr, 4% Fe, 12 - 17% Mo.</td>
</tr>
<tr>
<td>In an experiment, the melt in the saturation chamber was saturated with helium. A known amount of the saturated solution was transferred into the stripping chamber where the dissolved gas was stripped from the solvent and collected for measurement.</td>
</tr>
</tbody>
</table>

| SOURCE AND PURITY OF MATERIALS: |
| Not described. |

| ESTIMATED ERROR: |
| Nothing specified |

| REFERENCES: |
COMPONENTS:
(1) Helium; He; [7440-59-7]
(2) Lithium fluoride; LiF; [7789-24-4]
(3) Beryllium fluoride; BeF₂; [7789-49-7]

ORIGINAL MEASUREMENTS:
Watson, G. M.; Evans III, R. B.; Grimes, W. R.; Smith, N. V.

VARIABLES:
P/kPa = 101.325 - 202.650
T/K = 773 - 1073

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:

The values of Henry's law constant, $K_H$, for the solubility of helium in the melt LiF - BeF₂ (64 - 36 mol%) at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>$10^n K_H$/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>7.49 ± 0.07</td>
</tr>
<tr>
<td>600</td>
<td>11.55 ± 0.39</td>
</tr>
<tr>
<td>700</td>
<td>14.93 ± 0.42</td>
</tr>
<tr>
<td>800</td>
<td>19.48 ± 0.01</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of $K_H$ can be expressed by the relation:

$$\log(K_H$/mol cm⁻³ atm⁻¹) = -5.656 - 1131.4/(T/K)$$

(compiler)

std. dev. = 1.2%  (compiler)

The enthalpy of solution, $\Delta H$, and the standard entropy of solution, $\Delta S^o$, are:

$\Delta H$/kcal mol⁻¹ = 5.2

$\Delta S^o$/cal K⁻¹ mol⁻¹ = -3.4  (at 1000 K)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Stripping or elution method.

The apparatus and procedure used for the gas solubility measurements were the same as described elsewhere (1,2).

SOURCE AND PURITY OF MATERIALS:
Helium gas, (> 99.9% ) was obtained in cylinders from the Bureau of Mines, Amarillo, Texas.
LiF was of reagent grade. BeF₂ (99.5% ± 0.05%) used was obtained from the Beryllium Corp. of America. The molten solvent was prepared by mixing the two fluorides in proper proportions and purified by flushing at 800°C alternately with anhydrous HF and H₂.

ESTIMATED ERROR:
solubility = ± 5%  (authors)

REFERENCES:
1. Grimes, W. R.; Smith, N. V.; Watson, G. M.
2. Blander, M.; Grimes, W. R.; Smith, N. V.; Watson, G. M.
Ibid. 1959, 63, 1164.
COMPONENTS:
(1) Helium; He; [7440-59-7]
(2) Sodium fluoride; NaF; [7681-49-4]
(3) Beryllium fluoride; BeF₂; [7789-49-7]

ORIGINAL MEASUREMENTS:
Ward, W. T.; Watson, G. M.; Evans, R. B.; Grimes, W. R.
U.S.A.E.C. Rept. O.R.N.L. - 2931

VARIABLES:
P/kPa = 101.325 - 202.650
T/K = 773 - 1073

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The values of Henry's law constant, \( K_H \), for the solubility of helium in the melt NaF - BeF₂ (57 - 43 mol%) at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>( 10^7 K_H )/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>1.29</td>
</tr>
<tr>
<td>600</td>
<td>1.77</td>
</tr>
<tr>
<td>650</td>
<td>1.97</td>
</tr>
<tr>
<td>700</td>
<td>2.22</td>
</tr>
<tr>
<td>800</td>
<td>2.88</td>
</tr>
</tbody>
</table>

* Values read from the graph by the compiler.

Temperature dependence of \( K_H \) can be expressed by the equation:

\[
\log(10^7 K_H/mol \text{ cm}^{-3} \text{ atm}^{-1}) = -5.671 - 946.4/(T/K) \quad (\text{compiler})
\]

std. dev. = 1.1% (compiler)

The heat of solution, \( \Delta H \), and the standard entropy of solution, \( \Delta S^\circ \), are:

\[
\Delta H/\text{kcal mol}^{-1} = 4.3 \quad (\text{compiler})
\]

\[
\Delta S^\circ/\text{cal K}^{-1} \text{ mol}^{-1} = -3.2 \quad (\text{at 1000 K})
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Stripping method.

The method used for the determination of gas solubilities in the molten salt solvent was the same as described elsewhere (1).

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:
Nothing specified

REFERENCES:
1. Grimes, W. R.; Smith, N. V.; Watson, G. M.
COMPONENTS:
(1) Helium; He; [7440-59-7]
(2) Sodium fluoride; NaF; [7681-49-4]
(3) Zirconium fluoride; ZrF₄; [7783-64-4]

ORIGINAL MEASUREMENTS:
Grimes, W. R.; Smith, N. V.; Watson, G. M.

VARIABLES:
P/kPa = 50.663 - 202.650
T/K = 873 - 1073

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The values of Henry's law constant, Kₜ, for the solubility of He in the melt NaF - ZrF₄ (53 - 47 mol%) at three temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁶ Kₜ/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>21.6 ± 1.0</td>
</tr>
<tr>
<td>700</td>
<td>29.2 ± 0.7</td>
</tr>
<tr>
<td>800</td>
<td>42.0 ± 1.3</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of Kₜ can be expressed by the relation:

\[ \log(Kₜ/\text{mol cm}^{-3} \text{ atm}^{-1}) = -5.135 - 1344/(T/K) \]  
(std. dev. = 2.3%)  
(compiler)

The enthalpy of solution, \(^{\Delta}H\), and the entropy of dissolving the gas, \(^{\Delta}S\), with equal concentrations in the gaseous and liquid states, are:

\(^{\Delta}H/\text{kcal mol}^{-1} = 6.2\)  
\(^{\Delta}S/\text{cal K}^{-1} \text{ mol}^{-1} = -1.0\)  
(at 1000 K)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution or stripping method.

The diagram and details of the apparatus and procedure are described in detail in the original paper. In brief, the melt was saturated with helium by sparging it with the gas for 6 hours at the desired pressure. Part of the molten salt solution was allowed to transfer into the stripping section. The dissolved helium was stripped from the melt by circulation of argon through the system for about 15 minutes. The amount of helium present in the eluted gas mixture was determined by mass spectrometry.

REFERENCES:
COMPONENTS:
(1) Helium; He; [7440-59-7]
(2) Lithium fluoride; LiF; [7789-24-4]
(3) Sodium fluoride; NaF; [7681-49-4]
(4) Potassium fluoride; KF; [7789-23-3]

ORIGINAL MEASUREMENTS:

Blander, M.; Grimes, W. R.; Smith, N. V.; Watson, G. M.

VARIABLES:

T/K = 873 - 1073
P/kPa = 121.59

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:

The values of Henry's law constant, $K_H$, for the solubility of helium in the melt LiF - NaF - KF (46.5 - 11.5 - 42.0 mol%) at different temperatures, and pressures ranging from 1 - 2 atm, are:

<table>
<thead>
<tr>
<th>$t/°C$</th>
<th>$10^a K_H$/mol cm$^{-3}$ atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>11.3 ± 0.7</td>
</tr>
<tr>
<td>650</td>
<td>13.7</td>
</tr>
<tr>
<td>700</td>
<td>17.5 ± 0.2</td>
</tr>
<tr>
<td>800</td>
<td>23.0 ± 0.7</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of $K_H$ can be expressed by the relation:

$$\log(K_H$/mol cm$^{-3}$ atm$^{-2}$) = -5.261 - 1470.7/(T/K)$$

std. dev. = 1.4% (compiler)

The enthalpy of solution, $\Delta H$, and the standard entropy of solution, $\Delta S^\circ$, are:

$\Delta H$/kcal mol$^{-1}$ = 8.0

$\Delta S^\circ$/cal K$^{-1}$ mol$^{-1}$ = -0.3 (at 1000 K)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stripping or elution method.

The details of the apparatus and procedure used have been described elsewhere (1).

SOURCE AND PURITY OF MATERIALS:

Helium gas, purity better than 99.9%, was obtained from the Bureau of Mines at Amarillo, Texas.
The melt was prepared by mixing Reagent grade LiF, NaF and KF in proper proportions. The melt was purified at 800°C by flushing it alternately with anhydrous HF and H$_2$. Nickel apparatus was used.

ESTIMATED ERROR:

Nothing specified

REFERENCES:

1. Grimes, W. R.; Smith, N. V.; Watson, G. M.
COMPONENTS:
(1) Helium; He; [7440-59-7]
(2) Sodium fluoride; NaF; [7681-49-4]
(3) Zirconium fluoride; ZrF₄; [7783-64-4]
(4) Uranium tetrafluoride; UF₄; [10049-14-6]

VARIABLES: T/K = 873 - 1073
P/kPa = 50.663 - 202.650

EXPERIMENTAL VALUES:
The values of Henry's law constant, $K_H$, for the solubility of helium in the melt NaF - ZrF₄ - UF₄ (50 - 46 - 4 mol%) at different temperatures, and pressures ranging from 1 - 2 atm, are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>$10^n K_H$/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>20</td>
</tr>
<tr>
<td>700</td>
<td>27</td>
</tr>
<tr>
<td>800</td>
<td>41</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of $K_H$ can be expressed by the relation:

$$\log(K_H/$mol cm⁻³ atm⁻¹) = -5.054 - 1447/(T/K)$$

$\text{std. dev.} = 3.4\%$ (compiler)

The heat of solution, $\Delta H$, is estimated to be:

$$\Delta H$/kJ mol⁻¹ = 27.7$$ (compiler)

METHOD/APPARATUS/PROCEDURE:
Elution or stripping method.

The diagram and details of the apparatus and procedure employed are described in detail in the original paper. In brief, the melt was saturated with helium by sparging it with the gas for 6 hours at the desired gas pressure. Part of the molten salt solution was transferred into the stripping section. The dissolved helium was stripped from the melt by circulation of argon through the system for about 15 minutes. The amount of helium present in the eluted gas mixture was obtained by mass spectrometry.

SOURCE AND PURITY OF MATERIALS:
Helium gas, (>99.9%) was obtained from the Bureau of Mines at Amarillo, Texas.
Reagent grade NaF and UF₄ were obtained from the Mallinckrodt Chemical Co. ZrF₄ was prepared by hydrofluorination of ZrCl₄ at 773K in nickel equipment. The melt was prepared by mixing the three fluorides in proper ratio and purified at 800°C by sparging it alternatively with anhydrous HF and H₂. No oxide was present in the melt.

ESTIMATED ERROR:

solubility = ± 10% (authors)
COMPONENTS:

(1) Neon; Ne; [7440-01-9]
(2) Lithium fluoride; LiF; [7789-24-4]
(3) Beryllium fluoride; BeF₂; [7789-49-7]

VARIABLES:

\[
P/kPa = 101.325 - 202.650
T/K = 773 - 1073
\]

EXPERIMENTAL VALUES:

The Henry's law constant, \( K_H \), for the solubility of neon in the melt LiF - BeF₂ (64 - 36 mol%) at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>( 10^a K_H ) mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>3.09 ± 0.09</td>
</tr>
<tr>
<td>600</td>
<td>4.63 ± 0.01</td>
</tr>
<tr>
<td>700</td>
<td>6.80 ± 0.09</td>
</tr>
<tr>
<td>800</td>
<td>9.01 ± 0.15</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of \( K_H \) can be expressed by the relation:

\[
\log(K_H/\text{mol cm}^{-3} \text{ atm}^{-1}) = -5.839 - 1295.8/(T/K) \quad \text{(compiler)}
\]

std. dev. = 0.9% \quad \text{(compiler)}

The enthalpy of solution, \( \Delta H \), and the standard entropy of solution, \( \Delta S^0 \), are:

\[
\Delta H/\text{kcal mol}^{-1} = 5.9
\]

\[
\Delta S^0/\text{cal K}^{-1} \text{ mol}^{-1} = -4.2 \quad \text{(at 1000 K)}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stripping or elution method.

The apparatus and procedure used for gas solubility measurements have been described elsewhere (1,2).

SOURCE AND PURITY OF MATERIALS:

Neon gas, (>99.9%) was obtained from the Linde Co.

LiF was of reagent grade. BeF₂ (99.5 ± 0.5%) was obtained from the Beryllium Corp. of America.

The melt was prepared by mixing the two fluorides in proper proportions. The melt was purified by sparging it alternately with anhydrous HF and H₂ at 800°C.

ESTIMATED ERROR:

Nothing specified

REFERENCES:

1. Grimes, W. R.; Smith, N. V.; Watson, G. M.
2. Blander, M.; Grimes, W. R.; Smith, N. V.; Watson, G. M.
   Ibid. 1959, 63, 1164.
COMPONENTS:
(1) Neon; Ne; [7440-01-9]
(2) Sodium fluoride; NaF; [7681-49-4]
(3) Zirconium fluoride; ZrF₄; [7783-64-4]

ORIGINAL MEASUREMENTS:
Grimes, W. R.; Smith, N. V.; Watson, G. M.

VARIABLES:
P/kPa = 101.325 - 202.650
T/K = 873 - 1073

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The values of Henry's law constant, K_H, for the solubility of neon in the melt NaF - ZrF₄ (53 - 47 mol%) at three temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁸ K_H/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>11.3 ± 0.3</td>
</tr>
<tr>
<td>700</td>
<td>18.4 ± 0.5</td>
</tr>
<tr>
<td>800</td>
<td>24.7 ± 0.7</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of K_H can be expressed by the relation:
\[
\log(K_H/mol cm^{-3} atm^{-1}) = -5.109 - 1598.5/(T/K)
\]
std. dev. = 2% (compiler)

The enthalpy of solution, ΔH, and the entropy, ΔS, of dissolving the gas with equal concentrations in the gaseous and liquid states are:
\[
\Delta H/kcal mol^{-1} = 7.8
\]
\[
\Delta S/cal K^{-1} mol^{-1} = -0.4 \quad (at 1000K)
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution stripping method.
The diagram and details of the apparatus and procedure are described in detail in the original paper. Briefly, the melt was saturated with neon by sparging it with the gas for 6 hours at the desired gas pressure. Part of the molten salt solution was transferred into the stripping section. The dissolved neon was stripped from the melt by circulation of helium through the system for about 15 minutes. The amount of neon present in the eluted gas mixture was determined by mass spectrometry.

SOURCE AND PURITY OF MATERIALS:
Neon gas, (>99.9%), was obtained from Linde Air Products Co.
Sodium fluoride of Reagent grade was obtained from Mallinckrodt.
ZrF₄ was prepared by hydrofluorination of ZrCl₄ at 500°C in nickel apparatus. The melt was prepared by mixing the two salts in proper proportion and purified at 800°C by sparging it alternately with anhydrous HF and H₂.
No oxide was present in the melt.

ESTIMATED ERROR:
solubility = ± 10% (authors)

REFERENCES:
COMPONENTS:
(1) Neon; Ne; [7440-01-9]
(2) Lithium fluoride; LiF; [7789-24-4]
(3) Sodium fluoride; NaF; [7681-49-4]
(4) Potassium fluoride; KF; [7789-23-3]

VARIABLES:
T/K = 873 - 1073
P/kPa = 101.325 - 202.650

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>10^8 K_H/mol cm^3 atm^-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>4.36 ± 0.20</td>
</tr>
<tr>
<td>700</td>
<td>7.51 ± 0.22</td>
</tr>
<tr>
<td>800</td>
<td>11.18 ± 0.26</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of K_H can be expressed by the relation:

\[ \log(K_H/mol \text{ cm}^3 \text{ atm}^{-1}) = -5.158 - 1920/(T/K) \]  
\[ \text{std. dev.} = 0.9\% \]

The enthalpy of solution, \( \Delta H \), and the standard entropy of solution, \( \Delta S^\circ \), are:

\[ \Delta H/\text{kcal mol}^{-1} = 8.9 \]
\[ \Delta S^\circ/\text{cal K}^{-1} \text{ mol}^{-1} = -0.1 \]  
(at 1000 K)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stripping or elution method.

The apparatus and procedure employed have been described elsewhere (1).

SOURCE AND PURITY OF MATERIALS:

Neon gas, purity better than 99.9%, was obtained from Linde Air Products Company.

The melt was prepared by mixing Reagent grade LiF, NaF and KF in the proper ratio. The melt was purified at 800°C by flushing it alternately with anhydrous HF and H_2. Nickel apparatus was used.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

1. Grimes, W. R.; Smith, N. V.; Watson, G. M.
COMPONENTS:
(1) Argon; Ar; [7440-37-1]
(2) Lithium nitrate; LiNO₃; [7790-69-4]

VARIABLES:
\[ \frac{T}{K} = 531 - 595 \]
\[ P/kPa = 50.663 - 151.988 \]

EXPERIMENTAL VALUES:
The values of Henry's law constant, \( K_H \), for the solubility of Ar in molten LiNO₃, at different temperatures are:

<table>
<thead>
<tr>
<th>( \frac{T}{K} )</th>
<th>( 10^7 K_H/\text{mol cm}^{-3} \text{ atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>531</td>
<td>0.74</td>
</tr>
<tr>
<td>534</td>
<td>0.94</td>
</tr>
<tr>
<td>540</td>
<td>1.01</td>
</tr>
<tr>
<td>546</td>
<td>0.65</td>
</tr>
<tr>
<td>549</td>
<td>1.12</td>
</tr>
<tr>
<td>553</td>
<td>1.06</td>
</tr>
<tr>
<td>562</td>
<td>1.43</td>
</tr>
<tr>
<td>563</td>
<td>1.45</td>
</tr>
<tr>
<td>564</td>
<td>1.46</td>
</tr>
<tr>
<td>574</td>
<td>1.56</td>
</tr>
<tr>
<td>581</td>
<td>1.62</td>
</tr>
<tr>
<td>595</td>
<td>1.71</td>
</tr>
</tbody>
</table>

Smoothed Data:
The temperature dependence of \( K_H \) is expressed by the equation:

\[
\log(\frac{K_H}{\text{mol cm}^{-3} \text{ atm}^{-1}}) = -3.77 - \frac{1748.9}{(T/K)}
\]

std. dev. = 1.2% (compiler)

The enthalpy of solution, \( \Delta H \), and entropy of solution, \( \Delta S \), are:

\[ \Delta H/\text{cal mol}^{-1} = 8.0 \pm 0.99 \]
\[ \Delta S/\text{cal K}^{-1} \text{ mol}^{-1} = 4.16 \pm 1.60 \text{ (at 581 K)} \]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution technique.
Diagram and details of the gas solubility apparatus are given in the original publication.
The experimental process consisted of three steps: saturation, elution and analysis. After saturating the melt with argon, the gas phase was evacuated. Helium gas was introduced into the system as eluting gas to approximately 1 atm. pressure. The resultant gas mixture of argon and helium was analyzed with Aerograph Model 90-P gas chromatograph (Varian). The carrier gas used was also helium.

SOURCE AND PURITY OF MATERIALS:
Argon and helium obtained from Airco were used directly from the cylinder.
Reagent grade lithium nitrate from Baker was used without further purification.

ESTIMATED ERROR:
\[ \Delta C/P = \pm 5\% \text{ (authors)} \]

REFERENCES:
COMPONENTS:

(1) Argon; Ar; [7440-37-1]
(2) Lithium nitrate; LiNO₃; [7790-69-4]

ORIGINAl MEASUREMENTS:

Cleaver, B.; Mather, D. E.

VARIABLES:

T/K = 546 & 580
P/kPa = 25000 - 100000

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

Solubilities of argon in the melt at two experimental temperatures, are presented only in graphical form as a function of the gas pressure in the range 250 - 1000 bar. Values of Henry's law constant, $K_H$, are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>$10^7 K_H/\text{mol} \cdot \text{ml}^{-2} \cdot \text{bar}^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>273</td>
<td>0.91 ± 0.20</td>
</tr>
<tr>
<td>307</td>
<td>1.09 ± 0.15</td>
</tr>
</tbody>
</table>

Smoothed Data:

$\Delta H/\text{kJ mol}^{-1} = 14.0$

$\Delta S^0/\text{J K}^{-1} \text{mol}^{-1} = -19.3$

$\Delta H$ is the enthalpy of solution, and $\Delta S^0$ is the standard entropy of solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

High pressure elution technique.
Diagram and details of the apparatus are given in the original paper. The melt was saturated by stirring it in contact with the gas at high pressure. A sample of the saturated melt was isolated and analyzed by the elution technique.

SOURCE AND PURITY OF MATERIALS:

Argon (99.9%) from British Oxygen Company was used without further purification or drying.
Lithium nitrate (99.9%) obtained from Johnson Matthey & Co. was recrystallized from distilled water and dried at 120°C. It was stored in an air oven at 100°C.

ESTIMATED ERROR:

$\delta P/\text{bar} = \pm 10$

REFERENCES:
COMPONENTS:
(1) Argon; Ar; [7440-37-1]
(2) Sodium nitrate; NaNO₃; [7631-99-4]

EVALUATOR:
N. P. Bansal
National Aeronautics and Space Administration.
Lewis Research Center.
Cleveland, Ohio, 44135. U.S.A.
December, 1989.

CRITICAL EVALUATION:

Five different investigations (1 - 5) are available for the solubility of argon in molten sodium nitrate. Smoothed data from these studies are compared below:

<table>
<thead>
<tr>
<th>T/K</th>
<th>Ref. 1</th>
<th>Ref. 2</th>
<th>Ref.3</th>
<th>Ref. 4</th>
<th>Ref. 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>590</td>
<td>0.57</td>
<td>(0.60)</td>
<td>(22.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600</td>
<td>0.60</td>
<td>(0.64)</td>
<td>(21.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>620</td>
<td>0.66</td>
<td>0.70</td>
<td>(20.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>640</td>
<td>0.72</td>
<td>0.77</td>
<td>19.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>642</td>
<td>0.73</td>
<td>0.78</td>
<td>19.8</td>
<td>19.1</td>
<td>17.2</td>
</tr>
<tr>
<td>660</td>
<td>0.78</td>
<td>0.84</td>
<td>19.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>680</td>
<td>(0.85)</td>
<td>0.91</td>
<td>18.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>700</td>
<td>(0.91)</td>
<td>0.99</td>
<td>17.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>710</td>
<td>(0.95)</td>
<td>1.03</td>
<td>17.4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Values in ( ) outside temperature interval of experimental measurement; extrapolated by the evaluator.

According to Copeland and Christie (6), the solubility results reported earlier from their laboratory cannot be considered reliable. Therefore, the values of Copeland et al. (3 - 5) are rejected.

The results of Field and Green (1), and of Cleaver and Mather (2) are in very good agreement within the experimental error. The recommended numerical values based on these two data sets are given in Table 1 and Fig. 1.

Table 1 - Recommended Numerical Values

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁷ Kₚ/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>590</td>
<td>0.59</td>
</tr>
<tr>
<td>600</td>
<td>0.62</td>
</tr>
<tr>
<td>610</td>
<td>0.65</td>
</tr>
<tr>
<td>620</td>
<td>0.68</td>
</tr>
<tr>
<td>630</td>
<td>0.72</td>
</tr>
<tr>
<td>640</td>
<td>0.75</td>
</tr>
</tbody>
</table>

References:
COMPONENTS:
(1) Argon; Ar; [7440-37-1]
(2) Sodium nitrate; NaNO₃; [7631-99-4]

CRITICAL EVALUATION:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10^7 Kₑₑ/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>650</td>
<td>0.78</td>
</tr>
<tr>
<td>660</td>
<td>0.81</td>
</tr>
<tr>
<td>670</td>
<td>0.85</td>
</tr>
<tr>
<td>680</td>
<td>0.88</td>
</tr>
<tr>
<td>690</td>
<td>0.91</td>
</tr>
<tr>
<td>700</td>
<td>0.95</td>
</tr>
<tr>
<td>710</td>
<td>0.99</td>
</tr>
</tbody>
</table>

EVALUATOR:
N. P. Bansal
National Aeronautics and Space Administration.
Lewis Research Center.
Cleveland, Ohio, 44135. U.S.A.
December, 1989.

Fig 1
COMPONENTS:
(1) Argon; Ar; [7440-37-1]
(2) Sodium nitrate; NaNO₃; [7631-99-4]

VARIABLES:
\[ T/K = 588 - 675 \]
\[ P/kPa = 91.193 - 135.776 \]

EXPERIMENTAL VALUES:
Henry's law was obeyed over the pressure range studied (0.96 - 1.34 atm.). The values of Henry's law constant, \( K_H \), for the solubility of argon in molten NaNO₃ at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>( 10^7 K_H / \text{mol cm}^{-3} \text{atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>588</td>
<td>0.540</td>
</tr>
<tr>
<td>595</td>
<td>0.555</td>
</tr>
<tr>
<td>607</td>
<td>0.656</td>
</tr>
<tr>
<td>609</td>
<td>0.697</td>
</tr>
<tr>
<td>614</td>
<td>0.555</td>
</tr>
<tr>
<td>618</td>
<td>0.768</td>
</tr>
<tr>
<td>628</td>
<td>0.687</td>
</tr>
<tr>
<td>632</td>
<td>0.658</td>
</tr>
<tr>
<td>637</td>
<td>0.775</td>
</tr>
<tr>
<td>655</td>
<td>0.719</td>
</tr>
<tr>
<td>675</td>
<td>0.870</td>
</tr>
</tbody>
</table>

Smoothed Data:
The temperature dependence of \( K_H \) is given by the expression:

\[
\log(K_H/\text{mol cm}^{-3} \text{atm}^{-1}) = (-5.94 \pm 0.28) - (769.15 \pm 0.18)/(T/K)
\]
Std. dev. 1.1%

The enthalpy of solution, \( \Delta H \), and entropy of solution, \( \Delta S \) are:

\[
\Delta H/\text{kcal mol}^{-1} = (3.52 \pm 0.81)
\]
\[
\Delta S/\text{cal K}^{-1} \text{ mol}^{-1} = -(5.58 \pm 1.30)
\]
(at 637K)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution technique.

Diagram of the gas solubility apparatus is given in the original publication.

The experimental process consisted of three steps: saturation, elution and analysis. After saturating the melt with argon, the gas phase was evacuated. Helium was introduced into the system as eluting gas to approximately 1 atm. pressure. The resultant gas mixture of argon and helium was analyzed with an Aerograph Model 90 - P gas chromatograph (Varian). The carrier gas used was also helium. Average of four measurements was used for calculation of the gas solubility.

SOURCE AND PURITY OF MATERIALS:
Argon and helium obtained from Airco were used directly from the cylinder.
Baker's reagent grade sodium nitrate was used without further purification.

ESTIMATED ERROR:

solubility = ± 5%  (authors)

REFERENCES:

ORIGINAL MEASUREMENTS:

PREPARED BY:
N. P. Bansal
COMPONENTS:

(1) Argon; Ar; [7440-37-1]

(2) Sodium nitrate; NaN0 3 ; [7631-99-4]

ORIGINAL MEASUREMENTS:

Cleaver, B.; Mather, D. E.


VARIABLES:

T/K = 604 - 713
P/kPa = 9000 - 105000

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

Solubilities of argon in the melt at three temperatures are presented in graphical form as a function of the gas pressure in the range 90 - 1050 bar. The gas solubility versus pressure plot showed curvature above 500 bar. Values of Henry's law constant, KH, are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10^7 K_H/mol ml^-1 bar^-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>331</td>
<td>0.64 ± 0.15</td>
</tr>
<tr>
<td>410</td>
<td>0.90 ± 0.15</td>
</tr>
<tr>
<td>440</td>
<td>1.04 ± 0.15</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of K_H is given by the equation:

log(K_H/mol ml^-1 bar^-1) = -5.839 - 819/(T/K) (compiler)

std. dev. = 0.9% (compiler)

A_H/kJ mol^-1 = 15.8
A_S°/J K^-1 mol^-1 = -21.7

\( \bar{v}_d/ml mol^{-1} = 34 \pm 8 \)

A_H is the enthalpy of solution, A_S° is the standard entropy of solution, and \( \bar{v}_d \) is the partial molar volume of the dissolved gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

High pressure elution technique.

Diagram and details of the apparatus are given in the original paper. The melt was saturated by stirring it in contact with the gas at high pressure. A portion of the saturated melt was isolated and analyzed by the elution technique.

SOURCE AND PURITY OF MATERIALS:

Argon (99.9%) from British Oxygen Company was used without further purification or drying.

Sodium nitrate (>99.5%) A.R. grade from B. D. H. was purified by filtration through Pyrex frits in the molten state. The melt was allowed to freeze and stored in vacuo.

ESTIMATED ERROR:

\( \delta P/bar = \pm 10 \)

REFERENCES:
COMPONENTS:

(1) Argon; Ar; [7440-37-1]

(2) Sodium nitrate; NaN03; [7631-99-4]

ORIGINAL MEASUREMENTS:

Copeland, J. L.; Seibles, L.

J. Phys. Chem. 1968, 72, 603 - 07.

VARIABLES:

P/kPa = 15288.75 - 40023.38

T/K = 629 - 714

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

Henry's law was obeyed for the solubility of argon in molten sodium nitrate up to a saturating gas pressure of 395 atm. The values of Henry's law constant, KH, at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10^7 KH/mol cm^-3 atm^-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>629</td>
<td>20.2 ± 1.3</td>
</tr>
<tr>
<td>642</td>
<td>19.2 ± 0.9</td>
</tr>
<tr>
<td>663</td>
<td>19.5 ± 1.3</td>
</tr>
<tr>
<td>679.5</td>
<td>18.6 ± 1.1</td>
</tr>
<tr>
<td>701</td>
<td>17.7 ± 0.9</td>
</tr>
<tr>
<td>714</td>
<td>16.8 ± 1.3</td>
</tr>
</tbody>
</table>

Smoothed Data:

The temperature dependence of KH is expressed by the relation:

\[
\log(K_H/\text{mol cm}^{-3} \text{ atm}^{-1}) = -(6.28 \pm 0.02) + (370 \pm 45)/(T/K)
\]

std. dev. = 1.1% (compiler)

The values of the heat of solution, \(\Delta H\), and the entropy of solution, \(\Delta S^o\), are:

\(\Delta H/\text{kcal mol}^{-1} = -1.84 \pm 0.21\)

\(\Delta S^o/\text{cal K}^{-1} \text{ mol}^{-1} = -15.4 \pm 0.3\)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The experimental arrangement and procedure followed for gas solubility measurements were the same as described earlier (1). Known quantities of the gas and the melt were equilibrated in a heated pressure vessel and the final pressure was measured. The amount of gas dissolved in the melt was determined by subtracting the number of moles of gas present in the gas phase, calculated from the Beattie-Bridgeman equation (2), from the number of moles originally admitted.

SOURCE AND PURITY OF MATERIALS:

Not described.

ESTIMATED ERROR:

Nothing specified

REFERENCES:

1. Copeland, J. L.; Zybko, W. C.


2. Beattie, J. A.; Bridgeman, O. C.

COMPONENTS:

(1) Argon; Ar; [7440-37-1]
(2) Sodium nitrate; NaNO₃; [7631-99-4]

ORIGINAL MEASUREMENTS:

Copeland, J. L.; Zybko, W. C.

VARIABLES:

P/kPa = 7092.75 - 45697.58
one temperature: T/K = 642

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

The solubility of argon in molten sodium nitrate at 369°C was measured upto a saturating gas pressure of 451 atm. Henry's law was obeyed. The variation of gas solubility in the melt, C₁, with the saturating gas pressure, P, could be expressed by the equation:

C₁/mol cm⁻³ = (17.2 × 10⁻⁷)P/atm + (0.41 × 10⁻⁴)

The Henry's law constant, Kₜ, is given as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁷ Kₜ/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>369</td>
<td>17.2 ± 1.7</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The details of the procedure followed for gas solubility measurements have been given in the original paper. Briefly, dry sodium nitrate was placed in the bomb which was then sealed and evacuated. Argon was admitted at room temperature to some desired pressure. The bomb was then heated to a temperature of 642K. Equilibrium was supposed to have been attained when no pressure change was observed for at least 24 h. The number of moles of Ar dissolved in the melt was calculated from the initial and final equilibrium gas pressures, volume and temperature with the aid of detailed plots of P - V - T data compiled by Din (1).

SOURCE AND PURITY OF MATERIALS:

Argon (99.999%) supplied by the National Cylinder Gas Co. was used without further purification.

Reagent grade NaNO₃ was obtained from Baker and Adamson and also from Fisher. The Baker and Adamson sample was used without treatment other than drying. The Fisher salt was dried, melted and the pure melt was decanted off.

ESTIMATED ERROR:

solubility = ± 10%  (authors)

REFERENCES:

1. Din, F.

COMPONENTS:
(1) Argon; Ar; [7440-37-1]
(2) Sodium nitrate; NaN0₃; [7631-99-4]

ORIGINAL MEASUREMENTS:

VARIABLES: P/kPa = 36679.65
one temperature: T/K = 642

PREPARED BY: N. P. Bansal

EXPERIMENTAL VALUES:
The solubility of argon in molten sodium nitrate at 369°C was determined up to a saturating gas pressure of 362 atm. Henry's law was obeyed. The value of Henry's law constant, K_H, is given as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁷ K_H/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>369</td>
<td>19.15 ± 0.45</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPAUSURUS/PROCEDURE:
Known quantities of the gas and the melt were equilibrated in a heated pressure vessel and the final pressure was measured. The amount of gas dissolved in the melt was determined by subtracting the number of moles of gas present in the gas phase from the number of moles originally admitted.

SOURCE AND Purity OF MATERIALS:
Not described.

ESTIMATED ERROR:
Nothing specified

REFERENCES:
**COMPONENTS:**

<table>
<thead>
<tr>
<th>(1) Argon; Ar; [7440-37-1]</th>
<th>EVALUATOR:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2) Potassium nitrate; KNO₃; [7757-79-1]</td>
<td>N. P. Bansal</td>
</tr>
<tr>
<td></td>
<td>National Aeronautics and Space Administration.</td>
</tr>
<tr>
<td></td>
<td>Lewis Research Center.</td>
</tr>
<tr>
<td></td>
<td>Cleveland, Ohio, 44135, U.S.A.</td>
</tr>
<tr>
<td></td>
<td>December, 1989.</td>
</tr>
</tbody>
</table>

**CRITICAL EVALUATION:**

Two studies (1,2) are available for the solubility of argon in molten KNO₃. However, the temperature intervals of the two studies are different with some overlapping range. The solubility values of Green (1) are much higher than those of Woelk (2).

Further experimental studies are needed before recommended values can be advanced for this system.

**References:**

COMPONENTS:
(1) Argon; Ar; [7440-37-1]
(2) Potassium nitrate; KNO₃; [7757-79-1]

ORIGINAL MEASUREMENTS:

VARIABLES:
T/K = 608 - 678
P/kPa = 50.663 - 151.988

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The values of Henry's law constant, $K_H$, for the solubility of Ar in molten KNO₃ at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^7 K_H$/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>608</td>
<td>1.61</td>
</tr>
<tr>
<td>611</td>
<td>1.58</td>
</tr>
<tr>
<td>618</td>
<td>1.81</td>
</tr>
<tr>
<td>624</td>
<td>1.65</td>
</tr>
<tr>
<td>630</td>
<td>1.72</td>
</tr>
<tr>
<td>643</td>
<td>1.65</td>
</tr>
<tr>
<td>648</td>
<td>1.83</td>
</tr>
<tr>
<td>650</td>
<td>1.60</td>
</tr>
<tr>
<td>679</td>
<td>2.07</td>
</tr>
</tbody>
</table>

Smoothed Data:
The temperature dependence of $K_H$ is expressed by the relation:

$$\log(K_H \text{/mol cm}^{-3} \text{ atm}^{-1}) = -5.889 - 553.0/(T/K)$$

std. dev. = 0.87%

The enthalpy of solution, $\Delta H$, and the entropy of solution, $\Delta S$, are:

$\Delta H$/kcal mol⁻¹ = 2.53 ± 0.67  $\Delta S$/cal K⁻¹ mol⁻¹ = -5.26 ± 1.05 (at 668 K)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution technique.

Diagram and details of the gas solubility apparatus are given in the original publication.

The experimental process consisted of three steps: saturation, elution and analysis. After saturating the melt with argon, the gas phase was evacuated. Helium gas was introduced into the system as eluting gas to approximately 1 atm. gas pressure. The resultant gas mixture of argon and helium was analyzed with an Aerograph Model 90 - P gas chromatograph (Varian). The carrier gas used was also helium.

SOURCE AND PURITY OF MATERIALS:
Argon and helium obtained from Airco were used directly from the tank.
Reagent grade potassium nitrate from Baker was used without further purification.

ESTIMATED ERROR:
$6\epsilon/P = ± 5\%$  (authors)

REFERENCES:
COMPONENTS:

(1) Argon; Ar; [7440-37-1]
(2) Potassium nitrate; KNO₃; [7757-79-1]

ORIGINAL MEASUREMENTS:

Woelk, H. U.
Nukleonik 1960, 2, 278 - 79.

VARIABLES:

P/kPa: 101.325 (compiler)
T/K = 652 - 1000

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

The solubilities of argon in molten potassium nitrate have been reported in the temperature interval 650 - 1000K in graphical form only. The values of solubilities derived from this graph, by the compiler, are given below in the form of Henry's law constants, Kₕ:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10ⁿ Kₕ/mol ml⁻¹ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>652</td>
<td>3.8</td>
</tr>
<tr>
<td>726</td>
<td>7.1</td>
</tr>
<tr>
<td>818</td>
<td>10.3</td>
</tr>
<tr>
<td>910</td>
<td>15.8</td>
</tr>
<tr>
<td>1000</td>
<td>21.6</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of Kₕ is expressed by the equation:

\[
\log(Kₕ/mol \text{ ml}^{-1} \text{ atm}^{-1}) = -5.284 - 1380.4/(T/K) \quad (\text{compiler})
\]

\[
\text{std. dev.} = 2.5\% \quad (\text{compiler})
\]

The heat of solution, ΔH, is estimated to be:

ΔH/kJ mol⁻¹ = 26.4 \quad (\text{compiler})

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The methods used for solubility measurements was the same as described elsewhere (1).

SOURCE AND PURITY OF MATERIALS:

Not described.

ESTIMATED ERROR:

Nothing specified

REFERENCES:

1. Woelk, H. U.

2. Woelk, H. U.
Nukleonik 1960, 2, 278 - 79.
COMPONENTS:

(1) Argon; Ar; [7440-37-1]
(2) Rubidium nitrate; RbNO₃; [13126-12-0]

VARIABLES:

<table>
<thead>
<tr>
<th>T/K</th>
<th>P/kPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>604 &amp; 713</td>
<td>24000 - 100000</td>
</tr>
</tbody>
</table>

EXPERIMENTAL VALUES:

Solubilities of argon in the melt are presented at two experimental temperatures, only in the graphical form as a function of the gas pressure in the range 240 - 1000 bar. Values of Henry's law constant, $K_H$, are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>$10^7 K_H$/mol ml⁻¹ bar⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>331</td>
<td>1.30 ± 0.2</td>
</tr>
<tr>
<td>440</td>
<td>2.40 ± 0.2</td>
</tr>
</tbody>
</table>

Smoothed Data:

$\Delta H$/kJ mol⁻¹ = 20.1
$\Delta S^\circ$/J K⁻¹ mol⁻¹ = -8.6

$\Delta H$ is the enthalpy of solution, and $\Delta S^\circ$ is the standard entropy of solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

High pressure elution technique.
Diagram and details of the apparatus are given in the original paper. The melt was saturated by stirring it in contact with the gas at high pressure. A sample of the saturated melt was removed and analyzed by the elution technique.

SOURCE AND PURITY OF MATERIALS:

Argon (99.9%) from British Oxygen Company was used without further purification or drying. Rubidium nitrate (99.9%) from Johnson - Matthey & Co. was purified by filtration through Pyrex frits in the fused state. The melt was allowed to freeze and stored in vacuo.

ESTIMATED ERROR:

$\delta P$/bar = ± 10

REFERENCES:

COMPONENTS:
(1) Argon; Ar; [7440-37-1]
(2) Rubidium nitrate; RbNO₃; [13126-12-0]

ORIGINAL MEASUREMENTS:
Cleaver, B.; Williams, J. F.

VARIABLES:
P/kPa = 101.325 - 50662.5
one temperature: T/K = 585.5

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The solubility of argon in molten rubidium nitrate is:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>solubility/mol ml⁻¹ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freezing Point of RbNO₃ (312.5)</td>
<td>2.0 X 10⁻⁷</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Cryscopy.
Molten rubidium nitrate was allowed to equilibrate for twelve hours in contact with argon gas, at pressures up to 500 atm. The freezing point of argon saturated RbNO₃ was measured. Henry's law constant was calculated using Raoult's law and the heat of fusion of RbNO₃ (4.644 kJ mol⁻¹).

SOURCE AND PURITY OF MATERIALS:
Rubidium nitrate (99.9%) from Johnson, Matthey and Co. was recrystallized from distilled water. Source and purity of argon not given.

ESTIMATED ERROR:
Nothing specified

REFERENCES:
CRITICAL EVALUATION:

Only two studies (1 - 2) have been reported for the solubility of argon in molten silver nitrate. The solubility values from these investigations are compared below:

<table>
<thead>
<tr>
<th>T/K</th>
<th>Cleaver &amp; Mather</th>
<th>Copeland &amp; Radak</th>
</tr>
</thead>
<tbody>
<tr>
<td>507</td>
<td>0.19 ± 0.05</td>
<td></td>
</tr>
<tr>
<td>523</td>
<td></td>
<td>33.5 ± 5.5</td>
</tr>
</tbody>
</table>

According to Copeland and Christie (3), the solubility results reported earlier from their laboratory cannot be considered reliable. The value of Cleaver and Mather (1) may be treated as more reliable, at least tentatively. More detailed investigations are needed before recommended values can be advanced.

References:

COMPONENTS:
(1) Argon; Ar; [7440-37-1]
(2) Silver nitrate; AgNO₃; [7761-88-8]

VARIABLES: p/kPa = 33000 - 95000
one temperature: T/K = 507

EXPERIMENTAL VALUES:
Solubilities of argon in the melt are presented at only one temperature, in the graphical form as a function of the gas pressure in the range 330 - 950 bar. The value of Henry's law constant, $K_H$, at the experimental temperature is:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>$10^7 K_H$/mol ml⁻¹ bar⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>234</td>
<td>0.19 ± 0.05</td>
</tr>
</tbody>
</table>

METHOD/APPARATUS/PROCEDURE:
High pressure elution technique.
Diagram and details of the apparatus are given in the original paper. The melt was saturated by stirring it in contact with the gas at high pressure. A sample of the saturated melt was isolated and analyzed by the elution technique.

SOURCE AND PURITY OF MATERIALS:
Argon (99.9%) from British Oxygen Company was used without further purification or drying. Silver nitrate (99.9%) obtained from Johnson - Matthey & Co. was recrystallized from distilled water.

ESTIMATED ERROR:
$\delta P$/bar = ± 10

REFERENCES:
COMPONENTS:
(1) Argon; Ar; [7440-37-1]
(2) Silver nitrate; AgNO₃; [7761-88-8]

ORIGINAL MEASUREMENTS:
Copeland, J. L.; Radak, S.

VARIABLES:
\[ P/kPa = 4762.275 - 37996.875 \]
One temperature: \( T/K = 523 \)

EXPERIMENTAL VALUES:
The solubility of argon in molten silver nitrate at 523K was determined up to a saturating gas pressure of 375 atm. Henry’s law was obeyed. The value of Henry’s law constant, \( K_H \), is given as:

<table>
<thead>
<tr>
<th>( t/°C )</th>
<th>( 10^6 K_H/\text{mol cm}^{-3} \text{ atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>3.35 ± 0.55</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
The equipment and technique used for gas solubility measurements were exactly the same as described elsewhere (1).

SOURCE AND PURITY OF MATERIALS:
Argon (99.98%) was obtained from the National Cylinder Gas Co.
Reagent grade silver nitrate obtained from Mallinckrodt, Fisher Scientific and Baker were used. Before each measurement, silver nitrate was fused, allowed to cool and solidify in a porcelain casserole placed in a desiccator, and then finely pulverized.

ESTIMATED ERROR:
Nothing specified

REFERENCES:
1. Copeland, J. L.; Zybko, W. C.
COMPONENTS:

(1) Argon; Ar; [7440-37-1]

(2) Sodium chloride; NaCl; [7647-14-5]

VARIABLES:

P/kPa: 101.325 (compiler)
T/K = 1123 - 1223

EXPERIMENTAL VALUES:

The values of Henry's law constant, $K_H$, for the solubility of argon in molten NaCl at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^7 K_H$/mol cm$^{-3}$ atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1123</td>
<td>1.28</td>
</tr>
<tr>
<td>1173</td>
<td>1.54</td>
</tr>
<tr>
<td>1223</td>
<td>2.02</td>
</tr>
</tbody>
</table>

Smoothed Data:

The temperature dependence of $K_H$ could be expressed by the relation:

$$\log(K_H$/mol cm$^{-3}$ atm$^{-1}$) = -4.484 - 2712.1/(T/K)$$

std. dev. = 1.9% (compiler)

The enthalpy of solution, $\Delta H$, is:

$$\Delta H$/kJ mol$^{-1}$ = 51.9$$ (compiler)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Not available.

SOURCE AND PURITY OF MATERIALS:

Not available.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:
The solubility of argon in molten potassium chloride has been studied by two different groups (1 - 2). Smoothed data from the two studies are compared below at different temperatures:

<table>
<thead>
<tr>
<th>T/K</th>
<th>Novozhilov et al. (1)</th>
<th>Waelk (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1100</td>
<td>(3.08)</td>
<td>4.78</td>
</tr>
<tr>
<td>1140</td>
<td>3.53</td>
<td>5.47</td>
</tr>
<tr>
<td>1180</td>
<td>4.01</td>
<td>6.21</td>
</tr>
<tr>
<td>1220</td>
<td>4.51</td>
<td>6.98</td>
</tr>
<tr>
<td>1260</td>
<td>(5.05)</td>
<td>7.80</td>
</tr>
<tr>
<td>1300</td>
<td>-</td>
<td>8.65</td>
</tr>
<tr>
<td>1400</td>
<td>-</td>
<td>10.91</td>
</tr>
<tr>
<td>1500</td>
<td>-</td>
<td>(13.36)</td>
</tr>
</tbody>
</table>

Values in ( ) outside temperature interval of experimental measurement; extrapolated by the evaluator.

The results of Waelk are about 55% higher compared to those of Novozhilov et al. The enthalpies of solution in the two studies are in excellent agreement. This indicates that the disagreement between the results lies in magnitude rather than in the temperature dependence of the solubility.

Further investigations are needed before this system can be properly evaluated and recommended values can be advanced.

References:
COMPONENTS:

(1) Argon; Ar; [7440-37-1]
(2) Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS:
Novozhilov, A. L.; Devyatkin, V. N.; Pchelina, E. I.
Salts, Oxide Melts, Solid Electrolytes, Svedlovsk, 1973, Part 1, 118.

VARIABLES:

P/kPa: 101.325 (compiler)
T/K = 1123 - 1223

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:

The values of Henry's law constant, K_H, for the solubility of argon
in molten KCl at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10^7 K_H/mol cm^-3 atm^-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1123</td>
<td>3.32</td>
</tr>
<tr>
<td>1173</td>
<td>3.96</td>
</tr>
<tr>
<td>1223</td>
<td>4.53</td>
</tr>
</tbody>
</table>

Smoothed Data:

The temperature dependence of K_H could be expressed by the equation:

\[
\log(K_H/\text{mol cm}^{-3}\text{ atm}^{-1}) = -4.822 - \frac{1859.7}{(T/K)}
\]

(std. dev. = 0.6% (compiler)

The enthalpy of solution, \Delta H, is:

\[
\Delta H/\text{kJ mol}^{-1} = 35.6
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Not available.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:
COMPONENTS:

(1) Argon; Ar; [7440-37-1]

(2) Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS:

Woelk, H. U.
Nukleonik 1960, 2, 278 - 79.

VARIABLES:

P/kPa: 101.325 (compiler)
T/K = 1088 - 1495

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

Solubilities of argon in molten KCl at different temperatures have been reported only in graphical form. The values of solubilities derived from this graph are given below in the form of Henry's law constants, $K_H$:

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^7 K_H$/mol ml$^{-1}$ atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1088</td>
<td>4.39</td>
</tr>
<tr>
<td>1140</td>
<td>5.73</td>
</tr>
<tr>
<td>1224</td>
<td>6.99</td>
</tr>
<tr>
<td>1286</td>
<td>8.51</td>
</tr>
<tr>
<td>1495</td>
<td>13.02</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of $K_H$ is given by the equation:

$$\log(K_H$/mol ml$^{-1}$ atm$^{-1}$) = -4.647 - 1841/(T/K)$$  (compiler)

std. dev. = 1.7%  (compiler)

The heat of solution, $\Delta H$, is calculated to be:

$$\Delta H$/kJ mol$^{-1}$ = 35.2  (compiler)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The procedure employed for solubility was the same as described elsewhere (1).

SOURCE AND PURITY OF MATERIALS:

Not described.

ESTIMATED ERROR:

Nothing specified

REFERENCES:

1. Woelk, H. U.
COMPONENTS:

(1) Argon; Ar; [7440-37-1]
(2) Rubidium chloride; RbCl; [7791-11-9]

VARIABLES:

P/kPa: 101.325 (compiler)
T/K = 1073 - 1173

EXPERIMENTAL VALUES:

The values of Henry's law constant, \( K_H \), for the solubility of argon in molten RbCl at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>( 10^7 K_H ) mol cm(^{-3} ) atm(^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1073</td>
<td>3.28</td>
</tr>
<tr>
<td>1123</td>
<td>3.72</td>
</tr>
<tr>
<td>1173</td>
<td>4.38</td>
</tr>
</tbody>
</table>

Smoothed Data:

The temperature dependence of \( K_H \) could be expressed by the relation:

\[
\log(\text{mol cm}^{-3} \text{ atm}^{-1}) = 5.015 - 1579.2/(T/K) \quad \text{(compiler)}
\]

std. dev. = 0.9% \quad \text{(compiler)}

The enthalpy of solution, \( \Delta H \), is:

\[
\Delta H / \text{kJ mol}^{-1} = 30.2 \quad \text{(compiler)}
\]

REFERENCES:


METHOD/APPARATUS/PROCEDURE:

Not available.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

Nothing specified.
COMPONENTS:

1. Argon; Ar; [7440-37-1]
2. Cesium chloride; CsCl; [7647-17-8]

ORIGINAL MEASUREMENTS:

Novozhilov, A. L.; Devyatkin, V. N.; Pchelina, E. I.

VARIABLES:

P/kPa: 101.325 (compiler)
T/K = 1073 - 1173

EXPERIMENTAL VALUES:

The values of Henry's law constant, $K_H$, for the solubility of argon in molten CsCl at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^7 K_H$/mol cm$^{-3}$ atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1073</td>
<td>4.10</td>
</tr>
<tr>
<td>1123</td>
<td>4.66</td>
</tr>
<tr>
<td>1173</td>
<td>5.14</td>
</tr>
</tbody>
</table>

Smoothed Data:

The temperature dependence of $K_H$ could be expressed by the equation:

$$\log(\frac{K_H}{\text{mol cm}^{-3}\ \text{atm}^{-1}}) = -5.231 - \frac{1238.6}{(T/K)}$$

std. dev. = 0.4% (compiler)

The enthalpy of solution, $\Delta H$, is:

$$\Delta H/\text{kJ mol}^{-1} = 23.7$$ (compiler)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Not available.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

Std. Dev. = ± 0.4% (compiler)

REFERENCES:
### COMPONENTS:

(1) Argon; Ar; [7440-37-1]
(2) Zinc chloride; ZnCl₂; [7646-85-7]

### ORIGINAL MEASUREMENTS:

Borodzinski, A.; Sokolowski, A.; Suski, L.


### VARIABLES:

one temperature: \( T/K = 720 \)
\( P/kPa = 20 - 100 \)

### EXPERIMENTAL VALUES:

For the solubility of argon in the melt the Henry's law constant, \( K_H \), is:

<table>
<thead>
<tr>
<th>( T/K )</th>
<th>( 10^{10} x_1/\text{mol fraction} )</th>
<th>( 10^7 K_H/\text{mol ml}^{-1} \text{ atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>720</td>
<td>4.77 ± 0.03</td>
<td>8.23*</td>
</tr>
</tbody>
</table>


### AUXILIARY INFORMATION

**METHOD/APPARATUS/PROCEDURE:**

Volumetric method.

The experimental arrangement used is described in detail in the original paper. The melt was saturated with argon. The process of saturation was enhanced by a magnetic stirrer. The change in volume of the gas caused by its dissolution in the melt was determined. Temperature was controlled within ± 1K.

**SOURCE AND PURITY OF MATERIALS:**

Argon was 99.99% pure.

Zinc chloride p. a. was distilled under vacuum prior to its distillation directly into the apparatus.

**ESTIMATED ERROR:**

solubility = ± 5% (authors)

**REFERENCES:**
Solubilities of argon in molten KBr at different temperatures have been reported in graphical form only. The values of solubilities derived from this graph by the compiler are given below in the form of Henry's law constants, $K_H$:

<table>
<thead>
<tr>
<th>$T/K$</th>
<th>$K_H \times 10^7$/mol ml$^{-1}$ atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1017</td>
<td>6.43</td>
</tr>
<tr>
<td>1083</td>
<td>7.76</td>
</tr>
<tr>
<td>1151</td>
<td>9.12</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of $K_H$ is expressed by the relation:

$$\log(K_H$/mol ml$^{-1}$ atm$^{-1}$) = -4.887 - 1326/(T/K)$$  

std. dev. = 0.2%  

The heat of solution, $\Delta H$, is calculated to be:

$$\Delta H$/kJ mol$^{-1}$ = 25.4$  

source and purity of materials: Not described.

estimated error: Nothing specified

references:

1. Woelk, H. U.  
Chem. - Ing. - Techn.  
32, 765(1960)
**Components:**

1. Argon; Ar; [7440-37-1]
2. Potassium iodide; KI; [7681-11-0]

**Original Measurements:**

Woelk, H. U.

*Nukleonik* 1960, 2, 278 - 79.

**Variables:**

P/kPa: 101.325 (compiler)

T/K = 985 - 1263

**Experimental Values:**

Solubilities of argon in molten KI at different temperatures have been reported only in graphical form. The values of solubilities derived from this graph by the compiler are given below in the form of Henry's law constants, $K_H$:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10^7 $K_H$/mol ml^-1 atm^-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>985</td>
<td>8.0</td>
</tr>
<tr>
<td>1053</td>
<td>9.9</td>
</tr>
<tr>
<td>1125</td>
<td>11.8</td>
</tr>
<tr>
<td>1184</td>
<td>14.3</td>
</tr>
<tr>
<td>1263</td>
<td>16.6</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of $K_H$ is expressed by the relation:

$$\log(K_H$/mol ml^-1 atm^-1) = -4.642 - 1434.5/(T/K)$$

(std. dev. = 0.8%)

The heat of solution, $\Delta H$, is calculated to be:

$$\Delta H/kJ mol^-1 = 27.5$$

**Auxiliary Information**

**Method/Apparatus/Procedure:**

The procedure used for the solubility measurements was the same as described elsewhere (1).

**Source and Purity of Materials:**

Not described.

**Estimated Error:**

Nothing specified

**References:**

1. Woelk, H. U.
COMPONENTS:

(1) Argon; Ar; [7440-37-1]
(2) Sodium nitrate; NaNO₃; [7631-99-4]
(3) Potassium nitrate; KNO₃; [7757-79-1]

ORIGINAL MEASUREMENTS:

Paniccia, F; Zambonin, P. G.
1972, 68, 2083 - 89.

VARIABLES:

T/K = 508 - 603
P/kPa = 10²

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

The solvent was an equimolar mixture of sodium nitrate and potassium nitrate. The solubilities of argon in the melt at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁻⁸ Kₜ/mol cm⁻³ bar⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>508</td>
<td>1.0</td>
</tr>
<tr>
<td>533</td>
<td>1.3</td>
</tr>
<tr>
<td>573</td>
<td>1.7</td>
</tr>
<tr>
<td>603</td>
<td>2.1</td>
</tr>
</tbody>
</table>

Smoothed Data:

The temperature dependence of Henry's law constant, Kₜ, is given by the relation:

\[ \log(Kₜ/mol \text{ cm}^{-3} \text{ bar}^{-1}) = -5.99 - 1017.4/(T/K) \] (compiler)

std. dev. = 1.1% (compiler)

The enthalpy, \( \Delta H \), and the standard entropy, \( \Delta S^\circ \), of solution are:

\[ \Delta H/\text{kJ mol}^{-1} = 18.5 \]
\[ \Delta S^\circ/\text{J K}^{-1} \text{ mol}^{-1} = -28 \] (at 533 K)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Manometric technique.

The details of the apparatus and procedure employed for solubility measurements are described elsewhere (1). Briefly, the melt was vacuum - degassed for a few hours. The vacuum was disconnected and argon gas introduced at about one bar pressure. The melt was vigorously stirred and pressure changes were noted with a manometer as a function of time until the equilibrium was reached. The amount of gas dissolved was calculated from the final variation after a suitable calibration.

SOURCE AND PURITY OF MATERIALS:

Argon (High Purity Grade) was purified by keeping it in contact with Ascarite (A. H. Thomas Co.,) for several hours to remove CO₂ and other acidic impurities and molecular sieve 5A (Carlo Er里斯, Milano) at -80°C to remove water.

Reagent grade sodium and potassium nitrates were used to prepare the melt which was filtered in the molten state.

ESTIMATED ERROR:

Nothing specified

REFERENCES:

1. Desimoni, E.; Paniccia, F.; Zambonin, P. G.
COMPONENTS:

(1) Argon; Ar; [7440-37-1]
(2) Lithium fluoride; LiF; [7789-24-4]
(3) Beryllium fluoride; BeF₂; [7789-49-7]

ORIGINAL MEASUREMENTS:

Watson, G. M.; Evans III, R. B.; Grimes, W. R.; Smith, N. V.

VARIABLES:

\[
P/kPa = 101.325 - 202.650
\]
\[
T/K = 773 - 1073
\]

PREPARED BY: N. P. Bansal

EXPERIMENTAL VALUES:

The values of Henry's law constant, \( K_H \), for the solubility of argon in the melt LiF - BeF₂ (64 - 36 mol%) at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>( 10^a K_H/\text{mol cm}^{-3} \text{ atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>0.54 ± 0.02</td>
</tr>
<tr>
<td>600</td>
<td>0.98 ± 0.02</td>
</tr>
<tr>
<td>700</td>
<td>1.69 ± 0.10</td>
</tr>
<tr>
<td>800</td>
<td>2.66 ± 0.15</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of \( K_H \) can be expressed by the relation:

\[
\log(K_H/\text{mol cm}^{-3} \text{ atm}^{-1}) = -5.797 - 1918/(T/K) \quad \text{(compiler)}
\]

\[
\text{std. dev.} = 1.5\% \quad \text{(compiler)}
\]

The enthalpy of solution, \( \Delta H \), and the standard entropy of solution, \( \Delta S^\circ \), are:

\[
\Delta H/\text{kcal mol}^{-1} = 8.6
\]
\[
\Delta S^\circ/\text{cal K}^{-1} \text{ mol}^{-1} = -4.2 \quad \text{(at 1000 K)}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stripping or elution method.

The apparatus and procedure used for gas solubility measurements have been described elsewhere (1,2).

SOURCE AND PURITY OF MATERIALS:

Argon gas, (> 99.9%), was obtained from the Linde Co.
LiF was reagent grade. BeF₂ (99.5 ± 0.5%) was obtained from the Beryllium Corp. of America.
The melt was prepared by mixing the two fluorides in proper proportions. The melt was purified by flushing it alternately with anhydrous HF and F₂ at 800°C

ESTIMATED ERROR:

solubility = ± 10%

REFERENCES:

1. Grimes, W. R.; Smith, N. V.; Watson, G. M.
2. Blander, M.; Grimes, W. R.; Smith, N. V.; Watson, G. M.
   Ibid. 1959, 63, 1164.
### COMPONENTS:

1. Argon; Ar; \([7440-37-1]\)
2. Sodium fluoride; NaF; \([7681-49-4]\)
3. Beryllium fluoride; BeF₂; \([7789-49-7]\)

### ORIGINAL MEASUREMENTS:

Ward, W. T.; Watson, G. M.; Evans, R. E.; Grimes, W. R.

U.S.A.E.C. Rept. O.R.N.L. - 2931 

### VARIABLES:

<table>
<thead>
<tr>
<th>P/kPa</th>
<th>T/K</th>
</tr>
</thead>
<tbody>
<tr>
<td>101.325 - 202.650</td>
<td>773 - 1073</td>
</tr>
</tbody>
</table>

### PREPARED BY:

N. P. Bansal

### EXPERIMENTAL VALUES:

The values of Henry's law constant, \(K_H\), for the solubility of argon in the molten salt solvent NaF - BeF₂ (57 - 43 mol%) at different temperatures are:

<table>
<thead>
<tr>
<th>(t/°C)</th>
<th>(10^7 K_H/mmol cm^{-3} atm^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>1.16</td>
</tr>
<tr>
<td>600</td>
<td>1.92</td>
</tr>
<tr>
<td>700</td>
<td>2.97</td>
</tr>
<tr>
<td>800</td>
<td>4.55</td>
</tr>
</tbody>
</table>

* Values read from graph.

Smoothed Data:

Temperature dependence of \(K_H\) can be expressed by the equation:

\[
\log(K_H/mmol \text{ cm}^{-3} \text{ atm}^{-1}) = -5.839 - 1629.2/(T/K) 
\]

(compiler)

std. dev. = 1.8 %

The heat of solution, \(\Delta H\), and the standard entropy of solution, \(\Delta S^o\), are:

\(\Delta H/kcal \text{ mol}^{-1} = 7.5\) (compiler) \(\Delta S^o/\text{cal K}^{-1} \text{ mol}^{-1} = -3.1\) (at 1000 K)

### METHOD/APPARATUS/PROCEDURE:

Stripping method.

The method used for the determination of gas solubilities in the molten salt solvent was the same as described elsewhere (1).

### SOURCE AND PURITY OF MATERIALS:

Not described.

### ESTIMATED ERROR:

Nothing specified

### REFERENCES:

1. Grimes, W. R.; Smith, N. V.; Watson, G. M.

COMPONENTS:
(1) Argon; Ar; [7440-37-1]
(2) Sodium fluoride; NaF;
[7681-49-4]
(3) Zirconium fluoride; ZrF$_4$;
[7783-64-4]

ORIGINAL MEASUREMENTS:
Grimes, W. R.; Smith, N. V.;
Watson, G. M.

VARIABLES: $P$/kPa = 50.663 - 202.650
$T$/K = 873 - 1073

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The values of Henry's law constant, $K_H$, for the solubility of argon in the melt NaF - ZrF$_4$ (53 - 47 mol%) at different temperatures are:

<table>
<thead>
<tr>
<th>$t$/°C</th>
<th>$10^n K_H$/mol cm$^{-3}$ atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>5.06 ± 0.15</td>
</tr>
<tr>
<td>700</td>
<td>8.07 ± 0.08</td>
</tr>
<tr>
<td>800</td>
<td>12.0 ± 0.6</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of $K_H$ can be expressed by the relation:

$$\log(K_H$/mol cm$^{-3}$ atm$^{-1}$) = -5.286 - 1755.8/(T/K)$$ (compiler)

std. dev. = 0.4% (compiler)

The enthalpy of solution, $\Delta H$, and the entropy, $\Delta S$, of dissolving the gas with equal concentrations in the gaseous and liquid states are:

$\Delta H$/kcal mol$^{-1}$ = 8.2

$\Delta S$/cal K$^{-1}$ mol$^{-1}$ = -1.5 (at 1000 K)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution or stripping method.

The diagram and details of the apparatus and procedure are described in detail in the original publication. In brief, the melt was saturated with argon by sparging it with the gas for 6 hours at the desired gas pressure. Part of the molten salt solution was transferred into the stripping section. The dissolved argon was stripped from the melt by circulation of helium through the system for about 15 minutes. The amount of argon present in the eluted gas mixture was determined by mass spectrometry.

SOURCE AND PURITY OF MATERIALS:
Argon gas, (>99.9%) was obtained from Linde Air Products Company.
Sodium fluoride of reagent grade was obtained from Mallinckrodt Chemical Co.
ZrF$_4$ was prepared by hydrofluorination of ZrCl$_4$ at 500°C in nickel apparatus. The melt was prepared by mixing the two salts in proper ratio and purified at 800°C by sparging it alternately with anhydrous HF and H$_2$. No oxide was present in the melt.

ESTIMATED ERROR:
solubility = ± 10% (author)

REFERENCES:
COMPONENTS:

(1) Argon; Ar; [7440-37-1]
(2) Sodium oxide; Na₂O; [1313-59-3]
(3) Vanadium oxide; V₂O₅; [1314-62-1]

ORIGINAL MEASUREMENTS:

Nalimova, E. G.; Fedorov, A. A.; Ponomarev, V. E.
1983, 57, 478 - 479. (*)

VARIABLES:

T/K = 808 - 951
V₂O₅ / mole % = 61 - 70
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:

Henry's Law Constants, \(K_p\) (mol cm⁻³ atm⁻¹), for the solubility of argon in Na₂O - V₂O₅ melts of various compositions were determined at different temperatures. Coefficients of the equation \(\log K_p = A + B/T \pm \Delta\), where \(\Delta\) is the error obtained by linear least squares fit of the data are given below:

<table>
<thead>
<tr>
<th>Melt composition/ mole % V₂O₅</th>
<th>Temp. range (K)</th>
<th>-A</th>
<th>-B</th>
<th>(\Delta)</th>
</tr>
</thead>
<tbody>
<tr>
<td>61.0</td>
<td>808 - 903</td>
<td>2.506</td>
<td>3583</td>
<td>0.027</td>
</tr>
<tr>
<td>70.0</td>
<td>848 - 951</td>
<td>2.652</td>
<td>3304</td>
<td>0.010</td>
</tr>
</tbody>
</table>

The enthalpies \((\Delta H^o)\) and entropies \((\Delta S^o)\) of the solution were evaluated from the temperature dependence of the solubility constants expressed as \(K_o = C_m/C_o\), where \(C_m\) and \(C_o\) are the volume concentrations of the dissolved gas in the liquid and the gas phase respectively, are given below:

<table>
<thead>
<tr>
<th>Melt composition/ mole % V₂O₅</th>
<th>(\Delta H^o)/kJ mol⁻¹</th>
<th>(\Delta S^o)/JK⁻¹mol⁻¹ (at 855K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>61.0</td>
<td>75.55</td>
<td>50.06</td>
</tr>
<tr>
<td>70.0</td>
<td>70.37</td>
<td>51.88</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas solubilities were determined by desorption of the dissolved gas from the melt by an inert gas (helium) as well as by a gas - volumetric method. The discrepancy between the results of the two methods was 10 - 20 %.

The V₂O₅ content in the melt was determined by an amperometric titration.

SOURCE AND PURITY OF MATERIALS:

Not specified.

ESTIMATED ERROR:

Not specified.

REFERENCES:
COMPONENTS: ORIGINAL MEASUREMENTS:

(1) Argon; Ar; [7440-37-1]  
Nalimova, E. G.; Fedorov, A. A.; Ponomarev, V. E.; Ketov, A. N.  

(2) Potassium Oxide; K₂O; [12136-45-7]  
(3) Vanadium Oxide; V₂O₅; [1314-62-1]  

VARIABLES:  
T/K = 773 - 909  
V₂O₅/mole % = 55.5 - 66.5  
P/kPa: 101.325 (1 atm.)  

EXPERIMENTAL VALUES:
Solubilities of argon in K₂O - V₂O₅ melts of various compositions were determined at various temperatures at an initial pressure of 1 atm. The average gas solubilities obtained from five measurements at each temperature are given below:

<table>
<thead>
<tr>
<th>Mole % V₂O₅</th>
<th>T/K</th>
<th>10⁷ cm/mol cm⁻³ atm⁻¹</th>
<th>T/K</th>
<th>10⁷ cm/mol cm⁻³ atm⁻¹</th>
<th>T/K</th>
<th>10⁷ cm/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>55.5 mole % V₂O₅</td>
<td>816</td>
<td>0.89</td>
<td>773</td>
<td>1.20</td>
<td>783</td>
<td>3.47</td>
</tr>
<tr>
<td></td>
<td>858</td>
<td>1.55</td>
<td>813</td>
<td>2.04</td>
<td>810</td>
<td>3.63</td>
</tr>
<tr>
<td></td>
<td>876</td>
<td>1.78</td>
<td>828</td>
<td>2.34</td>
<td>837</td>
<td>4.57</td>
</tr>
<tr>
<td></td>
<td>898</td>
<td>1.95</td>
<td>853</td>
<td>2.69</td>
<td>873</td>
<td>7.08</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>893</td>
<td>4.17</td>
<td>909</td>
<td>7.76</td>
</tr>
</tbody>
</table>

The enthalpies of solution, ΔH°, and the entropies of solution, ΔS°, were evaluated from the temperature dependence of the solubility constants expressed as k₀ = Cm/Cₐ where Cm(mol cm⁻³) is the concentration of the gas in the melt and Cₐ is the concentration of the gas in the gas phase in mol cm⁻³. Thermodynamic parameters at 855K are given below:

<table>
<thead>
<tr>
<th>Mole % V₂O₅</th>
<th>ΔH°/kJ mol⁻²</th>
<th>ΔS°/J mol⁻²K⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>55.5</td>
<td>65.83</td>
<td>57.42</td>
</tr>
<tr>
<td>61.0</td>
<td>64.41</td>
<td>42.83</td>
</tr>
<tr>
<td>66.5</td>
<td>53.72</td>
<td>35.96</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Desorption Method: Gas solubilities were determined by desorption of the dissolved gas from the melt by an inert gas using a standard method. The argon content in the gas mixture was estimated by analysis based on thermal conductivity.

Volumetric Method: Recrystallized potassium metavanadate and vanadium pentoxide were fused together. The possible reducing impurities present in the melt were oxidized by bubbling oxygen for 3h. at 550°C. The dissolved oxygen was removed by bubbling helium through the melt for 30 min.

The discrepancy between the solubilities determined by the two methods was ± 10%.

SOURCE AND PURITY OF MATERIALS:

Potassium metavanadate of "chemically pure" grade was recrystallized. Vanadium pentoxide of "specially pure" grade was used.

ESTIMATED ERROR:

Solubility = ± 10% (authors)

REFERENCES:
COMPONENTS:

(1) Argon; Ar; [7440-37-1]
(2) Potassium oxide; K₂O; [12136-45-7]
(3) Vanadium oxide; V₂O₅; [1314-62-1]

ORIGINAL MEASUREMENTS:
Nalimova, E. G.; Fedorov, A. A.; Ponomarev, V. E.

VARIABLES:

T/K = 773 - 909
V₂O₅ / mole % = 55 - 66.5
P/kPa: 101.325 (compiler)

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:

Henry's Law Constants, $K_p$(mol cm⁻³ atm⁻¹), for the solubility of argon in K₂O - V₂O₅ melts of various compositions were determined at different temperatures. Coefficients of the equation $\log K_p = A + B/T ± Δ$, where $Δ$ is the error obtained by linear least squares fit of the data are given below:

<table>
<thead>
<tr>
<th>Melt composition/ mole % V₂O₅</th>
<th>Temp. range (K)</th>
<th>-A</th>
<th>-B</th>
<th>Δ</th>
</tr>
</thead>
<tbody>
<tr>
<td>55.0</td>
<td>800 - 898</td>
<td>3.027</td>
<td>3067</td>
<td>0.014</td>
</tr>
<tr>
<td>61.0</td>
<td>773 - 893</td>
<td>3.164</td>
<td>1863</td>
<td>0.038</td>
</tr>
<tr>
<td>66.5</td>
<td>783 - 909</td>
<td>3.392</td>
<td>2434</td>
<td>0.011</td>
</tr>
</tbody>
</table>

The enthalpies ($ΔH°$) and entropies ($ΔS°$) of the solution were evaluated from the temperature dependence of the solubility constants expressed as $K_o = C_m/C_q$, where $C_m$ and $C_q$ are the volume concentrations of the dissolved gas in the liquid and the gas phase respectively, are given below:

<table>
<thead>
<tr>
<th>Melt composition/ mole % V₂O₅</th>
<th>$ΔH°$/kJ mol⁻¹</th>
<th>$ΔS°$/JK⁻¹mol⁻¹ (at 855K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>55.0</td>
<td>65.83</td>
<td>57.42</td>
</tr>
<tr>
<td>61.0</td>
<td>64.40</td>
<td>42.83</td>
</tr>
<tr>
<td>66.5</td>
<td>53.72</td>
<td>35.96</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Gas solubilities were determined by desorption of the dissolved gas from the melt by an inert gas (helium) as well as by a gas - volumetric method. The discrepancy between the results of the two methods was 10 - 20 %. The V₂O₅ content in the melt was determined by an amperometric titration.

SOURCE AND PURITY OF MATERIALS:
Not specified.

ESTIMATED ERROR:
Not specified.

REFERENCES:
COMPONENTS:

(1) Argon; Ar; [7440-37-1]
(2) Cesium Oxide; Cs₂O; [20281-00-9]
(3) Vanadium oxide; V₂O₅; [1314-62-1]

ORIGINAL MEASUREMENTS:

Nalimova, E. G.; Fedorov, A. A.; Ponomarev, V. E.
1983, 57, 478 - 479. (*)

VARIABLES:

\[ T/K = 673 - 922 \]
\[ V₂O₅ / \text{mole} \% = 55 - 61 \]
\[ P/\text{kPa}: 101.325 \text{ (compiler)} \]

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

Henry's Law Constants, \( K_p \) (mol cm\(^{-3}\) atm\(^{-1}\)), for the solubility of argon in Cs₂O - V₂O₅ melts of various compositions were determined at different temperatures. Coefficients of the equation \( \log K_P = A + B/T \pm \Delta \), where \( \Delta \) is the error obtained by linear least squares fit of the data are given below:

<table>
<thead>
<tr>
<th>Melt composition/ mole % V₂O₅</th>
<th>Temp. range (K)</th>
<th>-A</th>
<th>-B</th>
<th>( \Delta )</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.0</td>
<td>832 - 922</td>
<td>3.030</td>
<td>3000</td>
<td>0.009</td>
</tr>
<tr>
<td>61.0</td>
<td>673 - 825</td>
<td>4.328</td>
<td>1863</td>
<td>0.028</td>
</tr>
</tbody>
</table>

The enthalpies (\( \Delta H^o \)) and entropies (\( \Delta S^o \)) of the solution were evaluated from the temperature dependence of the solubility constants expressed as \( K_o = C_m/C_g \), where \( C_m \) and \( C_g \) are the volume concentrations of the dissolved gas in the liquid and the gas phase respectively, are given below:

<table>
<thead>
<tr>
<th>Melt composition/ mole % V₂O₅</th>
<th>( \Delta H^o / \text{kJ mol}^{-1} )</th>
<th>( \Delta S^o / \text{JK}^{-1} \text{mol}^{-1} ) (at 855K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.0</td>
<td>64.55</td>
<td>43.07</td>
</tr>
<tr>
<td>61.0</td>
<td>53.06</td>
<td>32.68</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas solubilities were determined by desorption of the dissolved gas from the melt by an inert gas (helium) as well as by a gas - volumetric method.

The discrepancy between the results of the two methods was 10 - 20 %. The V₂O₅ content in the melt was determined by an amperometric titration.

SOURCE AND PURITY OF MATERIALS:

Not specified.

ESTIMATED ERROR:

Not specified.

REFERENCES:

Not specified.
COMPONENTS:
(1) Argon; Ar; [7440-37-1]
(2) Lithium fluoride; LiF; [7789-24-4]
(3) Sodium fluoride; NaF; [7681-49-4]
(4) Potassium fluoride; KF; [7789-23-3]

VARIABLES: \( T/K = 873 - 1073 \)
\( P/kPa = 101.325 - 202.650 \)

ORIGINAL MEASUREMENTS:
Blander, M.; Grimes, W. R.; Smith, N. V.; Watson, G. M.

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The values of Henry's law constant, \( K_H \), for the solubility of argon in the molten eutectic LiF - NaF - KF (46.5 - 11.5 - 42.0 mol%) at different temperatures, and pressures ranging from 1 - 2 atm, are:

<table>
<thead>
<tr>
<th>( t/^\circ C )</th>
<th>( 10^8 K_H/mol \ cm^{-3} \ atm^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>0.90 ± 0.04</td>
</tr>
<tr>
<td>700</td>
<td>1.80 ± 0.04</td>
</tr>
<tr>
<td>800</td>
<td>3.40 ± 0.03</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of \( K_H \) can be expressed by the relation:

\[
\log(K_H/mol \ cm^{-3} \ atm^{-1}) = -4.959 - 2699.8/(T/K) \quad \text{(compiler)}
\]

\[ \text{std. dev.} = 1.4\% \quad \text{(compiler)} \]

The enthalpy of solution, \( \Delta H \), and the standard entropy of solution, \( \Delta S^\circ \), are:

\[
\Delta H/kcal \ mol^{-1} = 12.4
\]

\[
\Delta S^\circ/cal \ K^{-1} \ mol^{-1} = -0.1 \quad (\text{at 1000 K})
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution or stripping method.
The apparatus and procedure employed have been described elsewhere (1).

SOURCE AND PURITY OF MATERIALS:
Argon gas, purity better than 99.9%, was obtained from Linde Air Products Company.
The melt was prepared by mixing Reagent grade LiF, NaF and KF in appropriate amounts. The melt was purified at 800°C by flushing it alternately with anhydrous HF and H₂. Nickel apparatus was used.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
1. Grimes, W. R.; Smith, N. V.; Watson, G. M.
### EXPERIMENTAL VALUES:

The values of Henry's law constants, $K_H$, for the solubility of xenon in the melt LiF - BeF$_2$ (64 - 36 mol%) at different temperatures are:

<table>
<thead>
<tr>
<th>$t/°C$</th>
<th>$10^8 K_H$/mol cm$^{-3}$ atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>0.233 ± 0.004</td>
</tr>
<tr>
<td>650</td>
<td>0.333 ± 0.015</td>
</tr>
<tr>
<td>700</td>
<td>0.505 ± 0.020</td>
</tr>
<tr>
<td>800</td>
<td>0.863 ± 0.020</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of $K_H$ can be expressed by the relation:

$$\log(K_H$/mol cm$^{-3}$ atm$^{-1}$) = -5.543 - 2698/(T/K)$$  
std. dev. = 1.6%  
(compiler)

The enthalpy of solution, $\Delta H$, and the standard entropy of solution, $\Delta S^\circ$, are:

- $\Delta H$/kcal mol$^{-1}$ = 12.1
- $\Delta S^\circ$/cal K$^{-1}$ mol$^{-1}$ = -3.1  
(at 1000 K)

### METHOD/APPARATUS/PROCEDURE:

Stripping or elution method.

The apparatus and procedure used for gas solubility measurements was the same as described elsewhere (1,2).
COMPONENTS:
(1) Xenon; Xe; [7440-63-3]
(2) Sodium fluoride; NaF; [7681-49-4]
(3) Beryllium fluoride; BeF$_2$; [7789-49-7]

ORIGINAL MEASUREMENTS:
Ward, W. T.; Watson, G. M.; Evans, R. B.; Grimes, W. R.

VARIABLES:
P/kPa = 101.325 - 202.650
T/K = 773 - 1073

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The values of Henry’s law constant, $K_H$, for the solubility of xenon in the molten solvent NaF - BeF$_2$ (57 - 43 mol%) at different temperatures are:

<table>
<thead>
<tr>
<th>$t/^{\circ} C$</th>
<th>$10^n K_H/\text{mol cm}^{-3} \text{ atm}^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>2.10</td>
</tr>
<tr>
<td>600</td>
<td>3.84</td>
</tr>
<tr>
<td>700</td>
<td>8.60</td>
</tr>
<tr>
<td>800</td>
<td>15.97</td>
</tr>
</tbody>
</table>

* Values read from the graph by the compiler.

Smoothed Data:
Temperature dependence of $K_H$ can be expressed by the equation:

$$\log(K_H/\text{mol cm}^{-3} \text{ atm}^{-1}) = -5.529 - 2464/(T/K)$$

(std. dev. = 5.7%)

The heat of solution, $\Delta H$, and the standard entropy of solution, $\Delta S^\circ$, are:

$\Delta H/\text{kcal mol}^{-1} = 11.28$ (compiler)

$\Delta S^\circ/\text{cal K}^{-1} \text{ mol}^{-1} = -2.3$ (at 1000 K)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Stripping method.
The method used for the determination of gas solubilities in the molten salt solvent was the same as described elsewhere (1).

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:
Nothing specified

REFERENCES:
1. Grimes, W. R.; Smith, N. V.; Watson, G. M.
**COMPONENTS:**

1. Xenon; Xe; [7440-63-3]
2. Sodium fluoride; NaF; [7681-49-4]
3. Zirconium fluoride; ZrF$_4$; [7783-64-4]

**ORIGINAL MEASUREMENTS:**

Grimes, W. R.; Smith, N. V.; Watson, G. M.

**VARIABLES:**

- P/kPa = 101.325 - 202.650
- T/K = 873 - 1073

**PREPARED BY:**
N. P. Bansal

**EXPERIMENTAL VALUES:**

The values of Henry's law constant, $K_H$, for the solubility of xenon in the melt NaF - ZrF$_4$ (53 - 47 mol%) at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>$10^8 K_H$/mol cm$^{-3}$ atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>1.94</td>
</tr>
<tr>
<td>700</td>
<td>3.56</td>
</tr>
<tr>
<td>800</td>
<td>6.32</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of $K_H$ can be expressed by the relation:

$$ \log(K_H/\text{mol cm}^{-3} \text{ mol}^{-1}) = -4.972 - 2397.3/(T/\text{K}) $$

std. dev. = 1.6%  
(compiler)

The enthalpy of solution, $\Delta H$, and the entropy, $\Delta S$, of dissolving the gas with equal concentrations in the gaseous and liquid states are:

- $\Delta H$/kcal mol$^{-1}$ = 11.1
- $\Delta S$/cal K$^{-1}$ mol$^{-1}$ = -0.1  
(at 1000 K)

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Elution or stripping method.

The diagram and details of the apparatus and procedure used are described in detail in the original paper. Briefly, the melt was saturated with xenon by sparging it with the gas for 6 hours at the desired gas pressure. Part of the molten salt was transferred into the stripping section. The dissolved xenon was stripped from the melt by circulation of helium through the system for about 15 minutes. The amount of xenon present in the eluted gas mixture was determined by mass spectrometry.

**SOURCE AND PURITY OF MATERIALS:**

Xenon gas, (>99.9%) was obtained from Linde Air Products Company.

Sodium fluoride of reagent grade was obtained from Mallinckrodt Chemical Co.

ZrF$_4$ was prepared by hydrofluorination of ZrCl$_4$ at 773K in nickel apparatus. The melt was prepared by mixing the two salts in proper amounts and purified at 800°C by sparging it alternately with anhydrous HF and H$_2$. No oxide was present in the melt.

**ESTIMATED ERROR:**

- solubility: ± 20%  
(authors)

**REFERENCES:**
COMPONENTS:
(1) Xenon; Xe; [7440-63-3]
(2) Sodium fluoride; NaF; [7681-49-4]
(3) Zirconium fluoride; ZrF₄ [7783-64-4]
(4) Uranium tetrafluoride; UF₄; [10049-14-6]

VARIABLES:
T/K = 873 - 1073
P/kPa = 50.663 - 202.650

EXPERIMENTAL VALUES:
The values of Henry's law constant, Kₜ, for the solubility of xenon in the melt NaF - ZrF₄ - UF₄ (50 - 46 - 4 mol%) at pressures ranging from 0.5 - 2 atm. and at three temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁸ Kₜ/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>873</td>
<td>2.0</td>
</tr>
<tr>
<td>973</td>
<td>4.0</td>
</tr>
<tr>
<td>1073</td>
<td>6.5</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of Kₜ can be expressed by the relation:

\[ \log(Kₜ/mol \text{ cm}^{-3} \text{ atm}^{-1}) = -4.939 - \frac{2404.3}{(T/K)} \]  

(compiler)

std. dev. = 1.5%  

(compiler)

The heat of solution, ΔH, is estimated to be:

\[ \Delta H/\text{kJ mol}^{-1} = 46.0 \]  

(compiler)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution or stripping method.

The diagram and details of the apparatus and procedure used are described in detail in the original paper. Briefly, the melt was saturated with xenon by sparging it with the gas for 6 hours at the desired gas pressure. Part of the molten salt solution was transferred into the stripping section. The dissolved xenon was stripped from the melt by circulation of helium through the system for about 15 minutes. The amount of xenon present in the eluted gas mixture was determined by mass spectrometry.

SOURCE AND PURITY OF MATERIALS:
Xenon gas, (>99.9%) was obtained from Linde Air Products Co.
Reagent grade NaF and UF₄ were obtained from Mallinckrodt Chemical Co. ZrF₄ was prepared by hydrofluorination of ZrCl₄ at 773K in nickel apparatus.
The melt was prepared by mixing the three salts in proper amounts and purified at 800°C by sparging it alternately with anhydrous HF and H₂. No oxide was present in the melt.

ESTIMATED ERROR:
solubility: ± 20%  (authors)

REFERENCES:
**COMPONENTS:**

1. Hydrogen; \(H_2\); [1333-74-0]
2. Sodium hydroxide; NaOH; [1310-73-2]

**ORIGINAL MEASUREMENTS:**

Sullivan, E. A.; Johnson, S.; Banus, M. D.


**VARIABLES:**

- one temperature: \(T/K = 773\)
- \(P/kPa = 689.286 - 5514.286\)

**PREPARED BY:**

N. P. Bansal

**EXPERIMENTAL VALUES:**

The solubility of hydrogen in molten NaOH at 500°C was found to be less than 60 mg of \(H_2/100\) g of melt unless corrosion products are present. Presence of corrosion products increase the solubility of hydrogen. The solubility of \(H_2\) in the melt was found to be independent of temperature and pressure.

**METHOD/APPARATUS/PROCEDURE:**

Solubility measurements were carried out by introducing a known amount of hydrogen into the system above the melt and allowed to attain equilibrium. The fall in pressure was recorded with a pressure gauge and the solubility calculated.

**SOURCE AND PURITY OF MATERIALS:**

- NaOH contained 0.07% sodium carbonate and other trace impurities. It was specially dehydrated.
- The container for molten hydroxide was made from INCO Grade "L" nickel. It was pretreated at 400°C with alternate 30 minute cycles of hydrogen and vacuum for four hours to free it from any surface oxidation and adsorbed gases.

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**


COMPONENTS:
(1) Hydrogen; H₂; [1333-74-0]
(2) Potassium hydroxide; KOH; [1310-58-3]

ORIGINAL MEASUREMENTS:
Sullivan, E. A.; Johnson, S.; Banus, M. D.

VARIABLES:
T/K = 683 - 773
P/σPa = 689.286 - 5514.286

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The solubility of hydrogen in molten KOH was determined at 410 and 500°C. It was found to be less than 60 mg of H₂/100 g of melt in the absence of corrosion products. Presence of corrosion products increase the solubility of hydrogen. The solubility of H₂ in the melt was found to be independent of temperature and pressure.

METHOD/APPARATUS/PROCEDURE:
Solubility measurements were carried out by introducing a known quantity of hydrogen into the system above the melt and allowing it to equilibrate. The gas solubility was calculated from the drop in pressure which was measured with a pressure gauge.

SOURCE AND PURITY OF MATERIALS:
KOH contained 0.12% potassium carbonate and other trace impurities. It was specially dehydrated.
The container for molten hydroxide was made from INCO Grade "L" nickel. It was pretreated at 400°C with alternate 30 minute cycles of hydrogen and vacuum for four hours to free it from any surface oxidation and adsorbed gases.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
COMPONENTS:

(1) Hydrogen; H₂; [1333-74-0]
(2) Dilithium beryllium fluoride; Li₂BeF₄

ORIGINAL MEASUREMENTS:
Malinauskas, A. P.; Richardson, D. M.

VARIABLES:
P/kPa = 101.325 – 202.650
T/K = .73 – 973

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:

The values of Henry's law constant, $K_H$, and the Ostwald coefficient, $K_e$, for the solubility of hydrogen in molten Li₂BeF₄ at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^8 K_H$/mol cm⁻³ atm⁻¹</th>
<th>$10^8 K_e$</th>
</tr>
</thead>
<tbody>
<tr>
<td>773</td>
<td>1.78 ± 0.13</td>
<td>1.13 ± 0.08</td>
</tr>
<tr>
<td>873</td>
<td>4.42 ± 0.12</td>
<td>3.17 ± 0.09</td>
</tr>
<tr>
<td>973</td>
<td>4.84 ± 0.46</td>
<td>3.87 ± 0.37</td>
</tr>
</tbody>
</table>

* Calculated by the compiler using the relation $K_H = K_e/RT$.

Smoothed Data:
Temperature dependence of $K_H$ and $K_e$ are expressed by the equations:

$$\log(K_H/$mol cm⁻³ atm⁻¹) = -5.535 - 1677.5/(T/K)$$  
(compiler)  
std. dev. = 12.5%  
(compiler)

$$\log K_e = \log(T/K) - 1535/(T/K) - 3.7684$$

The enthalpy of solution, $\Delta H$, is calculated to be:

$$\Delta H/kJ mol⁻¹ = 32.1$$  
(compiler)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stripping method.

The diagram and details of the apparatus and the experimental procedure are described in (1). In brief, the melt was saturated with hydrogen and a known volume of the saturated solution was transferred to the stripper. The dissolved hydrogen was freed by sparging with xenon and analyzing by mass spectroscopy.

SOURCE AND PURITY OF MATERIALS:

Hydrogen and xenon were at least 99.9% pure. Hydrogen gas was purified by passing through liquid nitrogen cooled coils of copper tubing.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

1. Malinauskas, A. P., Richardson, D. M.; Savolainen, J. E.; Shaffer, J. H.
## COMPONENTS:

1. Hydrogen; $\text{H}_2$; [1333-74-0]
2. Lithium fluoride; LiF; [7789-24-4]
3. Beryllium fluoride; BeF$_2$; [7789-49-7]

## VARIABLES:

- one temperature: $T/K = 873$
- $P/kPa = 101.325 - 202.650$

## EXPERIMENTAL VALUES:

The value of the Henry's law constant, $K_H$, for the solubility of hydrogen in the molten eutectic LiF - BeF$_2$ (66 -34 mol%) is:

<table>
<thead>
<tr>
<th>$t/^\circ C$</th>
<th>$10^a K_H/\text{mol cm}^{-3} \text{ atm}^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>4.34 ± 0.20</td>
</tr>
</tbody>
</table>

## AUXILIARY INFORMATION

**METHOD/APPARATUS/PROCEDURE:**

Stripping method.

The diagram and details of the apparatus used and procedure followed are given in the original paper. The main parts of the apparatus were constructed of Hastelloy, a nickel base alloy containing 7% Cr, 4% Fe, 12 - 17% Mo. In an experiment the melt in the saturation chamber was saturated with hydrogen by bubbling the gas through it. A known quantity of saturated solution was transferred into the stripping chamber where the dissolved gas was stripped from the solvent and collected for measurement.

## SOURCE AND PURITY OF MATERIALS:

Not described.

## ESTIMATED ERROR:

Nothing specified.

## REFERENCES:

COMPONENTS:

1. Hydrogen; \( H_2 \); [1333-74-0]
2. Sodium nitrate; \( NaNO_3 \); [7631-99-4]
3. Potassium nitrate; \( KNO_3 \); [7757-79-1]

VARIABLES:

\[ T/K = 508 - 603 \]
\[ P/kPa: 101.325 \ (1 \ atm.) \]

EXPERIMENTAL VALUES:

The melt used was an equimolar mixture of sodium nitrate - potassium nitrate. The solubilities of \( H_2 \) in the melt at various temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>( 10^7 \ K_H/mol \ cm^{-3} \ bar^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>508</td>
<td>1.26</td>
</tr>
<tr>
<td>533</td>
<td>1.48</td>
</tr>
<tr>
<td>573</td>
<td>1.86</td>
</tr>
<tr>
<td>603</td>
<td>2.19</td>
</tr>
</tbody>
</table>

Smoothed Data:

The temperature dependence of the Henry's law constant, \( K_H \), is given by the relation:

\[
\log(K_H/mol \ cm^{-3} \ bar^{-1}) = -5.38 - 772/(T/K) \quad \text{(compiler)}
\]

\[ \text{std. dev.} = 0.2\% \quad \text{(compiler)} \]

The heat of solution, \( \Delta H \), and the standard entropy of solution, \( \Delta S^o \), are:

\[
\Delta H/\text{kJ mol}^{-1} = 14
\]

\[
\Delta S^o/\text{J K}^{-1} \text{ mol}^{-1} = -22 \quad \text{at 533 K}
\]

METHOD/APPARATUS/PROCEDURE:

High sensitivity pressure measuring technique.

The diagram and details of the apparatus have been described elsewhere (1). A typical solubility measurement was performed as follows. The melt was evacuated at \( 10^{-5} \) bar for several hours for degassing. The vacuum was disconnected and hydrogen gas was introduced at one atm. The melt was vigorously stirred with a magnetic stirrer. The pressure variations were measured, with a high precision differential manometer, as a function of time until the equilibrium was attained. The amount of dissolved gas was calculated from the rapid initial pressure changes after a suitable calibration.

SOURCE AND PURITY OF MATERIALS:

High purity \( H_2 \) was used. It was freed from carbon dioxide impurities by keeping it in contact with Ascarite. The last traces of water were removed by adsorption on molecular sieves 5A (Carlo Erba, Milano) at \(-80^\circ C\). The final water content was <10 ppm. Reagent grade sodium and potassium nitrates were from Carlo Erba, Milano. The mixture was filtered in the molten state.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

1. Desimoni, E.; Paniccia, F.; Zambonin, P. G.
COMPONENTS:
(1) Hydrogen; H₂; [1333-74-0]
(2) Sodium hydroxide; NaOH; [1310-73-2]
(3) Potassium hydroxide; KOH; [1310-58-3]

ORIGINAL MEASUREMENTS:

VARIABLES:
one temperature: T/K = 500
P/kPa: 101.325 (compiler)

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The solubility of hydrogen in molten NaOH - KOH (51 - 49 mol%) has been reported at one temperature:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁸ Solubility/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>2.24</td>
</tr>
</tbody>
</table>

METHOD/APPARATUS/PROCEDURE:
Coulometric method.
The coulometric method used was developed by Vogel and Smith (1).

SOURCE AND PURITY OF MATERIALS:
Not available.

ESTIMATED ERROR:
Nothing specified

REFERENCES:
1. Vogel, W. M.; Smith, S. W.
COMPONENTS:
(1) Hydrogen; H₂; [1333-74-0]
(2) Lithium carbonate; Li₂CO₃; [554-13-2]
(3) Sodium carbonate; Na₂CO₃; [497-19-8]

ORIGINAL MEASUREMENTS:
Volgin, M. A.; L'vov, A. L.; Loskutkin, V. A.

VARIABLES:

P/kPa = 86.126
T/K = 783 - 973

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:

The Values of Henry's law constant, Kₜ, and the solubility of hydrogen in the molten binary eutectic Li₂CO₃ - Na₂CO₃ at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁷ Solubility a/g-mole cm⁻³</th>
<th>10⁷ Kₜ b/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>510</td>
<td>1.7</td>
<td>2.0</td>
</tr>
<tr>
<td>550</td>
<td>2.1</td>
<td>2.5</td>
</tr>
<tr>
<td>600</td>
<td>2.8</td>
<td>3.3</td>
</tr>
<tr>
<td>650</td>
<td>3.6</td>
<td>4.2</td>
</tr>
<tr>
<td>700</td>
<td>5.3</td>
<td>6.2</td>
</tr>
</tbody>
</table>

a PH₂ = 0.85 atm.  b Calculated by the compiler.

Smoothed Data:

Temperature dependence of Kₜ is expressed by the relation:

\[ \log(Kₜ/mol \text{ cm}^{-3} \text{ atm}^{-1}) = -4.278 - 1909.5/(T/K) \] (compiler)

std. dev. = 2.9% (compiler)

The enthalpy of solution, ΔH, is: \( \Delta H/\text{kJ mol}^{-1} = 36.6 \) (compiler)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Displacement method.

The melt was saturated with the gas by passing a mixture of H₂ + CO₂ (17 : 3) containing 2 volume% water. The dissolved hydrogen was displaced with chromatographically pure CO₂. The liberated H₂ was collected in a buret over alkali solution.

SOURCE AND PURITY OF MATERIALS:

A mixture of H₂ + CO₂ (17 : 3) containing 2 vol.% water vapor was used. The CO₂ used was chromatographically pure.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:
COMPONENTS:
(1) Hydrogen; H₂; [1333-74-0]
(2) Sodium acetate; CH₃COONa; [127-09-3]
(3) Potassium acetate; CH₃COOK; [127-08-2]

ORIGINAL MEASUREMENTS:
Marassi, R.; Bartocci, V.; Gusteri, O.; Cescon, P.

VARIABLES:
P/kPa = 10²
T/K = 529.6 - 573.3

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The values of Henry's law constant, Kᵢ, for the solubility of H₂ in molten eutectic mixture CH₃COONa - CH₃COOK (46.3 - 53.7 mol%) at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁷ Kᵢ⁻¹/mol cm⁻³ atm⁻¹</th>
<th>10⁸ Kᵢ/mol m⁻³ Pa⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>529.6</td>
<td>3.29</td>
<td>3.25</td>
</tr>
<tr>
<td>547.6</td>
<td>3.43</td>
<td>3.39</td>
</tr>
<tr>
<td>565.9</td>
<td>3.74</td>
<td>3.69</td>
</tr>
<tr>
<td>573.3</td>
<td>3.76</td>
<td>3.71</td>
</tr>
</tbody>
</table>

* Calculated by the compiler.

Smoothed Data:
Temperature dependence of Kᵢ is given by the expression:

\[ \log (Kᵢ/\text{mol cm}⁻³ \text{ atm}⁻¹) = -5.659 - 437.6/(T/K) \] (compiler)

std. dev. = 0.6% (compiler)

The enthalpy of solution, \( \Delta H \), and the entropy of solution, \( \Delta S \), are:

\[ \Delta H/\text{kJ mol}⁻¹ = 8.2 \]

\[ \Delta S/\text{J K}⁻¹ \text{ mol}⁻¹ = -19.8 \text{ (at 523 K)} \]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Manometric method.

The apparatus used for gas solubility measurements was essentially the same as described earlier (1). A modified form of the mercury manometer was employed. The method of calibration of the apparatus and calculating the solubility from pressure readings was the same as reported in (2).

SOURCE AND PURITY OF MATERIALS:
Reagent grade CH₃COONa and CH₃COOK supplied by Carlo Erba (Milan) were used without further treatment.
High purity hydrogen and nitrogen were dried with type 5A molecular sieves.

ESTIMATED ERROR:
solubility = 5 - 7%

REFERENCES:
1. Marassi, R.; Bartocci, V.; Pucciarelli, F.; Cescon, P.
2. Desimoni, E.; Paniccia, F.; Zambonin, P. G.
COMPONENTS:

(1) Hydrogen; H\textsubscript{2}; [1333-74-0]
(2) Deuterium; D\textsubscript{2}; [7782-39-0]
(3) Dillithium beryllium fluoride; Li\textsubscript{2}BeF\textsubscript{4}

VARIABLES:

\( P/\text{kPa} = 101.325 - 202.650 \)
\( T/K = 773 - 973 \)

EXPERIMENTAL VALUES:

Solubilities of hydrogen and deuterium were determined at different temperatures. Considering the results for H\textsubscript{2} and D\textsubscript{2} solubilities to be identical, the values of Henry's law constant, \( K_H \), and Ostwald coefficient, \( K_c \), are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>( 10^8 K_H^a \cdot b/\text{mol cm}^{-3} \text{ atm}^{-1} )</th>
<th>( 10^3 K_c^a )</th>
</tr>
</thead>
<tbody>
<tr>
<td>773</td>
<td>2.02 ± 0.24</td>
<td>1.28 ± 0.15</td>
</tr>
<tr>
<td>873</td>
<td>4.17 ± 0.29</td>
<td>2.99 ± 0.21</td>
</tr>
<tr>
<td>973</td>
<td>5.08 ± 0.56</td>
<td>4.06 ± 0.45</td>
</tr>
</tbody>
</table>

\( a \) H\textsubscript{2} and D\textsubscript{2} results considered identical.

\( b \) Calculated by the compiler using the relation \( K_H = K_c/RT \).

Smoothed Data:

Temperature dependence of \( K_H \) and \( K_c \) are expressed by the equations:

\[
\log(K_H/\text{mol cm}^{-3} \text{ atm}^{-1}) = -5.6825 - 1535/(T/K)
\]
\[
\log K_c = -0.3948 - 1910.7/(T/K) \quad \text{(compiler)}
\]

The enthalpy of solution, \( \Delta H \), and the standard entropy of solution, \( \Delta S^o \), are:

\( \Delta H/\text{kcal mol}^{-1} = 7.02 \pm 1.80 \)

\( \Delta S^o/\text{eu} = -3.5 \pm 2.1 \) (at 1000 K)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stripping method.

The diagram and details of the apparatus and the experimental procedure are described in (1). In brief, the melt was saturated with the gas and a known volume of the saturated melt was transferred to the stripper. The dissolved gas was freed by sparging with xenon and analyzed by mass spectroscopy.

SOURCE AND PURITY OF MATERIALS:

Hydrogen and xenon were at least 99.9% pure. Deuterium was 99.7% pure. Hydrogen and deuterium were purified by passing through coils of copper tubing cooled in liquid nitrogen.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

**COMPONENTS:**

1. Hydrogen; H₂; [1333-74-0]
2. Lithium carbonate; Li₂CO₃; [554-13-2]
3. Sodium carbonate; Na₂CO₃; [497-19-8]
4. Potassium carbonate; [584-08-7]

**VARIABLES:**

<table>
<thead>
<tr>
<th>T/K</th>
<th>P/kPa = 101.325 (1 atm)</th>
</tr>
</thead>
</table>

**EXPERIMENTAL VALUES:**

The value of Henry's law constant, Kₜ, for the solubility of H₂ in molten eutectic Li₂CO₃ - Na₂CO₃ - K₂CO₃ is:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁶ Kₜ/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>18</td>
</tr>
</tbody>
</table>

**ORIGINAL MEASUREMENTS:**


**PREPARED BY:** N. P. Bansal

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Electrochemical method.

**SOURCE AND PURITY OF MATERIALS:**

Not available.

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**
COMPONENTS:

(1) Deuterium, D₂, [7782-39-0]
(2) Dilithium beryllium fluoride; Li₂BeF₄

ORIGINAL MEASUREMENTS:

Malinauskas, A. P.; Richardson, D. M.

ORIGINAL MEASUREMENTS:

Malinauskas, A. P.; Richardson, D. M.

VARIABLES:

P/kPa = 101.325 - 202.650
T/K = 773 - 973

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

The values of Henry's law constant, K_H, and the Ostwald coefficient, K_e, for the solubility of deuterium in molten Li₂BeF₄ at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10^8 K_H a,b/mol cm⁻³ atm⁻¹</th>
<th>10^2 K_e a</th>
</tr>
</thead>
<tbody>
<tr>
<td>773</td>
<td>2.22 ± 0.13</td>
<td>1.41 ± 0.08</td>
</tr>
<tr>
<td>873</td>
<td>2.82 ± 0.22</td>
<td>2.74 ± 0.16</td>
</tr>
<tr>
<td>973</td>
<td>5.33 ± 0.55</td>
<td>4.26 ± 0.44</td>
</tr>
</tbody>
</table>

a Includes H₂ and HD also collected.
b Calculated by the compiler using the relation K_H = K_e/RT.

Smoothed Data:

Temperature dependence of K_H and K_e are expressed by the equations:

\[
\log(K_H/\text{mol cm}^{-3} \text{ atm}^{-1}) = -5.875 - 1399.4/(T/\text{K}) \quad \text{(compiler)}
\]

\[
\text{std. dev.} = 8.8\% \quad \text{(compiler)}
\]

\[
\log K_e = -0.5008 - 1811.8/(T/\text{K}) \quad \text{(compiler)}
\]

\[
\text{std. dev.} = 1.7\% \quad \text{(compiler)}
\]

The enthalpy of solution, \( \Delta H \), is calculated to be:

\[
\Delta H/\text{kJ mol}^{-1} = 34.7 \quad \text{(compiler)}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stripping method.

The diagram and details of the apparatus and the experimental procedure are described in (1). In brief, the melt was saturated with deuterium and a known volume of the saturated melt was transferred to the stripper. The dissolved deuterium was freed by sparging with xenon and analyzed by mass spectroscopy.

SOURCE AND PURITY OF MATERIALS:

Deuterium was 99.7% pure and xenon was at least 99.9% pure. Deuterium was purified by passing through coils of copper tubing cooled in liquid nitrogen.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

1. Malinauskas, A. P.; Richardson, D. M.; Savclainen, J. E.; Shaffer, J. H.
### COMPONENTS:

1. Oxygen; O₂; [7782-44-7]
2. Sodium nitrate; NaN₃; [7631-99-4]

### VARIABLES:

P/kPa: 101.325 (1 atm.)

### ORIGINAL MEASUREMENTS:

Frame, J. P.; Rhodes, E.; Ubbelohde, A. R.


### PREPARED BY:

N. P. Bansal

### EXPERIMENTAL VALUES:

No depression in freezing point of the solvent was observed from the solubility of oxygen at atmospheric pressure. This indicated that oxygen solubility in molten sodium nitrate was less than 10⁻⁴ mole/mole of salt.

### AUXILIARY INFORMATION

**METHOD/APPARATUS/PROCEDURE:**

Cryoscopy.

**SOURCE AND PURITY OF MATERIALS:**

- Oxygen from commercial cylinder (B.O.C.) was dried by passing through a liquid air trap.
- Sodium nitrate containing less than 0.0003% cation and less than 0.001% of anion impurities was dried for several days at 240°C followed by the thermal shock technique (1). Drying was completed by evacuating the system after melting the salt.

**ESTIMATED ERROR:**

Freezing point was measured within ± 0.02°C.

**REFERENCES:**

1. Rhodes, E.; Ubbelohde, A. R.

**COMPONENTS:**

1. Oxygen; O₂; [7782-44-7]
2. Potassium nitrate; KNO₃; [7757-79-1]

**ORIGINAL MEASUREMENTS:**

Frame, J. P.; Rhodes, E.; Ubbelohde, A. R.


**VARIABLES:**

P/kPa: 101.325 (1 atm.)

**PREPARED BY:**

N. P. Bansal

**EXPERIMENTAL VALUES:**

No depression in freezing point of the solvent was observed from the solubility of oxygen at atmospheric pressure. This indicated that oxygen solubility in molten potassium nitrate was less than $10^{-4}$ mole/mole of salt.

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Cryoscopy.

**SOURCE AND PURITY OF MATERIALS:**

Oxygen from commercial cylinder (B.O.C.) was dried by passing through a liquid air trap.

Potassium nitrate containing less than 0.0003% of cation and less than 0.001% of anion impurities was dried for several days at 240°C followed by the thermal shock technique (1). Drying was completed by evacuating the system after melting the salt.

**ESTIMATED ERROR:**

Freezing point was measured within ± 0.02°C

**REFERENCES:**

1. Rhodes, E.; Ubbelohde, A. R.

<table>
<thead>
<tr>
<th>COMPONENTS:</th>
<th>ORIGINAL MEASUREMENTS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Oxygen; O(_2); [7782-44-7]</td>
<td>Frame, J. P.; Rhodes, E.; Ubbelohde, A. R.</td>
</tr>
<tr>
<td>VARIABLES:</td>
<td>PREPARED BY:</td>
</tr>
<tr>
<td>P/kPa: 101.325 (1 atm.)</td>
<td>N. P. Bansal</td>
</tr>
</tbody>
</table>

**EXPERIMENTAL VALUES:**

No depression in freezing point of the solvent was observed from the solubility of oxygen at atmospheric pressure. This indicated that oxygen solubility in molten cesium nitrate was less than 10\(^{-4}\) mole/mole fraction.

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Cryoscopy.

**SOURCE AND PURITY OF MATERIALS:**

Oxygen from commercial cylinder (B.O.C.) was dried by passing through a liquid air trap.

Cesium nitrate containing less than 0.1% of all impurities was dried at 240°C for many days followed by the thermal shock technique (1). Drying was completed by evacuating the system after melting the salt.

**ESTIMATED ERROR:**

Freezing point was measured within ± 0.02°C

**REFERENCES:**

1. Rhodes, E.; Ubbelohde, A. R.

COMPONENTS:
(1) Oxygen; O₂, [7782-44-7]
(2) Lithium carbonate; Li₂CO₃; [554-13-2]

ORIGINAL MEASUREMENTS:
Appleby, A. J.; Van Drunen, C.

VARIABLES:
\( T/K = 1048 - 1098 \)
\( P/kPa = 10.133 - 40.530 \)

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>( P_{O_2}/atm )</th>
<th>( 10^4 K_H^o/mol \cdot cm^{-3} \cdot atm^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>775</td>
<td>0.10</td>
<td>1.68 ± 0.18</td>
</tr>
<tr>
<td>800</td>
<td>0.20</td>
<td>5.92 ± 0.25</td>
</tr>
<tr>
<td>825</td>
<td>0.40</td>
<td>10.30 ± 0.38</td>
</tr>
</tbody>
</table>

* Data refer to both physically and chemically dissolved oxygen in the melt.

Smoothed Data:
Temperature dependence of \( K_H \) can be expressed by the relation:
\[
\log(K_H/mol \cdot cm^{-3} \cdot atm^{-1}) = 10.624 - 18191/(T/K) \quad \text{(compiler)}
\]

std. dev. = 11.8% \quad \text{(compiler)}

The heat of solution, \( \Delta H \), for the solubility of oxygen in the melt is:
\( \Delta H/kJ \cdot mol^{-1} = 206 \)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Quenching or chilling method.
The diagram and details of the apparatus used and procedure followed are described in the original paper. In brief, the melt was saturated by bubbling the gas for 2 - 3 hr. A portion of the saturated melt was transferred into the chilling compartment where it was slowly quenched to allow all the gases to escape. The liberated gas was flushed with a stream of helium into a U - tube containing activated Linde 5A molecular sieve. The contents of the tube, after being allowed to come to room temperature were flushed with a stream of carrier gas into a Fisher - Hamilton gas partitioner with Linde 5A column and Katharometer detector for analysis. About 8 - 10 independent determinations were carried out.

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
COMPONENTS:

(1) Oxygen; O₂; [7782-44-7]

(2) Sodium carbonate; Na₂CO₃; [497-19-8]

VARIABLES:

one temperature: T/K = 1045
p/kPa = 93.459

EXPERIMENTAL VALUES:

The solubility, C₁, of O₂ in molten Na₂CO₃ is reported to be:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>P₀²/torr</th>
<th>10⁶ C₁/mol cm⁻³</th>
</tr>
</thead>
<tbody>
<tr>
<td>872</td>
<td>701</td>
<td>2.35 ± 0.40</td>
</tr>
</tbody>
</table>

Henry’s law is not obeyed; instead a mechanism of reaction between O₂ and Na₂O in the melt to form NaO₂ and Na₂O₂ has been proposed.

ORIGINAL MEASUREMENTS:

Andresen, R. E.

PREPARED BY:
N. P. Bansal

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Manometric technique.
The diagram and details of the apparatus used are given in the original publication. The procedure followed has been described in detail elsewhere (1). In brief, the apparatus was first evacuated and then filled with oxygen to a pressure of about 1 atm. Due to gas dissolution, the gas pressure dropped. Equilibrium was attained when the pressure did not alter for about 1 hr. The volume of gas dissolved was determined from the initial and final positions of the mercury meniscus in the manometer. The apparatus was earlier calibrated using argon. With a cathetometer, pressure changes as small as 0.05 torr could be read.

SOURCE AND PURITY OF MATERIALS:

Extra dry O₂ (99.6%) was used directly from the cylinder.
Reagent grade Na₂CO₃, supplied by Baker was dried at about 200°C in an oven, and then in the furnace at about 400°C under CO₂ pressure of 100 torr for about a day.

ESTIMATED ERROR:

solubility: ± 20 - 30%

REFERENCES:

1. Andresen, R. E.; Paniccia, F.; Zambonin, P. G.; Oye, H. A.
   Proceedings of the 4th Nordic High Temperature Symposium, Vol. 1
   (Tilli, M.; Editor), Helsinki 1975, 127.
COMPONENTS:
(1) Oxygen; O\textsubscript{2}; [7782-44-7]
(2) Sodium sulfate; Na\textsubscript{2}SO\textsubscript{4}; [7757-82-6]

ORIGINAL MEASUREMENTS:
Andresen, R. E.
J. Electrochem. Soc. 1979, 126, 328 - 34.

VARIABLES:
T/K = 1173 - 1359
P/kPa = 53.329 - 101.325

EXPERIMENTAL VALUES:

The values of Henry's law constant, K\text{a}, for the solubility of oxygen in molten sodium sulfate at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10\textsuperscript{7} K\text{a}/mol cm\textsuperscript{-3} atm\textsuperscript{-1}</th>
</tr>
</thead>
<tbody>
<tr>
<td>903</td>
<td>1.90 ± 0.20</td>
</tr>
<tr>
<td>964</td>
<td>2.63 ± 0.08</td>
</tr>
<tr>
<td>1015</td>
<td>3.0 ± 0.7</td>
</tr>
<tr>
<td>1075</td>
<td>5.42 ± 0.03</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of K\text{a} for the solubility of oxygen in molten Na\textsubscript{2}SO\textsubscript{4} is given by the relation:

\[
\log(K\text{a}/\text{mol cm}^{-3} \text{ atm}^{-1}) = -4.093 - 3088.2/(T/K)
\]

The standard enthalpy, \(\Delta H^o\), and standard entropy, \(\Delta S^o\), of solution are:

\[
\Delta H^o/\text{kJ mol}^{-1} = 59.1
\]
\[
\Delta S^o/\text{J K}^{-1} \text{ mol}^{-1} = 17.0 \quad \text{(at 1173 K)}
\]

AUXILIARY INFORMATION

METHOD/Apparatus/PROCEDURE:

Manometric technique.
The diagram and details of the apparatus used are given in the original paper. The procedure followed has been described in detail elsewhere (1). Briefly, the apparatus was first evacuated and then filled with the gas to a pressure of about 1 atm. Due to gas dissolution, the gas pressure dropped. Equilibrium was attained when the pressure did not change for about 1 hr. The volume of the gas dissolved was determined from the initial and final positions of the mercury meniscus in the manometer. The apparatus was earlier calibrated using argon. With a cathetometer, pressure changes as small as 0.05 torr could be read.

SOURCE AND Purity of MATERIALS:

Extra dry oxygen (99.6%) was used directly from the cylinder.
Reagent grade Na\textsubscript{2}SO\textsubscript{4} supplied by Matheson, Coleman and Bell was dried in an oven at about 200°C, then in the furnace at about 400°C under vacuum.

ESTIMATED ERROR:

solubility: ± 20 - 30%

REFERENCES:
1. Andresen, R. E.; Paniccia, F.; Zambonin, P. G.; Oye, H.A.
COMPONENTS:

(1) Oxygen; O₂; [7782-44-7]
(2) Lithium nitrate; LiNO₃ [7790-69-4]
(3) Potassium nitrate; KNO₃; [7757-79-1]

ORIGINAL MEASUREMENTS:

Yurkinškii, V. P.; Aganesova, S. B.; Morachevskii, A. G.; Zagrivnıy, V. N.

VARIABLES:

P/kPa: 101.325 (1 atm.)
T/K = 428 - 583

EXPERIMENTAL VALUES:

The solubilities of oxygen in the molten eutectic LiNO₃ - KNO₃ at 1 atm. oxygen partial pressure at various temperatures are reported to be:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁻⁴ C₁/mol liter⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>155</td>
<td>1.90</td>
</tr>
<tr>
<td>190</td>
<td>3.74</td>
</tr>
<tr>
<td>210</td>
<td>4.65</td>
</tr>
<tr>
<td>255</td>
<td>7.89</td>
</tr>
<tr>
<td>310</td>
<td>13.60</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of solubility is expressed by the relation:

\[
\log(C₁/mol \text{ ml}^{-1}) = -3.540 - 1351.6/(T/K) \quad \text{(compiler)}
\]

std. dev. = 2.4% \quad \text{(compiler)}

The heat of solution, \(\Delta H\), is given as:

\[
\Delta H/\text{kJ} \text{ mol}^{-1} = 26.0
\]

REFERENCES:

Lithium nitrate (cp) was dehydrated by heating in air for 8 - 10 hr. while the temperature was raised slowly to 300 - 350 °C. It was kept at 350°C till the evolution of water stopped and then kept in a desiccator over P₂O₅. The LiNO₃ - KNO₃ mixture was dried by purging the melt with dried argon at 400°C and finally by addition of metallic sodium.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:
COMPONENTS:

(1) Oxygen; O₂; [7782-44-7]
(2) Sodium nitrate; NaN₃; [7631-99-4]
(3) Potassium nitrate; KNO₃; [7757-79-1]

VARIABLES:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁶ Kₜ/mol cm⁻³ atm⁻¹</th>
<th>10⁶ Cₜ/mol kg⁻¹ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>511</td>
<td>0.9</td>
<td>4.6</td>
</tr>
<tr>
<td>533</td>
<td>1.0</td>
<td>5.3</td>
</tr>
<tr>
<td>555</td>
<td>1.2</td>
<td>6.4</td>
</tr>
<tr>
<td>587</td>
<td>1.55</td>
<td>8.1</td>
</tr>
<tr>
<td>603</td>
<td>1.6</td>
<td>8.4</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of Henry's law constant and solubility are given by the relations:

\[
\log(Kₜ/mol cm^{-3} atm^{-1}) = -6.286 - 904.6/(T/K) \quad \text{(compiler)}
\]

\[
\log(Cₜ/mol kg^{-1} atm^{-1}) = -3.528 - 925.9/(T/K) \quad \text{(compiler)}
\]

std. dev. = 1.6% (compiler)

The enthalpy of solution, \( \Delta H \), and the standard entropy of solution, \( \Delta S^\circ \), are:

\[
\Delta H/kJ mol^{-1} = 17.6 \pm 0.8
\]

\[
\Delta S^\circ/J K^{-1} mol^{-1} = -31 \quad \text{(at 533 K)}
\]

EXPERIMENTAL VALUES:

The solvent employed was an equimolar molten mixture of sodium nitrate - potassium nitrate. The solubilities of oxygen in the melt at various temperatures are:

METHOD/APPARATUS/PROCEDURE:

High sensitivity pressure measuring technique.

The diagram and details of the apparatus and procedure employed for solubility measurements are described in the original paper. Briefly, the melt was evacuated at 10⁻⁵ bar for several hours for degassing. The vacuum was disconnected and oxygen gas was introduced at one atm. The melt was vigorously stirred with a magnetic stirrer. The pressure variations were noted, using a mercury manometer, as a function of time until the equilibrium pressure was reached. The amount of gas dissolved was calculated from the rapid initial pressure changes after a suitable calibration.

REFERENCES:
Two independent studies (1, 2) have been reported for the solubility of oxygen in molten Li₂CO₃ - Na₂CO₃ (53.3 - 46.7 mol%). Results of the two investigations are compared in Fig. 1, below. It is interesting to note, from Fig. 1, that results obtained by Schenke et al. (2) using an amperometric titration technique are in good agreement (within experimental precision) with the data of Appleby and Van Drunen (1) who employed a melt chilling method.

![Graph showing solubility of oxygen in molten Li₂CO₃ - Na₂CO₃](image)

The recommended numerical values, obtained by least-squares fitting of the two data sets (1, 2), are given in Table 1.
COMPONENTS:
(1) Oxygen; O₂; [7782-44-7]
(2) Lithium carbonate; Li₂CO₃; [554-13-2]
(3) Sodium carbonate; Na₂CO₃; [497-19-8]

CRITICAL EVALUATION:

continued

Table 1
Recommended Solubilities as a Function of Temperature

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁷ Kₐ/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>860</td>
<td>1.05</td>
</tr>
<tr>
<td>880</td>
<td>1.27</td>
</tr>
<tr>
<td>900</td>
<td>1.52</td>
</tr>
<tr>
<td>920</td>
<td>1.81</td>
</tr>
<tr>
<td>940</td>
<td>2.14</td>
</tr>
<tr>
<td>960</td>
<td>2.52</td>
</tr>
<tr>
<td>980</td>
<td>2.94</td>
</tr>
<tr>
<td>1000</td>
<td>3.40</td>
</tr>
<tr>
<td>1020</td>
<td>3.92</td>
</tr>
<tr>
<td>1040</td>
<td>4.49</td>
</tr>
<tr>
<td>1060</td>
<td>5.12</td>
</tr>
<tr>
<td>1080</td>
<td>5.82</td>
</tr>
<tr>
<td>1100</td>
<td>6.57</td>
</tr>
<tr>
<td>1120</td>
<td>7.39</td>
</tr>
</tbody>
</table>

References:
COMPONENTS:
(1) Oxygen; O₂; [7782-44-7]
(2) Lithium carbonate; Li₂CO₃; [554-13-2]
(3) Sodium carbonate; Na₂CO₃; [497-19-8]

VARIABLES:
T/K = 1023 - 1123
P/kPa: 101.325 (compiler)

EXPERIMENTAL VALUES:
The values of Henry's law constant, Kₜ, for the solubility of oxygen in the melt Li₂CO₃ - Na₂CO₃ (53.3 - 46.7 mol%) at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>Pco₂/atm</th>
<th>10^4Kₜ*/mol dm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>750</td>
<td>0.026</td>
<td>3.57 ± 0.61</td>
</tr>
<tr>
<td>800</td>
<td>0.06</td>
<td>5.57 ± 0.27</td>
</tr>
<tr>
<td>850</td>
<td>0.10</td>
<td>8.36 ± 0.46</td>
</tr>
</tbody>
</table>

* Data refer to both physical and chemical solubilities of oxygen in the melt.

Smoothed Data:
Temperature dependence of Kₜ can be expressed by the relation:

log(Kₜ/mol cm⁻³ atm⁻¹) = -2.296 - 4247.8/(T/K) (compiler)

std. dev. = 0.04% (compiler)

The heat of solution, ΔH, for the solubility of oxygen in the melt is:

ΔH/kJ mol⁻¹ = 83

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Quenching or chilling method. The diagram and details of the apparatus used and procedure employed are described in the original paper. Briefly, the melt was saturated by bubbling the gas for 2 - 3 hr. A part of the saturated melt was transferred into the chilling compartment where it was slowly quenched to allow all the gases to escape. The liberated gas was flushed with a stream of helium into a U-tube containing activated Linde 5A molecular sieve. The contents of the tube, after being allowed to come to room temperature, were flushed with a stream of carrier gas into a Fisher - Hamilton gas partitioner with Linde 5A column and Katharometer detector for analysis. About 8 - 10 independent measurements were carried out.

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
Appleby, A. J.; Van Drunen, C.
COMPONENTS:
(1) Oxygen; O₂; [7782-44-7]
(2) Lithium carbonate; Li₂CO₃; [554-13-2]
(3) Sodium carbonate; Na₂CO₃; [497-19-8]

VARIABLES:
T/K = 860 - 1060
P/kPa: 101.325 (compiler)

EXPERIMENTAL VALUES:
The values of Henry's law constant, Kₗ, for the solubility of O₂ in the melt Li₂CO₃ - Na₂CO₃ (53.3 - 46.7 mol%) at various temperatures are given only in graphical form. The values of Kₗ derived from the plot at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁻⁷ Kₗ*/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>860</td>
<td>1.1</td>
</tr>
<tr>
<td>910</td>
<td>1.5</td>
</tr>
<tr>
<td>957</td>
<td>2.7</td>
</tr>
<tr>
<td>990</td>
<td>3.4</td>
</tr>
<tr>
<td>1066</td>
<td>4.8</td>
</tr>
</tbody>
</table>

* Values derived from the graph by the compiler.

Smoothed Data:
The temperature dependence of Kₗ can be expressed by the relation:

\[
\log(K_\text{mol cm}^{-3} \text{ atm}^{-1}) = -3.461 - 3014/(T/K) \quad \text{(compiler)}
\]

std. dev. = 4.7% \quad \text{(compiler)}

The heat of solution, ΔH, for the solubility of O₂ in the melt is:

\[\Delta H/\text{kJ mol}^{-1} = 62.3\]

FILE: 004304

REFERENCE:
Schenke, M.; Broers, G. H. J.; Ketelaar, J. A. A.
COMPONENTS:
(1) Oxygen; O\textsubscript{2}; [7782-44-7]
(2) Lithium carbonate; Li\textsubscript{2}CO\textsubscript{3}; [554-13-2]
(3) Potassium carbonate; K\textsubscript{2}CO\textsubscript{3}; [584-08-7]

VARIABLES:
one temperature: T/K = 923 \pm 5
melt comp./mol% K\textsubscript{2}CO\textsubscript{3} = 38.0

ORIGINAL MEASUREMENTS:
Smith, S. W.; Vogel, W. M.; Kapelner, S.

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
Oxygen reacts with the carbonate melt resulting in the formation of superoxide and peroxide ions. Henry's law was not applicable due to the chemical reaction. The concentration of molecular oxygen in the melt was found to be negligible. The total equilibrium oxygen content in the melt, at different partial pressures of CO\textsubscript{2}, were:

<table>
<thead>
<tr>
<th>P\textsubscript{O\textsubscript{2}}/atm</th>
<th>P\textsubscript{CO\textsubscript{2}}/atm</th>
<th>10\textsuperscript{-6} C\textsubscript{1}\textsuperscript{a}/mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>0.5</td>
<td>5.6</td>
</tr>
<tr>
<td>0.5</td>
<td>0.1</td>
<td>5.0</td>
</tr>
<tr>
<td>0.5</td>
<td>0.1</td>
<td>17.3</td>
</tr>
<tr>
<td>0.5</td>
<td>0.1</td>
<td>21.2</td>
</tr>
<tr>
<td>0.5</td>
<td>0.02</td>
<td>13.2</td>
</tr>
<tr>
<td>0.5</td>
<td>0.02</td>
<td>17.6</td>
</tr>
<tr>
<td>0.5</td>
<td>0.02</td>
<td>52.6</td>
</tr>
<tr>
<td>0.5</td>
<td>0.02</td>
<td>27.0</td>
</tr>
<tr>
<td>0.5</td>
<td>0.02</td>
<td>19.1</td>
</tr>
<tr>
<td>0.5</td>
<td>0.02</td>
<td>50.5</td>
</tr>
<tr>
<td>0.5</td>
<td>0.02</td>
<td>43.1</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Experimental value.

AUXILIARY INFORMATION

METHOD/APPROATUS/PROCEDURE:
A diagram of the apparatus is given in the original paper. A known amount of the melt was allowed to equilibrate with a gas mixture of CO\textsubscript{2} + O\textsubscript{2}. The system was then flushed with CO\textsubscript{2} + N\textsubscript{2} mixture of the same CO\textsubscript{2} partial pressure. An excess of finely powdered Cr\textsubscript{2}(SO\textsubscript{4})\textsubscript{3} was then added to the melt which reacted with all forms of oxygen completely and rapidly. After 2 hr., the melt was frozen and Cr\textsuperscript{6+} content was estimated by spectrophotometric technique using s-diphenyl-carbazide.

SOURCE AND PURITY OF MATERIALS:
Analytical grade melt components were used.
The gas mixtures were prepared by mixing "high purity" grade gases with a Matheson Model 8249 gas flow controller.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
**COMPONENTS:**

1. Oxygen; O₂; [7782-44-7]
2. Lithium carbonate; Li₂CO₃; [554-13-2]
3. Potassium carbonate; K₂CO₃; [584-08-7]

**ORIGINAL MEASUREMENTS:**

Appleby, A. J.; Van Drunen, C.

**VARIABLES:**

T/K = 973 - 1023
P/kPa: 101.325 (compiler)

**PREPARED BY:**

N. P. Bansal

**EXPERIMENTAL VALUES:**

The values of Henry's law constant, K_H, for the solubility of oxygen in the melt Li₂CO₃ - K₂CO₃ (42.7 - 57.3 mol%) at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>P_{CO₂}/atm</th>
<th>10⁴ K_{H}/mol dm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td>0.026</td>
<td>4.18 ± 0.35</td>
</tr>
<tr>
<td>750</td>
<td>0.026</td>
<td>6.16 ± 0.19</td>
</tr>
<tr>
<td>800</td>
<td>0.06</td>
<td>14.00 ± 0.80</td>
</tr>
<tr>
<td>850</td>
<td>0.10</td>
<td>25.90 ± 1.60</td>
</tr>
</tbody>
</table>

Data refer to both physically and chemically dissolved oxygen in the melt.

**Smoothed Data:**

Temperature dependence of K_H can be expressed by the relation:

\[
\log(K_H/\text{mol cm}^{-3} \text{ atm}^{-1}) = -0.319 - 5945.4/(T/K) \quad \text{(compiler)}
\]

std. dev. = 6.9% \quad \text{(compiler)}

The heat of solution, ΔH, for the solubility of oxygen in the melt is:

\[\Delta H/\text{kJ mol}^{-1} = 120.0\]

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Quenching or chilling method. The diagram and details of the apparatus used and procedure followed are described in the original paper. Briefly, the melt was saturated by bubbling the gas for 2 - 3 hr. A part of the saturated melt was transferred into the quenching compartment where it was slowly chilled to allow all the gases to escape. The liberated gas was flushed with a stream of helium into a U - tube containing activated Linde 5A molecular sieve. The contents of the tube, after being allowed to come to room temperature, were flushed with a stream of carrier gas into a Fisher - Hamilton gas partitioner with Linde 5A column and Katharometer detector for analysis. About 8 - 10 independent measurements were carried out.

**SOURCE AND PURITY OF MATERIALS:**

Not described.

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**
COMPONENTS:
(1) Oxygen; $\text{O}_2$; [7782-44-7]
(2) Sodium carbonate; $\text{Na}_2\text{CO}_3$; [497-19-8]
(3) Potassium carbonate; $\text{K}_2\text{CO}_3$; [584-08-7]

VARIABLES:
$T/\text{K} = 1048 - 1123$
$P/\text{kPa}: 101.325$ (compiler)

EXPERIMENTAL VALUES:

The values of Henry's law constant, $K_H$, for the solubility of oxygen in the melt $\text{Na}_2\text{CO}_3 - \text{K}_2\text{CO}_3$ (58 - 42 mol%) at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>$P_{\text{CO}_2}/\text{atm}$</th>
<th>$10^4 K_H^a/\text{mol dm}^{-3} \text{ atm}^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>775</td>
<td>0.10</td>
<td>$13.11 \pm 0.60$</td>
</tr>
<tr>
<td>800</td>
<td>0.10</td>
<td>$14.15 \pm 0.88$</td>
</tr>
<tr>
<td>850</td>
<td>0.10</td>
<td>$23.53 \pm 1.88$</td>
</tr>
</tbody>
</table>

$^a$ Data refer to both physical and chemical solubilities of oxygen in the melt.

Smoothed Data:
Temperature dependence of $K_H$ can be expressed by the relation:

$$\log(K_H/\text{mol cm}^{-3} \text{ atm}^{-1}) = -1.935 - 4161.3/(T/\text{K})$$

(std. dev. = 4.5% (compiler))

The heat of solution, $\Delta H$, for the solubility of oxygen in the melt is:

$$\Delta H/\text{kJ mol}^{-1} = 79$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Quenching or chilling method.
The diagram and details of the apparatus used and procedure employed are described in the original publication. Briefly, the melt was saturated by bubbling the gas for 2 - 3 hr. A portion of the saturated melt was transferred into the chilling compartment where it was slowly quenched to allow all the gases to escape. The liberated gas was flushed with a stream of helium into a U - tube containing activated Linde 5A molecular sieve. The contents of the tube, after being allowed to come to room temperature, were flushed with a stream of carrier gas into a Fisher - Hamilton gas partitioner with Linde 5A column and Katharometer detector for analysis. About 8 - 10 independent measurements were carried out.

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
COMPONENTS:

(1) Oxygen; \( \text{O}_2; [7782-44-7] \)
(2) Sodium oxide; \( \text{Na}_2\text{O}; [1313-59-3] \)
(3) Vanadium oxide; \( \text{V}_2\text{O}_3; [1314-62-1] \)

VARIABLES:

\[ T/K = 808 - 951 \]
\[ \text{V}_2\text{O}_3 / \text{mole} \% = 55 - 70 \]
\[ P/kPa: 101.325 (1 \text{ atm.}) \]

EXPERIMENTAL VALUES:

Henry's Law Constants, \( K_p \) (mol cm\(^{-3}\) atm\(^{-1}\)), for the solubility of oxygen in \( \text{Na}_2\text{O} - \text{V}_2\text{O}_3 \) melts of various compositions were determined at different temperatures. Temperature dependence of \( K_p \) (mol cm\(^{-3}\) atm\(^{-1}\)), obtained by linear least squares fit, is given below as the coefficients of the equation \( \log K_p = A + B/T \pm \Delta \), where \( \Delta \) is the error:

<table>
<thead>
<tr>
<th>mole % \text{V}_2\text{O}_3</th>
<th>Temp. range (K)</th>
<th>-A</th>
<th>-B</th>
<th>\Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td>55.0</td>
<td>820 - 922</td>
<td>1.590</td>
<td>4348</td>
<td>0.039</td>
</tr>
<tr>
<td>61.0</td>
<td>808 - 903</td>
<td>3.017</td>
<td>2857</td>
<td>0.026</td>
</tr>
<tr>
<td>70.0</td>
<td>848 - 951</td>
<td>3.482</td>
<td>2273</td>
<td>0.041</td>
</tr>
</tbody>
</table>

The enthalpies \( (\Delta H^\circ) \) and entropies \( (\Delta S^\circ) \) of the solution were evaluated from the temperature dependence of the solubility constants expressed as \( K_p = C_m/C_q \), where \( C_m \) and \( C_q \) are the volume concentrations of the dissolved gas in the liquid and the gas phase respectively, are given below:

<table>
<thead>
<tr>
<th>mole % \text{V}_2\text{O}_3</th>
<th>( \Delta H^\circ )/kJ mol(^{-1})</th>
<th>( \Delta S^\circ )/JK(^{-1})mol(^{-1}) (at 855K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>55.0</td>
<td>90.36</td>
<td>70.38</td>
</tr>
<tr>
<td>61.0</td>
<td>61.80</td>
<td>43.30</td>
</tr>
<tr>
<td>70.0</td>
<td>50.63</td>
<td>34.45</td>
</tr>
</tbody>
</table>

METHOD/APPARATUS/PROCEDURE:

Gas solubilities were determined by desorption of the dissolved gas from the melt by an inert gas (helium) as well as by a gas - volumetric method. The discrepancy between the results of the two methods was 10 - 20 %. The \( \text{V}_2\text{O}_3 \) content in the melt was determined by an amperometric titration.

SOURCE AND PURITY OF MATERIALS:

Not specified.

ESTIMATED ERROR:

Not specified.

REFERENCES:

COMPONENTS:
(1) Oxygen; O₂; [7782-44-7]
(2) Potassium Oxide; K₂O; [12136-45-7]
(3) Vanadium Oxide; V₂O₅; [1314-62-1]

ORIGINAL MEASUREMENTS:
Nalimova, E.G; Fedorov, A. A.; Ponomarev; V. E.; Ketov, A. N.

VARIABLES:
T/K = 773 - 909
V₂O₅/mol% = 50 - 66.5
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:
Solubilities of oxygen in K₂O - V₂O₅ melts of various compositions were determined at various temperatures at an initial pressure of 1 atm. The average solubilities obtained from five measurements at each temperature are given below:

<table>
<thead>
<tr>
<th>T/K</th>
<th>50.0 mole % V₂O₅</th>
<th>55.5 mole % V₂O₅</th>
<th>61.0 mole % V₂O₅</th>
<th>66.5 mole % V₂O₅</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10⁷ cm/mol cm⁻³ · atm⁻¹</td>
<td>10⁷ cm/mol cm⁻³ · atm⁻¹</td>
<td>10⁷ cm/mol cm⁻³ · atm⁻¹</td>
<td>10⁷ cm/mol cm⁻³ · atm⁻¹</td>
</tr>
<tr>
<td>798</td>
<td>1.05</td>
<td>1.54</td>
<td>3.13</td>
<td>7.41</td>
</tr>
<tr>
<td>818</td>
<td>1.41</td>
<td>1.70</td>
<td>3.72</td>
<td>8.91</td>
</tr>
<tr>
<td>848</td>
<td>2.04</td>
<td>2.34</td>
<td>4.68</td>
<td>8.71</td>
</tr>
<tr>
<td>893</td>
<td>3.39</td>
<td>3.16</td>
<td>5.37</td>
<td>12.30</td>
</tr>
<tr>
<td></td>
<td>898</td>
<td>4.27</td>
<td>7.41</td>
<td>13.80</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Desorption Method: Gas solubilities were determined by desorption of the dissolved gas from the melt by an inert gas using a standard method. The oxygen content in the gas mixture was estimated by analysis based on thermal conductivity.
Volumetric Method: Recrystallized potassium metavanadate and vanadium pentoxide were fused together. The possible reducing impurities present in the melt were oxidized for 3h. at 550°C. The dissolved oxygen was removed by bubbling helium through the melt for 30 min. The discrepancy between the solubilities determined by the two methods was ±10%.

SOURCE AND PURITY OF MATERIALS:
Potassium metavanadate of "chemically pure" grade was recrystallized. Vanadium pentoxide of "specially pure" grade was used.

ESTIMATED ERROR:
Solubility = ± 10% (authors)

REFERENCES:
COMPONENTS:

(1) Oxygen; O₂; [7782-44-7]
(2) Potassium Oxide; K₂O; [12136-45-7]
(3) Vanadium oxide; V₂O₅; [1314-62-1]

ORIGINAL MEASUREMENTS:

Nalimova, E. G.; Fedorov, A. A.; Ponomarev, V. E.
1983, 57, 478 - 479. (*).

VARIABLES:

T/K = 773 - 909
V₂O₅ / mole % = 50 - 66.5
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:

EXPERIMENTAL VALUES:

Henry's Law Constants, $K_p(mol~cm^{-3}~atm^{-1})$, for the solubility of oxygen in K₂O₅ - V₂O₅ melts of various compositions were determined at different temperatures. Coefficients of the equation $\log K_p = A + B/T \pm \Delta$, where $\Delta$ is the error obtained by linear least squares fit of the data are given below:

<table>
<thead>
<tr>
<th>mole % V₂O₅</th>
<th>Temp. range (K)</th>
<th>-A</th>
<th>-B</th>
<th>(\Delta)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.0</td>
<td>798 - 893</td>
<td>2.341</td>
<td>3689</td>
<td>0.043</td>
</tr>
<tr>
<td>55.5</td>
<td>778 - 898</td>
<td>3.251</td>
<td>2783</td>
<td>0.026</td>
</tr>
<tr>
<td>61.0</td>
<td>773 - 893</td>
<td>3.496</td>
<td>2214</td>
<td>0.015</td>
</tr>
<tr>
<td>66.5</td>
<td>783 - 909</td>
<td>4.345</td>
<td>1393</td>
<td>0.021</td>
</tr>
</tbody>
</table>

The enthalpies ($\Delta H^o$) and entropies ($\Delta S^o$) of the solution were evaluated from the temperature dependence of the solubility constants expressed as $K_p = C_m/C_q$, where $C_m$ and $C_q$ are the volume concentrations of the dissolved gas in the liquid and the gas phase respectively, are given below:

<table>
<thead>
<tr>
<th>mole % V₂O₅</th>
<th>$\Delta H^o$/kJ mol⁻¹</th>
<th>$\Delta S^o$/JK⁻¹mol⁻¹ (at 855K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.0</td>
<td>77.76</td>
<td>57.10</td>
</tr>
<tr>
<td>55.0</td>
<td>60.41</td>
<td>38.81</td>
</tr>
<tr>
<td>61.0</td>
<td>49.51</td>
<td>31.03</td>
</tr>
<tr>
<td>66.5</td>
<td>34.76</td>
<td>19.13</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas solubilities were determined by desorption of the dissolved gas from the melt by an inert gas (helium) as well as by a gas - volumetric method.

The discrepancy between the results of the two methods was 10 - 20 %.

The V₂O₅ content in the melt was determined by an amperometric titration.

SOURCE AND PURITY OF MATERIALS:

Not specified.

ESTIMATED ERROR:

Not specified.

REFERENCES:
COMPONENTS: ORIGINAL MEASUREMENTS:

(1) Oxygen; O₂; [7782-44-7]

(2) Cesium oxide; Cs₂O; [20281-00-9]

(3) Vanadium oxide; V₂O₅; [1314-62-1]

Nalinova, E. G.; Federov, A. A.; Ponomarev, V. E.
1983, 57, 478 - 479. (*).

VARIABLES:

\[
\begin{align*}
\text{T/K} &= 673 - 922 \\
\text{V}_2\text{O}_5 / \text{mole \%} &= 55 - 70 \\
\text{P/kPa} &= 101.325 \text{ (1 atm.)}
\end{align*}
\]

PREPARED BY:

T/K = 673 - 922

\[
\begin{array}{cccc}
\text{Melt composition mole \% V}_2\text{O}_5 & \text{Temp. range (K)} & -\Lambda & -B \\
55.0 & 832 - 922 & 3.402 & 2539 \\
61.0 & 673 - 825 & 3.703 & 1800 \\
70.0 & 770 - 879 & 4.209 & 1300 \\
\end{array}
\]

\[ \Delta \]

The enthalpies (\(\Delta H^\circ\)) and entropies (\(\Delta S^\circ\)) of solution evaluated from the temperature dependence of the solubility constants expressed as

\[ K_p = \frac{C_m}{C_g}, \]

where \(C_m\) and \(C_g\) are the volume concentrations of the dissolved gas in the liquid and the gas phase respectively, are given below:

\[
\begin{array}{cccc}
\text{Melt composition/mole \% V}_2\text{O}_5 & \Delta H^\circ/\text{kJ mol}^{-1} & \Delta S^\circ/\text{JK}^{-1}\text{mol}^{-1} \text{ (at 855K)} \\
55.0 & 55.72 & 35.98 \\
61.0 & 46.34 & 30.20 \\
70.0 & 32.00 & 20.32 \\
\end{array}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas solubilities were determined by desorption of the dissolved gas from the melt by an inert gas (helium) as well as by a gas - volumetric method.
The discrepancy between the results of the two methods was 10 - 20 \%.
The \(V_2O_5\) content in the melt was determined by an amperometric titration.

SOURCE AND PURITY OF MATERIALS:

Not specified.

ESTIMATED ERROR:

Not specified.

REFERENCES:
COMPONENTS:
(1) Oxygen; O₂; [7782-44-7]
(2) Sodium carbonate; Na₂CO₃; [497-19-8]
(3) Sodium chloride; NaCl; [7647-14-5]

ORIGINAL MEASUREMENTS:
Appleby, A. J.; Van Drunen, C.

VARIABLES:

T/K = 1073 - 1123
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:

The values of Henry's law constant, K⁺, for the solubility of oxygen in the melt Na₂CO₃ - NaCl (60 - 40 mol%) at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁴ K⁺/mol dm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>800</td>
<td>20.64 ± 1.31</td>
</tr>
<tr>
<td>850</td>
<td>29.15 ± 1.70</td>
</tr>
</tbody>
</table>

* Data refer to both physically and chemically dissolved oxygen in the melt.

Smoothed Data:

The heat of solution, ΔH, for the solubility of oxygen in the melt is:

ΔH/J mol⁻¹ = 70

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Quenching or chilling method. The diagram and details of the apparatus used and procedure followed are described in the original publication. Briefly, the melt was saturated by bubbling the gas for 2 - 3 hr. A portion of the saturated melt was transferred into the chilling compartment where it was slowly quenched to allow all the gases to escape. The liberated gas was flushed with a stream of helium into a U - tube containing activated Linde 5A molecular sieve. The contents of the tube, after being allowed to come to room temperature, were flushed with a stream of carrier gas into a Fisher - Hamilton gas partitioner with Linde 5A column and Katharometer detector for analysis. About 8 - 10 independent determinations were carried out.

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:
solubility: ± 20%

REFERENCES:
### COMPONENTS:

1. Oxygen; \( \text{O}_2 \); [7782-44-7]
2. Potassium sulfate; \( \text{K}_2\text{SO}_4 \); [7778-80-5]
3. Potassium bisulfate; \( \text{K}_2\text{S}_2\text{O}_7 \); [7646-93-7]

### VARIABLES:

- one temperature: \( T/\text{K} = 698 \)
- \( P/\text{kPa} = 101.325 \) (1 atm.)

### ORIGINAL MEASUREMENTS:

Comtat, M.; Vothi, N. D.

**J. Chim. Phys. 1976, 73, 109 - 12.**

### EXPERIMENTAL VALUES:

The solubility of oxygen in the molten \( \text{K}_2\text{SO}_4 - \text{K}_2\text{S}_2\text{O}_7 \) (saturated by sulfate) mixture at 1 atmosphere gas pressure is:

<table>
<thead>
<tr>
<th>( t/°C )</th>
<th>( 10^7 \text{C}_1/\text{mol cm}^{-3} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>425</td>
<td>4.4 ± 0.2</td>
</tr>
</tbody>
</table>

### AUXILIARY INFORMATION

**METHOD/APPARATUS/PROCEDURE:**

Constant potential electrolysis.

**SOURCE AND PURITY OF MATERIALS:**

Not described.

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**


COMPONENTS:
(1) Oxygen; \( \text{O}_2 \); [7782-44-7]
(2) Lithium carbonate; \( \text{Li}_2\text{CO}_3 \); [554-13-2]
(3) Sodium carbonate; \( \text{Na}_2\text{CO}_3 \); [497-19-8]
(4) Potassium carbonate; \( \text{K}_2\text{CO}_3 \); [584-08-7]

EVALUATOR:
N. P. Bansal
National Aeronautics and Space Administration
Lewis Research Center
Cleveland, Ohio, 44135. U.S.A.
December, 1989

CRITICAL EVALUATION:

Two independent investigations (1,2) are available for the solubility of oxygen in molten \( \text{Li}_2\text{CO}_3 - \text{Na}_2\text{CO}_3 - \text{K}_2\text{CO}_3 \) (43.5 - 31.5 - 25.0 mol%). Results of these two studies are compared in Fig. 1. It is interesting to note that results of Schenke et al. (2), obtained by using an amperometric titration method, are in good agreement (within experimental precision) with the data of Appleby and Van Drunen (1) who employed the melt chilling technique.

![Graph](image)

**Fig 1.**

The recommended numerical values, obtained by least-squares fitting of the two data sets (1,2) are given in Table 1.

continued
COMPONENTS:
(1) Oxygen; O₂; [7782-44-7]
(2) Lithium carbonate; Li₂CO₃; [554-13-2]
(3) Sodium carbonate; Na₂CO₃; [497-19-8]
(4) Potassium carbonate; K₂CO₃; [584-08-7]

CRITICAL EVALUATION:

EVALUATOR:
N. P. Bansal
National Aeronautics and Space Administration.
Lewis Research Center
Cleveland, Ohio, 44135. U.S.A.
December, 1989.

Table 1
Recommended solubilities as a Function of Temperature

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁷ Kₖ/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>860</td>
<td>1.11</td>
</tr>
<tr>
<td>880</td>
<td>1.40</td>
</tr>
<tr>
<td>900</td>
<td>1.75</td>
</tr>
<tr>
<td>920</td>
<td>2.17</td>
</tr>
<tr>
<td>940</td>
<td>2.66</td>
</tr>
<tr>
<td>960</td>
<td>3.24</td>
</tr>
<tr>
<td>980</td>
<td>3.91</td>
</tr>
<tr>
<td>1000</td>
<td>4.69</td>
</tr>
<tr>
<td>1020</td>
<td>5.58</td>
</tr>
<tr>
<td>1040</td>
<td>6.59</td>
</tr>
<tr>
<td>1060</td>
<td>7.74</td>
</tr>
<tr>
<td>1080</td>
<td>9.04</td>
</tr>
<tr>
<td>1100</td>
<td>10.49</td>
</tr>
<tr>
<td>1120</td>
<td>12.11</td>
</tr>
</tbody>
</table>

References:
COMPONENTS:
(1) Oxygen; O₂; [7782-44-7]
(2) Lithium carbonate; Li₂CO₃; [554-13-2]
(3) Sodium carbonate; Na₂CO₃; [497-19-8]
(4) Potassium carbonate; K₂CO₃; [584-08-7]

ORIGINAL MEASUREMENTS:
Schenke, M.; Broers, G. H. J.; Ketelaar, J. A. A.

VARIABLES:
T/K = 850 - 1069
P/kPa: 101.325 (compiler)

EXPERIMENTAL VALUES:
The values of Henry's law constant, Kᵢ, for the solubility of O₂ in the melt Li₂CO₃ - Na₂CO₃ - K₂CO₃ (43.5 - 31.5 - 25.0 mol%) at different temperatures are given only in graphical form. The values of Kᵢ derived from the plot at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁻⁷ Kᵢ^a/ mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>852</td>
<td>1.25</td>
</tr>
<tr>
<td>886</td>
<td>1.60</td>
</tr>
<tr>
<td>913</td>
<td>1.86</td>
</tr>
<tr>
<td>945</td>
<td>2.81</td>
</tr>
<tr>
<td>972</td>
<td>3.95</td>
</tr>
<tr>
<td>1002</td>
<td>4.25</td>
</tr>
<tr>
<td>1023</td>
<td>5.22</td>
</tr>
<tr>
<td>1069</td>
<td>10.40</td>
</tr>
</tbody>
</table>

^a Values derived from the graph by the compiler.

Smoothed Data:
The temperature dependence of Kᵢ can be expressed by the relation:
\[ \log(Kᵢ/\text{mol cm}^{-3} \text{ atm}^{-1}) = -2.602 - 3716.8/(T/K) \]  (compiler)

std. dev. = 6.2%  (compiler)

The heat of solution, \( \Delta H \), for the solubility of O₂ in the melt is:
\[ \Delta H/\text{kJ mol}^{-1} = 74.1 \]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Amperometric titration method.
The melt was saturated with oxygen by bubbling an O₂ - CO₂ gas mixture of known composition. The dissolved oxygen was titrated by adding stepwise solid Na₂SO₃ as reducing agent. During titration a cover of N₂ - CO₂ mixture was maintained while the partial pressure of CO₂ was kept constant. A pair of rotating platinum wire electrodes with a fixed potential difference maintained between them was used as an indicator. The current flowing through the system was the measure of the amount of oxygen dissolved in the melt.

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
**COMPONENTS:**

(1) Oxygen; O\textsubscript{2}; [7782-44-7]
(2) Lithium carbonate; Li\textsubscript{2}CO\textsubscript{3}; [554-13-2]
(3) Sodium carbonate; Na\textsubscript{2}CO\textsubscript{3}; [497-19-8]
(4) Potassium carbonate; K\textsubscript{2}CO\textsubscript{3}; [584-08-7]

**ORIGIANL MEASUREMENTS:**


**VARIABLES:**

\[
\begin{align*}
T/K &= 973 - 1123 \\
P/kPa &= 101.325 \text{ (1 atm.)}
\end{align*}
\]

**EXPERIMENTAL VALUES:**

The values of Henry's law constant, \(K_H\), for the solubility of O\textsubscript{2} in the melt Li\textsubscript{2}CO\textsubscript{3} - Na\textsubscript{2}CO\textsubscript{3} - K\textsubscript{2}CO\textsubscript{3} (43.5 - 31.5 - 25.0 mol%) at different temperatures are:

<table>
<thead>
<tr>
<th>(t/^\circ C)</th>
<th>(P_{\text{CO}_2}/\text{atm})</th>
<th>(10^4 K_H^*/\text{mol dm}^{-3} \text{ atm}^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td>0.026</td>
<td>2.52 ± 0.24</td>
</tr>
<tr>
<td>750</td>
<td>0.026</td>
<td>5.10 ± 0.08</td>
</tr>
<tr>
<td>800</td>
<td>0.06</td>
<td>8.47 ± 0.22</td>
</tr>
<tr>
<td>850</td>
<td>0.10</td>
<td>15.10 ± 0.53</td>
</tr>
</tbody>
</table>

* Data refer to both physically and chemically dissolved oxygen in the melt.

**Smoothed Data:**

Temperature dependence of \(K_H\) for the solubility of oxygen in the melt can be expressed by the relation:

\[
\log(K_H/\text{mol cm}^{-3} \text{ atm}^{-1}) = -0.851 - 5586.8/(T/K) \quad (\text{compiler})
\]

std. dev. = 1.8% (compiler)

The heat of solution, \(\Delta H\), for the solubility of oxygen in the melt is:

\[
\Delta H/\text{kJ mol}^{-1} = 106.3
\]

**METHOD/APPARATUS/PROCEDURE:**

Quenching or chilling method.

The diagram and details of the apparatus used and procedure employed have been described in the original publication. Briefly, the melt was saturated by bubbling the gas for 2 - 3 hr. A part of the saturated melt was transferred into the chilling compartment where it was slowly quenched to allow all the gases to escape. The liberated gas was flushed with a stream of helium into a U - tube containing activated Linde 5A molecular sieve. The contents of the tube, after being allowed to come to room temperature, were flushed with a stream of carrier gas into a Fisher - Hamilton gas partitioner with Linde 5A column and Katharometer detector for analysis. About 8 - 10 independent measurements were carried out.

**REFERENCES:**

Not described.

**ESTIMATED ERROR:**

Nothing specified.
### COMPONENTS:

<table>
<thead>
<tr>
<th>Component</th>
<th>Formula</th>
<th>CAS Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen</td>
<td>O₂</td>
<td>[7782-44-7]</td>
</tr>
<tr>
<td>Calcium oxide</td>
<td>CaO</td>
<td>[1305-78-8]</td>
</tr>
<tr>
<td>Silicon dioxide</td>
<td>SiO₂</td>
<td>[7631-86-9]</td>
</tr>
<tr>
<td>Alumina</td>
<td>Al₂O₃</td>
<td>[1344-28-1]</td>
</tr>
</tbody>
</table>

### VARIABLES:

<table>
<thead>
<tr>
<th>Temperature</th>
<th>T/K</th>
<th>1600 - 1785</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure</td>
<td>P/kPa</td>
<td>20.265 - 101.325</td>
</tr>
</tbody>
</table>

### EXPERIMENTAL VALUES:

The temperature dependence of the oxygen gas solubility, C(mol cm⁻³ atm⁻¹), in CaO - SiO₂ - Al₂O₃ melts of three different compositions are given by the following expressions.

- **25CaO - 65SiO₂ - 10Al₂O₃ (wt%)**
  
  \[ C/\text{mol cm}^{-3}\text{atm}^{-1} = 6.7 \times 10^{-10} \exp \left[ \frac{-44000}{RT} \right] \]

- **40CaO - 40SiO₂ - 20Al₂O₃ (wt%)**
  
  \[ C/\text{mol cm}^{-3}\text{atm}^{-1} = 2.9 \times 10^{-13} \exp \left[ \frac{-10000}{RT} \right] \]

- **45CaO - 40SiO₂ - 15Al₂O₃ (wt%)**
  
  \[ C/\text{mol cm}^{-3}\text{atm}^{-1} = 1.3 \times 10^{-13} \exp \left[ \frac{-6000}{RT} \right] \]

### AUXILIARY INFORMATION

**METHOD/APPROPARATUS/PROCEDURE:**

Oxygen solubilities in the melt were estimated from the permeability and diffusivity of the gas.

**SOURCE AND PURITY OF MATERIALS:**

**ESTIMATED ERROR:**

Not specified.

**REFERENCES:**

COMPONENTS:

(1) Nitrogen; N\textsubscript{2}; [7727-37-9]
(2) Lithium nitrate; LiNO\textsubscript{3}; [7790-69-4]

ORIGINAL MEASUREMENTS:


VARIABLES:

\[ T/K = 536 - 611 \]
\[ P/kPa = 50.663 - 151.988 \]

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

The values of Henry's law constant, \( K_H \), for the solubility of N\textsubscript{2} in molten LiNO\textsubscript{3}, at different temperatures, are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>( 10^7 K_H/\text{mol cm}^{-3} \text{ atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>536</td>
<td>1.66</td>
</tr>
<tr>
<td>541</td>
<td>1.73</td>
</tr>
<tr>
<td>553</td>
<td>1.68</td>
</tr>
<tr>
<td>554</td>
<td>1.78</td>
</tr>
<tr>
<td>565</td>
<td>1.76</td>
</tr>
<tr>
<td>567</td>
<td>1.87</td>
</tr>
<tr>
<td>570</td>
<td>1.74</td>
</tr>
<tr>
<td>586</td>
<td>1.91</td>
</tr>
<tr>
<td>589</td>
<td>1.89</td>
</tr>
<tr>
<td>611</td>
<td>2.10</td>
</tr>
</tbody>
</table>

Smoothed Data:

The temperature dependence of \( K_H \) is expressed by the relation:

\[
\log(K_H/\text{mol cm}^{-3} \text{ atm}^{-1}) = -6.04 - 397.0/(T/K)
\]

std. dev. = 0.27% (authors)

The enthalpy of solution, \( \Delta H \), and entropy of solution, \( \Delta S \), are:

\[
\Delta H/\text{kcal mol}^{-1} = 1.82 \pm 0.18
\]

\[
\Delta S/\text{cal K}^{-1} \text{ mol}^{-1} = -6.23 \pm 0.32 \quad \text{ (at 581 K)}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Elution technique.
Diagram and details of the gas solubility apparatus are given in the original publication.
After saturating the melt with nitrogen gas, the gas phase was evacuated. Helium gas was introduced into the system as eluting gas to approximately 1 atm. The resultant gas mixture of nitrogen and helium was analyzed with an Aerograph 90 - P gas chromatograph (Varian).

SOURCE AND PURITY OF MATERIALS:

Dry nitrogen and helium obtained from Airco were used directly from the tanks.
Reagent grade lithium nitrate from Baker was used without further purification.

ESTIMATED ERROR:

\[ \delta C/P = \pm 5\% \quad \text{(authors)} \]

REFERENCES:
### COMPONENTS:

1. Nitrogen; $\text{N}_2$; [7727-37-9]
2. Lithium nitrate; $\text{LiNO}_3$; [7790-69-4]

### VARIABLES:

- one temperature: $T/K = 550$
- $P/kPa = 25000 - 98000$

### EXPERIMENTAL VALUES:

Solubilities of nitrogen in the melt are presented at only one temperature, in the graphical form as a function of the gas pressure in the range 250 - 980 bar. The value of the Henry's law constant, $K_H$, at the experimental temperature is:

<table>
<thead>
<tr>
<th>$t/°C$</th>
<th>$10^7 K_H$/mol ml$^{-1}$ bar$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>277</td>
<td>0.73 ± 0.10</td>
</tr>
</tbody>
</table>

### ORIGINAL MEASUREMENTS:

Cleaver, B.; Mather, D. E.


### PREPARED BY:

N. P. Bansal

### METHOD/APPARATUS/PROCEDURE:

High pressure elution technique.

Diagram and details of the apparatus are given in the original paper. The melt was saturated by stirring it in contact with the gas at high pressure. A sample of the saturated melt was isolated and analyzed by the elution technique.

### SOURCE AND PURITY OF MATERIALS:

Nitrogen (99.9%) from British Oxygen Company was used without further purification or drying.

Lithium nitrate (99.9%) obtained from Johnson - Matthey & Co. was recrystallized from distilled water and dried at 120°C. It was stored in an air oven at 100°C.

### ESTIMATED ERROR:

$\delta P/bar = 10$

### REFERENCES:
Four investigations have been reported for the solubility of nitrogen in molten sodium nitrate. One of these studies (1) which uses a cryometric method is only of preliminary nature. Copeland and Seibles (2) use a manometric technique whereas Field and Green (3) and Cleaver and Mather (4) employ an elution process. Results of the three different studies have been compared below:

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^7 K_r$/mol cm$^{-2}$ atm$^{-2}$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Field &amp; Green</td>
</tr>
<tr>
<td>600</td>
<td>2.0</td>
</tr>
<tr>
<td>640</td>
<td>2.3</td>
</tr>
<tr>
<td>680</td>
<td>(2.6)</td>
</tr>
<tr>
<td>720</td>
<td>(2.9)</td>
</tr>
</tbody>
</table>

Values in ( ) outside temperature interval of experimental measurement; extrapolated by the evaluator.

The solubility results of Field and Green (3) are about an order of magnitude smaller than those reported by Copeland and Seibles (2) and about four - five times larger than those of Cleaver and Mather (4). The heat of solution reported by Copeland and Seibles is negative in contrast to the other two studies which report positive values. It has been pointed out by Copeland and Christie (5) that solubility results reported earlier from their laboratory are not reliable.

Further studies are needed in order to make a reliable evaluation of this system.

References:
COMPONENTS:

(1) Nitrogen; \( \text{N}_2 \); [7727-37-9]
(2) Sodium nitrate; \( \text{NaN}_3 \); [7631-99-4]

VARIABLES:

\[
\begin{align*}
T/\text{K} &= 586 - 639 \\
P/\text{kPa} &= 95.246 - 125.643
\end{align*}
\]

EXPERIMENTAL VALUES:

Henry’s law was obeyed over the pressure range studied (0.94 - 1.24 atm). The values of Henry’s law constant, \( K_H \), at different temperatures are:

\[
\begin{array}{c|c}
T/\text{K} & 10^7 K_H/\text{mol cm}^{-3} \text{ atm}^{-1} \\
586 & 1.886 \\
587 & 1.853 \\
601 & 1.958 \\
605 & 2.096 \\
615 & 2.024 \\
620 & 2.218 \\
623 & 2.356 \\
625 & 2.190 \\
639 & 2.096
\end{array}
\]

Smoothed Data:

Temperature dependence of \( K_H \) is expressed by the relation:

\[
\log(K_H/\text{mol cm}^{-3} \text{ atm}^{-1}) = -5.71 - 599.2/(T/\text{K})
\]

std. dev. = 0.83%

The enthalpy of solution, \( \Delta H \), and entropy of solution, \( \Delta S \), are:

\[
\begin{align*}
\Delta H/\text{kcal mol}^{-1} &= 2.74 \pm 0.83 \\
\Delta S/\text{cal K}^{-1} \text{ mol}^{-1} &= -4.54 \pm 1.36 \quad \text{(at 637 K)}
\end{align*}
\]

METHOD/APPARATUS/PROCEDURE:

Elution technique. Diagram of the gas solubility apparatus is given in the original paper.

After saturating the melt with nitrogen gas, the gas phase was evacuated. Helium was introduced into the system as eluting gas to approximately 1 atm. pressure. The resultant gas mixture of nitrogen and helium was analyzed with an Aerograph Model 90-P gas chromatograph (Varian). Average of four measurements was used for calculation of the gas solubility.

SOURCE AND PURITY OF MATERIALS:

Dry nitrogen obtained from Airco was used directly from the tank. Baker's reagent grade sodium nitrate was used without further purification.

ESTIMATED ERROR:

\[
\delta C/P = \pm 0.05 \quad \text{(authors)}
\]

REFERENCES:
COMPONENTS:
(1) Nitrogen; N₂; [7727-37-9]
(2) Sodium nitrate; NaN₃; [7631-99-4]

ORIGINAL MEASUREMENTS:
Cleaver, B.; Mather, D. E.

VARIABLES:
\[ \begin{align*} 
T/K &= 604 - 722 \\
P/kPa &= 0 - 10^5 
\end{align*} \]

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
Gas solubilities in the melt at three temperatures are presented as a function of gas pressure in the range 280 - 1000 bar in graphical form only. The values of the Henry's law constant, \( K_H \), at three temperatures are given as:

\[
\begin{array}{cccc}
 t/°C & 10^7 K_H/\text{mol ml}^{-1} \text{ bar}^{-1} \\
331 & 0.50 \pm 0.15 \\
390 & 0.64 \pm 0.15 \\
449 & 0.84 \pm 0.15 \\
\end{array}
\]

Smoothed Data:
Temperature dependence of \( K_H \) is expressed by the relation:

\[
\log(K_H/\text{mol ml}^{-1} \text{ bar}^{-1}) = -5.931 - 829.8/(T/K) \\
\text{std. dev.} = 1.3\% 
\]

The enthalpy of solution, \( \Delta H \), and the standard entropy of solution, \( \Delta S^\circ \), and the partial molar volume, \( \overline{V}_d \), of the dissolved gas are:

\[
\begin{align*}
\Delta H/\text{kJ mol}^{-1} &= 16.0 \\
\Delta S^\circ/\text{J K}^{-1} \text{ mol}^{-1} &= -23.6 \\
\overline{V}_d/\text{ml mol}^{-1} &= 46 \pm 40 
\end{align*}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
High pressure elution technique.
Diagram and details of the apparatus are given in the original publication. The melt was saturated by stirring it in contact with the gas at high pressure. A part of the saturated melt was isolated and analyzed by the elution technique.

SOURCE AND PURITY OF MATERIALS:
Nitrogen (99.9%) from British Oxygen Company was used without further purification.
Sodium nitrate (B. D. H.) A. R. grade was purified by filtration through Pyrex frits in the molten state. The melt was allowed to freeze and stored under vacuum.

ESTIMATED ERROR:
\( \delta P/\text{bar} = \pm 10 \)

REFERENCES:
COMPONENTS:
(1) Nitrogen; N\textsubscript{2}; [7727-37-9]
(2) Sodium nitrate; NaN\textsubscript{3}; [7631-99-4]

ORIGINAL MEASUREMENTS:
Copeland, J. L.; Seibles, L.

VARIABLES:
\begin{align*}
T/K &= 628 - 727 \\
P/kPa &= 14185.5 - 43164.5
\end{align*}

EXPERIMENTAL VALUES:
The value of Henry's law constant, \(K_H\), and gas solubilities, \(C_1\), at different temperatures and gas pressures are:

\begin{tabular}{cccccc}
\textbf{\(P\)} & \textbf{\(10^7 K_H\) mol cm\textsuperscript{-3} atm\textsuperscript{-1}\)} & \textbf{\(10^4 C_1\) mol cm\textsuperscript{-3}} & \textbf{\(P\)} & \textbf{\(10^7 K_H\) mol cm\textsuperscript{-3} atm\textsuperscript{-1}\)} & \textbf{\(10^4 C_1\) mol cm\textsuperscript{-3}} \\
\hline
\parbox{1cm}{\textbf{T = 727 K}} & & & \parbox{1cm}{	extbf{T = 696 K}} & & \\
364 & 16.5 & 6.00 & 349 & 16.0 & 5.57 \\
286 & 14.0 & 4.00 & 272 & 16.0 & 4.34 \\
227 & 13.7 & 3.11 & 217 & 14.9 & 3.24 \\
167 & 18.4 & 2.73 & 159 & 17.9 & 2.85 \\
\parbox{1cm}{\textbf{T = 718 K}} & & & \parbox{1cm}{	extbf{T = 686.5 K}} & & \\
357 & 16.7 & 5.97 & 426 & 17.4 & 7.40 \\
281 & 15.0 & 4.21 & 341 & 17.4 & 5.93 \\
223 & 15.1 & 3.37 & 266 & 17.5 & 4.66 \\
163 & 18.3 & 2.98 & 213 & 15.5 & 3.31 \\
155 & 18.8 & 2.91 & & & \\
\end{tabular}

continued

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Manometric method.
The apparatus and technique were the same as described by Copeland and Zybko (1). Known quantities of the gas and the melt were equilibrated in a heated pressure vessel and the final pressure was measured. The amount of gas dissolved was determined by subtracting the number of moles of gas present in the gas phase, calculated from the Beattie - Bridgeman equation (2), from the number of moles originally admitted.

SOURCE AND PURITY OF MATERIALS:
Bone dry grade nitrogen, at least 99.98% pure from the National Cylinder Gas Co. was used.
Reagent grade sodium nitrate from Baker and Adamson was employed.
To remove moisture, it was melted and allowed to freeze in a porcelain casserole contained in a dessicator.

ESTIMATED ERROR:
\(5P/\text{atm} = \pm 3\)

REFERENCES:
### COMPONENTS:
1. Nitrogen; N₂; [7727-37-9]
2. Sodium nitrate; NaNO₃; [7631-99-4]

### VARIABLES:
- T/K = 628 - 727
- P/kPa = 14185.5 - 43164.5

### EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>Temperature (K)</th>
<th>log(KH)</th>
<th>1/K</th>
<th>log(KH)</th>
<th>1/K</th>
</tr>
</thead>
<tbody>
<tr>
<td>415</td>
<td>6.64</td>
<td>49.2</td>
<td>6.64</td>
<td>49.2</td>
</tr>
<tr>
<td>332</td>
<td>5.87</td>
<td>55.9</td>
<td>5.87</td>
<td>55.9</td>
</tr>
<tr>
<td>258</td>
<td>4.64</td>
<td>69.8</td>
<td>4.64</td>
<td>69.8</td>
</tr>
<tr>
<td>205</td>
<td>3.75</td>
<td>77.8</td>
<td>3.75</td>
<td>77.8</td>
</tr>
<tr>
<td>151</td>
<td>3.08</td>
<td>82.8</td>
<td>3.08</td>
<td>82.8</td>
</tr>
<tr>
<td>398</td>
<td>7.77</td>
<td>49.2</td>
<td>7.77</td>
<td>49.2</td>
</tr>
<tr>
<td>323</td>
<td>5.91</td>
<td>55.9</td>
<td>5.91</td>
<td>55.9</td>
</tr>
<tr>
<td>251</td>
<td>4.71</td>
<td>69.8</td>
<td>4.71</td>
<td>69.8</td>
</tr>
<tr>
<td>200</td>
<td>3.77</td>
<td>77.8</td>
<td>3.77</td>
<td>77.8</td>
</tr>
<tr>
<td>148</td>
<td>2.75</td>
<td>82.8</td>
<td>2.75</td>
<td>82.8</td>
</tr>
</tbody>
</table>

### Smoothed Data:
Temperature dependence of $K_r$ is expressed by the equation:

$$\log(K_r/mol \text{ cm}^{-3} \text{ atm}^{-1}) = -(6.64 \pm 0.03) + (597 \pm 19)/(T/K)$$

The enthalpy of solution, $\Delta H$, and standard entropy of solution, $\Delta S^\circ$, are:

$$\Delta H/\text{kcal mol}^{-1} = -2.73 \pm 0.09$$

$$\Delta S^\circ/\text{cal K}^{-1} \text{ mol}^{-1} = -16.6 \pm 0.1$$

The errors indicated are the least-squares probable errors (authors).

### AUXILIARY INFORMATION

**METHOD/APPARATUS/PROCEDURE:**

**SOURCE AND PURITY OF MATERIALS:**

**ESTIMATED ERROR:**

**REFERENCES:**
<table>
<thead>
<tr>
<th>COMPONENTS:</th>
<th>ORIGINAL MEASUREMENTS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Nitrogen; $N_2$; [7727-37-9]</td>
<td>Frame, J. P.; Rhodes, E.; Ubbelohde, A. R.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VARIABLES:</th>
<th>PREPARED BY:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N. P. Bansal</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EXPERIMENTAL VALUES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>No depression in freezing point of the solvent was observed from the solubility of nitrogen at atmospheric pressure indicating that nitrogen solubility in sodium nitrate was less than $10^{-4}$ mole fraction.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AUXILIARY INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>METHOD/APPARATUS/PROCEDURE:</td>
</tr>
<tr>
<td>Cryoscopy.</td>
</tr>
<tr>
<td>SOURCE AND PURITY OF MATERIALS:</td>
</tr>
<tr>
<td>Nitrogen from commercial cylinders (B.O.C.) was dried by passing through a liquid air trap. Sodium nitrate containing less than 0.0003% of cation and less than 0.001% of anion impurities was dried for several days at 240°C followed by thermal shock technique (1). Drying was completed by evacuating the system after melting the salt.</td>
</tr>
<tr>
<td>ESTIMATED ERROR:</td>
</tr>
<tr>
<td>Freezing point was measured within ± 0.02°C.</td>
</tr>
<tr>
<td>REFERENCES:</td>
</tr>
</tbody>
</table>
## COMPONENTS:

1. Nitrogen; \( \text{N}_2 \); [7727-37-9]
2. Sodium nitrate; \( \text{NaNO}_3 \); [7631-99-4]

## ORIGINAL MEASUREMENTS:


## VARIABLES:

\[
\begin{align*}
T/\text{K} &= 593 - 643 \\
P/\text{kPa} &= 101.325 \text{ (compiler)}
\end{align*}
\]

## EXPERIMENTAL VALUES:

Nitrogen gas solubilities, \( K_p (\text{mol cm}^{-3} \text{atm}^{-1}) \), at various temperatures are given below:

<table>
<thead>
<tr>
<th>( T/\text{K} )</th>
<th>( 10^7 K_p / \text{mol cm}^{-3} \text{atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>593</td>
<td>2.5 ± 0.20</td>
</tr>
<tr>
<td>643</td>
<td>3.4 ± 0.30</td>
</tr>
</tbody>
</table>

The enthalpy, \( \Delta H \), for dissolution of gas in the melt was calculated from the relation:

\[
d \ln K_p / d(1/T) = - \Delta H / R
\]

and was found to be:

\[
\Delta H / \text{kcal mol}^{-1} = 4.7 ± 2.0
\]

## AUXILIARY INFORMATION

### METHOD/APPARATUS/PROCEDURE:

Elution Method. Details of the apparatus, which was almost identical to that developed by Grimes et al. (1), are given in the paper. The melt in the saturating vessel was saturated with \( \text{N}_2 \) by bubbling the gas for 4h. The saturated melt was then transferred to the elution vessel and helium gas bubbled through it to liberate the dissolved \( \text{N}_2 \) from the melt. The amount of \( \text{N}_2 \) gas was determined quantitatively using gas chromatography.

### SOURCE AND PURITY OF MATERIALS:

Reagent grade \( \text{NaNO}_3 \) was dried at 423K for a week. Nominal purities of nitrogen and helium gases were 99.9989 % and 99.998 % respectively.

### ESTIMATED ERROR:

Solubility = 6 - 10 % (authors)

### REFERENCES:

**COMPONENTS:**

1. Nitrogen; \( N_2 \); [7727-37-9]
2. Potassium nitrate; \( \text{KNO}_3 \); [7757-79-1]

**ORIGINAL MEASUREMENTS:**

- **Green, W. J. Ph. D. Thesis, Virginia Polytechnic Institute 1969.**
- **Green, W. J.; Field, P. E. J. Phys. Chem. 1980, 84, 3111 - 3114.**

**VARIABLES:**

- **T/K = 618 - 698**
- **P/kPa = 50.663 - 151.988**

**EXPERIMENTAL VALUES:**

The values of Henry's law constant, \( K_H \), for the solubility of \( N_2 \) in molten \( \text{KNO}_3 \) at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>( 10^7 ) ( K_H/\text{mol cm}^{-3} \text{ atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>618</td>
<td>2.93</td>
</tr>
<tr>
<td>623</td>
<td>2.71</td>
</tr>
<tr>
<td>624</td>
<td>2.77</td>
</tr>
<tr>
<td>632</td>
<td>2.39</td>
</tr>
<tr>
<td>643</td>
<td>2.58</td>
</tr>
<tr>
<td>672</td>
<td>3.05</td>
</tr>
<tr>
<td>685</td>
<td>3.16</td>
</tr>
<tr>
<td>686</td>
<td>3.21</td>
</tr>
<tr>
<td>698</td>
<td>2.90</td>
</tr>
</tbody>
</table>

Smoothed Data:

The temperature dependence of \( K_H \) is expressed by the equation:

\[
\log(K_H/\text{mol cm}^{-3} \text{ atm}^{-1}) = -5.972 - 376.37/(T/K)
\]

std. dev. = 1.1% (authors)

The enthalpy of solution, \( \Delta H \), and entropy of solution, \( \Delta S \), are:

- \( \Delta H/\text{kcal mol}^{-1} = 1.72 \pm 0.78 \)
- \( \Delta S/\text{cal K}^{-1} \text{ mol}^{-1} = -5.64 \pm 1.2 \) (at 668 K)

**METHOD/APPARATUS/PROCEDURE:**

Elution method.

Diagram and details of the gas solubility apparatus are given in the original publication.

After saturating the melt with nitrogen gas, the gas phase was evacuated. Helium was introduced into the system as eluting gas to approximately 1 atm. pressure. The resultant gas mixture of nitrogen and helium was analyzed with an Aerograph Model 90-P gas chromatograph (Varian).

**SOURCE AND PURITY OF MATERIALS:**

Dry nitrogen and helium obtained from Airco were used directly from the cylinders.

Reagent grade potassium nitrate from Baker was used without any further treatment.

**ESTIMATED ERROR:**

\( \delta C/P = \pm 5\% \) (authors)

**REFERENCES:**
<table>
<thead>
<tr>
<th>COMPONENTS:</th>
<th>ORIGINAL MEASUREMENTS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Nitrogen; N₂; [7727-37-9]</td>
<td>Frame, J. P.; Rhodes, E.; Ubbelohde, A. R.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VARIABLES:</th>
<th>PREPARED BY:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N. P. Bansal</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EXPERIMENTAL VALUES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>No depression in freezing point of the solvent was observed from the solubility of nitrogen at atmospheric pressure. This indicated that nitrogen solubility in molten potassium nitrate was less than 10⁻⁴ mole fraction.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AUXILIARY INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>METHOD/APPARATUS/PROCEDURE:</td>
</tr>
<tr>
<td>Cryoscopy.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SOURCE AND PURITY OF MATERIALS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen from commercial cylinders (B.O.C.) was dried by passing through a liquid air trap.</td>
</tr>
<tr>
<td>Potassium nitrate containing less than 0.0003% of cation and 0.001% of anion impurities was dried for several days at 240°C followed by the thermal shock technique (1). Drying was completed by evacuating the system after melting the salt.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ESTIMATED ERROR:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freezing point was measured within ± 0.02°C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REFERENCES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Rhodes, E.; Ubbelohde, A. R.</td>
</tr>
</tbody>
</table>
COMPONENTS:

(1) Nitrogen; N₂; [7727-37-9]
(2) Cesium nitrate; CsNO₃; [7789-18-6]

ORIGI NAL MEASUREMENTS:

Frame, J. P.; Rhodes, E.; Ubbelohde, A. R.


VARIABLES:

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

No depression in freezing point of the solvent was observed from the solubility of nitrogen at atmospheric pressure. This indicated that nitrogen solubility in molten cesium nitrate was less than 10⁻⁴ mole fraction.
COMPONENTS:
(1) Nitrogen; N₂; [7727-37-9]
(2) Zinc chloride; ZnCl₂; [7646-85-7]

VARIABLES: P/kPa = 10 - 100
one temperature: T/K = 720

ORIGINAL MEASUREMENTS:
Borodzinski, A.; Sokolowski, A.; Suski, L.

PREPARED BY: N. P. Bansal

EXPERIMENTAL VALUES:
For the solubility of nitrogen in the melt, the Henry's law constant, $K_H$, is:

<table>
<thead>
<tr>
<th>T/K</th>
<th>Solubility/mol fraction Pa⁻¹</th>
<th>$10^7 K_H$/mol ml⁻¹ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>720</td>
<td>$(3.33 \pm 0.10) \times 10^{-10}$</td>
<td>$5.74^a$</td>
</tr>
</tbody>
</table>


AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Volumetric method.
Schematic diagram of the experimental arrangement used is given in the original publication. The melt was saturated with nitrogen. The process of saturation was enhanced by a magnetic stirrer. The change in volume of the gas caused by its dissolution in the melt was determined. Temperature was controlled within ± 1 K.

SOURCE AND PURITY OF MATERIALS:
Nitrogen used was 99.99% pure.
Zinc chloride p. a. was distilled under vacuum prior to its distillation directly into the apparatus.

ESTIMATED ERROR:
solubility = ± 5% (authors)

REFERENCES:
COMPONENTS:
(1) Nitrogen; \( \text{N}_2 \); [7727-37-9]
(2) Sodium nitrate; \( \text{NaNO}_3 \); [7631-99-4]
(3) Potassium nitrate; \( \text{KNO}_3 \); [7757-79-1]

ORIGINAL MEASUREMENTS:
Paniccia, F.; Zambonin, P. G.

VARIABLES:
\( T/K = 508 - 603 \)
\( P/kPa = 10^2 \)

EXPERIMENTAL VALUES:

The solvent was an equimolar molten mixture of sodium and potassium nitrates. The solubilities of nitrogen in the melt at four temperatures are:

<table>
<thead>
<tr>
<th>( T/K )</th>
<th>( 10^6 \text{K}_H/\text{mol cm}^{-3} \text{ bar}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>508</td>
<td>0.73</td>
</tr>
<tr>
<td>533</td>
<td>0.88</td>
</tr>
<tr>
<td>573</td>
<td>1.1</td>
</tr>
<tr>
<td>603</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Smoothed Data:
The temperature dependence of Henry's law constant, \( K_H \), is expressed by:

\[
\log(\text{K}_H/\text{mol cm}^{-3} \text{ bar}^{-1}) = -6.395 - 885.9/(T/K) \quad \text{(compiler)}
\]

\[
\text{std. dev.} = 1.5\% \quad \text{(compiler)}
\]

The enthalpy, \( \Delta H \), and standard entropy, \( \Delta S^\circ \), of solution are:

\[
\Delta H/kJ \text{ mol}^{-1} = 16.5
\]

\[
\Delta S^\circ/J \text{ K}^{-1} \text{ mol}^{-1} = -34 \quad \text{(at 533 K)}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Manometric technique.
The details of the apparatus and procedure used for solubility measurements are described elsewhere (1). Briefly, the melt was vacuum degassed for a few hours. The vacuum was disconnected and nitrogen gas introduced at about one bar pressure. The melt was vigorously stirred and pressure changes were read from a manometer as a function of time until equilibrium was reached. The amount of gas dissolved was calculated from the final pressure variation after a suitable calibration.

SOURCE AND PURITY OF MATERIALS:

Nitrogen (High Purity grade) was purified by keeping in contact with Ascarite (A. H. Thomas Co) for several hours to remove \( \text{CO}_2 \) and other acidic impurities and molecular sieve 5A (Carlo Erba, Milano) at -80°C to remove water.

Reagent grade sodium and potassium nitrates were used to prepare the melt which was filtered in the molten state.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

1. Desimoni, E.; Paniccia, F.; Zambonin, P. G.
COMPONENTS:

(1) Nitrogen; N₂; [7727-37-9]
(2) Sodium Nitrate; NaNO₃; [7631-99-4]
(3) Potassium Nitrate; KNO₃; [7757-79-1]

ORIGINAL MEASUREMENTS:

VARIABLES:

T/K = 543 - 643
KNO₃/mol % = 25 - 75
P/kPa: 101.325 (compiler)

EXPERIMENTAL VALUES:

Nitrogen gas solubilities, K_p (mol cm⁻³ atm⁻¹), at various temperatures are given below:

<table>
<thead>
<tr>
<th>Melt composition /mole % KNO₃</th>
<th>25</th>
<th>50</th>
<th>66</th>
<th>75</th>
</tr>
</thead>
<tbody>
<tr>
<td>T/K 10⁷ K_p/mol cm⁻³ atm⁻¹</td>
<td>593</td>
<td>543</td>
<td>593</td>
<td>593</td>
</tr>
<tr>
<td>593 2.0 ± 0.12</td>
<td>543</td>
<td>1.8 ± 0.12</td>
<td>593</td>
<td>1.5 ± 0.12</td>
</tr>
<tr>
<td>643 2.6 ± 0.20</td>
<td>593</td>
<td>2.1 ± 0.12</td>
<td>643</td>
<td>2.0 ± 0.12</td>
</tr>
<tr>
<td>643 2.6 ± 0.20</td>
<td>643</td>
<td>2.4 ± 0.12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The enthalpies, ΔH, for dissolution of gas in the melt were calculated from the relation:

\[
d \ln K_p/d(1/T) = -\Delta H/R
\]

The values of ΔH are given below:

<table>
<thead>
<tr>
<th>Melt composition/mol % of KNO₃</th>
<th>ΔH/kcal mol⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>4.0 ± 1.8</td>
</tr>
<tr>
<td>50</td>
<td>2.0 ± 0.6</td>
</tr>
<tr>
<td>75</td>
<td>2.5 ± 1.0</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution Method. Details of the apparatus, which was almost identical to that developed by Grimes et al. (1), are given in the paper. The melt in the saturating vessel was saturated with N₂ by bubbling the gas for 4h. The saturated melt was then transferred to the elution vessel and helium gas bubbled through it to liberate the dissolved N₂ from the melt. The amount of N₂ gas was determined quantitatively using gas chromatography.

SOURCE AND PURITY OF MATERIALS:
Reagent grade NaN₃ and KNO₃ were dried at 423K for a week. Nominal purities of nitrogen and helium gases were 99.9989 % and 99.998 % respectively.

ESTIMATED ERROR:
Solubility = 6 - 10 % (authors)

REFERENCES:
COMPONENTS:
(1) Nitrogen; N\textsubscript{2}; [7727-37-9]
(2) Lithium carbonate; Li\textsubscript{2}CO\textsubscript{3}; [554-13-2]
(3) Sodium carbonate; Na\textsubscript{2}CO\textsubscript{3}; [497-19-8]
(4) Potassium carbonate; K\textsubscript{2}CO\textsubscript{3}; [584-08-7]

ORIGINAL MEASUREMENTS:

VARIABLES:
T/K = 973 - 1123
P/kPa: 101.325 (1 atm.)

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The values of Henry's law constant, $K_H$, for the solubility of N\textsubscript{2} in the melt Li\textsubscript{2}CO\textsubscript{3} - Na\textsubscript{2}CO\textsubscript{3} - K\textsubscript{2}CO\textsubscript{3} (43.5 - 31.5 - 25.0 mol\%) at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>$10^7 K_H$/mol cm\textsuperscript{-3} atm\textsuperscript{-2}</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td>0.69 ± 0.08</td>
</tr>
<tr>
<td>750</td>
<td>1.26 ± 0.07</td>
</tr>
<tr>
<td>800</td>
<td>1.34 ± 0.10</td>
</tr>
<tr>
<td>850</td>
<td>1.71 ± 0.11</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of $K_H$ can be expressed by the relation:

$$\log(K_H/\text{mol cm}^{-3} \text{ atm}^{-2}) = -4.367 - 2673.9/(T/K)$$

std. dev. = 6.8% (compiler)

The heat of solution, $\Delta H$, for the solubility of N\textsubscript{2} in the melt is:

$$\Delta H/kJ \text{ mol}^{-1} = 51.0$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Quenching or chilling method.
The diagram and details of the apparatus used and procedure employed are described in the original publication. Briefly, the melt was saturated by bubbling the gas for 2 - 3 hr. A portion of the saturated melt was transferred into the chilling compartment where it was slowly quenched to allow all the gases to escape. The liberated gas was flushed with a stream of helium into a U - tube containing activated Linde 5A molecular sieve. The contents of the tube, after being allowed to come to room temperature, were flushed with a stream of carrier gas into a Fisher - Hamilton gas partitioner with Linde 5A column and Katharometer detector for analysis. About 8 - 10 independent measurements were carried out.

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
**COMPONENTS:**

1. Fluorine; $\text{F}_2$; [7782-41-4]
2. Potassium chloride; KCl; [7447-40-7]
3. Cobalt chloride; $\text{CoCl}_2$; [7646-79-9]

**VARIABLES:**

- One temperature: $T/K = 598$
- $P/\text{kPa}: 101.325$ (compiler)

**ORIGINAL MEASUREMENTS:**

Klemm, W.; Huss, E.

**PREPARED BY:**

N. P. Bansal

**EXPERIMENTAL VALUES:**

The solubility of fluorine in the molten KCl - $\text{CoCl}_2$ (75 - 25 mol%) mixture at a single temperature is reported as:

<table>
<thead>
<tr>
<th>$t/°C$</th>
<th>Solubility/mol(mol of melt)$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>325</td>
<td>0.875</td>
</tr>
</tbody>
</table>

The high value of solubility is due to a chemical reaction between the melt and the fluorine resulting in the formation of $\text{K}_3\text{CoF}_7$.

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Weight change, X-ray, chemical analysis.

**SOURCE AND PURITY OF MATERIALS:**

Not available.

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**

-
<table>
<thead>
<tr>
<th>COMPONENTS:</th>
<th>ORIGINAL MEASUREMENTS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(3) Nickel chloride; NiCl(_2); [7718-54-9]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VARIABLES:</th>
<th>PREPARED BY:</th>
</tr>
</thead>
<tbody>
<tr>
<td>one temperature: T/K = 548</td>
<td>N. P. Bansal</td>
</tr>
<tr>
<td>P/kPa: 101.325 (compiler)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EXPERIMENTAL VALUES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>The solubility of fluorine in the molten KCl - NiCl(_2) (66 - 34 mol%) mixture at a single temperature is reported as:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>t/°C</th>
<th>Solubility/mol(mol of melt)(^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>275</td>
<td>1.0</td>
</tr>
</tbody>
</table>

The high solubility of fluorine in the melt is due to a chemical reaction between fluorine and the melt giving rise to the formation of K\(_2\)NiF\(_6\).  

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Weight change, X-ray, chemical analysis.

**SOURCE AND PURITY OF MATERIALS:**

Not available.

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**
COMPONENTS:
(1) Fluorine; F₂; [7782-41-4]
(2) Potassium chloride; KCl; [7447-40-7]
(3) Cupric chloride; CuCl₂; [7447-39-4]

ORIGINAL MEASUREMENTS:
Klemm, W.; Huss, E.

VARIABLES:
one temperature T/K = 523
P/kPa: 101.325 (compiler)

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The solubility of fluorine in molten KCl - CuCl₂ (75 - 25 mol %) mixture at a single temperature is reported as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>Solubility/mol(mol of melt)⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>0.75</td>
</tr>
</tbody>
</table>

The high value of solubility is due to a chemical reaction between fluorine and the melt giving rise to the formation of K₃CuF₆.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Weight change, X-ray, chemical analysis.

SOURCE AND PURITY OF MATERIALS:
Not available.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
<table>
<thead>
<tr>
<th>COMPONENTS:</th>
<th>EVALUATOR:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Chlorine; Cl₂; [7782-50-5]</td>
<td>N. P. Bansal</td>
</tr>
<tr>
<td>(2) Lithium chloride; LiCl;</td>
<td>National Aeronautics and Space</td>
</tr>
<tr>
<td>[7447-41-8]</td>
<td>Administration</td>
</tr>
<tr>
<td></td>
<td>Lewis Research Center</td>
</tr>
<tr>
<td></td>
<td>Cleveland, Ohio, 44135, U.S.A.</td>
</tr>
<tr>
<td></td>
<td>December, 1989.</td>
</tr>
</tbody>
</table>

CRITICAL EVALUATION:

Out of the three studies (1 - 3) available for the solubility of chlorine in molten lithium chloride, those by Wartenberg (1) and Tricklebank (2) are only of a preliminary nature. The results of Ryabukhin and Bukun (3) are not very reliable as the value of pressure, at which the gas solubilities have been measured, is not given.

Additional careful studies are needed before recommended solubilities can be advanced for this system.

References:

COMPONENTS:
(1) Chlorine; Cl₂ [7782-50-5]
(2) Lithium Chloride; LiCl [7447-41-8]

VARIABLES:
one temperature: T/K = 893
P/kPa: 101.325 (compiler)

EXPERIMENTAL VALUES:
The solubility of Cl₂ in molten LiCl at a single temperature has been reported as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>weight fraction</th>
<th>volume fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>620 ± 5</td>
<td>6.98 x 10⁻⁵</td>
<td>32.7 x 10⁻³</td>
</tr>
</tbody>
</table>

METHOD/APPARATUS/PROCEDURE:
The details of the apparatus used and procedure followed for gas solubility measurements are described in the original publication. Briefly, a quenched melt sample equilibrated with chlorine was analyzed for the chlorine content by reacting with KI solution and titrating with freshly standardized thiosulphate solution.

SOURCE AND PURITY OF MATERIALS:
Lithium chloride was pure and heated with NH₄Cl and NH₄Br to dehydrate.

ESTIMATED ERROR:
Nothing specified.
**COMPONENTS:**

1. Chlorine; Cl₂; [7782-50-5]
2. Lithium Chloride; LiCl; [7447-41-8]

**VARIABLES:**

- One temperature: T/K = 923
- P/kPa: 101.325 (compiler)

**EXPERIMENTAL VALUES:**

The solubility, $C_1$, of chlorine in molten LiCl at one temperature is reported as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>$10^6 \cdot C_1$/mol ml⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>650</td>
<td>1.5 ± 0.5</td>
</tr>
</tbody>
</table>

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Stripping technique.

**SOURCE AND PURITY OF MATERIALS:**

Not described.

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**

Tricklebank, S. B.

PREPARED BY: N. P. Bansal
**COMPONENTS:**

1. Chlorine; Cl₂; [7782-50-5]
2. Lithium chloride; LiCl; [7447-41-8]

**ORIGINAL MEASUREMENTS:**

Ryabukhin, Yu. M.; Bukun, N. G.

**VARIABLES:**

\[ T/K = 921 - 1145 \]

\[ P/kPa: \text{101.325 (1 atm.)} \]

**EXPERIMENTAL VALUES:**

The solubilities, \( C_1 \), of chlorine in molten LiCl at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>( 10^7 C_1/\text{mol cm}^{-3} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>648</td>
<td>0.35</td>
</tr>
<tr>
<td>718</td>
<td>0.53</td>
</tr>
<tr>
<td>719</td>
<td>0.56</td>
</tr>
<tr>
<td>787</td>
<td>1.16</td>
</tr>
<tr>
<td>788</td>
<td>0.88</td>
</tr>
<tr>
<td>870</td>
<td>1.78</td>
</tr>
<tr>
<td>872</td>
<td>1.88</td>
</tr>
</tbody>
</table>

Smoothed Data:

The temperature dependence of the solubility of Cl₂ in molten LiCl is expressed by the relation:

\[
\log(C_1/\text{mol cm}^{-3}) = -3.650 - 3548/(T/K) \quad \text{(compiler)}
\]

\[
\text{std. dev.} = 5.1\% \quad \text{(compiler)}
\]

The heat of solution, \( \Delta H \), is estimated to be:

\[
\Delta H/\text{kJ mol}^{-1} = 67.9 \quad \text{(compiler)}
\]

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Elution technique.
The details of the apparatus and procedure used have been described elsewhere (1). In brief, the melt was saturated with chlorine. A part of the saturated melt was separated and sparged with argon to free the dissolved chlorine. The liberated chlorine was absorbed in KI solution and iodine generated was titrated with thiosulfate solution.

**SOURCE AND PURITY OF MATERIALS:**

Not described.

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**

1. Ryabukhin, Yu. M.
COMPONENTS:

(1) Chlorine; Cl₂; [7782-50-5]
(2) Sodium chloride; NaCl; [7647-14-5]

CRITICAL EVALUATION:

Four experimental studies (1 - 4) are available for the solubility of chlorine in molten sodium chloride. One of these studies (1) is only of a preliminary nature. The results of reference (2) are not accurate because of the uncertainty in the temperature measurements and the reaction of dissolved gas with oxides on the stirrer or the walls of the vessel, according to Ryabukhin (3). The problem with the work of reference (3) is the value of the pressure, at which the gas solubilities have been measured, is not given. Tentative values based on the work of Andresen et al. (4) are given in Table 1.

Table 1

<table>
<thead>
<tr>
<th>T/K</th>
<th>10^7 Kₜ/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>1090</td>
<td>4.18</td>
</tr>
<tr>
<td>1100</td>
<td>4.33</td>
</tr>
<tr>
<td>1110</td>
<td>4.48</td>
</tr>
<tr>
<td>1120</td>
<td>4.63</td>
</tr>
<tr>
<td>1130</td>
<td>4.79</td>
</tr>
<tr>
<td>1140</td>
<td>4.95</td>
</tr>
<tr>
<td>1150</td>
<td>5.11</td>
</tr>
<tr>
<td>1160</td>
<td>5.28</td>
</tr>
<tr>
<td>1170</td>
<td>5.44</td>
</tr>
</tbody>
</table>

References:

COMPONENTS:

(1) Chlorine; Cl₂; [7782-50-5]
(2) Sodium chloride; NaCl; [7647-14-5]

ORIGINAL MEASUREMENTS:

Wartenberg, H. U.

VARIABLES:

one temperature: T/K = 1093
P/kPa: 101.325 (compiler)

EXPERIMENTAL VALUES:

The solubility of Cl₂ in molten NaCl at a single temperature has been reported as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>weight fraction</th>
<th>volume fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>820 ± 5</td>
<td>1.16 x 10⁻⁵</td>
<td>5.63 x 10⁻³</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

For details of the apparatus and procedure, see the original paper. A quenched melt sample equilibrated with chlorine was analyzed for the chlorine content by reacting with KI solution and titrating with freshly standardized thiosulfate solution.

SOURCE AND PURITY OF MATERIALS:

Sodium chloride used was pure and heated with NH₄Cl and NH₄Br to dehydrate.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:
COMPONENTS:

(1) Chlorine; Cl₂; [7782-50-5]
(2) Sodium chloride; NaCl; [7647-14-5]

ORIGINAL MEASUREMENTS:

Ryabukhin, Yu. M.; Bukun, N. G.
1968, 13, 597 - 600. (*).

VARIABLES:

T/K = 1113 - 1304
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:

The solubilities, C₁, of chlorine in molten NaCl at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁷ C₁/mol cm⁻³</th>
</tr>
</thead>
<tbody>
<tr>
<td>840</td>
<td>2.31</td>
</tr>
<tr>
<td>843</td>
<td>2.42</td>
</tr>
<tr>
<td>891</td>
<td>2.99</td>
</tr>
<tr>
<td>892</td>
<td>3.04</td>
</tr>
<tr>
<td>950</td>
<td>4.22</td>
</tr>
<tr>
<td>1030</td>
<td>5.87</td>
</tr>
<tr>
<td>1031</td>
<td>5.30</td>
</tr>
</tbody>
</table>

Smoothed Data:

The temperature dependence of the solubility of Cl₂ in molten NaCl is given by the equation:

\[
\log(C₁/mol \text{ cm}^{-3}) = -4.02 - \frac{2905.9}{(T/K)} \quad \text{(compiler)}
\]

std. dev. = 1.9% (compiler)

The standard enthalpy, ΔH°, and standard entropy, ΔS°, changes for the solubility of Cl₂ are:

ΔH°/kJ mol⁻¹ = 55.9 ± 3.0
ΔS°/J K⁻¹ mol⁻¹ = -76.7 (at 1123 K)

METHOD/APPARATUS/PROCEDURE:

Elution technique.
The details of the apparatus and procedure used have been described elsewhere (1). In brief, the melt was saturated with chlorine. A portion of the saturated melt was separated and purged with argon to free the dissolved chlorine. The liberated chlorine was absorbed in KI solution and iodine generated was titrated with thiosulfate solution.

SOURCE AND PURITY OF MATERIALS:

Not described.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

1. Ryabukhin, Yu. M.
COMPONENTS:
(1) Chlorine; Cl₂; [7782-50-5]
(2) Sodium chloride; NaCl; [7647-14-5]

ORIGINAL MEASUREMENTS:
Ryabukhin; Yu. M.
Zh. Neorg. Khim. 1962, 7, 1101 – 04;
1962, 7, 565 – 67. (*).

VARIABLES: P/kPa = 98.925
T/K = 1120 – 1298

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:

The solubilities, C₁, of chlorine in molten NaCl at different temperatures, under a pressure of 742 mm Hg are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁷ C₁/mol cm⁻³</th>
</tr>
</thead>
<tbody>
<tr>
<td>847</td>
<td>2.21</td>
</tr>
<tr>
<td>881</td>
<td>3.02</td>
</tr>
<tr>
<td>935</td>
<td>4.65</td>
</tr>
<tr>
<td>973</td>
<td>5.80</td>
</tr>
<tr>
<td>1025</td>
<td>7.40</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of the solubility of Cl₂ in molten NaCl is given by the relation:

\[
\log(C₁/mol cm⁻³) = -2.777 - \frac{4325}{(T/K)} \quad \text{(compiler)}
\]

std. dev. = 2.3% (compiler)

The standard enthalpy, ΔH°, and standard entropy, ΔS°, changes for the solubility of Cl₂ are:

ΔH°/kJ mol⁻¹ = 82.7 ± 4

ΔS°/J K⁻¹ mol⁻¹ = -53.2 (at 1123 K)

METHOD/APPARATUS/PROCEDURE:
Elution method.
The diagram and details of the apparatus used and procedure followed for gas solubility measurements are described in the original paper. In brief, the melt was saturated with chlorine by bubbling the gas through it. The dissolved chlorine was removed from the saturated melt by sparging it with argon. The liberated chlorine was absorbed in KI solution and iodine generated was titrated with standard thiosulfate solution.

SOURCE AND PURITY OF MATERIALS:
Liquified chlorine (99.5%) was used.
Argon used contained 0.008% oxygen and 0.04% nitrogen.
Chlorine and argon were purified by bubbling through conc. H₂SO₄ and passing over P₂O₅.
Dried and remelted "chemically pure" grade NaCl was used.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
COMPONENTS:

(1) Chlorine; Cl₂; [7782-50-5]
(2) Sodium chloride; NaCl; [7647-14-5]

VARIABLES:

T/K = 1091 - 1170
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:

The values of Henry's law constant, $K_H$, for the solubility of chlorine in molten NaCl at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>$10^7 K_H$/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>818</td>
<td>4.12 ± 0.28</td>
</tr>
<tr>
<td>833</td>
<td>4.52</td>
</tr>
<tr>
<td>860</td>
<td>4.94 ± 0.39</td>
</tr>
<tr>
<td>897</td>
<td>5.39 ± 0.23</td>
</tr>
</tbody>
</table>

Smoothed Data:

The temperature dependence of $K_H$ is given by the expression:

$$\log(K_H$/mol cm⁻³ atm⁻¹) = -4.699 - 1831.3/(T/K)$$

std. dev. = 1.1% (compiler)

The standard enthalpy, $\Delta H^\circ$, and standard entropy, $\Delta S^\circ$, for the dissolution of chlorine are:

$\Delta H^\circ$/kJ mol⁻¹ = 36.5 ± 4.7
$\Delta S^\circ$/J K⁻¹ mol⁻¹ = -88.8 (at 1123 K)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Manometric technique.

The diagram and details of the apparatus are given in the original paper and the method and procedure followed are described elsewhere (1). In brief, chlorine gas is filled into a thermostated volume above the melt which is kept in a closed quartz vessel. The drop in gas pressure is recorded as a function of time. The value of the pressure, at equilibrium, is used for determination of the gas solubility.

SOURCE AND PURITY OF MATERIALS:

Chlorine (99.5%) gas of "High Purity" from Matheson was used directly from the cylinder.

NaCl used was Baker Analysed and Merck suprapur. Before use the salt was melted and Cl₂ bubbled through the melt for about an hour and then recrystallized. Salts were handled in a glove box.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

1. Andresen, R. E.; Paniccia, F.; Zambonin, F. G.; Oye, H. A.

COMPONENTS:

(1) Chlorine; Cl₂; [7782-50-5]
(2) Sodium chloride; NaCl; [7647-14-5]

VARIABLES:

\[ T/K = 1090 - 1168 \]
\[ P/kPa: 101.325 \text{ (1 atm.)} \]

ORIGINAL MEASUREMENTS:

Andresen, R. E.; Paniccia, F.; Zambonin, P. G.; Oye, H. A.

EXPERIMENTAL VALUES:

Henry's Law constants, \( K_H \), at various temperatures are given below

<table>
<thead>
<tr>
<th>( t/°C )</th>
<th>( 10^7 K_H/\text{mol cm}^{-3}\text{atm}^{-2} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>817</td>
<td>4.22</td>
</tr>
<tr>
<td></td>
<td>4.63</td>
</tr>
<tr>
<td></td>
<td>4.41</td>
</tr>
<tr>
<td></td>
<td>4.12</td>
</tr>
<tr>
<td></td>
<td>3.98</td>
</tr>
<tr>
<td></td>
<td>3.97</td>
</tr>
<tr>
<td>860</td>
<td>5.05</td>
</tr>
<tr>
<td></td>
<td>4.18</td>
</tr>
<tr>
<td></td>
<td>5.28</td>
</tr>
<tr>
<td></td>
<td>5.02</td>
</tr>
<tr>
<td></td>
<td>5.18</td>
</tr>
<tr>
<td>895</td>
<td>5.30</td>
</tr>
<tr>
<td></td>
<td>5.18</td>
</tr>
<tr>
<td></td>
<td>5.20</td>
</tr>
<tr>
<td></td>
<td>5.36</td>
</tr>
</tbody>
</table>

Heat of dissolution, \( \Delta H \), as evaluated from the expression:

\[ \Delta H = -R \left( \ln K_H \right) / d(1/T) \]
was found to be 8.0 kcal mol\(^{-1}\).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Manometric method. The method used for gas solubility measurements was the same as described earlier(1). The furnace temperature was controlled to better than ± 2°C.

SOURCE AND PURITY OF MATERIALS:

NaCl (Baker Analyzed) was melted and Cl₂ bubbled through it for 1 h. The dissolved Cl₂ was removed by bubbling Ar for 10-15 min. The salt solidified, heated under dry N₂ to 20°C above its melting point, and then slowly recrystallized by lowering the temperature 4-5°C each hour. Clear salt crystals were picked up and used in the solubility experiment. Ar was 99.997%, from Norsk Hydro a. s.

ESTIMATED ERROR:

Not specified.

REFERENCES:

1. Desimoni, E.; Paniccia, F.; Zambonin, P. G.
### COMPONENTS:

1. Chlorine; Cl₂; [7782-50-5]
2. Sodium chloride; NaCl; [7647-14-5]

### VARIABLES:

- T/K = 1100 - 1300
- P/kPa = 10²

### ORIGINAL MEASUREMENTS:

Ratvik, A. P.; Ostvald, T.; Oye, H. A.

### EXPERIMENTAL VALUES:

The validity of Henry's law was verified by measuring the solubility at various Cl₂ pressures. Temperature dependence of solubility, \( K_p \) (mol cm⁻³ bar⁻¹), is expressed by the relation:

\[
\log K_p = (-4.263 ± 0.214) - \frac{2508.8 ± 259.2}{T}
\]

### AUXILIARY INFORMATION

#### METHOD/APPARATUS/PROCEDURE:

Manometric method.
The procedure used for gas solubility measurements was similar to the one described elsewhere (1,2). For details see the original publication.

#### SOURCE AND PURITY OF MATERIALS:

The quality and purification of salts have been described earlier(3).

#### ESTIMATED ERROR:

S. D. for \( \log(\text{solubility}) \) = 0.027.

### REFERENCES:

1. Waernes, O.; Ostvald, T.
2. Waernes, O.; Palmisano, F.; Ostvald, T
COMPONENTS:

(1) Chlorine; Cl₂; [7782-50-5]
(2) Sodium chloride; NaCl; [7647-14-5]

ORIGINAL MEASUREMENTS:


VARIABLES:

T/K = 1119 - 1210
P/kPa = 119.990 - 133.322

EXPERIMENTAL VALUES:

Values of Henry's law constant, K_H, for the solubility of Cl₂ at various temperatures are given below

<table>
<thead>
<tr>
<th>T/°C</th>
<th>10⁷ K_H/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>846</td>
<td>4.54 ± 0.19</td>
</tr>
<tr>
<td>892</td>
<td>5.87 ± 0.17</td>
</tr>
<tr>
<td>937</td>
<td>6.86 ± 0.50</td>
</tr>
</tbody>
</table>

Temperature dependence of K_H can be expressed as:

log K_H = -3.973 - 2646/T

Standard enthalpy for the dissolution of Cl₂ was evaluated from the equation:

ΔH° = - R dln K_H/d(1/T)

and was found to be (50.7 ± 8.5)kJ mol⁻¹.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Manometric method. The method used for gas solubility measurements was essentially the same as earlier described(1). For details see the original paper.

SOURCE AND PURITY OF MATERIALS:

NaCl(p.a) from E. Merck AG was dried under vacuum at 400°C for 2h. The salt was recrystallized from the melt under N₂ atmosphere. Only clear crystals were used.
Ar (>99.99%) from Norsk Hydro a.s., Norway was used without further purification.
Cl₂ (>99.6%) from J. T. Baker Chemicals was used.

ESTIMATED ERROR:

Not specified.

REFERENCES:

COMPONENTS:

(1) Chlorine; Cl₂; [7782-50-5]
(2) Potassium chloride; KCl; [7447-40-7]

EVALUATOR:

N. P. Bansal
National Aeronautics and Space Administration
Lewis Research Center
Cleveland, Ohio, 44135, U.S.A.
December, 1989.

CRITICAL EVALUATION:

Out of the four studies (1 - 4) available for the solubility of chlorine in molten potassium chloride, the one by Wartenberg (1) is only of a preliminary nature. According to Ryabukhin (3), the results of their earlier work (2) are not accurate because of the uncertainty in the temperature measurements and the reaction of dissolved gas with oxides on the walls of the container or the stirrer. These problems have been overcome in their later investigation (3). However, in this study the value of the atmospheric pressure, at which the gas solubilities have been measured, is not reported.

Tentative solubility values based on the work of Andresen et al. (4) are given in Table 1.

Table 1
Tentative Solubilities as a Function of Temperature

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^7$ K_H/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>1070</td>
<td>(14.88)</td>
</tr>
<tr>
<td>1080</td>
<td>15.29</td>
</tr>
<tr>
<td>1090</td>
<td>15.71</td>
</tr>
<tr>
<td>1100</td>
<td>16.13</td>
</tr>
<tr>
<td>1110</td>
<td>16.56</td>
</tr>
<tr>
<td>1120</td>
<td>16.98</td>
</tr>
<tr>
<td>1130</td>
<td>17.42</td>
</tr>
<tr>
<td>1140</td>
<td>17.85</td>
</tr>
<tr>
<td>1150</td>
<td>18.29</td>
</tr>
<tr>
<td>1160</td>
<td>(18.73)</td>
</tr>
</tbody>
</table>

Values in ( ) outside temperature interval of experimental measurement; extrapolated by the evaluator.

References:

COMPONENTS:

(1) Chlorine; Cl₂; [7782-50-5]
(2) Potassium chloride; KCl; [7447-40-7]

VARIABLES:

one temperature: T/K = 1093
P/kPa: 101.325 (compiler)

EXPERIMENTAL VALUES:

The solubility of Cl₂ in molten KCl at a single temperature has been reported as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>weight fraction</th>
<th>volume fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>820</td>
<td>5.03 x 10⁻⁵</td>
<td>23.8 x 10⁻³</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Details of the apparatus and procedure followed for gas solubility measurements are given in the original paper. In brief, a quenched melt sample equilibrated with chlorine was analyzed for the chlorine content by reacting with KI solution and titrating with freshly standardized thiosulfate solution.

SOURCE AND PURITY OF MATERIALS:

Potassium chloride used was pure and was dehydrated by heating with NH₄Cl and NH₄Br.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

**COMPONENTS:**

1. Chlorine; Cl₂; [7782-50-5]
2. Potassium chloride; KCl; [7447-40-7]

**VARIABLES:**

\[
\begin{align*}
T/K &= 1073 - 1158 \\
P/kPa &= 101.325 \text{ (1 atm.)}
\end{align*}
\]

**EXPERIMENTAL VALUES:**

The values of Henry's law constant, \( K_H \), for the solubility of chlorine in molten KCl at different temperatures are:

<table>
<thead>
<tr>
<th>( t/°C )</th>
<th>( 10^7 K_H/\text{mol cm}^{-3} \text{ atm}^{-2} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>800</td>
<td>15.06 ± 0.35</td>
</tr>
<tr>
<td>839</td>
<td>16.49 ± 0.59</td>
</tr>
<tr>
<td>885</td>
<td>18.71 ± 0.22</td>
</tr>
</tbody>
</table>

Smoothed Data:

The temperature dependence of \( K_H \) is given by the expression:

\[
\log(\text{mol cm}^{-3} \text{ atm}^{-2}) = -4.538 - 1379.8/(T/K) \quad \text{(compiler)}
\]

std. dev. = 0.5% \quad \text{(compiler)}

The standard enthalpy, \( \Delta H^o \), and the standard entropy, \( \Delta S^o \), changes for the dissolution of chlorine are:

\[
\begin{align*}
\Delta H^o/\text{kJ mol}^{-1} &= 26.3 \pm 2.2 \\
\Delta S^o/\text{J K}^{-1} \text{ mol}^{-1} &= -87.0 \quad \text{(at 1123 K)}
\end{align*}
\]

**METHOD/APPARATUS/PROCEDURE:**

Manometric technique.

The diagram and details of the apparatus are given in the original publication and the method and procedure followed are described elsewhere (1). In brief, chlorine gas is filled into a thermostated volume above the melt which is kept in a closed quartz vessel. The drop in gas pressure is measured with time. The pressure reading, at equilibrium, is used for calculation of the gas solubility.

**SOURCE AND PURITY OF MATERIALS:**

Matheson "High Purity" chlorine (99.5%) was used directly from the cylinder.

Merck p.a. KCl was used. Before use, it was melted, Cl₂ bubbled through the melt for about an hour and then recrystallized. Salts were handled in a glove box.

**REFERENCES:**

COMPONENTS:

(1) Chlorine; Cl₂; [7782-50-5]
(2) Potassium chloride; KCl; [7447-40-7]

VARIABLES:

T/K = 1073 - 1158
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:

Henry's law constants, $K_H$, at various temperatures are given below:

<table>
<thead>
<tr>
<th>T/°C</th>
<th>$10^7 K_H$/mol cm⁻³atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>800</td>
<td>14.96</td>
</tr>
<tr>
<td></td>
<td>15.28</td>
</tr>
<tr>
<td></td>
<td>14.87</td>
</tr>
<tr>
<td></td>
<td>14.66</td>
</tr>
<tr>
<td></td>
<td>15.54</td>
</tr>
<tr>
<td>840</td>
<td>16.38</td>
</tr>
<tr>
<td></td>
<td>16.54</td>
</tr>
<tr>
<td></td>
<td>17.18</td>
</tr>
<tr>
<td></td>
<td>16.76</td>
</tr>
<tr>
<td></td>
<td>15.57</td>
</tr>
<tr>
<td>885</td>
<td>18.65</td>
</tr>
<tr>
<td></td>
<td>18.90</td>
</tr>
<tr>
<td></td>
<td>18.87</td>
</tr>
<tr>
<td></td>
<td>18.42</td>
</tr>
</tbody>
</table>

Heat of dissolution, $\Delta H$, as evaluated from the expression:

$$\Delta H = -R \frac{d \ln K_H}{d(1/T)}$$

was found to be 7.5 kcal mol⁻¹.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Manometric method.
The method used for gas solubility measurements was the same as described earlier(1). The furnace temperature was controlled to better than ± 2°C.

SOURCE AND PURITY OF MATERIALS:

KCl (Merck, P. A.) was melted and Cl₂ bubbled through it for 1h. The dissolved Cl₂ was removed by bubbling Ar for 10-15 min. The salt was solidified, heated under dry N₂ to 20°C above its melting point, and then slowly recrystallized by lowering the temperature 4-5°C each hour. Clear salt crystals were picked up and used in the solubility experiment. Ar was 99.997%, from Norsk Hydro a. s.

ESTIMATED ERROR:

Not specified.

REFERENCES:

1. Desimoni, E.; Paniccia, F.; Zambonin, P. G.
COMPONENTS:
(1) Chlorine; Cl₂; [7782-50-5]
(2) Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS:
Ryabukhin, Yu. M.; Bukun, N. G.
1968, 13, 597 - 600. (*).

VARIABLES:
P/kPa: 101.325 (1 atm.)
T/K = 1096 - 1299

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The solubilities, C₁, of chlorine in molten KCl at different
temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁷ C₁/mol cm⁻³</th>
</tr>
</thead>
<tbody>
<tr>
<td>823</td>
<td>13.30</td>
</tr>
<tr>
<td>824</td>
<td>12.04</td>
</tr>
<tr>
<td>827</td>
<td>13.90</td>
</tr>
<tr>
<td>828</td>
<td>12.90</td>
</tr>
<tr>
<td>890</td>
<td>16.30</td>
</tr>
<tr>
<td>890</td>
<td>16.88</td>
</tr>
<tr>
<td>958</td>
<td>20.00</td>
</tr>
<tr>
<td>958</td>
<td>20.30</td>
</tr>
<tr>
<td>1025</td>
<td>25.14</td>
</tr>
<tr>
<td>1026</td>
<td>25.50</td>
</tr>
</tbody>
</table>

Smoothed Data:
The temperature dependence of the solubility of Cl₂ in molten KCl is
expressed by the relation:
\[ \log(C₁/mol cm⁻³) = -4.025 - 2044.9/(T/K) \] (compiler)
std. dev. = 1.8% (compiler)

The standard enthalpy, \( \Delta H^o \), and standard entropy, \( \Delta S^o \), changes for the
solubility of Cl₂ are:
\[ \Delta H^o/kJ mol⁻¹ = 38.8 \pm 2 \]
\[ \Delta S^o/J K⁻¹ mol⁻¹ = -77.4 \] (at 1123 K)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution technique.
The details of the apparatus and procedure employed have been
described elsewhere (1). In brief, the melt was saturated
with chlorine. A portion of the saturated melt was separated and
purged with argon to remove dissolved chlorine. The liberated
chlorine was absorbed in KI
solution and iodine generated was
titrated with thiosulfate
solution.

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
1. Ryabukhin, Yu. M.
COMPONENTS:
(1) Chlorine; C\textsubscript{2}; [7782-50-5]
(2) Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS:
Ryabukhin; Yu. M.
Zh. Neorg. Khim. 1962, 7, 1101 - 04;
1962, 7, 565 - 67. (*)

VARIABLES:
P/kPa = 98.925
T/K = 1121 - 1318

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The solubilities, C\textsubscript{1}, of chlorine in molten KCl at different temperatures, under a pressure of 742 mm Hg are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10\textsuperscript{7} C\textsubscript{1}/mol cm\textsuperscript{-3}</th>
</tr>
</thead>
<tbody>
<tr>
<td>848</td>
<td>10.40</td>
</tr>
<tr>
<td>851</td>
<td>11.24</td>
</tr>
<tr>
<td>925</td>
<td>13.93</td>
</tr>
<tr>
<td>985</td>
<td>16.63</td>
</tr>
<tr>
<td>1038</td>
<td>20.32</td>
</tr>
<tr>
<td>1045</td>
<td>18.89</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of the solubility of C\textsubscript{2} in molten KCl is given by the expression:

\[
\log(C_1/\text{mol cm}^{-3}) = -4.204 - 1978.6/(T/K)
\]

std. dev. = 1.7% (compiler)

The standard enthalpy, ΔH\textsuperscript{o}, and standard entropy, ΔS\textsuperscript{o}, of solution are

ΔH\textsuperscript{o}/kJ mol\textsuperscript{-1} = 26.4 ± 7
ΔS\textsuperscript{o}/J K\textsuperscript{-1} mol\textsuperscript{-1} = -89.4 (at 1123 K)

METHOD/APPARATUS/PROCEDURE:
Elution method.
The diagram and details of the apparatus used and procedure followed for gas solubility measurements are described in the original paper. In brief, the melt was saturated with chlorine by bubbling the gas through it. The dissolved chlorine was removed from the saturated melt by flushing it with argon. The liberated chlorine was absorbed in KI solution and amount of iodine generated was titrated with a standard thiosulfate solution.

SOURCE AND PURITY OF MATERIALS:
Liquified chlorine (99.5%) was used. Argon used contained 0.008% oxygen and 0.04% nitrogen. Chlorine and argon were purified by bubbling through conc. H\textsubscript{2}SO\textsubscript{4} and passing over P\textsubscript{2}O\textsubscript{5}.

Dried and remelted "chemically pure" grade KCl was used.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
### COMPONENTS:

(1) Chlorine; Cl₂; \([7782-50-5]\)

(2) Potassium chloride; KCl; \([7747-40-7]\)

### VARIABLES:

<table>
<thead>
<tr>
<th>T/K</th>
<th>P/kPa: 101.325 (1 atm.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1073 - 1173</td>
<td></td>
</tr>
</tbody>
</table>

### EXPERIMENTAL VALUES:

The solubility of Cl₂, C(mol cm⁻³), in molten KCl is expressed by the equation:

\[
C = \frac{1.215 \times 10^{-2}}{T} \exp \left[ -\frac{10780 - 5.28T}{RT} \right]
\]

Where T is the temperature in kelvin, and R is the gas constant.

### AUXILIARY INFORMATION

**METHOD/APPARATUS/PROCEDURE:**

Desorption Method: The melt was saturated with Cl₂ by bubbling the gas for about 1.5h at the rate of 6 - 10 liters/h. The melt was allowed to stand for 5 min. The melt was stripped of the dissolved Cl₂ by bubbling argon gas for about 20 mins. at a rate of 12 liters/h and the liberated gas was absorbed in a KI solution.

The salt was melted under a continuous flow of dry hydrogen chloride gas. The melt was purified with HCl gas for 0.5h followed by Ar gas for 0.5h. It took 15 min. (approx.) to saturate the chloride melt with HCl and 15-20 mins. to expel the dissolved HCl by bubbling Ar gas.

### SOURCE AND PURITY OF MATERIALS:

Liquified Cl₂ (=99.5%) and argon meeting the GOST standard 10157-62 were used.

Dried and remelted chemically-pure salts were used.

### ESTIMATED ERROR:

Not specified.

### REFERENCES:

Two experimental studies (1,2) have been reported for the solubility of chlorine in molten rubidium chloride. However, in the work of Leonova and Ukshe (1), the chlorine gas pressure at which solubility measurements have been carried out is not given. Tentative values based on the work of Andresen et al. (2) are given in Table 1.

Table 1

<table>
<thead>
<tr>
<th>T/K</th>
<th>(10^7 K_H/mol \text{ cm}^{-2} \text{ atm}^{-2})</th>
</tr>
</thead>
<tbody>
<tr>
<td>1020</td>
<td>18.94</td>
</tr>
<tr>
<td>1030</td>
<td>19.47</td>
</tr>
<tr>
<td>1040</td>
<td>20.02</td>
</tr>
<tr>
<td>1050</td>
<td>20.56</td>
</tr>
<tr>
<td>1060</td>
<td>21.11</td>
</tr>
<tr>
<td>1070</td>
<td>21.66</td>
</tr>
</tbody>
</table>

References:

COMPONENTS:
(1) Chlorine; Cl₂; [7782-50-5]
(2) Rubidium chloride; RbCl; [7791-11-9]

ORIGIONAL MEASUREMENTS:
Andresen, R. E.; Ostvald, T.; Oye, H. A.
Proc. Int. Symp. Molten Salts
(Pemsler, J. F. et al., eds.) The

VARIABLES:
T/K = 1016 - 1070
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:

The values of Henry's law constant, $K_H$, for the solubility of chlorine in molten RbCl at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>$10^7 K_H$/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>743</td>
<td>18.49 ± 0.89</td>
</tr>
<tr>
<td>771</td>
<td>20.76 ± 0.36</td>
</tr>
<tr>
<td>797</td>
<td>21.36 ± 0.48</td>
</tr>
</tbody>
</table>

Smoothed Data:
The temperature dependence of $K_H$ is given by the relation:

$$\log(K_H$/mol cm⁻³ atm⁻¹) = -4.472 - 1275.7/(T/K)$$

(compiler)

std. dev. = 1.4% (compiler)

The standard enthalpy, $\Delta H^\circ$, and standard entropy, $\Delta S^\circ$, changes for the dissolution of chlorine are:

$\Delta H^\circ$/kJ mol⁻¹ = 23.7 ± 3.5

$\Delta S^\circ$/J K⁻¹ mol⁻¹ = -86.3 (at 1123 K)

METHOD/APPARATUS/PROCEDURE:
Manometric technique.
The diagram and details of the apparatus are given in the original paper. The method and procedure followed are described elsewhere (1). In brief, chlorine gas is filled into a thermostated volume above the melt which is kept in a closed quartz vessel. The drop in gas pressure is measured with time. The pressure reading, at equilibrium, is used for calculation of gas solubility.

SOURCE AND PURITY OF MATERIALS:
Matheson "High Purity" chlorine (99.5%) was used directly from the cylinder.
Merck p.a. RbCl was used. Before use, it was melted, Cl₂ bubbled through the melt for about an hour and then recrystallized. Salts were handled in a glove box.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
1. Andresen, R. E.; Paniccia, F.; Zambonin, P. G.; Oye, H. A.
COMPONENTS:
(1) Chlorine; Cl₂; [7782-50-5]
(2) Rubidium chloride; RbCl; [7791-11-9]

ORIGINAL MEASUREMENTS:
Leonova, L. S.; Ukshe, E. A.
Elektrokhim. 1970, 6, 892 - 3;

VARIABLES:
T/K = 1054 - 1275
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:

The solubilities, C₁, of chlorine in molten RbCl at different
temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁻⁷ C₁/mol cm⁻³</th>
</tr>
</thead>
<tbody>
<tr>
<td>781</td>
<td>24.0</td>
</tr>
<tr>
<td>789</td>
<td>24.6</td>
</tr>
<tr>
<td>858</td>
<td>27.8</td>
</tr>
<tr>
<td>860</td>
<td>28.2</td>
</tr>
<tr>
<td>940</td>
<td>33.3</td>
</tr>
<tr>
<td>943</td>
<td>34.1</td>
</tr>
<tr>
<td>977</td>
<td>35.3</td>
</tr>
<tr>
<td>1002</td>
<td>36.6</td>
</tr>
</tbody>
</table>

Smoothed Data:
The temperature dependence of the solubility of Cl₂ in molten RbCl is
given by the expression:
\[ \log(C₁/mol cm⁻³) = -4.537 - 1143.2/(T/K) \] (compiler)
std. dev. = 0.6% (compiler)

The heat of solution, \( \Delta H \), is estimated to be:
\[ \Delta H/kJ mol⁻¹ = 21.9 \] (compiler)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution technique.
The method followed for the
determination of gas solubilities
has been described elsewhere (1).

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
1. Ryabukhin, Yu. M.
COMPONENTS:
(1) Chlorine; Cl₂; [7782-50-5]
(2) Cesium chloride; CsCl; [7647-17-8]

EVALUATOR:
N. P. Bansal
National Aeronautics and Space Administration
Lewis Research Center
Cleveland, Ohio, 44135, U.S.A.
December, 1989.

CRITICAL EVALUATION:

Two studies (1 - 2) are available for the solubility of chlorine in molten cesium chloride. However, in the work of Ryabukhin and Bukun (1), the value of atmospheric pressure, at which the gas solubilities have been measured, is not given.

Tentative values based on the work of Andresen et al. (2) are given in Table 1.

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁷ Kₐ/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>940</td>
<td>34.32</td>
</tr>
<tr>
<td>960</td>
<td>34.86</td>
</tr>
<tr>
<td>980</td>
<td>35.39</td>
</tr>
<tr>
<td>1000</td>
<td>35.91</td>
</tr>
<tr>
<td>1020</td>
<td>36.41</td>
</tr>
<tr>
<td>1040</td>
<td>36.90</td>
</tr>
<tr>
<td>1060</td>
<td>37.38</td>
</tr>
<tr>
<td>1080</td>
<td>37.85</td>
</tr>
<tr>
<td>1100</td>
<td>38.31</td>
</tr>
<tr>
<td>1120</td>
<td>38.75</td>
</tr>
<tr>
<td>1140</td>
<td>39.19</td>
</tr>
</tbody>
</table>

References:

COMPONENTS:

(1) Chlorine; Cl₂;  [7782-50-5]
(2) Cesium chloride; CsCl;  [7647-17-8]

VARIABLES:

\[ T/K = 935 - 1138 \]
\[ P/kPa: 101.325 \text{ (1 atm.)} \]

EXPERIMENTAL VALUES:

The values of Henry's law constant, \( K_H \), for the solubility of chlorine in molten CsCl at different temperatures are:

<table>
<thead>
<tr>
<th>( t/\degree C )</th>
<th>( 10^7 K_H/\text{mol cm}^{-3} \text{ atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>662</td>
<td>35.96 ± 1.63</td>
</tr>
<tr>
<td>711</td>
<td>33.21 ± 1.60</td>
</tr>
<tr>
<td>731</td>
<td>35.57 ± 0.60</td>
</tr>
<tr>
<td>798</td>
<td>38.30 ± 2.00</td>
</tr>
<tr>
<td>865</td>
<td>39.57 ± 2.22</td>
</tr>
</tbody>
</table>

Smoothed Data:

The temperature dependence of \( K_H \) is expressed by the relation:

\[
\log(K_H/\text{mol cm}^{-3} \text{ atm}^{-1}) = -5.136 - 308.8/(T/K) \quad \text{(compiler)}
\]

std. dev. = 2.2% (compiler)

The standard enthalpy, \( \Delta H^0 \), and standard entropy, \( \Delta S^0 \), changes for the dissolution of chlorine are:

\[
\Delta H^0/\text{kJ mol}^{-1} = 11.1 ± 1.9 \quad \text{(compiler)}
\]

\[
\Delta S^0/\text{J K}^{-1} \text{ mol}^{-1} = -93.5 \quad \text{(at 1123 K)}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Manometric technique. The diagram and details of the apparatus are given in the original paper. The method and procedure followed are described elsewhere (1). In brief, chlorine gas is filled into a thermostated volume above the melt which is kept in a closed quartz vessel. The drop in gas pressure is measured with time. The pressure reading, at equilibrium, is used for calculation of gas solubility.

SOURCE AND PURITY OF MATERIALS:

Matheson "High Purity" chlorine (99.5%) was used directly from the cylinder. Merck p.a. CsCl was used. Before use, it was melted, Cl₂ bubbled through the melt for about an hour and then recrystallized. Salts were handled in a glove box.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

COMPONENTS:
(1) Chlorine; Cl₂; [7782-50-5]
(2) Cesium chloride; CsCl; [7647-17-8]

VARIABLES:

T/K = 954 - 1195
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:
The solubilities, C₁, of chlorine in molten CsCl at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁻⁷ C₁/mol cm⁻³</th>
</tr>
</thead>
<tbody>
<tr>
<td>661</td>
<td>34.8</td>
</tr>
<tr>
<td>678</td>
<td>34.6</td>
</tr>
<tr>
<td>721</td>
<td>36.6</td>
</tr>
<tr>
<td>721</td>
<td>35.3</td>
</tr>
<tr>
<td>760</td>
<td>37.9</td>
</tr>
<tr>
<td>778</td>
<td>38.2</td>
</tr>
<tr>
<td>849</td>
<td>42.1</td>
</tr>
<tr>
<td>851</td>
<td>41.1</td>
</tr>
<tr>
<td>851</td>
<td>43.6</td>
</tr>
<tr>
<td>919</td>
<td>45.9</td>
</tr>
<tr>
<td>922</td>
<td>44.8</td>
</tr>
<tr>
<td>922</td>
<td>47.6</td>
</tr>
</tbody>
</table>

Smoothed Data:
The temperature dependence of the solubility of Cl₂ in molten CsCl is expressed by the relation:

\[
\log(C₁/mol \ cm^{-3}) = -4.877 - \frac{557.2}{(T/K)} \quad (\text{compiler})
\]

The standard enthalpy, ΔH°, and standard entropy, ΔS°, of solution are:

\[
\Delta H°/kJ \ mol^{-1} = 11.9 \pm 1
\]

\[
\Delta S°/J \ K^{-1} \ mol^{-1} = -92.9 \quad (\text{at 1123 K})
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution technique.
The details of the apparatus and procedure used have been described elsewhere (1). In brief, the melt was saturated with chlorine. A portion of the saturated melt was separated and purged with argon to remove the dissolved chlorine. The liberated chlorine was absorbed in KI solution and iodine generated was titrated with thiosulfate solution.

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
1. Ryabukhin, Yu. M.
COMPONENTS:
(1) Chlorine; Cl₂; [7782-50-5]
(2) Cesium chloride; CsCl; [7647-17-8]

ORIGINAL MEASUREMENTS:
Ratvik, A. P.; Ostvald, T.; Oye, H. A.

VARIABLES:
\[ T/K = 975 - 1175 \]
\[ P/kPa = 10^2 \]

EXPERIMENTAL VALUES:
The validity of Henry's law was verified by measuring the solubility at various Cl₂ pressures. Temperature dependence of solubility, \( K_p \) (mol cm\(^{-3}\) bar\(^{-1}\)), is given by the expression:

\[
\log K_p = (-5.383 \pm 0.045) - \frac{114.2 \pm 47.8}{T}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Manometric method. The procedure used for gas solubility measurements was similar to the one described elsewhere (1,2). For details see the original publication.

SOURCE AND PURITY OF MATERIALS:
The quality and purification of salts have been described earlier(3).

ESTIMATED ERROR:
S. D. in log(solubility) = 0.007.

REFERENCES:
1. Waernes, O.; Ostvald, T.
2. Waernes, O.; Palmisano, F.; Ostvald, T
3. Andreson, R. E; Ostvald, T; Oye, H. A; Proc.
COMPONENTS:

(1) Chlorine; Cl₂; [7782-50-5]

(2) Magnesium chloride; MgCl₂; [7786-30-3]

ORIGIANL MEASUREMENTS:

Ryabukhin, Yu. M.
Zh. Neorg. Khim. 1962, 7, 1101 - 04;

VARIABLES:

\[ P/kPa = 98.925 \]
\[ T/K = 1058 - 1226 \]

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

The solubilities, \( C_1 \), of chlorine in molten MgCl₂ at different temperatures, under a pressure of 742 mm Hg, are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁷ C₁/mol cm⁻³</th>
</tr>
</thead>
<tbody>
<tr>
<td>785</td>
<td>5.72</td>
</tr>
<tr>
<td>833</td>
<td>6.76</td>
</tr>
<tr>
<td>925</td>
<td>7.12</td>
</tr>
<tr>
<td>953</td>
<td>8.33</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of the solubility of Cl₂ in molten MgCl₂ is expressed by the relation:

\[
\log(C_1/mol \text{ cm}^{-3}) = -5.248 - 1043.3/(T/K) \quad (\text{compiler})
\]

\[
\text{std. dev.} = 2.9\% \quad (\text{compiler})
\]

The standard enthalpy, \( \Delta H^° \), and standard entropy, \( \Delta S^° \), of solution are:

\[
\Delta H^°/\text{kJ mol}^{-1} = 19.9 \pm 5
\]

\[
\Delta S^°/\text{J K}^{-1} \text{ mol}^{-1} = -100.5 \quad (\text{at 1123 K})
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Elution method.

The diagram and details of the apparatus used and procedure followed for gas solubility measurements are described in the original publication. Briefly speaking, the melt was saturated with chlorine by bubbling the gas through it. The dissolved chlorine was freed from the saturated melt by flushing it with argon. The liberated chlorine was absorbed in KI solution and iodine generated was titrated with a standard thiosulfate solution.

SOURCE AND PURITY OF MATERIALS:

Liquefied chlorine (99.5%) was used. Argon used contained 0.008% oxygen and 0.04% nitrogen. The two gases were purified by bubbling through conc. H₂SO₄ and passing over P₂O₅.

Dried and remelted "chemically pure" grade MgCl₂ was used.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:
**COMPONENTS:**

(1) Chlorine; Cl\(_2\); [7782-50-5]
(2) Magnesium chloride; MgCl\(_2\); [7786-30-3]

**ORIGINAL MEASUREMENTS:**


**VARIABLES:**

\[ \text{T/K = 1023 - 1173} \]
\[ \text{P/kPa: 101.325 (1 atm.)} \]

**EXPERIMENTAL VALUES:**

The temperature dependence of the solubility of Cl\(_2\), \( C(\text{mol cm}^{-3}) \), in molten MgCl\(_2\) is expressed by the equation:

\[
C = \frac{1.215 \times 10^{-2}}{T} \exp \left[ \frac{-3880 + 3.43T}{RT} \right]
\]

where \( T \) is the temperature in kelvin, and \( R \) is the gas constant.

**METHOD/APPARATUS/PROCEDURE:**

Desorption Method: The melt was saturated with Cl\(_2\) by bubbling the gas for about 1.5h at the rate of 6 - 10 liters/h. The melt was allowed to stand for 5 min. The melt was stripped of the dissolved Cl\(_2\) by bubbling argon gas for about 20 mins. at a rate of 12 liters/h and the liberated gas was absorbed in a KI solution.

The salt was melted under a continuous flow of dry hydrogen chloride gas. The melt was purified with HCl gas for 0.5h followed by Ar gas for 0.5h. It took \( \approx 15 \) min. to saturate the chloride melt with HCl and \( \approx 15-20 \) mins. to expel the dissolved HCl by bubbling Ar gas.

**SOURCE AND PURITY OF MATERIALS:**

Liquified Cl\(_2\) (99.5%) and argon meeting the GOST standard 10157-62 were used.

Dried and remelted chemically - pure salts were used.

**ESTIMATED ERROR:**

Not specified.
COMPONENTS:

(1) Chlorine; Cl₂; [7782-50-5]
(2) Calcium chloride; CaCl₂; [10043-52-4]

ORIGINAL MEASUREMENTS:

Wartenberg, H. U.

VARIABLES:

one temperature: T/K = 1073
P/kPa: 101.325 (compiler)

EXPERIMENTAL VALUES:

The solubility of chlorine in molten CaCl₂ at a single temperature has been reported as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>weight fraction</th>
<th>volume fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>800</td>
<td>2.2 x 10⁻³</td>
<td>6.96 x 10⁻³</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The details of the apparatus used and procedure followed for gas solubility measurements are described in the original publication. Briefly, a quenched melt sample equilibrated with chlorine was analyzed for the chlorine content by reacting with KI solution and titrating with freshly standardized thiosulfate solution.

SOURCE AND PURITY OF MATERIALS:

Calcium chloride used was pure and was dehydrated by heating with NH₄Cl and NH₄Br.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:
COMPONENTS:
(1) Chlorine; Cl₂; [7782-50-5]
(2) Lead chloride; PbCl₂; [7758-95-4]

VARIABLES:
T/K = 786 - 912
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:
The solubilities of chlorine in molten lead chloride at different temperatures, at one atmosphere pressure, are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁷ C₁/mol cm⁻³</th>
<th>10⁶ X₃/mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>513</td>
<td>0.52</td>
<td>2.95</td>
</tr>
<tr>
<td>535</td>
<td>0.64</td>
<td>3.62</td>
</tr>
<tr>
<td>585</td>
<td>0.78</td>
<td>4.45</td>
</tr>
<tr>
<td>630</td>
<td>1.34</td>
<td>6.12</td>
</tr>
<tr>
<td>639</td>
<td>1.10</td>
<td>6.47</td>
</tr>
</tbody>
</table>

Smoothed Data:
The temperature dependence of solubility is expressed by the relation:

$$\log(C₁/mol \text{ cm}^{-3}) = -5.03 - \frac{1765.6}{(T/K)}$$

(compiler)
std. dev. = 1.8% (compiler)

The standard heat of solution, $\Delta H^\circ$, for the dissolution of Cl₂ is:

$$\Delta H^\circ/\text{kJ mol}^{-1} = 39.3$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution method.
The diagram and details of the apparatus used and procedure followed for gas solubility measurements are given in the original publication. In brief, the melt was saturated with chlorine by bubbling the gas through it. After saturation, the melt was sparged with argon to liberate the dissolved chlorine. The freed chlorine was absorbed in an aqueous KI solution and the iodine produced was titrated with a standard thiosulfate solution.

SOURCE AND PURITY OF MATERIALS:
Reagent grade lead chloride was treated by passing HCl gas through the powder and temperature was slowly raised from room temperature to about 50°C above the melting point. Last traces of moisture were removed by bubbling HCl through the melt for about 2 hrs. The dissolved HCl gas was removed by argon flushing. Finally the melt was filtered through a quartz frit.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
COMPONENTS:
(1) Chlorine; Cl₂; [7782-50-5]
(2) Silver chloride; AgCl; [7783-90-6]

VARIABLES:
one temperature: T/K = 791
P/kPa: 101.325 (1 atm.)

ORIGINAL MEASUREMENTS:
Van Norman, J. D.; Tivers, R. J.

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The solubility of chlorine in molten AgCl at one atmosphere pressure is:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>solubility/mol cm⁻³</th>
<th>solubility/mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>518</td>
<td>2.31 x 10⁻⁷</td>
<td>6.95 x 10⁻⁸</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution technique.
The diagram and details of the apparatus used and procedure followed for gas solubility measurements are given in the original paper. In brief, chlorine was bubbled through the gas. After saturation, the melt was flushed with argon to liberate the chlorine in solution. The freed chlorine was absorbed in aqueous KI solution and the iodine produced was titrated against a standard thiosulfate solution.

SOURCE AND PURITY OF MATERIALS:
Reagent grade AgCl was treated by passing HCl gas through the salt powder and temperature was slowly raised from room temperature to about 50°C above the melting point. Last traces of moisture were removed by bubbling HCl through the melt for about 2 hrs. The dissolved HCl gas was removed by argon flushing. Finally the melt was filtered through a quartz frit.

ESTIMATED ERROR:
solubility: ± 10% (compiler)

REFERENCES:
Four experimental studies are available for the solubility of chlorine in the molten eutectic LiCl - KCl. The results of Greenberg and Sundheim (1), and Olander and Camahort (2) are only of preliminary nature and are not worth consideration here any further. Smoothed data at different temperatures from the other two investigations are presented below for comparison:

<table>
<thead>
<tr>
<th>T/K</th>
<th>Nakajima et al. (3)</th>
<th>Van Norman &amp; Tivers (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>680</td>
<td>1.24</td>
<td>1.30</td>
</tr>
<tr>
<td>700</td>
<td>1.36</td>
<td>1.40</td>
</tr>
<tr>
<td>720</td>
<td>1.48</td>
<td>1.49</td>
</tr>
<tr>
<td>740</td>
<td>1.61</td>
<td>1.59</td>
</tr>
<tr>
<td>760</td>
<td>1.74</td>
<td>1.70</td>
</tr>
<tr>
<td>780</td>
<td>1.87</td>
<td>1.80</td>
</tr>
<tr>
<td>800</td>
<td>2.01</td>
<td>1.90</td>
</tr>
<tr>
<td>820</td>
<td>2.15</td>
<td>2.00</td>
</tr>
<tr>
<td>840</td>
<td>2.29</td>
<td>(2.11)</td>
</tr>
<tr>
<td>850</td>
<td>2.36</td>
<td>(2.16)</td>
</tr>
</tbody>
</table>

Values in ( ) outside temperature interval of experimental measurement; extrapolated by the evaluator.

The results of Nakajima et al. (3), and of Van Norman and Tivers (4) are in very good agreement within experimental precision. The recommended solubility values for this gas - molten salt system, taken as the mean of these two data sets are presented in Table 1 and also in Fig. 1.

References:
Table 1
Recommended Solubilities as a Function of Temperature

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^7 K_{\text{H}}$/mol cm$^{-3}$ atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>680</td>
<td>1.27</td>
</tr>
<tr>
<td>700</td>
<td>1.38</td>
</tr>
<tr>
<td>720</td>
<td>1.49</td>
</tr>
<tr>
<td>740</td>
<td>1.60</td>
</tr>
<tr>
<td>760</td>
<td>1.72</td>
</tr>
<tr>
<td>780</td>
<td>1.83</td>
</tr>
<tr>
<td>800</td>
<td>1.95</td>
</tr>
<tr>
<td>820</td>
<td>2.08</td>
</tr>
<tr>
<td>840</td>
<td>2.20</td>
</tr>
<tr>
<td>850</td>
<td>2.26</td>
</tr>
</tbody>
</table>

Fig. 1
COMPONENTS:
(1) Chlorine; Cl₂; [7782-50-5]
(2) Lithium chloride; LiCl; [7447-41-8]
(3) Potassium chloride; KCl; [7447-40-7]

CRITICAL EVALUATION:

EFFECT OF MELT COMPOSITION

Only Nakajima et al. (3) have studied the effect of solvent composition on the solubility of chlorine in molten LiCl - KCl. Their numerical values, which may be treated as tentative, at different melt compositions are given in Table 2. These are also presented in Fig. 2.

Table 2
Solubilities as a Function of Melt Composition

<table>
<thead>
<tr>
<th>T/K</th>
<th>Melt Composition/mol% LiCl</th>
<th>(10^7 K_m/\text{mol cm}^{-3} \text{ atm}^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>848</td>
<td>50</td>
<td>2.80 ± 0.10</td>
</tr>
<tr>
<td>848</td>
<td>59</td>
<td>2.32 ± 0.18</td>
</tr>
<tr>
<td>848</td>
<td>69</td>
<td>1.65 ± 0.19</td>
</tr>
<tr>
<td>848</td>
<td>78</td>
<td>1.10 ± 0.11</td>
</tr>
</tbody>
</table>

Fig. 2
COMPONENTS:
(1) Chlorine; Cl₂; [7782-50-5]
(2) Lithium chloride; LiCl; [7447-41-8]
(3) Potassium chloride; KCl; [7447-40-7]

VARIABLES:
T/K = 723 - 848
melt comp./mol% LiCl = 50 - 78
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:
The solubilities of chlorine in molten mixtures of LiCl - KCl of different compositions are:

<table>
<thead>
<tr>
<th>melt comp./mol% LiCl</th>
<th>t/°C</th>
<th>10⁷ C₁/mol ml⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>575</td>
<td>2.80 ± 0.10</td>
</tr>
<tr>
<td>59</td>
<td>450</td>
<td>1.49 ± 0.02</td>
</tr>
<tr>
<td>69</td>
<td>525</td>
<td>2.03 ± 0.08</td>
</tr>
<tr>
<td></td>
<td>575</td>
<td>2.32 ± 0.18</td>
</tr>
<tr>
<td>78</td>
<td>575</td>
<td>1.65 ± 0.19</td>
</tr>
<tr>
<td></td>
<td>575</td>
<td>1.10 ± 0.11</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of solubility in the molten eutectic LiCl - KCl (59 - 41 mol%) can be expressed by the relation:

\[ \log(C₁/mol \text{ ml}^{-1}) = -5.504 - 954.7/(T/K) \] (compiler)

std. dev. = 0.9% (compiler)

The heat of solution, \( \Delta H \), in the molten LiCl - KCl eutectic is:

\[ \Delta H/\text{kJ mol}^{-1} = 18.0 \]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution method.
The diagram and details of the apparatus and the procedure are given in the original paper.
Chlorine gas is passed through the melt till saturation is reached. A portion of the saturated melt is separated and flushed with argon to free the dissolved chlorine which is allowed to react with KI and the iodine liberated is titrated with a standard sodium thiosulfate solution.

SOURCE AND PURITY OF MATERIALS:
Lithium and potassium chlorides were of reagent grade.
The Cl₂ gas had a purity better than 98%.
LiCl - KCl melt was prepared by dehydrating under an atmosphere of HCl using the method of Laitinen et al. (1).

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
1. Laitinen, H. A.; Ferguson, W. S.; Osteryoung, R. A.
The solubilities of chlorine in the molten LiCl - KCl eutectic at different temperatures, at one atmosphere pressure, are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10^7 C_i/mol cm^-3</th>
<th>10^6 x_i/mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>1.26</td>
<td>4.19</td>
</tr>
<tr>
<td>450</td>
<td>1.54</td>
<td>5.21</td>
</tr>
<tr>
<td>500</td>
<td>1.70</td>
<td>5.83</td>
</tr>
<tr>
<td>550</td>
<td>2.05</td>
<td>7.14</td>
</tr>
</tbody>
</table>

Smoothed Data:

The temperature dependence of solubility is given by the relation:

\[ \log(C_i/\text{mol cm}^{-3}) = -5.784 - 749.9/(T/\text{K}) \]  

\[ \text{std. dev.} = 1.3\% \]  

The standard heat of solution, \( \Delta H^o \), for the dissolution of Cl_2 is:

\[ \Delta H^o/kJ \text{ mol}^{-1} = 15.5 \]

**REFERENCES:**

1. Laitinen, H. A.; Ferguson, W. S.; Osteryoung, R. A.  
COMPONENTS:

(1) Chlorine; Cl₂; [7782-50-5]
(2) Lithium chloride; LiCl; [7447-41-8]
(3) Potassium chloride; KCl; [7447-40-7]

VARIABLES:

T/K = 673 & 773
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:

The solubility of chlorine in molten eutectic LiCl - KCl (59 - 41 mol%) was measured at 400 and 500°C at one atmosphere pressure of the gas. It was found to be less than 4 x 10⁻⁹ g-mol cm⁻³, the limit of detectability of the technique employed.

ORIGINAL MEASUREMENTS:

Olander, D. R.; Camahort, J. L.
A.I.Ch.E. Jour. 1966, 12, 693 - 99.

PREPARED BY:

N. P. Bansal

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Elution or stripping method.
The method used for solubility measurements was essentially the same as described by Blander et al. (1). Chlorine was bubbled through the melt for 1 - 4 hours. A known amount of the saturated melt was transferred into the stripping section and flushed with argon to remove the dissolved chlorine. The freed chlorine was absorbed in sodium hydroxide solution and analyzed.

SOURCE AND PURITY OF MATERIALS:

Not described.

REFERENCES:

ESTIMATED ERROR:
### COMPONENTS:

1. Chlorine; Cl₂; [7782-50-5]
2. Lithium chloride; LiCl; [7447-41-8]
3. Potassium chloride; KCl; [7447-40-7]

### VARIABLES:

- one temperature: T/K = 673

### ORIGINAL MEASUREMENTS:

- Greenberg, J.; Sundheim, B. R.

### EXPERIMENTAL VALUES:

Solubility of chlorine in molten LiCl - KCl eutectic at the gas pressure of slightly less than one atmosphere is reported as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁻³ Solubility/molar</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>0.1 - 1</td>
</tr>
</tbody>
</table>

### AUXILIARY INFORMATION

#### SOURCE AND PURITY OF MATERIALS:

Analytical grade LiCl - KCl were used without further purification except for careful drying.

#### ESTIMATED ERROR:

Nothing specified.

#### REFERENCES:

1. Sundheim, B. R.; Greenberg, J.
Three experimental studies (1 - 3) are available for the solubility of chlorine in molten equimolar NaCl - KCl. All these investigations are from the same group of workers. According to Ryabukhin the results reported in ref. (2) are better than those reported in his earlier work (1) because of some errors associated with the experimental procedure. However, in ref. (2) the value of the pressure, at which the gas solubilities have been measured, is not given. Also, the results are reported only in graphical form and the graph given is so small that accurate values of gas solubilities cannot be read at different temperatures. The results of Leonova et al. (3) who have reported gas solubilities for four different melt compositions at different temperatures, may be treated as highly tentative, at least until additional studies become available for comparison. Smoothed data at different temperatures and melt compositions, based on (3), are given in Table 1.

Table 1
Solubilities as a Function of Temperature and Composition

<table>
<thead>
<tr>
<th>Melt Composition/mol% NaCl</th>
<th>T/K</th>
<th>12.5</th>
<th>25.0</th>
<th>50.0</th>
<th>75.0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1020</td>
<td>-</td>
<td>(7.44)</td>
<td>6.15</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>1050</td>
<td>-</td>
<td>8.25</td>
<td>6.82</td>
<td>4.01</td>
</tr>
<tr>
<td></td>
<td>1080</td>
<td>12.29</td>
<td>9.09</td>
<td>7.51</td>
<td>4.52</td>
</tr>
<tr>
<td></td>
<td>1110</td>
<td>13.34</td>
<td>9.97</td>
<td>8.24</td>
<td>5.06</td>
</tr>
<tr>
<td></td>
<td>1140</td>
<td>14.42</td>
<td>10.87</td>
<td>8.99</td>
<td>5.64</td>
</tr>
<tr>
<td></td>
<td>1170</td>
<td>15.53</td>
<td>11.81</td>
<td>9.77</td>
<td>6.25</td>
</tr>
<tr>
<td></td>
<td>1200</td>
<td>16.66</td>
<td>12.77</td>
<td>10.57</td>
<td>6.89</td>
</tr>
<tr>
<td></td>
<td>1230</td>
<td>17.82</td>
<td>13.76</td>
<td>11.39</td>
<td>7.56</td>
</tr>
<tr>
<td></td>
<td>1260</td>
<td>18.99</td>
<td>14.77</td>
<td>12.23</td>
<td>8.25</td>
</tr>
<tr>
<td></td>
<td>1290</td>
<td>20.18</td>
<td>15.81</td>
<td>13.10</td>
<td>8.98</td>
</tr>
<tr>
<td></td>
<td>1320</td>
<td>21.38</td>
<td>(16.87)</td>
<td>(13.97)</td>
<td>(9.73)</td>
</tr>
</tbody>
</table>

Values in ( ) outside temperature interval of experimental measurement; extrapolated by the evaluator.

References:
COMPONENTS:
(1) Chlorine; Cl₂; [7782-50-5]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Potassium chloride; KCl; [7447-40-7]

VARIABLES:
T/K = 1011 - 1320
melt comp./mol% NaCl = 12.5 - 75
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:
The solubilities of chlorine in molten NaCl - KCl mixtures (12.5, 25, 50, 75 mol% NaCl), at different temperatures, at one atmosphere pressure, are:

<table>
<thead>
<tr>
<th>Melt composition/mol% NaCl</th>
<th>t/°C</th>
<th>10⁷ C₁/mol cm⁻³</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.5</td>
<td>810</td>
<td>12.4</td>
</tr>
<tr>
<td></td>
<td>814</td>
<td>12.5</td>
</tr>
<tr>
<td></td>
<td>885</td>
<td>14.8</td>
</tr>
<tr>
<td></td>
<td>960</td>
<td>18.25</td>
</tr>
<tr>
<td></td>
<td>962</td>
<td>18.55</td>
</tr>
<tr>
<td></td>
<td>1041</td>
<td>20.8</td>
</tr>
<tr>
<td></td>
<td>1047</td>
<td>21.2</td>
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<tr>
<td>25.0</td>
<td>755</td>
<td>7.75</td>
</tr>
<tr>
<td></td>
<td>798</td>
<td>8.17</td>
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<td>10.86</td>
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<td></td>
<td>956</td>
<td>13.60</td>
</tr>
<tr>
<td></td>
<td>959</td>
<td>13.70</td>
</tr>
<tr>
<td></td>
<td>1033</td>
<td>16.80</td>
</tr>
</tbody>
</table>

continued

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution method.
The technique employed for solubility measurements was the same as described earlier (1). The melt was saturated with chlorine by bubbling the gas at a gas pressure of 1 atm. A part of the saturated melt was transferred into the stripping section and the dissolved chlorine was displaced by flushing with argon. The liberated chlorine was absorbed in KI solution. The iodine generated was titrated against a standard thiosulfate solution.

SOURCE AND PURITY OF MATERIALS:
Not reported.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
1. Ryabukhin, Yu. M.
COMPONENTS:
(1) Chlorine; Cl₂; [7782-50-5]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS:
Leonova, L. S.; Ryabukhin, Yu. M.; Ukshe, E. A.

VARIABLES:

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>Melt composition/mol% NaCl</th>
<th>t/°C</th>
<th>10⁷ C₄/mol cm⁻³</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.0</td>
<td>738</td>
<td>6.10</td>
</tr>
<tr>
<td></td>
<td>793</td>
<td>7.28</td>
</tr>
<tr>
<td></td>
<td>843</td>
<td>8.30</td>
</tr>
<tr>
<td></td>
<td>855</td>
<td>8.37</td>
</tr>
<tr>
<td></td>
<td>948</td>
<td>11.22</td>
</tr>
<tr>
<td></td>
<td>952</td>
<td>10.80</td>
</tr>
<tr>
<td></td>
<td>1014</td>
<td>13.30</td>
</tr>
<tr>
<td></td>
<td>1020</td>
<td>13.56</td>
</tr>
<tr>
<td>75.0</td>
<td>780</td>
<td>4.20</td>
</tr>
<tr>
<td></td>
<td>853</td>
<td>5.12</td>
</tr>
<tr>
<td></td>
<td>855</td>
<td>5.50</td>
</tr>
<tr>
<td></td>
<td>935</td>
<td>6.95</td>
</tr>
<tr>
<td></td>
<td>938</td>
<td>6.99</td>
</tr>
<tr>
<td></td>
<td>1008</td>
<td>8.82</td>
</tr>
<tr>
<td></td>
<td>1014</td>
<td>9.23</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:

1. Chlorine; Cl₂; [7782-50-5]
2. Sodium chloride; NaCl; [7647-14-5]
3. Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS:

Leonova, L. S.; Ryabukhin, Yu. M.; Ukshe, E. A.
Elektrokhim. 1969, 5, 464 - 6;
Sov. Electrochem. (Eng. Transl.)
1969, 5, 424 - 25. (*).

VARIABLES:

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

continued

Smoothed Data:

Temperature dependence of solubility in the ranges studied obeyed the relation:

\[ \log(C_1 / \text{mol cm}^{-3}) = a + b / (T/K) \]

Values of the coefficients \( a \) and \( b \), together with the enthalpies of solution, \( \Delta H \), in the four molten mixtures (evaluated by the compiler) are:

<table>
<thead>
<tr>
<th>Melt composition/ mol% NaCl</th>
<th>a</th>
<th>b</th>
<th>( \Delta H/\text{kJ mol}^{-1} )</th>
<th>std. dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.5</td>
<td>-4.586</td>
<td>-1430.5</td>
<td>27.4</td>
<td>0.8%</td>
</tr>
<tr>
<td>25.0</td>
<td>-4.564</td>
<td>-1595.8</td>
<td>30.6</td>
<td>2.4%</td>
</tr>
<tr>
<td>50.0</td>
<td>-4.641</td>
<td>-1601.8</td>
<td>30.7</td>
<td>1.3%</td>
</tr>
<tr>
<td>75.0</td>
<td>-4.512</td>
<td>-1979.1</td>
<td>37.9</td>
<td>1.5%</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:

(1) Chlorine; Cl₂; [7782-50-5]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS:

Ryabukhin, Yu. M.
Zh. Neorg. Khim. 1962, 7, 1101 - 04;

VARIABLES:
P/kPa = 98.925
T/K = 1023 - 1301

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:

The solubilities, C₁, of chlorine in molten NaCl - KCl (50 - 50 mol%) at different temperatures, under a pressure of 742 mm Hg, are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁻⁷ C₁/mol cm⁻³</th>
</tr>
</thead>
<tbody>
<tr>
<td>750</td>
<td>3.65</td>
</tr>
<tr>
<td>800</td>
<td>4.59</td>
</tr>
<tr>
<td>825</td>
<td>5.85</td>
</tr>
<tr>
<td>850</td>
<td>7.00</td>
</tr>
<tr>
<td>855</td>
<td>6.65</td>
</tr>
<tr>
<td>900</td>
<td>8.72</td>
</tr>
<tr>
<td>900</td>
<td>8.23</td>
</tr>
<tr>
<td>968</td>
<td>12.43</td>
</tr>
<tr>
<td>970</td>
<td>12.10</td>
</tr>
<tr>
<td>1028</td>
<td>14.10</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of the solubility of Cl₂ in molten NaCl - KCl (50 - 50 mol%) is given by the expression:

\[ \log(C₁/mol \text{ cm}^{-3}) = -3.536 - 2971.7/(T/K) \]  

std. dev. = 2.3%  
(compiler)

The heat of solution, ΔH, is estimated to be:

\[ ΔH/\text{kJ mol}^{-1} = 56.9 \]  
(compiler)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Elution method.

The diagram and details of the apparatus used and procedure followed for gas solubility measurements are described in the original publication. In brief, the melt was saturated with chlorine by bubbling the gas through it. The chlorine dissolved was freed from the saturated melt by sparging it with argon. The liberated chlorine was absorbed in KI solution and iodine generated was titrated with a standard thiosulfate solution.

SOURCE AND PURITY OF MATERIALS:

Liquified chlorine (99.5%) was used. Argon contained 0.008% oxygen and 0.04% nitrogen. Chlorine and argon were purified by bubbling through conc. H₂SO₄ and passing over P₂O₅.

Dried and remelted "chemically pure" grade NaCl and KCl were used.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:
<table>
<thead>
<tr>
<th>COMPONENTS:</th>
<th>ORIGINAL MEASUREMENTS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Chlorine; Cl₂; [7782-50-5]</td>
<td>Ryabukhin, Yu. N.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VARIABLES:</th>
<th>PREPARED BY:</th>
</tr>
</thead>
<tbody>
<tr>
<td>T/K = 1003 - 1273</td>
<td>N. P. Bansal</td>
</tr>
<tr>
<td>P/kPa = 101.325 (1 atm)</td>
<td></td>
</tr>
</tbody>
</table>

**EXPERIMENTAL VALUES:**

The solubilities of chlorine in the molten mixture NaCl - KCl (50 - 50 mol%) at different temperatures are presented in graphical form. The graph given is too small to justify the interpolation of gas solubilities, with reasonable accuracy, at different temperatures.

**AUXILIARY INFORMATION**

<table>
<thead>
<tr>
<th>METHOD/APPARATUS/PROCEDURE:</th>
<th>SOURCE AND PURITY OF MATERIALS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elution technique. The diagram and details of the apparatus used and procedure followed for gas solubility measurements are described in the original paper. Briefly, the melt was saturated with chlorine by bubbling the gas through it at a gas pressure of 1 atm. A portion of the saturated melt was transferred into the stripping section. From this melt the dissolved chlorine was freed by purging it with argon. The liberated chlorine was absorbed in KI solution, and iodine generated was titrated with thiosulfate solution.</td>
<td>Chlorine was prepared by electrolysis of fused lead chloride. Argon contained 0.01% nitrogen, 0.003% oxygen, 0.004% water. Argon was purified by passing through columns of Anhydrone and phosphorus pentoxide. NaCl and KCl were of &quot;chemically pure&quot; grade.</td>
</tr>
</tbody>
</table>

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**
COMPONENTS:

(1) Chlorine; Cl₂; [7782-50-5]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Potassium chloride; KCl; [7447-40-7]

VARIABLES:

\[ T/K = 1024 - 1175 \]
\[ P/kPa: 101.325 \text{ (1 atm.)} \]

EXPERIMENTAL VALUES:

The solubilities of Cl₂ in 55.6 NaCl - 44.4 KCl (wt%) melt at various temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>(10^7)C/mol cm⁻³</th>
</tr>
</thead>
<tbody>
<tr>
<td>751</td>
<td>1.430</td>
</tr>
<tr>
<td>803</td>
<td>1.973</td>
</tr>
<tr>
<td>855</td>
<td>2.900</td>
</tr>
<tr>
<td>902</td>
<td>4.930</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Desorption Method: The melt was saturated with Cl₂ by bubbling the gas for about 1.5h at the rate of 6 - 10 liters/h. The melt was allowed to stand for 5 min. The melt was stripped of the dissolved Cl₂ by bubbling argon gas for about 20 min. at a rate of 12 liters/h and the liberated gas was absorbed in a KI solution.

The salt was melted under a continuous flow of dry hydrogen chloride gas. The melt was purified with HCl gas for 0.5h followed by Ar gas for 0.5h. It took = 15 min. to saturate the chloride melt with HCl and =15-20 mins. to expel the dissolved HCl by bubling Ar gas.

ORIGINAL MEASUREMENTS:


PREPARED BY:

N. P. Bansal

REFERENCES:
COMPONENTS:

(1) Chlorine; Cl₂; [7782-50-5]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Cesium chloride; CsCl; [7647-17-8]

VARIABLES:

T/K = 1119 - 1210
Melt comp./ mol% NaCl = 35
P/kPa = 119.990 - 133.322

EXPERIMENTAL VALUES:

Values of Henry's law constant, K₉, for the solubility of Cl₂ at various temperatures are given below

<table>
<thead>
<tr>
<th>Melt comp/mol% NaCl</th>
<th>T/°C</th>
<th>10⁷ K₉/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td>554</td>
<td>18.5 ± 0.7</td>
</tr>
<tr>
<td></td>
<td>652</td>
<td>19.8 ± 0.2</td>
</tr>
<tr>
<td></td>
<td>701</td>
<td>21.0 ± 0.3</td>
</tr>
</tbody>
</table>

Temperature dependence of K₉ can be expressed as:

\[
\log K₉ = -5.384 - 290.4/T
\]

Standard enthalpy for the dissolution of Cl₂ was evaluated from the equation:

\[
\Delta H^\circ = -R \frac{d\ln K₉}{d(1/T)}
\]

and was found to be \((5.6 \pm 1.3)\) kJ mol⁻¹.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
The method used for gas solubility measurements was essentially the same as earlier described (1).

For details see the original paper.

SOURCE AND PURITY OF MATERIALS:
NaCl was dried under vacuum at 400°C for 2h. The salt was recrystallized from the melt under N₂ atmosphere. Only clear crystals were used. CsCl ("suprapur") was dehydrated with HCl HCl upto 400°C for 10h and melted under Cl₂. It was cooled to 50°C below the melting point and evacuated. Saturatn with Cl₂ and evacuation were repeated three times and the salt recrystallized from the melt. HCl gas (99.8%) and Ar (99.9%) were used without further purification.

ESTIMATED ERROR:
Not specified.

REFERENCES:
1. Andresen, R. E.; Paniccia, F.; Zambonin, P. G.; Oye, H.
COMPONENTS:
(1) Chlorine; Cl₂; [7782-50-5]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Magnesium chloride; MgCl₂; [7786-30-3]

ORIGNAL MEASUREMENTS:
Ryabukhin, Yu. M.
Zh. Neorg. Khim. 1962, 7, 1101 - 04;
1962, 7, 565 - 67. (*).

VARIABLES:
\[ P/kPa = 98.925 \]
\[ T/K = 842 - 1295 \]

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The solubilities, \( C_1 \), of chlorine in molten NaCl - MgCl₂ (50 - 50 mol%) at different temperatures, under a pressure of 742 mm Hg, are:

<table>
<thead>
<tr>
<th>( t/°C )</th>
<th>( 10^7 C_1 /\text{mol cm}^{-3} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>569</td>
<td>0.48</td>
</tr>
<tr>
<td>659</td>
<td>1.31</td>
</tr>
<tr>
<td>731</td>
<td>1.77</td>
</tr>
<tr>
<td>820</td>
<td>2.12</td>
</tr>
<tr>
<td>913</td>
<td>3.37</td>
</tr>
<tr>
<td>1022</td>
<td>5.82</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of the solubility of Cl₂ in molten NaCl - MgCl₂ (50 - 50 mol%) is expressed by the relation:

\[
\log(C_1/\text{mol cm}^{-3}) = -4.426 - 2381.7/(T/K) \quad \text{(compiler)}
\]

\[ \text{std. dev.} = 7.6\% \quad \text{(compiler)} \]

The heat of solution, \( \Delta H \), is estimated to be:

\[ \Delta H/\text{kJ mol}^{-1} = 45.6 \quad \text{(compiler)} \]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution method.
The diagram and details of the apparatus used and procedure followed for gas solubility measurements are described in the original paper. Briefly, the melt was saturated with chlorine by bubbling the gas through it. The dissolved chlorine was freed the saturated melt by sparging it with argon. The liberated chlorine was absorbed in KI solution and iodine generated was titrated with a standard thiosulfate solution.

SOURCE AND PURITY OF MATERIALS:
Liquified chlorine (99.5%) was used. Argon contained 0.008% oxygen and 0.04% nitrogen. The two gases were purified by bubbling through conc. H₂SO₄ and passing over P₂O₅. Dried and remelted "chemically pure" grade NaCl and MgCl₂ were used.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
Two studies (1,2) are available for the solubility of chlorine in molten equimolar KCl - MgCl₂ using the same (elution) technique. Smoothed data from these studies at different temperatures are presented below for comparison.

<table>
<thead>
<tr>
<th>T/K</th>
<th>Ryabukhin (1)</th>
<th>Lukmanova &amp; Vil'nyanskii (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>800</td>
<td>1.90</td>
<td>2.69</td>
</tr>
<tr>
<td>850</td>
<td>2.42</td>
<td>3.03</td>
</tr>
<tr>
<td>900</td>
<td>3.01</td>
<td>3.35</td>
</tr>
<tr>
<td>950</td>
<td>3.65</td>
<td>3.67</td>
</tr>
<tr>
<td>1000</td>
<td>4.34</td>
<td>3.98</td>
</tr>
<tr>
<td>1050</td>
<td>5.08</td>
<td>4.27</td>
</tr>
<tr>
<td>1100</td>
<td>5.86</td>
<td>4.54</td>
</tr>
<tr>
<td>1150</td>
<td>6.67</td>
<td>4.80</td>
</tr>
<tr>
<td>1200</td>
<td>7.52</td>
<td>(5.04)</td>
</tr>
<tr>
<td>1250</td>
<td>8.40</td>
<td>(5.26)</td>
</tr>
<tr>
<td>1300</td>
<td>9.29</td>
<td>(5.47)</td>
</tr>
</tbody>
</table>


Values in ( ) outside temperature interval of experimental measurements; extrapolated by the evaluator.

The two sets of data are not in agreement with each other. Values of Lukmanova et al. (2) are higher in the lower temperature range but lower at higher temperatures as compared to the results of Ryabukhin (1).

Further work is needed before recommended values can be advanced for this system.

References:
**COMPONENTS:**

(1) Chlorine; Cl₂; [7782-50-5]
(2) Potassium chloride; KCl; [7447-40-7]
(3) Magnesium chloride; MgCl₂; [7786-30-3]

**ORIGINAL MEASUREMENTS:**

Ryabukhin, Yu. M.

**VARIABLES:**

P/kPa = 98.925
T/K = 838 - 1320

**PREPARED BY:**

N. P. Bansal

**EXPERIMENTAL VALUES:**

The solubilities, C₁, of chlorine in molten KCl - MgCl₂ (50 - 50 mol%) at different temperatures, under a pressure of 742 mm Hg, are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁷ C₁/mol cm⁻³</th>
<th>10⁷ Kₜₐₜ/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>565</td>
<td>2.18</td>
<td>2.23</td>
</tr>
<tr>
<td>585</td>
<td>2.42</td>
<td>2.48</td>
</tr>
<tr>
<td>586</td>
<td>2.62</td>
<td>2.68</td>
</tr>
<tr>
<td>685</td>
<td>3.07</td>
<td>3.14</td>
</tr>
<tr>
<td>685</td>
<td>3.90</td>
<td>3.99</td>
</tr>
<tr>
<td>767</td>
<td>4.22</td>
<td>4.32</td>
</tr>
<tr>
<td>779</td>
<td>5.84</td>
<td>5.98</td>
</tr>
<tr>
<td>844</td>
<td>6.94</td>
<td>7.11</td>
</tr>
<tr>
<td>866</td>
<td>5.62</td>
<td>5.76</td>
</tr>
<tr>
<td>927</td>
<td>7.13</td>
<td>7.30</td>
</tr>
<tr>
<td>983</td>
<td>8.06</td>
<td>8.26</td>
</tr>
<tr>
<td>1027</td>
<td>10.20</td>
<td>10.45</td>
</tr>
<tr>
<td>1047</td>
<td>8.70</td>
<td>8.91</td>
</tr>
</tbody>
</table>

* Calculated by the compiler assuming validity of Henry's law.

**METHOD/APPARATUS/PROCEDURE:**

Elution technique.

The diagram and details of the apparatus used and procedure followed for gas solubility measurements are described in the original paper. In brief, the melt was saturated with chlorine by bubbling the gas through it. The chlorine dissolved was freed from the saturated melt by flushing it with argon. The liberated chlorine was absorbed in KI solution and iodine generated was titrated with a standard thiosulfate solution.

**SOURCE AND PURITY OF MATERIALS:**

Liquefied chlorine (99.5%) was used. Argon contained 0.008% oxygen and 0.04% nitrogen. The two gases were purified by bubbling through conc. H₂SO₄ and passing over P₂O₅. Dried and remelted "chemically pure" grade KCl and MgCl₂ were used.

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**

continued
### COMPONENTS:

1. Chlorine; Cl₂; [7782-50-5]
2. Potassium chloride; KCl; [7447-40-7]
3. Magnesium chloride; MgCl₂; [7786-30-3]

### ORIGINAL MEASUREMENTS:

Ryabukhin, Yu. M.
Zh. Neorg. Khim. 1962, 7, 1101 - 04;

### VARIABLES:

### EXPERIMENTAL VALUES:

Smoothed Data:

Temperature dependence of the solubility of Cl₂ in molten equimolar KCl - MgCl₂ is expressed by the equation:

\[
\log(C_1/\text{mol cm}^{-3}) = -4.940 - \frac{1432.9}{(T/K)} \quad \text{(compiler)}
\]

\[
\text{std. dev.} = 4.5\% \quad \text{(compiler)}
\]

The enthalpy of solution, ΔH, is estimated to be:

\[
\Delta H/\text{kJ mol}^{-1} = 27.4 \quad \text{(compiler)}
\]

### AUXILIARY INFORMATION

### METHOD/APPARATUS/PROCEDURE:

### SOURCE AND PURITY OF MATERIALS:

### ESTIMATED ERROR:

### REFERENCES:
COMPONENTS:
(1) Chlorine; Cl₂; [7782-50-5]
(2) Potassium chloride; KCl; [7447-40-7]
(3) Magnesium chloride; MgCl₂; [7786-30-3]

VARIABLES:
T/K = 773 - 1173
P/kPa = 36.447 - 102.338

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>Temperature/°C</th>
<th>P_{Cl₂}/atm</th>
<th>10^6 x₁/mole fraction</th>
<th>10^5 C₁/wt%</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>0.42</td>
<td>5.3</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>0.65</td>
<td>8.1</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>0.78</td>
<td>9.9</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td>1.01</td>
<td>12.2</td>
<td>102</td>
</tr>
<tr>
<td>650</td>
<td>0.39</td>
<td>7.1</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>0.61</td>
<td>11.7</td>
<td>98</td>
</tr>
<tr>
<td></td>
<td>0.80</td>
<td>14.9</td>
<td>125</td>
</tr>
<tr>
<td></td>
<td>1.00</td>
<td>18.2</td>
<td>150</td>
</tr>
<tr>
<td>750</td>
<td>0.36</td>
<td>10.7</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>0.63</td>
<td>15.6</td>
<td>129</td>
</tr>
<tr>
<td></td>
<td>0.75</td>
<td>18.4</td>
<td>154</td>
</tr>
<tr>
<td></td>
<td>1.01</td>
<td>22.3</td>
<td>190</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution or stripping method. The apparatus and the method used for gas solubility measurements have been described earlier (1). Dry Cl₂ gas was passed through about 150 g of the melt at a rate of 10 l/hr. After saturation, a portion of the melt was transferred into the desorber and flushed with nitrogen. The chlorine gas liberated was determined iodometrically.

SOURCE AND PURITY OF MATERIALS:
The method of preparation of the anhydrous melt from carnellite has been described earlier (1).

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
1. Lukmanova, T. L.; Vil'nyanskii, Ya. E.
COMPONENTS:
(1) Chlorine; Cl₂; [7782-50-5]
(2) Potassium chloride; KCl; [7447-40-7]
(3) Magnesium chloride; MgCl₂; [7786-30-3]

ORIGINAL MEASUREMENTS:
Lukmanova, T. L.; Vil'nyanskii, Ya. E.

VARIABLES:
T/K = 773 - 1173
P/kPa = 36.447 - 102.338

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>P_{Cl₂}/atm</th>
<th>10^6 x₁/mol fraction</th>
<th>10^5 C₁/wt%</th>
</tr>
</thead>
<tbody>
<tr>
<td>850</td>
<td>0.38</td>
<td>15.4</td>
<td>127</td>
</tr>
<tr>
<td></td>
<td>0.61</td>
<td>18.6</td>
<td>155</td>
</tr>
<tr>
<td></td>
<td>0.79</td>
<td>22.0</td>
<td>183</td>
</tr>
<tr>
<td></td>
<td>0.99</td>
<td>25.3</td>
<td>220</td>
</tr>
<tr>
<td>900</td>
<td>0.39</td>
<td>16.4</td>
<td>137</td>
</tr>
<tr>
<td></td>
<td>0.62</td>
<td>20.7</td>
<td>177</td>
</tr>
<tr>
<td></td>
<td>0.79</td>
<td>24.2</td>
<td>203</td>
</tr>
<tr>
<td></td>
<td>1.00</td>
<td>27.1</td>
<td>230</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:
(1) Chlorine; Cl₂; [7782-50-5]
(2) Potassium chloride; KCl; [7447-40-7]
(3) Cadmium chloride; CdCl₂; [10108-64-2]

VARIABLES:
T/K = 753 - 848
melt comp./mol% KCl = 33 - 63
P/kPa = 101.325 (1 atm)

EXPERIMENTAL VALUES:
The solubilities of chlorine in molten mixtures of KCl - CdCl₂ of different compositions are:

<table>
<thead>
<tr>
<th>melt comp./mol% KCl</th>
<th>t/°C</th>
<th>10⁷ C₂/mol ml⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>33</td>
<td>575</td>
<td>2.67 ± 0.32</td>
</tr>
<tr>
<td>50</td>
<td>575</td>
<td>4.21 ± 0.34</td>
</tr>
<tr>
<td>63</td>
<td>575</td>
<td>5.69 ± 0.26</td>
</tr>
<tr>
<td></td>
<td>530</td>
<td>5.57 ± 0.18</td>
</tr>
<tr>
<td></td>
<td>480</td>
<td>5.08 ± 0.08</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of solubility in the molten mixture KCl - CdCl₂ (63 - 37 mol%) can be expressed by the relation:

\[ \log(C₂/mol \text{ cm}^{-3}) = -5.843 - 336.4/(T/K) \] (compiler)

std. dev. = 1.0% (compiler)

The heat of solution, ΔH, in the melt KCl - CdCl₂ (63 - 37 mol%) is:

ΔH/kJ mol⁻¹ = 6.28

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution method.
The diagram and details of the apparatus and the procedure are given in the original publication. Chlorine gas is passed through the melt till saturated. A portion of the saturated melt is separated and flushed with argon. The chlorine gas liberated is reacted with KI and the iodine generated is titrated against a standard sodium thiosulfate solution.

SOURCE AND PURITY OF MATERIALS:
Potassium and cadmium chlorides were of reagent grade.
The chlorine gas had a purity better than 98%.
The KCl - CdCl₂ mixture was gradually heated under vacuum. Argon gas was blown in near the melting point. Dehydration was achieved by using Cl₂ and HCl.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
### COMPONENTS:

1. Chlorine; Cl₂; [7782-50-5]
2. Potassium chloride; KCl; [7447-40-7]
3. Lead chloride; PbCl₂; [7758-95-4]

### VARIABLES:

- \( T/K = 716 - 975 \)
- melt comp./\( NK_{Cl} = 0.23 - 0.70 \)
- P/kPa: 101.325 (1 atm.)

### EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>melt composition/( NK_{Cl} )</th>
<th>( t/°C )</th>
<th>( 10^6 C_1/\text{mol cm}^{-3} \text{ atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.23</td>
<td>454</td>
<td>1.41</td>
</tr>
<tr>
<td></td>
<td>566</td>
<td>3.44</td>
</tr>
<tr>
<td></td>
<td>635</td>
<td>5.40</td>
</tr>
<tr>
<td>0.48</td>
<td>443</td>
<td>1.84</td>
</tr>
<tr>
<td></td>
<td>574</td>
<td>1.70</td>
</tr>
<tr>
<td></td>
<td>692</td>
<td>1.59</td>
</tr>
<tr>
<td>0.60</td>
<td>513</td>
<td>1.90</td>
</tr>
<tr>
<td></td>
<td>581</td>
<td>1.58</td>
</tr>
<tr>
<td></td>
<td>671</td>
<td>1.32</td>
</tr>
<tr>
<td>0.70</td>
<td>588</td>
<td>1.77</td>
</tr>
<tr>
<td></td>
<td>648</td>
<td>1.52</td>
</tr>
<tr>
<td></td>
<td>702</td>
<td>1.40</td>
</tr>
</tbody>
</table>

### AUXILIARY INFORMATION

**METHOD/APPARATUS/PROCEDURE:**

Elution method.
A known volume of the melt at the desired temperature was saturated with chlorine by bubbling the gas through the melt. The dissolved chlorine is liberated by flushing the saturated melt with nitrogen. The freed chlorine is absorbed in aqueous KI solution and the iodine generated is determined by titration against a standard thiosulfate solution.

**SOURCE AND PURITY OF MATERIALS:**

Not described.

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**

Kowalski, M.; Harrington, G. W.
The temperature dependence of solubility is expressed by an equation of the type:

$$\log(C_2/cm^3 atm^{-1}) = a + b/(T/K)$$

The values of the coefficients $a$ and $b$, along with the heats of solution, $\Delta H$, for the dissolution of $Cl_2$ in molten KCl - PbCl$_2$ mixtures of different compositions are:

<table>
<thead>
<tr>
<th>Melt composition/ N$_{KCl}$</th>
<th>a&quot;</th>
<th>b&quot;</th>
<th>$\Delta H^*/kJ mol^{-1}$</th>
<th>std. dev.&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.23</td>
<td>-2.929</td>
<td>2125.4</td>
<td>33.2</td>
<td>0.26%</td>
</tr>
<tr>
<td>0.48</td>
<td>-5.978</td>
<td>174.7</td>
<td>-4.16</td>
<td>0.3%</td>
</tr>
<tr>
<td>0.60</td>
<td>-6.667</td>
<td>742.5</td>
<td>-14.1</td>
<td>0.4%</td>
</tr>
<tr>
<td>0.70</td>
<td>-6.631</td>
<td>755.2</td>
<td>-15.4</td>
<td>0.8%</td>
</tr>
</tbody>
</table>

* Based on about 20 measurements over temperature range studied.

* Estimated by the compiler.
Solutions of chlorine in molten NaCl - AlCl₃ obeyed Henry's law. The values of Henry's law constant, $K_H$, at different temperatures in NaCl - AlCl₃ melts of two different compositions are:

<table>
<thead>
<tr>
<th>Melt Composition/ mol% NaCl</th>
<th>$T/K$</th>
<th>$K_H \times 10^6$/ mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>40.1</td>
<td>432</td>
<td>12.59</td>
</tr>
<tr>
<td></td>
<td>454</td>
<td>10.76</td>
</tr>
<tr>
<td>50.4</td>
<td>434</td>
<td>9.39</td>
</tr>
<tr>
<td></td>
<td>452</td>
<td>8.13</td>
</tr>
<tr>
<td></td>
<td>472</td>
<td>6.84</td>
</tr>
<tr>
<td></td>
<td>495</td>
<td>6.0 ± 0.2</td>
</tr>
<tr>
<td></td>
<td>518</td>
<td>5.31</td>
</tr>
<tr>
<td></td>
<td>544</td>
<td>4.3 ± 0.1</td>
</tr>
</tbody>
</table>

Data in this table are derived from the graph given in the original paper, by the compiler.

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Manometric technique. The method used for chlorine solubility measurements was essentially the same as described elsewhere (1,2). The diagram of the apparatus is given in the original paper. Briefly, chlorine gas is filled into a thermostated volume above the melt. The drop in gas pressure, due to its solubility in the melt, is recorded as a function of time till a stable equilibrium pressure is reached. The gas solubility is calculated from the equilibrium gas pressure.

**SOURCE AND PURITY OF MATERIALS:**

Chlorine gas (ultra high purity) supplied by Matheson was used without further purification. NaCl, Merck, p.a., was evacuated while the temperature was slowly raised to above the melting point. The salt was crystallized from the melt and only clear crystals were used for the experiments.

**ESTIMATED ERROR:**

solubility: ± 4% (authors)

**REFERENCES:**

1. Zambonin, P. G.; Cardetta, V. L.; Signorile, G.
### COMPONENTS:

1. Chlorine; Cl₂; [7782-50-5]
2. Sodium chloride; NaCl; [7647-14-5]
3. Aluminum chloride; AlCl₃; [7446-70-0]

### ORIGINAL MEASUREMENTS:


### VARIABLES:

\[ \frac{\text{melt comp.}}{\text{mol% NaCl}} = 40.1 \text{ & } 50.4 \]

### EXPERIMENTAL VALUES:

Smoothed Data:

The temperature dependence of \( K_a \) in the melt containing 50.4 mol% NaCl can be expressed by the relation:

\[
\log(K_a) = -6.649 + \frac{704}{(T/K)}
\]

The enthalpy of solution, \( \Delta H \), is:

\[
\Delta H / \text{kJ mol}^{-1} = -13.6
\]

### METHOD/APPARATUS/PROCEDURE:

AlCl₃ (Fluka) was distilled twice and filtered through a quartz frit, leaving 10% behind each time. Some samples of AlCl₃ were purified by enclosing in a pyrex tube along with a very small amount of NaCl and high purity Al wire bits. The salt was melted and the ampoule slowly pulled out of the furnace. The impurities were left in the NaCl phase. This procedure was repeated.

### REFERENCES:

**COMPONENTS:**

1. Chlorine; Cl₂; [7782-50-5]
2. Sodium chloride; NaCl; [7647-14-5]
3. Aluminum chloride; AlCl₃; [7446-70-0]

**ORIGINAL MEASUREMENTS:**

Ratvik, A. P.; Ostvald, T.; Oye, H. A.


**VARIABLES:**

\[
\begin{align*}
T/K &= 450 - 1300 \\
\text{Melt comp./mol% AlCl₃} &= 0 - 60 \\
P/kPa &= 10^2
\end{align*}
\]

**EXPERIMENTAL VALUES:**

The validity of Henry's law was verified by measuring the solubility at various Cl₂ pressures. Temperature dependence of solubility, \( K_p \) (mol cm\(^{-3}\) bar\(^{-1}\)), can be expressed by the relation:

\[
\log K_p = A + B/T
\]

Values of the coefficients A and B for Cl₂ solubility in NaCl - AlCl₃ melts of various compositions are given below:

<table>
<thead>
<tr>
<th>Melt composition (mol % AlCl₃)</th>
<th>Temp. range (K)</th>
<th>A ±</th>
<th>B ±</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1100 - 1300</td>
<td>-4.263 ± 0.214</td>
<td>-2508.8 ± 259.2</td>
</tr>
<tr>
<td>5</td>
<td>1075 - 1275</td>
<td>-3.647 ± 0.204</td>
<td>-2927.3 ± 238.7</td>
</tr>
<tr>
<td>10</td>
<td>1100 - 1200</td>
<td>-3.803 ± 0.561</td>
<td>-2535.5 ± 643.9</td>
</tr>
<tr>
<td>20</td>
<td>1000 - 1300</td>
<td>-3.915 ± 0.123</td>
<td>-2120.9 ± 139.3</td>
</tr>
<tr>
<td>30</td>
<td>1000 - 1225</td>
<td>-4.563 ± 0.108</td>
<td>-1185.0 ± 119.4</td>
</tr>
<tr>
<td>40</td>
<td>950 - 1150</td>
<td>-4.724 ± 0.087</td>
<td>-845.0 ± 89.2</td>
</tr>
<tr>
<td>50</td>
<td>625 - 825</td>
<td>-5.754 ± 0.028</td>
<td>-271.5 ± 19.7</td>
</tr>
<tr>
<td>60</td>
<td>450 - 575</td>
<td>-5.012 ± 0.044</td>
<td>-542.7 ± 22.2</td>
</tr>
</tbody>
</table>

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Manometric method. The procedure used for gas solubility measurements was similar to the one described elsewhere(1,2). For details see the original publication.

**SOURCE AND PURITY OF MATERIALS:**

The quality and purification of salts have been described earlier(3).

**ESTIMATED ERROR:**

Not specified.

**REFERENCES:**

1. Waernes, O.; Ostvald, T.
2. Waernes, O.; Palmisano, F; Ostvald T; Acta Chem. Scand. 1983, A37, 207
   The Electrochem Soc. NJ. 1976, 111.
COMPONENTS:
(1) Chlorine; Cl₂; [7782-50-5]
(2) Cesium chloride; CsCl; [7647-17-8]
(3) Aluminium chloride; AlCl₃; [7446-70-0]

ORIGINAL MEASUREMENTS:
Waernes, O.; Ostvald, T.

VARIABLES:
T/K = 633 - 1000
melt comp/mol% AlCl₃ = 42.5 - 52.0
P/kPa = 26.664 - 119.990

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
Values of Henry's law constant, K_H, at various temperatures in CsCl-AlCl₃ melts of three different compositions are given below:

<table>
<thead>
<tr>
<th>Melt comp/mol% AlCl₃</th>
<th>T/°C</th>
<th>10^7 K_H/mol cm⁻³atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>42.5</td>
<td>390°</td>
<td>5.53 ± 0.03</td>
</tr>
<tr>
<td>43.5</td>
<td>360°</td>
<td>5.59 ± 0.29</td>
</tr>
<tr>
<td>52</td>
<td>377</td>
<td>5.22 ± 0.12</td>
</tr>
<tr>
<td>427</td>
<td></td>
<td>4.75</td>
</tr>
<tr>
<td>477</td>
<td></td>
<td>4.21</td>
</tr>
<tr>
<td>527</td>
<td></td>
<td>4.21</td>
</tr>
<tr>
<td>627</td>
<td></td>
<td>3.73 ± 0.01</td>
</tr>
<tr>
<td>727</td>
<td></td>
<td>3.60</td>
</tr>
</tbody>
</table>

* Saturated with CsCl. Melt composition is given as the intercept between the liquidus line and the actual melt temperature.

Linear regression analysis of the experimental data gives the following expression

log K_H = -5.824 + 360.1/T

with a relative standard deviation of 5% in K_H.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Manometric method.
The method used for gas solubility measurements was essentially the same as described earlier(1).
Due to high vapor pressure of chloroaluminate melts, Cl₂ gas dissolved in these melts was removed by reducing the Cl₂ pressure to 300 Torr, allowing the melt to remain at this pressure for equilibration.

SOURCE AND PURITY OF MATERIALS:
CsCl was purified as described earlier(1). AlCl₃ was distilled under vacuum just above the melting point. The procedure was repeated three times. Mixtures of AlCl₃+CsCl were prepared by melting and filtering of purified AlCl₃ and CsCl under vacuum. After remelting the filtrate was properly mixed and quenched. Purified salts were handled in a glove box under N₂ with water level < 2ppm.

ESTIMATED ERROR:
Not specified.

REFERENCES:
1. Waernes, O.; Palmisano, F.; Ostvald, T.
COMPONENTS:
(1) Chlorine; [7782-50-5]
(2) Cesium chloride; CsCl; [7647-17-8]
(3) Aluminum chloride; AlCl₃; [7446-70-0]

VARIABLES:
T/K = 650 - 1175
Melt comp./mol% AlCl₃ = 0 - 52
P/kPa = 10²

EXPERIMENTAL VALUES:
The validity of Henry's law was verified by measuring the solubility at various Cl₂ pressures. Temperature dependence of solubility, K_p (mol cm⁻³ bar⁻¹), can be expressed by the relation:

\[
\log K_p = A + \frac{B}{T}
\]

Values of the coefficients A and B for Cl₂ solubility in CsCl - AlCl₃ melts of various compositions are given below:

<table>
<thead>
<tr>
<th>Melt composition (mol% AlCl₃)</th>
<th>Temp. range (K)</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>975 - 1175</td>
<td>-5.383 ± 0.045</td>
<td>-114.2 ± 47.8</td>
</tr>
<tr>
<td>5</td>
<td>925 - 1125</td>
<td>-5.707 ± 0.032</td>
<td>252.0 ± 31.8</td>
</tr>
<tr>
<td>10</td>
<td>925 - 1200</td>
<td>-5.559 ± 0.022</td>
<td>123.5 ± 23.3</td>
</tr>
<tr>
<td>20</td>
<td>900 - 1200</td>
<td>-5.627 ± 0.020</td>
<td>220.8 ± 20.5</td>
</tr>
<tr>
<td>30</td>
<td>875 - 1100</td>
<td>-5.717 ± 0.022</td>
<td>315.5 ± 21.4</td>
</tr>
<tr>
<td>30</td>
<td>850 - 1025</td>
<td>-5.689 ± 0.046</td>
<td>293.6 ± 42.6</td>
</tr>
<tr>
<td>40</td>
<td>750 - 1075</td>
<td>-5.658 ± 0.023</td>
<td>257.2 ± 21.1</td>
</tr>
<tr>
<td>49</td>
<td>650 - 950</td>
<td>-5.669 ± 0.015</td>
<td>267.7 ± 11.5</td>
</tr>
<tr>
<td>52</td>
<td>650 - 875</td>
<td>-5.661 ± 0.062</td>
<td>263.3 ± 46.6</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Manometric method.
The procedure used for gas solubility measurements was similar to the one described elsewhere(1,2). For details see the original publication.

SOURCE AND PURITY OF MATERIALS:
The quality and purification of salts have been described earlier(3).

ESTIMATED ERROR:
Not specified.

REFERENCES:
COMPONENTS:
(1) Chlorine; Cl₂; [7782-50-5]
(2) Silver chloride; AgCl; [7783-90-6]
(3) Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS:
Sternberg, S.; Petrescu, V.

VARIABLES:
T/K = 673 - 973

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
Solubilities, C₁, of chlorine in molten AgCl - KCl at different temperature are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁻² C₁/mol cm⁻³</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>8.24</td>
</tr>
<tr>
<td>500</td>
<td>12.9</td>
</tr>
<tr>
<td>600</td>
<td>23.9</td>
</tr>
<tr>
<td>700</td>
<td>24.7</td>
</tr>
</tbody>
</table>

The gas pressure under which the solubility measurements are made is not reported. The solubility values may be taken to be approximate only.

Smoothed Data:
Temperature dependence of C₁ is expressed by the equation:

\[ \log(C₁/mol \text{ cm}^{-3}) = -4.402 - 1129.3/(T/K) \] (compiler)

std. dev. = 6.4%

The heat of solution, ΔH, is:

\[ \Delta H/kJ \text{ mol}^{-1} = + 15.65 \]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Chronopotentiometric method.

SOURCE AND PURITY OF MATERIALS:
Not reported.

ESTIMATED ERROR:
The solubility values are only approximate.

REFERENCES:
COMPONENTS:
(1) Chlorine; Cl₂; [7782-50-5]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Potassium chloride; KCl; [7758-40-7]
(4) Magnesium chloride; MgCl₂; [7786-30-3]

VARIABLES:
T/K = 988 - 1180
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:
The solubility of Cl₂, C in NaCl - KCl - MgCl₂ melts of various compositions at different temperatures are:

<table>
<thead>
<tr>
<th>Melt comp/ wt%</th>
<th>t/°C</th>
<th>10°C/mol cm⁻³</th>
<th>Melt comp/ wt%</th>
<th>t/°C</th>
<th>10°C/mol cm⁻³</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.55 NaCl -</td>
<td>750</td>
<td>3.31</td>
<td>39 NaCl -</td>
<td>715</td>
<td>0.595</td>
</tr>
<tr>
<td>4.45 KCl -</td>
<td>807</td>
<td>3.84</td>
<td>31 KCl -</td>
<td>751</td>
<td>1.06</td>
</tr>
<tr>
<td>80 MgCl₂</td>
<td>845</td>
<td>3.93</td>
<td>30 MgCl₂</td>
<td>800</td>
<td>2.30</td>
</tr>
<tr>
<td>903</td>
<td>3.92</td>
<td></td>
<td>870</td>
<td>904</td>
<td>4.18</td>
</tr>
<tr>
<td>16.6 NaCl -</td>
<td>744</td>
<td>1.06</td>
<td>47.2 NaCl -</td>
<td>730</td>
<td>1.38</td>
</tr>
<tr>
<td>13.4 KCl -</td>
<td>800</td>
<td>1.58</td>
<td>37.8 KCl -</td>
<td>770</td>
<td>1.71</td>
</tr>
<tr>
<td>70 MgCl₂</td>
<td>851</td>
<td>1.37</td>
<td>5 MgCl₂</td>
<td>810</td>
<td>2.44</td>
</tr>
<tr>
<td>905</td>
<td>1.69</td>
<td></td>
<td>850</td>
<td>3.08</td>
<td></td>
</tr>
<tr>
<td>27.7 NaCl -</td>
<td>715</td>
<td>0.566</td>
<td>53 NaCl -</td>
<td>905</td>
<td>3.50</td>
</tr>
<tr>
<td>23.3 KCl -</td>
<td>743</td>
<td>0.763</td>
<td>42 KCl -</td>
<td>977</td>
<td>1.84</td>
</tr>
<tr>
<td>50 MgCl₂</td>
<td>861</td>
<td>2.73</td>
<td>5 MgCl₂</td>
<td>853</td>
<td>2.48</td>
</tr>
<tr>
<td>902</td>
<td>3.39</td>
<td></td>
<td>907</td>
<td>3.00</td>
<td></td>
</tr>
</tbody>
</table>

SOURCE AND PURITY OF MATERIALS:
Liquified Cl₂ (≥99.5%) and argon meeting the GOST standard 10157-62 were used.
Dried and remelted chemically pure salts were used.

REFERENCES:

PREPARED BY:
N. P. Bansal

METHOD/APPARATUS/PROCEDURE:
Desorption Method: The melt was saturated with Cl₂ by bubbling the gas for about 1.5h at the rate of 6 - 10 liters/h. The melt was allowed to stand for 5 min. The melt was stripped of the dissolved Cl₂ by bubbling argon gas for about 20 mins. at a rate of 12 liters/h and the liberated gas was absorbed in a KI solution.
The salt was melted under a continuous flow of dry hydrogen chloride gas. The melt was purified with HCl gas for 0.5h followed by Ar gas for 0.5h. It took ~15 min. to saturate the chloride melt with HCl and ~15-20 mins. to expel the dissolved HCl by bubbling Ar gas.

ESTIMATED ERROR:
Not specified.

REFERENCES:
### COMPONENTS:

<table>
<thead>
<tr>
<th>Component</th>
<th>Formula</th>
<th>CAS Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorine</td>
<td>Cl₂</td>
<td>[7782-50-5]</td>
</tr>
<tr>
<td>Sodium chloride</td>
<td>NaCl</td>
<td>[7647-14-5]</td>
</tr>
<tr>
<td>Potassium chloride</td>
<td>KCl</td>
<td>[7447-40-7]</td>
</tr>
<tr>
<td>Magnesium chloride</td>
<td>MgCl₂</td>
<td>[7786-30-3]</td>
</tr>
</tbody>
</table>

### VARIABLES:

- \( T/K = 988 - 1180 \)
- \( P/kPa: 101.325 \) (1 atm.)

### EXPERIMENTAL VALUES:

Temperature dependence of the solubility of Cl₂ in NaCl - KCl - MgCl₂ melts of two compositions is given by the equations:

\[
C(\text{mol cm}^{-3}) = \frac{1.215 \times 10^{-2}}{T} \exp \left( \frac{-40660 - 30.3T}{RT} \right)
\]

in 15 NaCl - 75 KCl - 10MgCl₂ (wt%) in the temperature range 700 - 940°C and

\[
C(\text{mol cm}^{-3}) = \frac{1.215 \times 10^{-2}}{T} \exp \left( \frac{-24150 - 14.4T}{RT} \right)
\]

in 50 NaCl - 40 KCl - 10 MgCl₂ (wt%) in the temperature region 730 - 870°C. \( T \) is the temperature in kelvin and \( R \) is the gas constant.

### AUXILIARY INFORMATION

**METHOD/APPARATUS/PROCEDURE:**

Desorption Method: The melt was saturated with Cl₂ by bubbling the gas for about 1.5h at the rate of 6 - 10 liters/h. The melt was allowed to stand for 5 min. The melt was stripped of the dissolved Cl₂ by bubbling argon gas for about 20 mins. at a rate of 12 liters/h and the liberated gas was absorbed in a KI solution.

The salt was melted under a continuous flow of dry hydrogen chloride gas. The melt was purified with HCl gas for 0.5h followed by Ar gas for 0.5h. It took = 15 min. to saturate the chloride melt with HCl and =15-20 mins. to expel the dissolved HCl by bubbling Ar gas.

**SOURCE AND PURITY OF MATERIALS:**

- Liquified Cl₂ (=99.5%) and argon meeting the GOST standard 10157-62 were used.
- Dried and remelted chemically - pure salts were used.

**ESTIMATED ERROR:**

Not specified.

**REFERENCES:**


PREPARED BY:

N. P. Bansal
COMPONENTS:
(1) Chlorine; Cl₂; [7782-50-5]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Potassium chloride; KCl; [7447-40-7]
(4) Magnesium chloride; MgCl₂; [7786-30-3]
(5) Calcium chloride; CaCl₂; [10043-52-4]

VARIABLES:
T/K = 993 - 1213
p/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:

Temperature dependence of the solubility of Cl₂, C(mol cm⁻³), in 50 NaCl - 5KCl - 10MgCl₂ - 35CaCl₂ (wt%) melt is given by the expression:

\[
C(\text{mol cm}^{-3}) = \frac{1.215 \times 10^{-2}}{T} \exp \left[ -\frac{-34580}{RT} - 22.55T \right]
\]

where T is the temperature in kelvin and R is the gas constant.

METHOD/APPARATUS/PROCEDURE:
Desorption Method: The melt was saturated with Cl₂ by bubbling the gas for about 1.5h at the rate of 6 - 10 liters/h. The melt was allowed to stand for 5 min. The melt was stripped of the dissolved Cl₂ by bubbling argon gas for about 20 mins. at a rate of 12 liters/h and the liberated gas was absorbed in a KI solution.

The salt was melted under a continuous flow of dry hydrogen chloride gas. The melt was purified with HCl gas for 0.5h followed by Ar gas for 0.5h. It took ~15 min. to saturate the chloride melt with HCl and ~15-20 mins. to expel the dissolved HCl by bubbling Ar gas.

SOURCE AND PURITY OF MATERIALS:
Liquified Cl₂ (~99.5%) and argon meeting the GOST standard 10157-62 were used.
Dried and remelted chemically pure salts were used.

ESTIMATED ERROR:
Not specified.

REFERENCES:
COMPONENTS:
(1) Chlorine; Cl₂; [7782-50-5]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Potassium chloride; KCl; [7447-40-7]
(4) Magnesium chloride; MgCl₂; [7786-30-3]
(5) Barium chloride; BaCl₂; [10361-37-2]

VARIABLES:
T/K = 993 - 1093
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:

Temperature dependence of the solubility of Cl₂, C (mol cm⁻³), in 50 NaCl - 10KCl - 10MgCl₂ - 30BaCl₂ (wt%) melt is given by the relation:

\[
C \text{ (mol cm}^{-3} \text{)} = \frac{1.215 \times 10^{-2}}{T} \exp \left( -\frac{39620 - 28.53T}{RT} \right)
\]

where T is the temperature in kelvin and R is the gas constant.

ORIGINAL MEASUREMENTS:

PREPARED BY:
N. P. Bansal

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Desorption Method: The melt was saturated with Cl₂ by bubbling the gas for about 1.5h at the rate of 6 - 10 liters/h. The melt was allowed to stand for 5 min. The melt was stripped of the dissolved Cl₂ by bubbling argon gas for about 20 mins. at a rate of 12 liters/h and the liberated gas was absorbed in a KI solution.

The salt was melted under a continuous flow of dry hydrogen chloride gas. The melt was purified with HCl gas for 0.5h followed by Ar gas for 0.5h. It took ≈ 15 min. to saturate the chloride melt with HCl and ≈15-20 mins. to expel the dissolved HCl by bubbling Ar gas.

SOURCE AND PURITY OF MATERIALS:
Liquified Cl₂ (≈99.5%) and argon meeting the GOST standard 10157-62 were used.
Dried and remelted chemically pure salts were used.

ESTIMATED ERROR:
Not specified.

REFERENCES:
COMPONENTS:
(1) Bromine; Br₂; [7726-95-6]
(2) Lithium bromide; LiBr; [7550-35-8]

VARIABLES:
T/K = 890 & 981
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:
The solubilities of bromine in molten lithium bromide at two
temperatures, at one atmosphere pressure, are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁷ C₁/mol cm⁻³</th>
<th>10⁶ x₁/mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>617</td>
<td>17.5</td>
<td>61.0</td>
</tr>
<tr>
<td>709</td>
<td>10.4</td>
<td>37.2</td>
</tr>
</tbody>
</table>

Smoothed Data:
The temperature dependence of solubility is expressed by the relation:

\[ \log(C₁/mol \text{ cm}^{-3}) = -8.17 + \frac{2148}{(T/K)} \]  

std. dev. = 0.08%  

The standard heat of solution, \( ΔH^o \), for the dissolution of bromine is:

\[ ΔH^o/kJ \text{ mol}^{-1} = -39.7 \]

METHOD/APPARATUS/PROCEDURE:
Elution technique.
The diagram and details of the apparatus used and procedure followed for gas solubility measurements are given in the original paper. In brief, the melt was saturated with bromine by bubbling the gas through it. After saturation, the melt was purged with argon to free the dissolved bromine. The liberated bromine was passed through an aqueous KI solution and the iodine produced was titrated against a standard thiosulfate solution.

SOURCE AND PURITY OF MATERIALS:
Lithium bromide was treated by passing HBr gas through the salt powder while the temperature was raised from room temperature about 50°C above the melting point. Last traces of moisture were removed by bubbling HBr through the melt for about 2h. The dissolved HBr was removed by argon flushing. The melt was finally filtered through a quartz frit.

ESTIMATED ERROR:
Nothing specified

REFERENCES:
**COMPONENTS:**

(1) Bromine; Br₂; [7726-95-6]
(2) Sodium bromide; NaBr; [7647-15-6]

**ORIGINAL MEASUREMENTS:**

Wartenberg, H. U.

**VARIABLES:**

- one temperature: T/K = 1073
- P/kPa: 101.325 (compiler)

**PREPARED BY:**

N. P. Bansal

**EXPERIMENTAL VALUES:**

The solubility of Br₂ in molten NaBr at a single temperature has been reported as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁻⁶ Solubility/ wt. fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>800</td>
<td>26.9</td>
</tr>
</tbody>
</table>

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

The details of the apparatus used and procedure followed for gas solubility measurements are described in the original paper. Briefly, a quenched melt sample equilibrated with bromine was analyzed for the bromine content by reacting with KI solution and titration against a freshly standardized thiosulfate solution.

**SOURCE AND PURITY OF MATERIALS:**

Sodium bromide was pure and was dehydrated by heating with NH₄Cl and NH₄Br.

**ESTIMATED ERROR:**

Nothing specified

**REFERENCES:**
COMPONENTS:
(1) Bromine; Br₂; [7726-95-6]
(2) Potassium bromide; KBr; [7758-02-3]

VARIABLES: P/kPa: 101.325 (compiler)
one temperature: T/K = 1073

EXPERIMENTAL VALUES:
The solubility of Br₂ in molten KBr at a single temperature has been reported as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁵ Solubility/wt. fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>800 ± 5</td>
<td>98.2</td>
</tr>
</tbody>
</table>

ORIGINAL MEASUREMENTS:
Wartenberg, H. U.

PREPARED BY:
N. P. Bansal

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
The details of the apparatus used and the procedure followed for gas solubility measurements are described in the original paper. Briefly, a quenched melt sample equilibrated with bromine was analyzed for bromine content by reacting with KI solution and titration against a freshly standardized thiosulphate solution.

SOURCE AND PURITY OF MATERIALS:
Potassium bromide was pure and was dehydrated by heating with NH₄Cl and NH₄Br.

ESTIMATED ERROR:
Nothing specified

REFERENCES:
### COMPONENTS:

1. Bromine; Br$_2$; [7726-95-6]
2. Calcium bromide; CaBr$_2$; [7789-41-5]

### ORIGINAL MEASUREMENTS:

Wartenberg, H. U.

### VARIABLES:

- one temperature: T/K = 1073
- P/kPa: 101.325 (compiler)

### PREPARED BY:

N. P. Bansal

### EXPERIMENTAL VALUES:

The solubility of Br$_2$ in molten CaBr$_2$ at a single temperature has been reported as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10$^5$ Solubility/wt. fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>800 ± 5</td>
<td>18.4</td>
</tr>
</tbody>
</table>

### AUXILIARY INFORMATION

**METHOD/APPARATUS/PROCEDURE:**

The details of the apparatus used and the procedure followed for gas solubility measurements are given in the original paper. In brief, a quenched melt sample equilibrated with bromine was analyzed for the bromine content by reacting with KI solution and titration against a freshly standardized thiosulfate solution.

**SOURCE AND PURITY OF MATERIALS:**

Calcium bromide was pure and was dehydrated by heating with NH$_4$Cl and NH$_4$Br.

**ESTIMATED ERROR:**

Nothing specified

**REFERENCES:**
### COMPONENTS:

1. Bromine; Br₂; [7726-95-6]
2. Silver bromide; AgBr; [7785-23-1]

### ORIGINAL MEASUREMENTS:

Block-Bolten, A.; Flengas, S. N.

### VARIABLES:

<table>
<thead>
<tr>
<th>T/K</th>
<th>P/kPa: 101.325 (1 atm.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>760 - 950</td>
<td></td>
</tr>
</tbody>
</table>

### PREPARED BY:

N. P. Bansal

### EXPERIMENTAL VALUES:

The solubilities of bromine in molten AgBr at different temperatures, at one atmosphere pressure of bromine, are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁴ C₁/mol cm⁻³</th>
<th>10³ x₁/mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>760</td>
<td>1.076</td>
<td>3.66</td>
</tr>
<tr>
<td>790</td>
<td>0.985</td>
<td>3.38</td>
</tr>
<tr>
<td>810</td>
<td>0.865</td>
<td>2.97</td>
</tr>
<tr>
<td>860</td>
<td>0.645</td>
<td>2.24</td>
</tr>
<tr>
<td>862</td>
<td>0.639          *</td>
<td>2.22*</td>
</tr>
<tr>
<td>885</td>
<td>0.543</td>
<td>1.89</td>
</tr>
<tr>
<td>897</td>
<td>0.491          *</td>
<td>1.71*</td>
</tr>
<tr>
<td>950</td>
<td>0.414          *</td>
<td>1.46*</td>
</tr>
</tbody>
</table>

* Values by spring balance; other values by torsion balance.

The temperature dependence of solubility are given by the equations:

\[
\log(C₁/mol \text{ cm}^{-3}) = -6.32 + \frac{1830}{(T/K)}
\]

(compiler)

\[
\log(x₁/mol \text{ fraction}) = -4.72 + \frac{1776}{(T/K)}
\]

(compiler)

std. dev. = 1.5% (compiler)

\[\Delta H_{\text{soln}}(\text{KJ mol}^{-1}) = -34.60 \pm 2.51;\]

\[\Delta S_{\text{soln}}(\text{JK}^{-1}\text{mol}^{-1}) = -40.2 \text{ (at 860K)};\]

### AUXILIARY INFORMATION

**METHOD/APPARATUS/PROCEDURE:**

Gravimetric method.

A quartz spring thermobalance, and the Ruska - Worden torsion quartz - fiber type microbalance were used. For further details about the experimental arrangement and the procedure followed for solubility measurements, refer to the original paper.

**SOURCE AND PURITY OF MATERIALS:**

Not described.

**ESTIMATED ERROR:**

Nothing specified

**REFERENCES:**
COMPONENTS:
(1) Bromine; Br₂; [7726-95-6]
(2) Lead bromide; PbBr₂; [10031-22-8]

VARIABLES:
T/K = 703 - 792
P/kPa: 101.325 (1 atm.)

ORIGINAL MEASUREMENTS:
Van Norman, J. D.; Tivers, R. J.

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:

The solubilities of bromine in molten lead bromide at two temperatures, at one atmosphere pressure, are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁻⁷ C₄/mol cm⁻³</th>
<th>10⁻⁶ x₄/mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>430</td>
<td>13.9</td>
<td>92.1</td>
</tr>
<tr>
<td>519</td>
<td>12.3</td>
<td>83.2</td>
</tr>
</tbody>
</table>

Smoothed Data:

The temperature dependence of solubility is expressed by the equation:

\[ \log(\text{C}_4/\text{mol cm}^{-3}) = -6.33 + \frac{332}{(T/K)} \] (compiler)

std. dev. = 0.05% (compiler)

The standard heat of solution, \(\Delta H^\circ\), for the dissolution of bromine is:

\[ \frac{\Delta H^\circ}{\text{kJ mol}^{-1}} = -5.4 \]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Elution technique.

The diagram and details of the apparatus used and procedure followed for gas solubility measurements are given in the original paper. In brief, the melt was saturated with bromine by bubbling the gas through it. After saturation, the melt was purged with argon to free the dissolved bromine. The liberated bromine was absorbed in an aqueous KI solution and the iodine produced was titrated against a standard thiosulfate solution.

SOURCE AND PURITY OF MATERIALS:

Lead bromide was treated by passing HBr gas through the salt powder while the temperature was slowly raised from room temperature to about 50°C above the melting point. Last traces of moisture were removed by bubbling HBr through the melt for about 2 hrs. The dissolved HBr was removed by argon flushing. Finally, the melt was filtered through a quartz frit.

ESTIMATED ERROR:

solubility: ± 15% (compiler)

REFERENCES:
COMPONENTS:

(1) Bromine; Br₂; [7726-95-6]
(2) Lithium bromide; LiBr; [7550-35-8]
(3) Potassium bromide; KBr; [7758-02-3]

VARIABLES:

one temperature: T/K = 673

ORIGINAL MEASUREMENTS:

Greenberg, J.; Sundheim, B. R.

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

Solubility, C, of bromine in molten LiBr - KBr eutectic at the gas pressure of slightly less than one atmosphere is reported as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>Solubility/molar</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>10⁻³ - 10⁻⁴</td>
</tr>
</tbody>
</table>

METHOD/APPARATUS/PROCEDURE:

High temperature spectroscopy.

The technique for obtaining absorption spectra of molten salt solutions has been described elsewhere (1).

SOURCE AND PURITY OF MATERIALS:

Analytical grade LiBr and KBr were used without further purification except for careful drying.

ESTIMATED ERROR:

Nothing specified

REFERENCES:

1. Sundheim, B. R.; Greenberg, J.
COMPONENTS:

(1) Iodine; I₂; [7553-56-2]
(2) Sodium iodide; NaI; [7681-82-5]

ORIGINAL MEASUREMENTS:

Wartenberg, H. U.

VARIABLES:

one temperature: T/K = 973
P/kPa: 101.325 (compiler)

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

The solubility of iodine in molten NaI at a single temperature has been reported as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10² Solubility/wt. fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td>± 5 2.87</td>
</tr>
</tbody>
</table>

* approximate value only

AUXILIARY INFORMATION

METHOD APPARATUS PROCEDURE:

The details of the apparatus used and procedure followed for gas solubility measurements are given in the original paper. In brief, a quenched melt sample equilibrated with iodine was analyzed for the iodine content by titration against a freshly standardized thiosulfate solution.

SOURCE AND PURITY OF MATERIALS:

Sodium iodide was pure and was dehydrated by heating with NH₄Cl and NH₄Br

ESTIMATED ERROR:

The solubility value is only approximate. (author)

REFERENCES:
**COMPONENTS:**

(1) Iodine; I₂; [7553-56-2]

(2) Potassium iodide; KI; [7681-11-0]

**ORIGINAL MEASUREMENTS:**

Wartenberg, H. U.

**VARIABLES:**

one temperature: T/K = 973
P/kPa: 101.325 (compiler)

**PREPARED BY:**

N. P. Bansal

**EXPERIMENTAL VALUES:**

The solubility of iodine in molten KI at a single temperature has been reported as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10³ Solubility/wt. fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>700 ± 5</td>
<td>6.29^a</td>
</tr>
</tbody>
</table>

^a approximate value only

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

The details of the apparatus used and procedure employed for gas solubility measurements are given in the original paper. In brief, a quenched melt sample equilibrated with iodine was analyzed for the iodine content by titration against a freshly standardized thiosulfate solution.

**SOURCE AND PURITY OF MATERIALS:**

Potassium iodide was pure and was dehydrated by heating with NH₄Cl and NH₄Br.

**ESTIMATED ERROR:**

The solubility value is only approximate. (author)

**REFERENCES:**

COMPONENTS:
(1) Iodine; \( I_2 \); [7553-56-2]
(2) Lithium nitrate; \( \text{LiNO}_3 \); [7790-69-4]
(3) Potassium nitrate; \( \text{KNO}_3 \); [7757-79-1]

ORIGINAL MEASUREMENTS:
Sacchetto, G. A.; Bombi, G. G.; Fiorani, M.

VARIABLES:
\[ \frac{T}{K} = 415 - 512 \]
\[ \frac{P}{\text{kPa}} = 1.814 - 37.490 \]

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
Solubilities, \( C_1 \), of iodine in the molten \( \text{LiNO}_3 - \text{KNO}_3 \) (43 - 57 mol%) mixture, in the temperature interval 415 - 512 K, are presented in the form of a \( \log C_1 \) vs. \( 1/T \) plot. Solubility of iodine at 450 K is given as:

<table>
<thead>
<tr>
<th>( T/K )</th>
<th>( C_1 \times 10^3/\text{mol kg}^{-1} \text{ atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>450</td>
<td>1.46 ± 0.13</td>
</tr>
</tbody>
</table>

Smoothened Data:

Temperature dependence of \( C_1 \) is expressed by the relation:

\[ \log C_1 = -2.836 + 962(1/T - 1/450) \quad (T = 415 - 512 \text{ K}) \]

The enthalpy of solution, \( \Delta H \), and the entropy of solution, \( \Delta S \), are:

\[ \Delta H/\text{kJ mol}^{-1} = -18.41 ± 5.02 \]
\[ \Delta S/\text{J K}^{-1} \text{ mol}^{-1} = -94.98 ± 10.88 \]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
A mixture of iodine and nitrogen at a known partial pressure of iodine was passed through the melt. A part of the molten solution was quenched and dissolved in aqueous KI solution and its absorbance at 350 nm was measured with a Zeiss PMQ II spectrophotometer.

SOURCE AND PURITY OF MATERIALS:
Iodine from C. Erba, Milan, was used without further purification. Reagent grade lithium and potassium nitrates from C. Erba, Milan were used. The procedure employed for preparing the molten salt solvent has been described elsewhere (1).

ESTIMATED ERROR:
Nothing specified

REFERENCES:
1. Mazzocchin, G. A.; Bombi, G. G.; Fiorani, M.
J. Electroanal. Chem. 1968, 17, 95.
**COMPONENTS:**
(1) Iodine; I₂; [7553-56-2]
(2) Lithium chloride; LiCl; [7447-41-8]
(3) Potassium chloride; KCl; [7447-40-7]

**ORIGINAL MEASUREMENTS:**
Greenberg, J.; Sundheim, B. R.

**VARIABLES:**
- one temperature: T/K = 673
- P/kPa: 101.325 (compiler)

**PREPARED BY:**
N. P. Bansal

**EXPERIMENTAL VALUES:**
The solubility of iodine in molten LiCl - KCl eutectic at a single temperature is reported as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>Solubility/molar</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>10⁻³ - 10⁻⁴</td>
</tr>
</tbody>
</table>

**METHOD/APPARATUS/PROCEDURE:**
High temperature spectroscopy.

The technique for obtaining absorption spectra of molten salt solutions has been described elsewhere (1).

**SOURCE AND PURITY OF MATERIALS:**
Analytical grade LiCl and KCl were used without further purification except for careful drying.

**ESTIMATED ERROR:**
Nothing specified

**REFERENCES:**
1. Sundheim, B. R.; Greenberg, J.
### COMPONENTS:

1. Iodine; \( I_2 \); [7553-56-2]
2. Lithium iodide; LiI; [10377-51-2]
3. Potassium iodide; KI; [7681-11-0]

### ORIGINAL MEASUREMENTS:

Greenberg, J.; Sundheim, B. R.

### VARIABLES:

- One temperature: \( T/K = 673 \)
- Pressure/kPa: 101.325 (compiler)

### EXPERIMENTAL VALUES:

The solubility of iodine in molten LiI - KI eutectic at one temperature is reported as:

<table>
<thead>
<tr>
<th>( t/)°C</th>
<th>Solubility/molar</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>( 10^{-3} - 10^{-4} )</td>
</tr>
</tbody>
</table>

### AUXILIARY INFORMATION

**METHOD/APPARATUS/PROCEDURE:**

High temperature spectroscopy.

The technique for obtaining absorption spectra of molten salt solutions has been described elsewhere (1).

**SOURCE AND PURITY OF MATERIALS:**

Analytical grade LiI and KI were used without further purification except for careful drying.

**ESTIMATED ERROR:**

Nothing specified

**REFERENCES:**

1. Sundheim, B. R.; Greenberg, J.
## COMPONENTS:

1. Carbon monoxide; \( \text{CO; [630-08-0]} \)
2. Magnesium chloride; \( \text{MgCl}_2; [7786-30-3] \)

## ORIGINAL MEASUREMENTS:

Prutskov, D. V.; Krivoruchko, N. P.; Prisyashnyi, V. D.

## VARIABLES:

- \( P/\text{kPa} \): 101.325 (compiler)
- \( T/\text{K} \) = 1023 - 1223

## EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>( T/\text{K} )</th>
<th>( 10^7 \text{K}_{p}/\text{mol cm}^{-3} \text{atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1023</td>
<td>4.59 ± 0.52</td>
</tr>
<tr>
<td>1073</td>
<td>4.31 ± 0.36</td>
</tr>
<tr>
<td>1123</td>
<td>3.65 ± 0.29</td>
</tr>
<tr>
<td>1173</td>
<td>3.48 ± 0.32</td>
</tr>
<tr>
<td>1223</td>
<td>3.24 ± 0.27</td>
</tr>
</tbody>
</table>

Temperature dependence of \( K_p \) can be expressed by the relation:

\[
\log K_p = -7.356 + \frac{1043}{T}
\]

## AUXILIARY INFORMATION

### METHOD/APPARATUS/PROCEDURE:

Elution method.

The melt was prepared by melting the chloride under dry \( \text{HCl} \) atmosphere. The melt was saturated with CO gas by bubbling at the rate of 3-5 lit/h. It was established that saturation was attained in 50-60 min. Argon was bubbled at the rate of 6-9 lit/h through the saturated melt to liberate the dissolved CO gas. In order to determine the amount of dissolved CO, it was oxidized to \( \text{CO}_2 \) by passing over powdered \( \text{CuO} \) at 800 - 900 K. The resulting \( \text{CO}_2 \) was absorbed in 0.0175M \( \text{Ba(OH)}_2 \) solution excess of which was titrated against potassium biphthalate.

The experiment was repeated 4 - 5 times.

### SOURCE AND PURITY OF MATERIALS:

High purity \( \text{MgCl}_2 \) was recrystallized twice from doubly distilled water and dried in a vacuum oven without permitting melting of the hydrated salt.

Argon gas was purified to remove \( \text{H}_2\text{O} \) and \( \text{O}_2 \) by passing through columns containing \( \text{P}_2\text{O}_5 \) and titanium sponge heated at 1200 K.

\( \text{CO} \) gas was produced through decomposition of formic acid.

### ESTIMATED ERROR:

Not specified.

### REFERENCES:
**COMPONENTS:**

1. Carbon monoxide; CO; [630-08-0]
2. Calcium chloride; CaCl$_2$; [10043-52-4]

**ORIGINAL MEASUREMENTS:**

- Prutskov, D. V.; Krivoruchko, N. P.; Prisyashnyi, V. D.
- Rasplavy 1988, 2, 70 - 73.

**VARIABLES:**

- $P$/kPa: 101.325 (compiler)
- $T$/K = 1073 - 1123

**EXPERIMENTAL VALUES:**

Gas solubilities, $K_p$(mol cm$^{-3}$atm$^{-1}$), in the melt at various temperatures are given below, where $K_p$ is the Henry's law constant.

<table>
<thead>
<tr>
<th>$T$/K</th>
<th>$10^7 K_p$/mol cm$^{-3}$ atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1073</td>
<td>1.02 ± 0.12</td>
</tr>
<tr>
<td>1093</td>
<td>0.98 ± 0.09</td>
</tr>
<tr>
<td>1113</td>
<td>0.94 ± 0.10</td>
</tr>
<tr>
<td>1123</td>
<td>0.93 ± 0.07</td>
</tr>
</tbody>
</table>

Temperature dependence of $K_p$ can be expressed by the relation:

$$\log K_p = -7.940 + \frac{1012}{T}$$

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

- Elution method.
  - The melt was prepared by melting the chloride under dry HCl atmosphere. The melt was saturated with CO gas by bubbling at the rate of 3-5 lit/h. It was established that saturation was attained in 50-60 min. Argon was bubbled at the rate of 6-9 lit/h through the saturated melt to liberate the dissolved CO gas. In order to determine the amount of dissolved CO, it was oxidized to CO$_2$ by passing over powdered CuO at 800 - 900 K. The resulting CO$_2$ was absorbed in 0.0175M Ba(OH)$_2$ solution excess of which was titrated against potassium biphthalate.
  - The experiment was repeated 4 - 5 times.

**SOURCE AND PURITY OF MATERIALS:**

- High purity CaCl$_2$ was recrystallized twice from doubly distilled water and dried in a vacuum oven without permitting melting of the hydrated salt.
- Argon gas was purified to remove H$_2$O and O$_2$ by passing through columns containing P$_2$O$_5$ and titanium sponge heated at 1200 K.
- CO gas was produced through decomposition of formic acid.

**ESTIMATED ERROR:**

Not specified.

**REFERENCES:**
COMPONENTS:
(1) Carbon monoxide; CO; [630-08-0]
(2) Strontium chloride; SrCl₂; [10476-85-4]

ORIGINAL MEASUREMENTS:
Prutskov, D. V.; Krivoruchko, N. P.; Prisyashnyi, V. D.
Rasplavy 1988, 2, 70 - 73.

VARIABLES:
P/kPa: 101.325 (compiler)
T/K = 1173 - 1323

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
Gas solubilities, $K_p$ (mol cm⁻³ atm⁻¹), in the melt at various temperatures are given below, where $K_p$ is the Henry's law constant.

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^7 K_p$/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>1173</td>
<td>1.25 ± 0.13</td>
</tr>
<tr>
<td>1213</td>
<td>1.01 ± 0.14</td>
</tr>
<tr>
<td>1253</td>
<td>0.99 ± 0.09</td>
</tr>
<tr>
<td>1293</td>
<td>0.98 ± 0.11</td>
</tr>
<tr>
<td>1323</td>
<td>0.97 ± 0.12</td>
</tr>
</tbody>
</table>

Temperature dependence of $K_p$ can be expressed by the relation:

$$\log K_p = -7.816 + \frac{1041}{T}$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution method.
The melt was prepared by melting the chloride under dry HCl atmosphere. The melt was saturated with CO gas by bubbling at the rate of 3-5 lit/h. It was established that saturation was attained in 50-60 min. Argon was bubbled at the rate of 6-9 lit/h through the saturated melt to liberate the dissolved CO gas. In order to determine the amount of dissolved CO, it was oxidized to CO₂ by passing over powdered CuO at 800 - 900 K. The resulting CO₂ was absorbed in 0.0175M Ba(OH)₂ solution excess of which was titrated against potassium bipthalate.
The experiment was repeated 4 - 5 times.

SOURCE AND PURITY OF MATERIALS:
High purity SrCl₂ was recrystallized twice from doubly distilled water and dried in a vacuum oven without permitting melting of the hydrated salt.
Argon gas was purified to remove H₂O and O₂ by passing through columns containing P₂O₅ and titanium sponge heated at 1200 K.
CO gas was produced through decomposition of formic acid.

ESTIMATED ERROR:
Not specified.

REFERENCES:
COMPONENTS:

(1) Carbon monoxide; CO; [630-08-0]

(2) Barium chloride; BaCl₂; [10361-37-2]

ORIGINAL MEASUREMENTS:

Prutskov, D. V.; Krivoruchko, N. P.; Prisyashnyi, V. D.
Rasplavy 1988, 2, 70 - 73.

VARIABLES:

P/kPa: 101.325 (compiler)

T/K = 1253 - 1373

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

Gas solubilities, $K_p$ (mol cm⁻³ atm⁻¹), in the melt at various temperatures are given below, where $K_p$ is the Henry's law constant.

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^7 K_p$/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>1253</td>
<td>0.75 ± 0.12</td>
</tr>
<tr>
<td>1293</td>
<td>0.98 ± 0.12</td>
</tr>
<tr>
<td>1333</td>
<td>1.02 ± 0.17</td>
</tr>
<tr>
<td>1373</td>
<td>1.37 ± 0.23</td>
</tr>
</tbody>
</table>

Temperature dependence of $K_p$ can be expressed by the relation:

$$\log K_p = -4.599 - \frac{3154}{T}$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Elution method.

The melt was prepared by melting the chloride under dry HCl atmosphere. The melt was saturated with CO gas by bubbling at the rate of 3-5 lit/h. It was established that saturation was attained in 50-60 min. Argon was bubbled at the rate of 6-9 lit/h through the saturated melt to liberate the dissolved CO gas. In order to determine the amount of dissolved CO, it was oxidized to CO₂ by passing over powdered CuO at 800 - 900 K. The resulting CO₂ was absorbed in 0.0175M Ba(OH)₂ solution excess of which was titrated against potassium bipthalate.

The experiment was repeated 4 - 5 times.

SOURCE AND PURITY OF MATERIALS:

High purity BaCl₂ was recrystallized twice from doubly distilled water and dried in a vacuum oven without permitting melting of the hydrated salt.

Argon gas was purified to remove H₂O and O₂ by passing through columns containing P₂O₅ and titanium sponge heated at 1200 K.

CO gas was produced through decomposition of formic acid.

ESTIMATED ERROR:

Not specified.

REFERENCES:
COMPONENTS:

(1) Carbon monoxide; CO; [630-08-0]
(2) Lithium carbonate; Li₂CO₃; [554-13-2]

ORIGINAL MEASUREMENTS:

Appleby, A. J.; Van Drunen, C.

VARIABLES:

P/kPa: 101.325 (1 atm.)
T/K = 1073 & 1123

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:

Solubilities of CO in the molten Li₂CO₃ at two temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁴ C₁⁻/mol dm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>800</td>
<td>0.59 ± 0.09</td>
</tr>
<tr>
<td>850</td>
<td>2.25 ± 0.36</td>
</tr>
</tbody>
</table>

The solubility of CO in molten Li₂CO₃ appears to be entirely chemical.

Smoothed Data:

The heat of solution, ΔH, for the solubility of CO in the melt is:

ΔH/kJ mol⁻¹ = 250.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Quenching or chilling method.
The diagram and details of the apparatus used and the procedure followed are described in the original paper. Briefly, the melt was saturated by bubbling the gas for 2 - 3 hrs. A portion of the saturated melt was transferred into the chilling compartment where it was slowly quenched to allow all of the gases to escape. The liberated gas was flushed with a stream of helium into a U - tube containing activated Linde 5A molecular sieve. The contents of the tube, after being allowed to come to room temperature, were flushed with a stream of carrier gas into a Fisher - Hamilton gas partitioner with Linde 5A column and Katharometer detector for analysis. About 8 - 10 independent measurements were made.

SOURCE AND PURITY OF MATERIALS:

Not described.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:
## COMPONENTS:
(1) Carbon monoxide; CO; [630-08-0]
(2) Lithium nitrate; LiNO₃; [7790-69-4]
(3) Potassium nitrate; KNO₃; [7757-79-1]

## ORIGINAL MEASUREMENTS:
Allulli, S.

## VARIABLES:
one temperature: T/K = 433

## EXPERIMENTAL VALUES:
The solubility of carbon monoxide in the molten eutectic LiNO₃ - KNO₃ at 433K was found to be too small (<10⁻⁷ mol fraction torr⁻¹) to be measured with the experimental technique used.

## METHOD/APPROATUS/PROCEDURE:
Manometric technique.

## SOURCE AND PURITY OF MATERIALS:
CO from Gerling Halz & Co., Hamburg, was used without further purification. Its purity, checked by mass spectrometry, was better than 99.5%.

LiNO₃ (ERBA RP) was dehydrated at 70°C to avoid hydrolysis. KNO₃ (ERBA RP) was finely powdered and dried under vacuum at 110°C for 24 hr.

## ESTIMATED ERROR:
Nothing specified

## REFERENCES:
COMPONENTS:
(1) Carbon monoxide; CO; [630-08-0]
(2) Sodium nitrate; NaNO₃; [7631-99-4]
(3) Potassium nitrate; KNO₃; [7757-79-1]

ORIGINAL MEASUREMENTS:
Desimoni, E.; Paniccia, F.; Zambonin, P. G.

VARIABLES:
T/K = 508 - 573
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:
The solvent was an equimolar molten mixture of sodium nitrate - potassium nitrate. The solubilities of carbon monoxide in the melt at various temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁻⁷ K_H/mol cm⁻³ bar⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>508</td>
<td>0.123</td>
</tr>
<tr>
<td>533</td>
<td>0.152</td>
</tr>
<tr>
<td>573</td>
<td>0.204</td>
</tr>
</tbody>
</table>

Smoothed Data:
The temperature dependence of Henry's law constant, K_H, is given by the relation:

\[ \log(K_H/mol \text{ cm}^{-3} \text{ bar}^{-1}) = -5.98 - 980/(T/K) \]

std. dev. = 0.12% (compiler)

The heat of solution, \( \Delta H \), and the standard entropy of solution, \( \Delta S^\circ \), are:

\[ \Delta H/\text{kJ mol}^{-1} = 18 \]

\[ \Delta S^\circ/\text{J K}^{-1} \text{ mol}^{-1} = -26 \text{ (at 533 K) } \]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
High sensitivity pressure measuring technique.
The diagram and details of the apparatus are described elsewhere (1). The melt was evacuated at 10⁻⁵ bar for several hours for degassing. The vacuum was disconnected and carbon monoxide was introduced at one atm. The melt was vigorously stirred with a magnetic stirrer. The pressure variations were noted, with a high precision differential manometer, as a function of time until the equilibrium pressure was reached. The amount of gas dissolved was calculated from the rapid initial pressure changes after a suitable calibration.

SOURCE AND PURITY OF MATERIALS:
Carbon monoxide (High Purity grade) was further purified by keeping it in contact with Ascarite (A. H. Thomas Co., Philadelphia) to remove carbon dioxide and with molecular sieve 5Å (Carlo Erba, Milano) at -80°C to remove moisture. The final water content was <10 ppm.
The sodium and potassium nitrates were of reagent grade (Carlo Erba, Milano). The solvent was purified and filtered in the molten state.

ESTIMATED ERROR:
Nothing specified

REFERENCES:
1. Desimoni, E.; Paniccia, F.; Zambonin, P. G.
COMPONENTS:
(1) Carbon monoxide; CO; [630-08-0]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS:
Zeyanov, S. P.; Ll'ichev, V. A.
1972, 17, 1329 - 30. (*).

VARIABLES:
\[ \frac{P}{kPa} = 10.133 - 101.325 \]
\[ T/K = 963 - 1173 \]

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The solubilities, \( C_1 \), of CO in molten NaCl - KCl (50 - 50 mol%) at different temperatures are:

<table>
<thead>
<tr>
<th>( t/\degree C )</th>
<th>( 10^7 C_1/\text{mol cm}^{-3} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>690</td>
<td>2.78</td>
</tr>
<tr>
<td>705</td>
<td>2.95</td>
</tr>
<tr>
<td>755</td>
<td>3.42</td>
</tr>
<tr>
<td>800</td>
<td>3.86</td>
</tr>
<tr>
<td>805</td>
<td>3.92</td>
</tr>
<tr>
<td>875</td>
<td>4.74</td>
</tr>
<tr>
<td>895</td>
<td>4.98</td>
</tr>
<tr>
<td>900</td>
<td>5.07</td>
</tr>
</tbody>
</table>

Gas pressure at which solubilities are measured, not given.

Smoothed Data:
Variation of the solubility with temperature is expressed by the equation:

\[ \log(C_1/\text{mol cm}^{-3}) = -5.116 - 1388.3/(T/K) \]  

std. dev. 0.34%  

The heat of solution, \( \Delta H \), has been estimated to be:

\[ \Delta H/\text{kJ mol}^{-1} = 26.6 \]  

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution method.

The diagram and details of the apparatus used and procedure followed are given in the original paper. In brief, the melt was saturated with CO by bubbling the gas through it. A part of the saturated melt was transferred into the desorber and purged with argon to liberate the dissolved CO. The carbon monoxide was oxidized to carbon dioxide by passing the mixture of CO and argon from the desorber over copper (II) oxide heated to 673 - 773 K. The carbon dioxide was absorbed in 0.005N barium hydroxide solution. The excess of hydroxide was back titrated with hydrochloric acid and thymol phthalein.

SOURCE AND PURITY OF MATERIALS:
Carbon monoxide was prepared by the decomposition of formic acid in concentrated sulfuric acid. It was further purified and dried. Argon used was to specification GOST10157-62.
"Chemically Pure" grade NaCl and KCl were used.

ESTIMATED ERROR:
Nothing specified

REFERENCES:
**COMPONENTS:**
1. Carbon monoxide; CO; [630-08-0]
2. Potassium chloride; KCl; [7447-40-7]
3. Magnesium chloride; MgCl₂; [7786-30-3]

**ORIGINAL MEASUREMENTS:**
Lukmanova, T. L., Vil'nyanskii, Ya. E.

**VARIABLES:**
\[ \frac{T}{K} = 773 - 1123 \]
\[ P_{CO}/\text{atm} = 0.2 - 1.0 \]

**PREPARED BY:**
N. P. Bansal

**EXPERIMENTAL VALUES:**
The solubilities of carbon monoxide in molten equimolar KCl - MgCl₂ at 500, 650, 750 and 850°C are presented in the form of a figure, as a function of pressure. It is not possible to read precise values of solubility from the figure which is too small.

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**
Elution or stripping method.
The apparatus and the method used for gas solubility measurements have been described earlier (1). Dry CO gas was passed through about 170 g of the melt at a rate of 10 l/hr. After saturation, a portion of the melt was transferred into the desorber and flushed with nitrogen. The liberated CO was determined by oxidation with \( \text{I}_2\text{O}_5 \).

**SOURCE AND PURITY OF MATERIALS:**
The method for preparation of the anhydrous melt from carnallite has been described elsewhere (1).

**ESTIMATED ERROR:**
Nothing specified

**REFERENCES:**
1. Lukmanova, T. L.; Vil'nyanskii, Ya. E.
**COMPONENTS:**

1. Carbon monoxide; CO; [630-08-0]
2. Lithium carbonate; Li₂CO₃; [554-13-2]
3. Sodium carbonate; Na₂CO₃; [497-19-8]

**ORIGINAL MEASUREMENTS:**

Appleby, A. J.; Van Drunen, C.

**VARIABLES:**

P/kPa: 101.325 (1 atm.)
T/K = 1023 - 1123

**PREPARED BY:**

N. P. Bansal

**EXPERIMENTAL VALUES:**

Solubilities of CO in the melt Li₂CO₃ - Na₂CO₃ (53.3 - 46.7 mol%) at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁻⁴ C₁⁻³/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>750</td>
<td>3.04 ± 0.24</td>
</tr>
<tr>
<td>800</td>
<td>3.68 ± 0.20</td>
</tr>
<tr>
<td>850</td>
<td>5.61 ± 0.20</td>
</tr>
</tbody>
</table>

* Physical solubility of CO in the melt

Smoothed Data:
The temperature dependence of C₁ can be expressed by the relation:

\[
\log(C₁/mol \text{ cm}^{-3} \text{ atm}^{-1}) = -3.564 - 3039.8/(T/K) \quad \text{(compiler)}
\]

std. dev. = 4.6% (compiler)

The heat of solution, ΔH, for the solubility of CO in the melt is:

\[
ΔH/\text{kJ mol}^{-1} = 58.0
\]

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Quenching or chilling method. The diagram and details of the apparatus used and procedure followed are described in the original publication. In brief, the melt was saturated by bubbling the gas for 2 - 3 hrs. A portion of the saturated melt was transferred into the chilling compartment where it was slowly quenched to allow all of the gases to escape. The liberated gas was flushed with a stream of helium into a U - tube containing activated Linde 5A molecular sieve. The contents of the tube, after being allowed to come to room temperature, were flushed with a stream of carrier gas into a Fisher - Hamilton gas partitioner with Linde 5A column and Katharometer detector for analysis. About 8 - 10 independent samples were carried out.

**SOURCE AND PURITY OF MATERIALS:**

Not described.

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**
COMPONENTS:
(1) Carbon monoxide; CO; [630-08-0]
(2) Lithium carbonate; Li₂CO₃; [554-13-2]
(3) Potassium carbonate; K₂CO₃; [584-08-7]

ORIGINAL MEASUREMENTS:
Appleby, A. J.; Van Drunen, C.

VARIABLES:
P/kPa: 101.325 (1 atm.)
T/K = 1023 - 1123

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:

Solubilities of CO in the melt Li₂CO₃ - K₂CO₃ (42.7 - 57.3 mol%) at three temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁴ C₁⁻⁵/mol dm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>750</td>
<td>3.25 ± 0.22</td>
</tr>
<tr>
<td>800</td>
<td>4.54 ± 0.39</td>
</tr>
<tr>
<td>850</td>
<td>5.36 ± 0.22</td>
</tr>
</tbody>
</table>

A Physical solubility of CO in the melt.

Smoothed Data:
Temperature dependence of C₁ can be expressed by the relation:

\[
\log(C₁/mol \text{ cm}^{-3} \text{ atm}^{-1}) = -4.025 - 2510.4/(T/K) \quad \text{(compiler)}
\]

std. dev. = 2.6% \quad \text{(compiler)}

The heat of solution, ΔH, for the solubility of CO in the melt is:

\[
ΔH/\text{kJ mol}^{-1} = 48.0
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Quenching or chilling method.
The diagram and details of the apparatus used and the procedure followed have been described in the original paper. Briefly, the melt was saturated by bubbling the gas for 2 - 3 hrs. After saturation, a portion of the melt was transferred into the quenching compartment where it was slowly chilled to allow all the gases to escape. The liberated gas was flushed with a stream of helium into a U - tube containing Linde 5A molecular sieve. The contents of the tube, after being allowed to come to room temperature, were flushed with a stream of carrier gas into a Fisher - Hamilton gas partitioner with Linde 5A column and Katharometer detector for analysis. About 8 - 10 independent measurements were made.

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
COMPONENTS:
(1) Carbon monoxide; CO; [630-08-0]
(2) Sodium carbonate; Na₂CO₃; [497-19-8]
(3) Potassium carbonate; K₂CO₃; [584-08-7]

VARIABLES:
T/K = 1073 & 1123
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:

Solubilities of CO in the melt Na₂CO₃ - K₂CO₃ (58 - 42 mol%) at two temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁴ C₁⁹/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>800</td>
<td>13.30 ± 0.9</td>
</tr>
<tr>
<td>850</td>
<td>20.10 ± 1.6</td>
</tr>
</tbody>
</table>

* Physical and chemical solubility of CO in the melt.

Smoothed Data:

The heat of solution, ΔH, for the solubility of CO in the melt is:

ΔH/kJ mol⁻¹ = 80

AUXILIARY INFORMATION

METHOD/APPAURATUS/PROCEDURE:
Quenching or chilling method.

The diagram and details of the apparatus used and procedure followed are described in the original publication. In brief, the melt was saturated by bubbling the gas for 2 - 3 hrs. A portion of the saturated melt was transferred into the chilling compartment where it was slowly quenched to allow all the gases to escape. The liberated gas was flushed with a stream of helium into a U-tube containing activated Linde 5A molecular sieve. The contents of the tube, after being allowed to come to room temperature, were flushed with a stream of carrier gas into a Fisher-Hamilton gas partitioner with Linde 5A column and Katharometer detector for analysis. About 8 - 10 independent measurements were carried out.

REFERENCES:

ORIGINAL MEASUREMENTS:

Appleby, A. J.; Van Drunen, C.

PREPARED BY:

N. P. Bansal

SOURCE AND PURITY OF MATERIALS:

Not described.

ESTIMATED ERROR:

Nothing specified.
COMPONENTS:
(1) Carbon monoxide; CO; [630-08-0]
(2) Lithium carbonate; Li$_2$CO$_3$; [554-13-2]
(3) Sodium carbonate; Na$_2$CO$_3$; [497-19-8]
(4) Potassium carbonate; K$_2$CO$_3$; [584-08-7]

ORIGINAL MEASUREMENTS:
Appleby, A. J.; Van Drunen, C.

VARIABLES:
P/kPa: 101.325 (1 atm.)
T/K = 973 - 1123

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10$^a$ C$_1$ /mol dm$^{-3}$ atm$^{-2}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td>0.86 ± 0.10</td>
</tr>
<tr>
<td>750</td>
<td>1.30 ± 0.10</td>
</tr>
<tr>
<td>800</td>
<td>1.75 ± 0.09</td>
</tr>
<tr>
<td>850</td>
<td>2.82 ± 0.18</td>
</tr>
</tbody>
</table>

$^a$ Physical solubility of CO in the melt.

Smoothed Data:
The temperature dependence of C$_1$ can be expressed by the relation:
\[
\log(C_1 /\text{mol cm}^{-3} \text{ atm}^{-2}) = -3.317 - 3655.8/(T/K) \quad \text{(compiler)}
\]
\[
\text{std. dev.} = 2.9\% \quad \text{(compiler)}
\]
The heat of solution, ΔH, for the solubility of CO in the melt is:
\[
\Delta H /\text{kJ mol}^{-1} = 69.5
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Quenching or chilling method.
The diagram and details of the apparatus used and the procedure followed have been described in the original paper. Briefly, the molten salt solvent was saturated by bubbling the gas for 2 - 3 hr. After saturation a portion of the melt was transferred into the chilling compartment where it was slowly quenched to allow all the gases to escape. The liberated gas was flushed with a stream of helium into a U - tube containing activated 5A Linde molecular sieve. The contents of the tube, after being allowed to come to room temperature, were flushed with a stream of carrier gas into a Fisher - Hamilton gas partitioner with Linde 5A column and Katharometer detector for analysis. About 8 - 10 independent measurements were carried out.

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
<table>
<thead>
<tr>
<th>COMPONENTS:</th>
<th>ORIGINAl MEASUREMENTS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Carbon monoxide; CO; [630-08-0]</td>
<td>Borucka, A.; Appleby, A. J.</td>
</tr>
<tr>
<td>(3) Sodium carbonate; Na₂CO₃; [497-19-8]</td>
<td></td>
</tr>
<tr>
<td>(4) Potassium carbonate; K₂CO₃; [584-08-7]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VARIABLES:</th>
<th>PREPARED BY:</th>
</tr>
</thead>
<tbody>
<tr>
<td>One temperature = T/K 1073</td>
<td>N. P. Bansal</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EXPERIMENTAL VALUES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the molten ternary eutectic Li₂CO₃ - Na₂CO₃ - K₂CO₃ (43.5 - 31.5 - 25.0 mol%), carbon monoxide dissolves in the physical as well as chemical form. At 1073K, the concentrations of physically and chemically (as CO₂⁻) dissolved carbon monoxide, respectively are 2.1 x 10⁻⁴ mol dm⁻³ and 1.7 x 10⁻³ mol dm⁻³ in equilibrium with 0.382 atm CO + 0.618 atm CO₂ gas mixture.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AUXILIARY INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>METHOD/APPARATUS/PROCEDURE:</td>
</tr>
<tr>
<td>Steady-state polarization and rapid scan voltammetry.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ESTIMATED ERROR:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nothing specified.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REFERENCES:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>
Two studies (1, 2) have been reported for the solubility of carbon dioxide in molten LiNO₃. The values of Paniccia and Zambonin have been obtained by extrapolating their results in LiNO₃-KNO₃ mixtures. Out of the two data points, the one at 523 K is at a temperature below the melting point of LiNO₃. The value of $K_H$ at 623 K is in excellent agreement with the results of Sada et al. (2). The enthalpy of solution, $\Delta H$, reported by Sada et al. is positive while Paniccia and Zambonin reported a negative value.

Tentative values of solubility based on the results of Sada et al. (2), are given in Table 1.

Table 1
Tentative Solubilities as a Function of Temperature

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^6 K_H$/mol cm$^{-3}$ atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>570</td>
<td>3.38</td>
</tr>
<tr>
<td>580</td>
<td>3.46</td>
</tr>
<tr>
<td>590</td>
<td>3.54</td>
</tr>
<tr>
<td>600</td>
<td>3.62</td>
</tr>
<tr>
<td>610</td>
<td>3.70</td>
</tr>
<tr>
<td>620</td>
<td>3.78</td>
</tr>
<tr>
<td>630</td>
<td>3.86</td>
</tr>
<tr>
<td>640</td>
<td>3.93</td>
</tr>
<tr>
<td>650</td>
<td>4.01</td>
</tr>
</tbody>
</table>

References:


COMPONENTS:
(1) Carbon dioxide; CO₂; [124-38-9]
(2) Lithium nitrate; LiNO₃; [7790-69-4]

ORIGINAL MEASUREMENTS:
Paniccia, F.; Zambonin, P. G.

VARIABLES:
T/K = 523 & 623
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:
Solubilities of carbon dioxide were measured in molten LiNO₃ - KNO₃ mixtures of various compositions. A linear relationship was observed between the logarithm of the solubility (x₁) and the melt compositions. The extrapolated values of x₁ in pure molten LiNO₃ at two temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10^4 x₁/mol fraction bar⁻¹</th>
<th>10⁶ Kₙ/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>523</td>
<td>2.1</td>
<td></td>
</tr>
<tr>
<td>623</td>
<td>1.5</td>
<td>3.8</td>
</tr>
</tbody>
</table>

This temp. is below the melting point of pure LiNO₃ (527 K)


Smoothed Data:
The enthalpy of solution, ΔH, and the standard entropy of solution, ΔS°, are reported to be:

ΔH/kJ mol⁻¹ = -9.0
ΔS°/J K⁻¹ mol⁻¹ = -28.0 (at 623 K)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Extrapolated from the solubility data of carbon dioxide in lithium nitrate - potassium nitrate mixtures. Solubilities in the nitrate mixtures were measured by the manometric method (1,2).

SOURCE AND PURITY OF MATERIALS:
High purity quality carbon dioxide (S.I.O., Milan) was dried in dry ice.
Reagent grade lithium nitrate (Carlo Erba, Milan) was used without further treatment.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
1. Desimoni, E.; Paniccia, F.; Zambonin, P. G.
2. Zambonin, P. G.; Cardetta, V. L.; Signorile, G.
COMPONENTS:

(1) Carbon dioxide; CO₂; [124-38-9]
(2) Lithium nitrate; LiNO₃; [7790-69-4]

ORIGINAL MEASUREMENTS:
Sada, E.; Katoh, S.; Yoshii, H.; Takemato, I.; Shiomi, N.

VARIABLES:
P/kPa: 101.325 (1 atm.)
T/K = 573 - 648

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:

The solubilities of CO₂ in molten LiNO₃, at different temperatures, at one atmosphere pressure are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁶ K_H/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>3.39</td>
</tr>
<tr>
<td>325</td>
<td>3.64</td>
</tr>
<tr>
<td>350</td>
<td>3.86</td>
</tr>
<tr>
<td>375</td>
<td>3.96</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of K_H is expressed by the relation:

\[
\log(\text{K}_H/\text{mol cm}^{-3} \text{ atm}^{-1}) = -4.87 - \frac{342.5}{(T/\text{K})} \quad \text{(compiler)}
\]

std. dev. = 0.6% (compiler)

The heat of solution, \(\Delta H\), is estimated to be:

\[
\Delta H/\text{kJ mol}^{-1} = 6.6 \quad \text{(compiler)}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Elution technique.
The apparatus and procedure used for solubility measurements was the same as described in (1). The melt was saturated with carbon dioxide by bubbling the gas through the melt. Carbon dioxide dissolved in the melt was eluted by bubbling nitrogen. The amount of carbon dioxide in the eluted mixture was measured with an infrared carbon dioxide analyzer.

SOURCE AND PURITY OF MATERIALS:

Carbon dioxide (99.96%) was of superpure grade and free from water.
Lithium nitrate was of reagent grade.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO₂; [124-38-9]
(2) Sodium nitrate; NaN₃; [7631-99-4]

EVALUATOR:

N. P. Bansal
National Aeronautics and Space Administration.
Lewis Research Center.
Cleveland, Ohio, 44135, U.S.A.
December, 1989.

CRITICAL EVALUATION:

Four investigations are available (1 - 4) for the solubility of carbon dioxide in molten NaN₃ using three different experimental methods. Paniccia and Zambonin (1) employed a manometric technique, Bratland and Krohn (2) chilling method, while Field and Green (3) and Sada et al. (4) used the elution technique. Smoothed data at different temperatures from various studies are compared below:

<table>
<thead>
<tr>
<th>T/K</th>
<th>Ref. 1</th>
<th>Ref. 2</th>
<th>Ref. 3</th>
<th>Ref. 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>4.04</td>
<td>12.8</td>
<td>1.19</td>
<td>10.3</td>
</tr>
<tr>
<td>620</td>
<td>4.03</td>
<td>14.7</td>
<td>1.11</td>
<td>10.8</td>
</tr>
<tr>
<td>640</td>
<td>4.25</td>
<td>16.6</td>
<td>1.03</td>
<td>--</td>
</tr>
<tr>
<td>660</td>
<td>18.6</td>
<td>(0.97)</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

Values in ( ) outside temperature interval of experimental measurement; extrapolated by the evaluator.

The results of all four investigations are quite different. Further studies are needed in order to recommend solubility values for this gas - molten salt system.

References:

COMPONENTS:

(1) Carbon dioxide; CO₂; [124-38-9]
(2) Sodium nitrate; NaNO₃; [7631-99-4]

ORIGINAL MEASUREMENTS:

Paniccia, F.; Zambonin, P. G.

VARIABLES:

\[ P/kPa = 10^2 \]
\[ T/K = 592 - 671 \]

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

The solubilities, \( x_1 \), of CO₂ in molten NaNO₃, as a function of temperature, are presented in the form of a graph. The values of \( x_1 \) derived from the graph, by the compiler, are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>( 10^5 x_1/ \text{mole fraction bar}^{-1} )</th>
<th>( 10^7 K_H/ \text{mol cm}^{-3} \text{atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>592</td>
<td>1.78</td>
<td>4.02</td>
</tr>
<tr>
<td>607</td>
<td>1.80</td>
<td>4.05</td>
</tr>
<tr>
<td>626</td>
<td>1.80</td>
<td>4.02</td>
</tr>
<tr>
<td>639</td>
<td>1.91</td>
<td>4.24</td>
</tr>
<tr>
<td>652</td>
<td>1.82</td>
<td>4.02</td>
</tr>
<tr>
<td>671</td>
<td>2.00</td>
<td>4.39</td>
</tr>
</tbody>
</table>


Smoothed Data:
The temperature dependence of \( x_1 \) and \( K_H \) are expressed by the relations:

\[
\log(x_1/\text{mole fraction bar}^{-1}) = -4.304 - 267.1/(T/K) \quad \text{(compiler)}
\]

\[
\log(K_H/\text{mol cm}^{-3} \text{atm}^{-1}) = -6.055 - 204.6/(T/K) \quad \text{(compiler)}
\]

The enthalpy of solution, \( \Delta H \), and the standard entropy of solution, \( \Delta S^0 \), are:

\[
\Delta H/\text{kJ mol}^{-1} = 4.0
\]

\[
\Delta S^0/\text{J K}^{-1} \text{mol}^{-1} = -25.0 \quad \text{(at 623 K)}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Manometric technique.
Details of the experimental method are described elsewhere (1,2). Briefly, the apparatus was evacuated and carbon dioxide was introduced into the system at about one bar pressure. The initial pressure was immediately noted. The melt was vigorously stirred and the pressure variations, due to the gas dissolution, were recorded until equilibrium was attained. The final value of gas pressure was noted and Henry's law constant was calculated.

SOURCE AND PURITY OF MATERIALS:

High purity quality carbon dioxide (S.I.O., Milan) was dried in dry ice.
Reagent-grade sodium nitrate (Carlo Erba, Milan) was used without further treatment.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

1. Desimoni, E.; Paniccia, F.; Zambonin, P. G.
2. Zambonin, P. G.; Cardet, V. L.; Signorile, G.
COMPONENTS:

(1) Carbon dioxide; CO₂; [124-38-9]
(2) Sodium nitrate; NaNO₃; [7631-99-4]

ORIGINAL MEASUREMENTS:

Bratland, D.; Krohn, C.

VARIABLES:

T/K = 590 - 670
P/kPa: 101.325 (1 atm.)

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

The solubilities of CO₂ in the melt are reported only in the graphical form in the temperature range 590 - 670 K. The values of Henry's law constants, Kₜ, extracted from the graph, at different temperatures, are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁰ Kₜ/mol ml⁻¹ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>595</td>
<td>1.26</td>
</tr>
<tr>
<td>636</td>
<td>1.59</td>
</tr>
<tr>
<td>670</td>
<td>1.99</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of Kₜ is expressed by the relation:

\[
\log(Kₜ/mol ml⁻¹ atm⁻¹) = -4.132 - 1055.2/(T/K) \quad (\text{compiler})
\]

std. dev. = 1.3% \quad (\text{compiler})

The heat of solution, ΔH, is estimated to be:

\[
ΔH/kJ mol⁻¹ = 20.2 \quad (\text{compiler})
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chilling method.

The experimental method has been described in detail elsewhere (1,2). The melt is saturated with the gas. The dissolved gas is separated from the salt by freezing the melt. The expelled carbon dioxide is measured by transporting it by a stream of pure argon into absorption vessels containing Ascarite/Dehydrite.

SOURCE AND PURITY OF MATERIALS:

Carbon dioxide (99.95%) was obtained from Oslo Kulsyrefabric A/S.
Sodium nitrate of pro analysi grade was obtained from E. Merck A. G. and Riedel de Haen A. G.
Sodium nitrate was vacuum dried at 450°C for 12 hrs.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

**COMPONENTS:**

1. Carbon dioxide; CO₂; [124-38-9]
2. Sodium nitrate; NaNO₃; [7631-99-4]

**ORIGINAL MEASUREMENTS:**
Field, F. E.; Green, W. J. 
Green, W. J. 

**VARIABLES:**

\[ T/K = 587 - 639 \]
\[ P/kPa = 93.219 - 121.59 \]

**EXPERIMENTAL VALUES:**

Henry's law was obeyed over the pressure range studied (0.92 - 1.20 atm). The values of Henry's law constant, \( K_H \), at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>(10^7 K_H/\text{mol cm}^{-3} \text{ atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>587</td>
<td>1.251</td>
</tr>
<tr>
<td>589</td>
<td>1.255</td>
</tr>
<tr>
<td>614</td>
<td>1.117</td>
</tr>
<tr>
<td>635</td>
<td>1.077</td>
</tr>
<tr>
<td>639</td>
<td>1.024</td>
</tr>
</tbody>
</table>

Smoothed Data:

The temperature dependence of \( K_H \) is given by the expression:

\[
\log(K_H/\text{mol cm}^{-3} \text{ atm}^{-1}) = (-7.90 \pm 0.04) + (585.08 \pm 0.03)/(T/K)
\]

std. dev. = 0.16%

The enthalpy of solution, \( \Delta H \), and entropy of solution, \( \Delta S \), are:

\[
\Delta H/\text{kcal mol}^{-1} = (-2.68 \pm 0.12)
\]
\[
\Delta S/\text{cal K}^{-1} \text{ mol}^{-1} = (-14.55 \pm 0.20) \quad (\text{at 637 K})
\]

**EXPERIMENTAL VALUES:**

**PREPARED BY:**
N. P. Bansal

**METHOD/APPARATUS/PROCEDURE:**

Elution technique. 
Diagram of the gas solubility apparatus is given in the original publication. 

The experimental operation consisted of three steps: saturation, elution and analysis. After saturating the melt with carbon dioxide gas, the gas phase was evacuated. Helium was introduced into the system as eluting gas to approximately 1 atm. pressure. The resultant gas mixture of carbon dioxide and helium was analyzed with an Aerograph 90-P gas chromatograph (Varian). The carrier gas used was also helium. Average of four measurements was used for calculation of the gas solubility.

**SOURCE AND PURITY OF MATERIALS:**

Matheson Bone Dry carbon dioxide and helium obtained from Airco were used directly from the cylinders. 
Baker's reagent grade sodium nitrate was used without further purification.

**ESTIMATED ERROR:**

solubility = ± 5% (authors)

**REFERENCES:**
**COMPONENTS:**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Carbon dioxide; CO₂; [124-38-9]</td>
</tr>
<tr>
<td>(2)</td>
<td>Sodium nitrate; NaNO₃; [7631-99-4]</td>
</tr>
</tbody>
</table>

**VARIABLES:**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>P/kPa:</td>
<td>101.325 (1 atm.)</td>
</tr>
<tr>
<td>T/K:</td>
<td>583 - 623</td>
</tr>
</tbody>
</table>

**ORIGINAL MEASUREMENTS:**


**PREPARED BY:**

N. P. Bansal

**EXPERIMENTAL VALUES:**

The solubilities of CO₂ in molten NaNO₃, at different temperatures, at one atmosphere pressure are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁶ K unw/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>310</td>
<td>1.07</td>
</tr>
<tr>
<td>330</td>
<td>1.03</td>
</tr>
<tr>
<td>350</td>
<td>1.08</td>
</tr>
</tbody>
</table>

The gas solubility in molten sodium nitrate appears to be independent of temperature in the range studied.

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Elution technique. Diagram and details of the solubility apparatus are given in the original paper. The melt was saturated with CO₂ by bubbling the gas through the melt for about 50 min. Carbon dioxide dissolved in the melt was eluted by bubbling nitrogen. The concentration of carbon dioxide in the eluted mixture was determined with an infrared carbon dioxide analyzer (Shimadzu, Type URA-25).

**SOURCE AND PURITY OF MATERIALS:**

Carbon dioxide (99.96%) was superpure grade and free from water. Sodium nitrate was of reagent grade. It was dried in a dessicator for a few days followed by drying in a vacuum oven at 423 - 473 K drying for several hours. It was further dried by bubbling anhydrous nitrogen through the molten salt.

**ESTIMATED ERROR:**

std. error in solubility: < ± 10%

**REFERENCES:**
COMPONENTS:

(1) Carbon dioxide; CO₂; [124-38-9]
(2) Potassium nitrate; KNO₃; [7757-79-1]

EVALUATOR:

N. P. Bansal
National Aeronautics and Space Administration.
Lewis Research Center.
Cleveland, Ohio, 44135, U.S.A.
December, 1989.

CRITICAL EVALUATION:

Three investigations are available (1 - 3) for the solubility of carbon dioxide in molten KNO₃ employing two different experimental methods. Smoothed data at different temperatures from the three studies are compared below:

<table>
<thead>
<tr>
<th>T/K</th>
<th>Ref. 1</th>
<th>Ref. 2</th>
<th>Ref. 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>620</td>
<td>2.83</td>
<td></td>
<td>1.59</td>
</tr>
<tr>
<td>640</td>
<td>2.85</td>
<td>10.5</td>
<td>1.50</td>
</tr>
<tr>
<td>670</td>
<td>2.95</td>
<td>11.1</td>
<td>1.38</td>
</tr>
</tbody>
</table>

ΔH/kJ mol⁻¹

+ 3.0    --     -10.0

The solubility values of the three investigations are quite different. The ΔH values are not only different in magnitude, but also opposite in sign.

Further experimental studies are required before this system can be properly evaluated and recommended values can be advanced.

References:

COMPONENTS:

(1) Carbon dioxide; CO₂; [124-38-9]
(2) Potassium nitrate; KNO₃; [7757-79-1]

ORIGINAL MEASUREMENTS:

Paniccia, F.; Zambonin, P. G.

VARIABLES:

P/kPa = 10²
T/K = 616 - 670

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

The solubilities, x₁, of CO₂ in molten KNO₃ at different temperatures are reported in graphical form. The values of x₁ derived from the graph, by the compiler, are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁻¹ x₁/mol fraction bar⁻¹</th>
<th>10⁻⁷ K₉/mol cm⁻³ atm⁻¹a</th>
</tr>
</thead>
<tbody>
<tr>
<td>616</td>
<td>1.54</td>
<td>2.88</td>
</tr>
<tr>
<td>628</td>
<td>1.46</td>
<td>2.72</td>
</tr>
<tr>
<td>640</td>
<td>1.54</td>
<td>2.85</td>
</tr>
<tr>
<td>670</td>
<td>1.61</td>
<td>2.95</td>
</tr>
</tbody>
</table>


Smoothed Data:

The temperature dependence of x₁ and K₉ are expressed by the relations:

\[
\log(x₁/mol fraction bar⁻¹) = -4.473 - 217.3/(T/K) \quad \text{(compiler)}
\]

\[
\log(K₉/mol cm⁻³ atm⁻¹) = -6.308 - 149.1/(T/K) \quad \text{(compiler)}
\]

The enthalpy of solution, ΔH, and the standard entropy of solution, ΔS°, are:

\[
\Delta H/kJ mol⁻¹ = 3.0
\]

\[
\Delta S°/J K⁻¹ mol⁻¹ = -31.0 \quad \text{(at 623 K)}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Manometric technique.

The experimental procedure has been described in detail elsewhere (1,2). In brief, the apparatus was evacuated and then carbon dioxide was introduced into the system at about one bar pressure. The initial gas pressure was immediately noted. The melt was vigorously stirred and the fall in gas pressure due to its solubility in the melt was recorded till equilibrium was attained. The final gas pressure was noted and Henry's constant was evaluated.

SOURCE AND PURITY OF MATERIALS:

High purity quality carbon dioxide (S.I.O., Milan) was dried in dry ice. Reagent grade potassium nitrate (Carlo Erba, Milan) was used without further purification.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

1. Desimoni, E.; Paniccia, F.; Zambonin, P.G.
2. Zambonin, P. G.; Cardetta, V.L.; Signorile, G.
COMPONENTS:

1. Carbon dioxide; CO₂; [124-38-9]
2. Potassium nitrate; KNO₃; [7757-79-1]

ORIGINAL MEASUREMENTS:


VARIABLES:

P/kPa: 101.325 (1 atm.)
T/K = 643 - 673

EXPERIMENTAL VALUES:

The solubilities of CO₂ in molten KNO₃, at different temperatures, at one atmosphere pressure are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁶ K_m/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>370</td>
<td>1.06</td>
</tr>
<tr>
<td>375</td>
<td>1.20</td>
</tr>
<tr>
<td>400</td>
<td>1.12</td>
</tr>
</tbody>
</table>

METHOD/APPARATUS/PROCEDURE:

Elution technique.
The apparatus and procedure used for solubility measurements was the same as described in (1). The melt was saturated with carbon dioxide by bubbling the gas through the melt. Carbon dioxide dissolved in the melt was eluted by bubbling nitrogen. The amount of carbon dioxide in the eluted mixture was measured with an infrared carbon dioxide analyzer.

AUXILIARY INFORMATION

SOURCE AND PURITY OF MATERIALS:

Carbon dioxide (99.96%) was superpure grade and free from water. Potassium nitrate used was of reagent grade.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

**COMPONENTS:**

1. Carbon dioxide, \( \text{CO}_2 \); [124-38-9]
2. Potassium nitrate, \( \text{KNO}_3 \); [7757-79-1]

**ORIGINAL MEASUREMENTS:**

Green, W. J.

**VARIABLES:**

\( T/K = 611 - 669 \)

**EXPERIMENTAL VALUES:**

For the solubility of \( \text{CO}_2 \) in molten \( \text{KNO}_3 \), Henry's law was obeyed only up to the pressure of 200 torr. The experimental data in this pressure range was only used in calculating the thermodynamic parameters and the reported solubilities. The values of Henry's law constant, \( K_H \), at different temperatures are:

<table>
<thead>
<tr>
<th>( T/K )</th>
<th>( 10^7 K_H/\text{mol cm}^{-3} \text{ atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>611</td>
<td>0.57</td>
</tr>
<tr>
<td>613</td>
<td>1.37</td>
</tr>
<tr>
<td>614</td>
<td>1.64</td>
</tr>
<tr>
<td>615</td>
<td>1.10</td>
</tr>
<tr>
<td>624</td>
<td>1.83</td>
</tr>
<tr>
<td>625</td>
<td>1.01</td>
</tr>
<tr>
<td>631</td>
<td>1.50</td>
</tr>
<tr>
<td>633</td>
<td>1.31</td>
</tr>
<tr>
<td>643</td>
<td>0.97</td>
</tr>
<tr>
<td>646</td>
<td>1.75</td>
</tr>
<tr>
<td>654</td>
<td>1.19</td>
</tr>
<tr>
<td>667</td>
<td>1.40</td>
</tr>
<tr>
<td>669</td>
<td>1.03</td>
</tr>
</tbody>
</table>

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Elution technique.
Diagram and details of the gas solubility apparatus are given in the original publication.

The experimental process consisted of three steps: saturation, elution and analysis. After saturating the melt with carbon dioxide, the gas phase was evacuated. Helium was introduced into the system as eluting gas to approximately 1 atm. pressure. The resultant gas mixture of carbon dioxide and helium was analyzed with an Aerograph Model 90-P gas chromatograph (Varian). The carrier gas used was also helium.

**SOURCE AND PURITY OF MATERIALS:**

Matheson Bone Dry carbon dioxide and helium obtained from Airco were used directly from the cylinders.
Source and purity of \( \text{KNO}_3 \) not described.

**ESTIMATED ERROR:**

\( \delta C/P = \pm 5\% \) (authors)

**REFERENCES:**
**COMPONENTS:**

(1) Carbon dioxide; CO₂; [124-38-9]

(2) Potassium nitrate; KNO₃; [7757-79-1]

**VARIABLES:**

**EXPERIMENTAL VALUES:**

Smoothed Data:

Temperature dependence of $K_W$ is expressed by the equation:

$$\log(K_W/\text{mol cm}^{-3} \text{ atm}^{-1}) = -7.604 + 499.06/(T/K)$$

std. dev. = 0.52%

The enthalpy of solution, $\Delta H$, and entropy of solution, $\Delta S$, are:

$$\Delta H/\text{kcal mol}^{-1} = -2.28 \pm 0.44$$

$$\Delta S/\text{cal K}^{-1} \text{ mol}^{-1} = -13.11 \pm 0.69 \text{ (at 670 K)}$$

**REFERENCES:**

Green, W. J.


**PREPARED BY:**

N. P. Bansal
COMPONENTS:

(1) Carbon dioxide; $\text{CO}_2$; [124-38-9]

(2) Rubidium nitrate; $\text{RbNO}_3$; [13126-12-0]

ORIGIANAL MEASUREMENTS:

Sada, E.; Katoh, S.; Yoshii, H.; Takemoto, I.; Shiomi, N.

VARIABLES:

\[ P/\text{kPa}: 101.325 \ (1 \text{ atm.}) \]
\[ T/K = 623 - 723 \]

EXPERIMENTAL VALUES:

The solubilities of $\text{CO}_2$ in molten $\text{RbNO}_3$, at different temperatures, at one atmosphere pressure are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>$10^6 K_m/\text{mol cm}^{-3} \text{ atm}^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>350</td>
<td>1.88</td>
</tr>
<tr>
<td>400</td>
<td>1.78</td>
</tr>
<tr>
<td>450</td>
<td>1.77</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of $K_m$ is expressed by the relation:

\[
\log(K_m/\text{mol cm}^{-3} \text{ atm}^{-1}) = -5.921 + 119.2/(T/K) \quad \text{(compiler)}
\]

std. dev. = 0.8% \quad \text{(compiler)}

The heat of solution, $\Delta H$, is estimated to be:

$\Delta H/\text{kJ mol}^{-1} = -2.3 \quad \text{(compiler)}$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Elution technique.
The apparatus and procedure used for solubility measurements was the same as described in (1).
The melt was saturated with carbon dioxide by bubbling the gas through the melt. Carbon dioxide dissolved in the melt was eluted by bubbling nitrogen. The amount of carbon dioxide in the eluted mixture was measured with an infrared carbon dioxide analyzer.

SOURCE AND PURITY OF MATERIALS:

Carbon dioxide (99.96%) was of superpure grade and free from water.
Rubidium nitrate was of reagent grade.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO₂; [124-38-9]
(2) Cesium nitrate; CsNO₃; [7789-18-6]

ORIGINAL MEASUREMENTS:

Sada, E.; Katoh, S.; Yoshii, H.; Takemoto, I.; Shiomi, N.

VARIABLES:

P/kPa: 101.325 (1 atm.)
T/K = 723 - 773

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

The solubilities of CO₂ in molten CsNO₃, at different temperatures, at one atmosphere pressure are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁷ K_m/mol cm⁻³ atm⁻²</th>
</tr>
</thead>
<tbody>
<tr>
<td>450</td>
<td>9.60</td>
</tr>
<tr>
<td>475</td>
<td>8.10</td>
</tr>
<tr>
<td>500</td>
<td>9.30</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Elution technique.
The apparatus and procedure used for solubility measurements was the same as described in (1). The melt was saturated with carbon dioxide by bubbling the gas through the melt. Carbon dioxide dissolved in the melt was eluted by bubbling nitrogen. The amount of CO₂ in the eluted gas mixture was measured with an infrared carbon dioxide analyzer.

SOURCE AND PURITY OF MATERIALS:

Carbon dioxide (99.96%) was of superpure grade and free from water. Cesium nitrate was of reagent grade.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO\textsubscript{2}; [124-38-9]
(2) Sodium chloride; NaCl; [7647-14-5]

EVALUATOR:

N. P. Bansal
National Aeronautics and Space Administration.
Lewis Research Center.
Cleveland, Ohio, 44135, U.S.A.
December, 1989.

CRITICAL EVALUATION:

Six studies (1 - 6) are available for the solubility of carbon dioxide in molten NaCl. Values of refs. 1 and 2 are too high by about an order of magnitude, probably, due to the formation of nickel oxide from the nickel containers which reacts with carbon dioxide to form carbonate ions (3). These two investigations are, therefore, rejected. Smoothed data at different temperatures from the remaining four studies are compared below:

<table>
<thead>
<tr>
<th>T/K</th>
<th>Ref. 3</th>
<th>Ref. 4</th>
<th>Ref. 5</th>
<th>Ref. 6\textsuperscript{a}</th>
</tr>
</thead>
<tbody>
<tr>
<td>1100</td>
<td>5.20</td>
<td>5.18</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>1130</td>
<td>5.59</td>
<td>5.57</td>
<td>--</td>
<td>7.10</td>
</tr>
<tr>
<td>1160</td>
<td>5.98</td>
<td>5.97</td>
<td>--</td>
<td>7.51</td>
</tr>
<tr>
<td>1190</td>
<td>6.37</td>
<td>6.37</td>
<td>--</td>
<td>7.92</td>
</tr>
<tr>
<td>1220</td>
<td>6.77</td>
<td>6.78</td>
<td>9.9\textsuperscript{b}</td>
<td>8.31</td>
</tr>
<tr>
<td>1250</td>
<td>7.18</td>
<td>7.20</td>
<td>--</td>
<td>8.72</td>
</tr>
<tr>
<td>1270</td>
<td>7.45</td>
<td>7.48</td>
<td>10.1\textsuperscript{b}</td>
<td>8.98</td>
</tr>
</tbody>
</table>

\textsuperscript{a} At 1223 K
\textsuperscript{b} At 1273 K

Values in (mol cm\textsuperscript{-3} atm\textsuperscript{-1}) were calculated by the evaluator using density data from Janz, G. J. "Molten Salts Handbook", Academic Press, New York, 1967.

The studies (3,4) are from the same group of workers using the same techniques and their results are lower compared to the other two investigations. The values of Bezukladnikov et al. (6) are 10 - 15\% lower than those of Sada et al. (5).

Further studies are needed in order to advance recommended solubility values for this gas - molten salt system.

References:

COMPONENTS:
(1) Carbon dioxide; CO₂; [124-38-9]
(2) Sodium chloride; NaCl; [7647-14-5]

ORIGINAL MEASUREMENTS:

VARIABLES:
P/kPa: 101.325 (1 atm.)
T/K = 1085 - 1221

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:

Solubilities of CO₂ at 1 atm. pressure at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁶ Kₜ/mol ml⁻¹ atm⁻²</th>
</tr>
</thead>
<tbody>
<tr>
<td>812.2</td>
<td>4.20</td>
</tr>
<tr>
<td>813.0</td>
<td>4.81</td>
</tr>
<tr>
<td>829.8</td>
<td>4.14</td>
</tr>
<tr>
<td>830.4</td>
<td>4.18</td>
</tr>
<tr>
<td>852.0</td>
<td>5.07</td>
</tr>
<tr>
<td>903.9</td>
<td>5.47</td>
</tr>
<tr>
<td>948.3</td>
<td>5.71</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of the Henry's law constant, Kₜ, is given by the equation:

\[
\log(\text{Kₜ/mol ml}^{-1}\text{ atm}^{-2}) = -4.19 - 1273.5/(T/K)
\]

std. dev. = 3.4%  (compiler)

The heat of solution, ΔH, is:

\[
\Delta H/\text{kJ mol}^{-1} = 29.7
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Stripping method.
The technique was essentially the same as used by Grimes et al. (1). The detailed description of the apparatus and procedure is given in the original paper. This method is basically the elution technique. The melt was saturated with carbon dioxide by bubbling the gas through it. A part of this saturated molten salt was transferred to the stripping section and stripped of its CO₂ content by bubbling pure nitrogen. The amount of CO₂ was determined by absorption in Ascarite.

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
COMPONENTS:

(1) Carbon dioxide; CO₂; [124-38-9]  
(2) Sodium chloride; NaCl; [7647-14-5]

ORIGINAL MEASUREMENTS:

Bratland, D.; Grjotheim, K.; Krohn, C.; Matzfeldt, K.  

VARIABLES:  
P/kPa: 101.325 (1 atm.)  
T/K = 1074 - 1270

PREPARED BY:  
N. P. Bansal

EXPERIMENTAL VALUES:

Solubilities of CO₂ at 1 atmosphere CO₂ pressure at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10^7 K_H/mol ml⁻¹ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>801</td>
<td>5.9 ± 0.64</td>
</tr>
<tr>
<td>829</td>
<td>5.20 ± 0.35</td>
</tr>
<tr>
<td>862</td>
<td>5.64 ± 0.29</td>
</tr>
<tr>
<td>904</td>
<td>6.19 ± 0.20</td>
</tr>
<tr>
<td>951</td>
<td>6.89 ± 0.56</td>
</tr>
<tr>
<td>997</td>
<td>7.58 ± 0.47</td>
</tr>
</tbody>
</table>

* By volumetric method; rest by chilling method.

Smoothed Data:

Temperature dependence of Henry's law constant, K_H, is given by the equation:

\[ \log(K_H/mol \text{ ml}^{-1} \text{ atm}^{-1}) = -5.12 - 1280/(T/K) \]  
(compiler)  
std. dev. = 3.2%  
(compiler)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Three different techniques have been used: volumetric, thermogravimetric and chilling method. Detailed description of each technique is given in the original publication.

Volumetric Method: The change in volume of the gas (at constant pressure) caused by its dissolution in the melt is directly determined. This is not a very accurate method and was finally abandoned. The estimated uncertainty in the results was about 25%.

Thermogravimetric Method: The gain in the weight of the melt sample due to the dissolution of the gas is determined using a balance.

Chilling Method: It employs the separation of the dissolved gas from the salt by freezing of

SOURCE AND PURITY OF MATERIALS:

Carbon dioxide - not mentioned.  
Sodium chloride was of pro analysis quality from E. Merck A. G.  
In the volumetric and thermogravimetric measurements, the salt was dried in situ, whereas in the chilling method, the salt was dried under vacuum at 450°C for 4 hrs.

ESTIMATED ERROR:

solubility = ± 10%  
(authors)

REFERENCES:
COMPONENTS:

(1) Carbon dioxide; CO₂; \[124-38-9\]
(2) Sodium chloride; NaCl; \[7647-14-5\]

VARIABLES:

\[ T/K = 1074 - 1270 \]

EXPERIMENTAL VALUES:

continued

The heat of dissolution, \( \Delta H \), and the entropy of dissolution, \( \Delta S \), are:

\[
\Delta H/\text{kJ mol}^{-1} = 24.7
\]

\[
\Delta S/\text{J K}^{-1} \text{ mol}^{-1} = 21.3 \quad \text{(at 1150 K)}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

continued

the melt. The expelled carbon dioxide is carried into the absorption vessel by a stream of pure nitrogen. This method is less cumbersome and more expeditious than the other two but with comparable or better accuracy.

ORIGINAL MEASUREMENTS:

Bratland, D.; Grjotheim, K.; Krohn, C.; Matzfeldt, K.


PREPARED BY:

N. P. Bansal

SOURCE AND PURITY OF MATERIALS:

REFERENCES:

ESTIMATED ERROR:
COMPONENTS:

(1) Carbon dioxide; CO₂; [124-38-9]

(2) Sodium chloride; NaCl; [7647-14-5]

ORIGINAL MEASUREMENTS:

Bratland, D.; Grjotheim, K.; Krohn, C.; Matzfeldt, K.

VARIABLES:

P/kPa: 101.325 (1 atm.)

T/K = 1100 - 1285

EXPERIMENTAL VALUES:

Solubilities of CO₂ in molten sodium chloride at different temperatures are reported in the form of a log Kₜ vs. 1/T plot. Values of Kₜ derived from the plot, by the compiler, at different temperatures are presented below:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10^7 Kₜ/mol ml⁻¹ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>1101</td>
<td>5.2 ± 0.2</td>
</tr>
<tr>
<td>1133</td>
<td>5.6 ± 0.3</td>
</tr>
<tr>
<td>1176</td>
<td>6.2 ± 0.2</td>
</tr>
<tr>
<td>1223</td>
<td>6.8 ± 0.4</td>
</tr>
<tr>
<td>1285</td>
<td>7.7 ± 0.5</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of Kₜ is expressed by the equation:

\[ \log(Kₜ/mol \text{ ml}⁻¹ \text{ atm}⁻¹) = -5.094 - 1311/(T/K) \]  

(std. dev. = 0.15% (compiler)

The heat of dissolution, ΔH, and entropy of dissolution, ΔS, are:

ΔH/kJ mol⁻¹ = 25.94  

ΔS/J K⁻¹ mol⁻¹ = 22.6 (at 1150 K)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Four different techniques have been employed. Detailed description of the apparatus and procedure for each method are given in the original paper.

Stripping Method: The melt is saturated with the gas. The dissolved gas is stripped with an inert gas and absorbed in Ascarite. This method gave results about an order of magnitude higher than those obtained by all other methods.

Volumetric Method: The change in volume of gas (at constant pressure) caused by its dissolution in the melt is directly determined. This is not an accurate method, the estimated uncertainty being about 25%.

Thermogravimetric Method: The gain in the weight of the melt sample due to the dissolution of

continued

SOURCE AND PURITY OF MATERIALS:

Sodium chloride, pro analysi quality, from Merck AG, Darmstadt, West Germany was used. It was either dried in situ (volumetric and thermogravimetric methods) or pre-dried in vacuum at 450°C for 4 hrs. (chilling method).

ESTIMATED ERROR:

solubility = ± 10% (authors)

REFERENCES:
<table>
<thead>
<tr>
<th>COMPONENTS:</th>
<th>ORIGINAL MEASUREMENTS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>VARIABLES:</td>
<td>PREPARED BY:</td>
</tr>
<tr>
<td>T/K = 1100 - 1285</td>
<td>N. P. Bansal</td>
</tr>
</tbody>
</table>

EXPERIMENTAL VALUES:

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

continued

the gas is measured using a thermobalance.

Chilling Method: The dissolved gas is removed from the melt by freezing of the melt. The expelled gas is carried into absorption vessels containing Ascarite/Dehydrite by a stream of pure argon. This method is simpler and more expedient than the others but giving comparable or better accuracy.

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:

<table>
<thead>
<tr>
<th>Component</th>
<th>CAS Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon dioxide; CO₂;</td>
<td>124-38-9</td>
</tr>
<tr>
<td>Potassium chloride; KCl;</td>
<td>7447-40-7</td>
</tr>
</tbody>
</table>

ORIGINAL MEASUREMENTS:

<table>
<thead>
<tr>
<th>Authors</th>
<th>Source</th>
</tr>
</thead>
</table>

VARIABLES:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>P/kPa</td>
<td>101.325 (1 atm.)</td>
</tr>
<tr>
<td>T/K</td>
<td>1208 - 1273</td>
</tr>
</tbody>
</table>

EXPERIMENTAL VALUES:

The gas solubilities at 1 atmosphere pressure are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>$10^7 K_H$/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>935</td>
<td>8.33</td>
</tr>
<tr>
<td>950</td>
<td>9.78</td>
</tr>
<tr>
<td>970</td>
<td>8.74</td>
</tr>
<tr>
<td>1000</td>
<td>9.08</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of $K_H$ is given by the equation:

$$\log(K_H/\text{mol cm}^{-3} \text{ atm}^{-2}) = -5.758 - 358.3/(T/K)$$

(compiler)

std. dev. = 3.5% (compiler)

The enthalpy of solution, $\Delta H$, is estimated to be:

$$\Delta H/\text{kJ mol}^{-1} = 6.9$$

(compiler)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Elution technique.

The apparatus and procedure used for solubility measurements was the same as described in (1). The melt was saturated with carbon dioxide by bubbling the gas through the melt. Dissolved gas in the melt was eluted by bubbling nitrogen. The amount of carbon dioxide in the eluted mixture was measured with an infrared carbon dioxide analyzer.

SOURCE AND PURITY OF MATERIALS:

Carbon dioxide (99.96%) was of superpure grade and free from water. Potassium chloride was of reagent grade.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:


COMPONENTS:

(1) Carbon dioxide; CO₂; [124-38-9]
(2) Sodium chloride; NaCl; [7647-14-5]

ORIGINAL MEASUREMENTS:
Bezukladnikov, A. B.; Devyatkin, V. N.; L'icheva, O. N.

VARIABLES:  
P/kPa: 101.325 (compiler)  
T/K = 1133 - 1273

PREPARED BY:  
N. P. Bansal

EXPERIMENTAL VALUES:

Solutions of carbon dioxide in molten NaCl obey Henry's law. The temperature dependence of solubility, \( x_1 \) (mol fraction), in the range 1133 - 1273 K, is expressed by the relations:

\[
\begin{align*}
x_1 \text{(mol fraction)} & = 36.1 \times 10^{-5} \exp[-5804 \text{ cal/RT}] \\
\log(x_1 / \text{mol fraction}) & = -3.4425 - 1268.6/(T/\text{K}) 
\end{align*}
\]

The heat of solution, \( \Delta H \), is given as:

\[ \Delta H / \text{kJ mol}^{-1} = +24.28 \]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution method.  
Carbon dioxide is bubbled through the melt till saturated. The dissolved gas is displaced by flushing with an inert gas. The liberated CO₂ is absorbed in barium hydroxide solution. The excess of barium hydroxide is titrated with potassium hydrogen phthalate.

SOURCE AND PURITY OF MATERIALS:
Not reported.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
COMPONENTS:
(1) Carbon dioxide; CO₂; [124-38-9]
(2) Potassium chloride; KCl; [7447-40-7]

EVALUATOR:
N. P. Bansal
National Aeronautics and Space Administration
Lewis Research Center
Cleveland, Ohio, 44135, U.S.A.
December, 1989.

CRITICAL EVALUATION:

Seven investigations (1 - 7) have been reported for the solubility of carbon dioxide in molten KCl. Results of refs. 1 and 2 are too high by almost an order of magnitude, probably, due to the formation of nickel oxide from the nickel containers which reacts with carbon dioxide to form carbonate ions (4). These two studies are, therefore, rejected. Smoothed data from the remaining sources at different temperatures are presented below for comparison:

<table>
<thead>
<tr>
<th>T/K</th>
<th>Ref. 3</th>
<th>Ref. 4</th>
<th>Ref. 5</th>
<th>Ref. 6</th>
<th>Ref. 7*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1070</td>
<td>6.50</td>
<td>6.37</td>
<td>(7.42)</td>
<td>--</td>
<td>(7.35)</td>
</tr>
<tr>
<td>1100</td>
<td>6.88</td>
<td>6.75</td>
<td>7.70</td>
<td>--</td>
<td>(7.75)</td>
</tr>
<tr>
<td>1130</td>
<td>7.27</td>
<td>7.12</td>
<td>7.99</td>
<td>(8.41)</td>
<td>8.14</td>
</tr>
<tr>
<td>1160</td>
<td>7.65</td>
<td>7.50</td>
<td>8.26</td>
<td>(8.57)</td>
<td>8.53</td>
</tr>
<tr>
<td>1190</td>
<td>8.04</td>
<td>7.88</td>
<td>8.53</td>
<td>(8.73)</td>
<td>8.90</td>
</tr>
<tr>
<td>1220</td>
<td>8.42</td>
<td>8.26</td>
<td>8.80</td>
<td>8.88</td>
<td>9.27</td>
</tr>
<tr>
<td>1250</td>
<td>8.80</td>
<td>8.63</td>
<td>(9.06)</td>
<td>9.02</td>
<td>9.62</td>
</tr>
<tr>
<td>1280</td>
<td>(9.18)</td>
<td>(9.00)</td>
<td>(9.32)</td>
<td>(9.16)</td>
<td>9.97</td>
</tr>
<tr>
<td>1300</td>
<td>(9.43)</td>
<td>(9.25)</td>
<td>--</td>
<td>(9.26)</td>
<td>10.19</td>
</tr>
<tr>
<td>1320</td>
<td>(9.69)</td>
<td>(9.50)</td>
<td>--</td>
<td>--</td>
<td>10.41</td>
</tr>
</tbody>
</table>


Values in ( ) outside the temperature interval of experimental measurement; extrapolated by the evaluator.

The studies (3,4) are from the same group of workers using the same techniques and their results are consistently low by about 10% in comparison to the values of Bezukladnikov et al. (7). The results of (5,6,7) agree with each other in certain temperature ranges but differ at other temperatures due to the difference in the values of ΔH reported by them.

Additional investigations are required in order to advance recommended solubility values for this system.

References:
COMPONENTS:

(1) Carbon dioxide; CO$_2$; [124-38-9]
(2) Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS:


VARIABLES:

- $P$/kPa: 101.325 (1 atm.)
- $T$/K = 1064 - 1243

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

Solubilities of CO$_2$ at 1 atm pressure at different temperatures are:

<table>
<thead>
<tr>
<th>$t$/°C</th>
<th>$10^6$ $K_H$/mol ml$^{-1}$ atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>791.0</td>
<td>2.73</td>
</tr>
<tr>
<td>792.9</td>
<td>3.02</td>
</tr>
<tr>
<td>802.0</td>
<td>2.78</td>
</tr>
<tr>
<td>823.5</td>
<td>3.76</td>
</tr>
<tr>
<td>835.5</td>
<td>4.14</td>
</tr>
<tr>
<td>863.1</td>
<td>5.26</td>
</tr>
<tr>
<td>876.4</td>
<td>4.02</td>
</tr>
<tr>
<td>903.0</td>
<td>4.85</td>
</tr>
<tr>
<td>925.0</td>
<td>6.81</td>
</tr>
<tr>
<td>969.9</td>
<td>8.90</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of the Henry's law constant, $K_H$, is given by the equation:

$$\log(K_H$/mol ml$^{-1}$ atm$^{-1}$) = -2.339 - 3415.8/(T/K)$$

std. dev. = 5.7% (compiler)

The heat of solution, $\Delta H$, is: $\Delta H$/kJ mol$^{-1}$ = 61.9

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stripping method.
The technique used was essentially the same as used by Grimes et al. (1). The detailed description of the apparatus and procedure is given in the original publication. This method is basically the elution technique. The melt was saturated with carbon dioxide by bubbling the gas through it. A part of this saturated molten salt was transferred to the stripping section and stripped of its CO$_2$ content by bubbling pure nitrogen. The amount of CO$_2$ was determined by absorption in Ascarite.

SOURCE AND PURITY OF MATERIALS:

Not described.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO₂;
[124-38-9]

(2) Potassium chloride; KCl;
[7447-40-7]

VARIABLES:

\[
T/K = 1074 - 1276 \\
P/kPa: 101.325 (1 \text{ atm.})
\]

EXPERIMENTAL VALUES:

Solubilities of CO₂ in fused KCl are reported in the form of a log \( K_H \) vs. 1/T plot. Values of \( K_H \) at different temperatures derived from the plot, by the compiler, are given below:

<table>
<thead>
<tr>
<th>T/K</th>
<th>( 10^7 K_H/\text{mol ml}^{-2} \text{ atm}^{-2} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1074</td>
<td>6.5 ± 0.3</td>
</tr>
<tr>
<td>1123</td>
<td>7.2 ± 0.2</td>
</tr>
<tr>
<td>1188</td>
<td>8.0 ± 0.3</td>
</tr>
<tr>
<td>1224</td>
<td>8.6 ± 0.2</td>
</tr>
<tr>
<td>1276</td>
<td>9.0 ± 0.1</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of \( K_H \) is expressed by the equation:

\[
\log(K_H/\text{mol ml}^{-2} \text{ atm}^{-2}) = -5.272 - 979.3/(T/K) \quad \text{(compiler)}
\]

\[
\text{std. dev.} = 0.6\% \quad \text{(compiler)}
\]

The heat of solution, \( \Delta H \), and entropy of dissolution, \( \Delta S \), are:

\[
\Delta H/\text{kJ mol}^{-1} = 19.7
\]

\[
\Delta S/\text{J K}^{-1} \text{ mol}^{-1} = 17.2 \quad \text{(at 1150 K)}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Four different techniques have been employed. Detailed description of the apparatus and procedure for each method are given in the original paper. Stripping Method: The melt is saturated with the gas. The dissolved gas is stripped with an inert gas and absorbed in Ascarite. This method gave results about an order of magnitude higher than those obtained by all other methods. Volumetric Method: The change in volume of gas (at constant pressure) caused by its dissolution in the melt is directly determined. This is not an accurate method, the estimated uncertainty being about 25%. Thermogravimetric Method: The gain in the weight of the melt continued

SOURCE AND PURITY OF MATERIALS:

Potassium chloride, pro analysi quality, from Merck AG, Darmstadt, West Germany, was used. It was either dried in situ (volumetric and thermogravimetric methods) or pre-dried in vacuum at 450°C for 4 hrs. (chilling method).

ESTIMATED ERROR:

solubility = ± 10% \quad \text{(authors)}

REFERENCES:
**COMPONENTS:**

1. Carbon dioxide; CO₂; [124-38-9]
2. Potassium chloride; KCl; [7447-40-7]

**VARIABLES:**

$$T/K = 1074 - 1276$$

**ORIGINAL MEASUREMENTS:**

Bratland, D.; Grjotheim, K.; Krohn, C.; Matzfeldt, K.

**J. Metals 1967, 19, 13 - 20.**

**PREPARED BY:**

N. P. Bansal

**METHOD/APPARATUS/PROCEDURE:**

Continued

Sample due to the dissolution of the gas is measured using a thermobalance.

Chilling Method: The dissolved gas is removed from the melt by freezing of the melt. The expelled gas is carried into absorption vessels containing Ascarite/Dehydrite by a stream of pure argon. This method is simpler and more expedient than the others but giving comparable or better accuracy.

**REFERENCES:**
COMPONENTS:

(1) Carbon dioxide; CO₂; [124-38-9]
(2) Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS:

Bratland, D.; Grjotheim, K.; Krohn, C.; Matzfeldt, K.

VARIABLES:

T/K = 1049 - 1275
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:

Solubilities of CO₂ at different temperatures at 1 atm. pressure are:

<table>
<thead>
<tr>
<th>℃</th>
<th>10⁻⁷ Kₜ/mol ml⁻¹ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>776</td>
<td>7.2 ± 1.8</td>
</tr>
<tr>
<td>799</td>
<td>6.45 ± 0.23</td>
</tr>
<tr>
<td>851</td>
<td>7.15 ± 0.20</td>
</tr>
<tr>
<td>903</td>
<td>7.90 ± 0.01</td>
</tr>
<tr>
<td>912</td>
<td>8.03 ± 0.24</td>
</tr>
<tr>
<td>952</td>
<td>8.57 ± 0.21</td>
</tr>
<tr>
<td>1002</td>
<td>8.95 ± 0.19</td>
</tr>
</tbody>
</table>

† By volumetric method; other values by chilling method.

Smoothed Data:
Temperature dependence of the Henry's law constant, Kₜ, is given by the equation:

\[ \log(Kₜ/mol \text{ ml}⁻¹ \text{ atm}⁻¹) = -5.28 - 980/(T/K) \]

std. dev. = 2.2% (compiler)

The heat of dissolution, ∆H, and the entropy of dissolution, ∆S, are:

∆H/kJ mol⁻¹ = 18.8
∆S/J K⁻¹ mol⁻¹ = 16.3 (at 1150 K)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Detailed description of each technique is given in the original publication.

Volumetric Method: The change in volume of the gas (at constant pressure) caused by its dissolution in the melt is directly determined. This is not a very accurate method and was finally abandoned. The estimated uncertainty in the results was 25%.

Thermogravimetric Method: The gain in the weight of the melt sample due to the dissolution of the gas is determined using a balance.

Chilling Method: It employs the separation of the dissolved gas from the salt by freezing of the melt. The expelled CO₂ is carried into the absorption vessel by a stream of pure nitrogen. This method is less cumbersome and more expedient than the other two but the accuracy is comparable or better.

SOURCE AND PURITY OF MATERIALS:

Carbon dioxide - not mentioned.
Potassium chloride was of pro analysi grade from E. Merck A. G. in the volumetric and thermogravimetric measurements, the salt was dried in situ, whereas in the chilling method, the salt was dried under vacuum at 450°C for 4 hrs.

ESTIMATED ERROR:

solubility ± 10% (authors)

REFERENCES:
COMPONENTS:
(1) Carbon dioxide; CO₂; [124-38-9]
(2) Potassium chloride; KCl; [7447-40-7]

VARIABLES:
P/kPa: 101.325 (compiler)
T/K = 1078 - 1223

EXPERIMENTAL VALUES:
The solubilities of CO₂ in molten KCl at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁴ Soly./M</th>
</tr>
</thead>
<tbody>
<tr>
<td>1078</td>
<td>7.50</td>
</tr>
<tr>
<td>1120</td>
<td>7.93</td>
</tr>
<tr>
<td>1175</td>
<td>8.41</td>
</tr>
<tr>
<td>1223</td>
<td>8.84</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of Kₘ is expressed by the relation:

\[
\log(\text{Soly/mol cm}^{-3}) = -5.526 - \frac{646}{(T/K)}
\]

std. dev. = 0.14% (compiler)

The heat of solution, ΔH, is estimated to be:

\[
\Delta H/\text{kJ mol}^{-1} = 12.4
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Volumetric method.
The diagram and details of the apparatus used and procedure followed are given in the original paper. In brief, the melt is saturated with carbon dioxide. A portion of the saturated melt is either sparged with argon or it is solidified and the solid salt evacuated. The volume of liberated CO₂ is then determined with a gas burette.

SOURCE AND PURITY OF MATERIALS:
Condensation method was employed for drying the gases.

ESTIMATED ERROR:
solubility = ± 1% (authors)

REFERENCES:
COMPONENTS:

(1) Carbon dioxide; CO$_2$; [124-38-9]
(2) Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS:

Sada, E.; Katoh, S.; Yoshii, H.; Takemoto, I.; Shiomi, N.

VARIABLES:

P/kPa: 101.325 (1 atm.)
T/K = 1208 - 1273

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

The gas solubilities at 1 atmosphere pressure are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>$10^7$ $K_H$/mol cm$^{-3}$ atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>935</td>
<td>8.33</td>
</tr>
<tr>
<td>950</td>
<td>9.78</td>
</tr>
<tr>
<td>970</td>
<td>8.74</td>
</tr>
<tr>
<td>1000</td>
<td>9.08</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of $K_H$ is given by the equation:

$$\log(K_H$/mol cm$^{-3}$ atm$^{-1}$) = -5.758 - 358.3/(T/K)$$
(compiler)

std. dev. = 3.5% (compiler)

The enthalpy of solution, $\Delta H$, is estimated to be:

$$\Delta H$/kJ mol$^{-1}$ = 6.9$$
(compiler)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Elution technique.

The apparatus and procedure used for solubility measurements was the same as described in (1). The melt was saturated with carbon dioxide by bubbling the gas through the melt. Dissolved gas in the melt was eluted by bubbling nitrogen. The amount of carbon dioxide in the eluted mixture was measured with an infrared carbon dioxide analyzer.

SOURCE AND PURITY OF MATERIALS:

Carbon dioxide (99.96%) was of superpure grade and free from water. Potassium chloride was of reagent grade.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

<table>
<thead>
<tr>
<th>COMPONENTS:</th>
<th>ORIGINAL MEASUREMENTS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Carbon dioxide; CO₂; [124-38-9]</td>
<td>Bezukladnikov, A. B.; Devyatkin, V. N.; Ll'icheva, O. N.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VARIABLES:</th>
<th>PREPARED BY:</th>
</tr>
</thead>
<tbody>
<tr>
<td>P/kPa: 101.325 (compiler)</td>
<td>N. P. Bansal</td>
</tr>
<tr>
<td>T/K = 1133 - 1323</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EXPERIMENTAL VALUES:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Solutions of carbon dioxide in molten KCl obey Henry's law. The temperature dependence of solubility, x₁ (mol fraction), in the range 1133 - 1323 K, is expressed by the equations:</td>
<td></td>
</tr>
<tr>
<td>x₁ (mol fraction) = 38.9 x 10⁻⁵ exp[-5047 cal/R(T/K)]</td>
<td></td>
</tr>
<tr>
<td>log(x₁/mol fraction) = -3.410 - 1103.1/(T/K) (compiler)</td>
<td></td>
</tr>
<tr>
<td>The heat of solution, ΔH, is given as:</td>
<td></td>
</tr>
<tr>
<td>ΔH/kJ mol⁻¹ = + 21.12</td>
<td></td>
</tr>
</tbody>
</table>

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Elution method. Carbon dioxide is bubbled through the melt till saturated. The dissolved gas is displaced by flushing with an inert gas. The liberated CO₂ is absorbed in barium hydroxide solution. The excess barium hydroxide is titrated with potassium hydrogen phthalate.

**SOURCE AND PURITY OF MATERIALS:**

Not reported.

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**


COMPONENTS:

| (1) Carbon dioxide; CO₂; [124-38-9] | (2) Rubidium chloride; RbCl; [7791-11-9] |

ORIGINAL MEASUREMENTS:

Sada, E.; Katoh, S.; Yoshii, H.; Takemoto, I.; Shiomi, N.


VARIABLES:

| P/kPa: 101.325 (1 atm.) |
| T/K = 1123 - 1223 |

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

The gas solubilities, K_H, at a pressure of one atmosphere are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10^7 K_H/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>850</td>
<td>6.09</td>
</tr>
<tr>
<td>950</td>
<td>6.63</td>
</tr>
<tr>
<td>950</td>
<td>7.31</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of K_H is expressed by the equation:

\[
\log(K_H/\text{mol cm}^{-3} \text{ atm}^{-1}) = -5.247 - 1087.5/(T/\text{K}) \quad \text{(compiler)}
\]

std. dev. = 0.4% \quad \text{(compiler)}

The heat of solution, ΔH, is estimated to be:

\[\Delta H/\text{kJ mol}^{-1} = 20.8 \quad \text{(compiler)}\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Elution technique. The apparatus and procedure used for solubility measurements was the same as described in (1). The melt was saturated with carbon dioxide by bubbling the gas through the melt. Gas dissolved in the melt was eluted by bubbling nitrogen. The amount of carbon dioxide in the eluted mixture was measured with an infrared carbon dioxide analyzer.

SOURCE AND PURITY OF MATERIALS:

Carbon dioxide (99.96%) was of superpure grade and free from water. Rubidium chloride was of reagent grade.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:


COMPONENTS:

(1) Carbon dioxide; CO\textsubscript{2}; [124-38-9]
(2) Cesium chloride; CsCl; [7647-17-8]

ORIGINAL MEASUREMENTS:
Bezukladnikov, A. B.; Devyatkin, V. N.; Ll'icheva, O. N.

VARIABLES:
P/kPa: 101.325 (compiler)
T/K = 1060 - 1230

EXPERIMENTAL VALUES:

Solutions of carbon dioxide in molten CsCl obey Henry's law. The temperature dependence of solubility, \(x_1\) (mol fraction), in the range 1060 - 1230 K, is expressed by the equations:

\[
x_1(\text{mol fraction}) = 108.4 \times 10^{-5} \exp[-6434 \text{ cal}/R(T/K)]
\]

\[
\log(x_1/\text{mol fraction}) = -2.965 - 1406.3/(T/K) \quad \text{(compiler)}
\]

The heat of solution, \(\Delta H\), is given as:

\[
\Delta H/\text{kJ} \text{ mol}^{-1} = +26.92
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Elution method. Carbon dioxide is bubbled through the melt till saturated. The dissolved gas is displaced by sparging with an inert gas. The liberated CO\textsubscript{2} is absorbed in barium hydroxide solution. The excess of barium hydroxide is titrated with potassium hydrogen phthalate.

SOURCE AND PURITY OF MATERIALS:
Not reported.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
COMPONENTS:

(1) Carbon dioxide; CO₂; [124-38-9]
(2) Magnesium chloride; MgCl₂; [7786-30-3]

ORIGINAL MEASUREMENTS:

Prutskov, D. V.; Krivoruchko, N. P.; Prisyashnyi, V. D.
Rasplavy 1988, 2, 70 - 73.

VARIABLES:

<table>
<thead>
<tr>
<th>P/kPa: 101.325 (compiler)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T/K = 1023 - 1223</td>
</tr>
</tbody>
</table>

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

Gas solubilities, \( K_p (\text{mol cm}^{-3}\text{atm}^{-1}) \), in the melt at various temperatures are given below, where \( K_p \) is the Henry's law constant.

<table>
<thead>
<tr>
<th>T/K</th>
<th>( 10^6 K_p/\text{mol cm}^{-3}\text{atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1023</td>
<td>5.69 ± 0.51</td>
</tr>
<tr>
<td>1073</td>
<td>4.52 ± 0.44</td>
</tr>
<tr>
<td>1123</td>
<td>3.55 ± 0.25</td>
</tr>
<tr>
<td>1273</td>
<td>3.18 ± 0.20</td>
</tr>
<tr>
<td>1223</td>
<td>3.00 ± 0.22</td>
</tr>
</tbody>
</table>

Temperature dependence of \( K_p \) can be expressed by the relation:

\[
\log K_p = -7.164 + \frac{1947}{T}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Elution method.

The melt was prepared by melting the chloride under dry HCl atmosphere. The melt was saturated with CO gas by bubbling at the rate of 3-5 lit/h. It was established that saturation was attained in 50-60 min. Argon was bubbled at the rate of 6-9 lit/h through the saturated melt to liberate the dissolved CO gas. In order to determine the amount of dissolved CO, it was oxidized to CO₂ by passing over powdered CuO at 800 - 900 K. The resulting CO₂ was absorbed in 0.0175M Ba(OH)₂ solution excess of which was titrated against potassium biphthalate.

Experiment was repeated 4 - 5 times.

SOURCE AND PURITY OF MATERIALS:

High purity MgCl₂ was recrystallized twice from doubly distilled water and dried in a vacuum oven without permitting melting of the hydrated salt.

Argon gas was purified to remove H₂O and O₂ by passing through columns containing P₂O₅ and titanium sponge heated at 1200 K.

CO gas was produced through decomposition of formic acid.

ESTIMATED ERROR:

Not specified.

REFERENCES:
COMPONENTS:

(1) Carbon dioxide; CO₂; [124-38-9]
(2) Calcium chloride; CaCl₂; [10043-52-4]

ORIGINAL MEASUREMENTS:

Prutkov; D. V.; Krivoruchko, N. P.; Prisyashnyi, V. D.
Rasplavy 1988, 2, 70 - 73.

VARIABLES:

P/kPa: 101.325 (compiler)
T/K = 1073 - 1123

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:

Gas solubilities, \( K_p \) (mol cm\(^{-3}\) atm\(^{-1}\)), in the melt at various temperatures are given below, where \( K_p \) is the Henry's law constant.

<table>
<thead>
<tr>
<th>T/K</th>
<th>( 10^7 K_p ) (mol cm(^{-3}) atm(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1073</td>
<td>3.49 ± 0.37</td>
</tr>
<tr>
<td>1100</td>
<td>3.19 ± 0.39</td>
</tr>
<tr>
<td>1123</td>
<td>2.96 ± 0.32</td>
</tr>
</tbody>
</table>

Temperature dependence of \( K_p \) can be expressed by the relation:

\[
\log K_p = -7.061 + \frac{1720}{T}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Elution method.
The melt was prepared by melting the chloride under dry HCl atmosphere. The melt was saturated with CO gas by bubbling at the rate of 3-5 lit/h. It was established that saturation was attained in 50-60 min. Argon was bubbled at the rate of 6-9 lit/h through the saturated melt to liberate the dissolved CO gas. In order to determine the amount of dissolved CO, it was oxidized to CO₂ by passing over powdered CuO at 800 - 900 K. The resulting CO₂ was absorbed in 0.0175M Ba(OH)₂ solution excess of which was titrated against potassium biphthalate.
The experiment was repeated 4 - 5 times.

SOURCE AND PURITY OF MATERIALS:

High purity CaCl₂ was recrystallized twice from doubly distilled water and dried in a vacuum oven without permitting melting of the hydrated salt. Argon gas was purified to remove H₂O and O₂ by passing through columns containing P₂O₅ and titanium sponge heated at 1200 K. CO₂ was purified to remove moisture and O₂ by passing over P₂O₅ and heated copper shavings.

ESTIMATED ERROR:

Not specified.

REFERENCES:
COMPONENTS:

(1) Carbon Dioxide; CO₂; [124-38-9]

(2) Strontium chloride; SrCl₂; [10476-85-4]

ORIGINAL MEASUREMENTS:

Prutskov, D. V.; Krivoruchko, N. P.; Prisyashnyi, V. D.
Rasplavy 1988, 2, 70 - 73.

VARIABLES:

P/kPa: 101.325 (compiler)

T/K = 1173 - 1323

EXPERIMENTAL VALUES:

Gas solubilities, K_p (mol cm⁻³ atm⁻¹), in the melt at various temperatures are given below, where K_p is the Henry's law constant.

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁶ K_p/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>1173</td>
<td>3.06 ± 0.27</td>
</tr>
<tr>
<td>1213</td>
<td>2.81 ± 0.29</td>
</tr>
<tr>
<td>1253</td>
<td>2.41 ± 0.17</td>
</tr>
<tr>
<td>1293</td>
<td>2.00 ± 0.19</td>
</tr>
<tr>
<td>1323</td>
<td>2.04 ± 0.18</td>
</tr>
</tbody>
</table>

Temperature dependence of K_p could be expressed by the relation:

\[ \log K_p = -6.821 + \frac{1517}{T} \]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Elution method.

The melt was prepared by melting the chloride under dry HCl atmosphere. The melt was saturated with CO gas by bubbling at the rate of 3-5 lit/h. It was established that saturation was attained in 50-60 min. Argon was bubbled at the rate of 6-9 lit/h through the saturated melt to liberate the dissolved CO gas. In order to determine the amount of dissolved CO, it was oxidized to CO₂ by passing over powdered CuO at 800 - 900 K. The resulting CO₂ was absorbed in 0.0175M Ba(OH)₂ solution excess of which was titrated against potassium bipthalate.

The experiment was repeated 4 - 5 times.

SOURCE AND PURITY OF MATERIALS:

High purity SrCl₂ was recrystallized twice from doubly distilled water and dried in a vacuum oven without permitting melting of the hydrated salt.

Argon gas was purified to remove H₂O and O₂ by passing through columns containing P₂O₅ and titanium sponge heated at 1200 K.

CO gas was produced through decomposition of formic acid.

ESTIMATED ERROR:

Not specified.

REFERENCES:
COMPONENTS:

(1) Carbon Dioxide; CO₂; [124-38-9]
(2) Barium chloride; BaCl₂; [10361-37-2]

ORIGINAL MEASUREMENTS:

Prutskov, D. V.; Krivoruchko, N. P.; Prisyashnyi, V. D.
Rasplavy 1988, 2, 70 - 73.

VARIABLES:

P/kPa: 101.325 (compiler)
T/K = 1253 - 1373

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

Gas solubilities, K_p (mol cm⁻³ atm⁻¹), in the melt at various temperatures are given below, where K_p is the Henry's law constant.

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁶ K_p/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>1253</td>
<td>1.86 ± 0.23</td>
</tr>
<tr>
<td>1293</td>
<td>1.84 ± 0.15</td>
</tr>
<tr>
<td>1333</td>
<td>1.89 ± 0.22</td>
</tr>
<tr>
<td>1373</td>
<td>1.92 ± 0.17</td>
</tr>
</tbody>
</table>

Temperature dependence of K_p can be expressed by the relation:

\[ \log K_p = -5.543 - \frac{293}{T} \]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Elution method.
The melt was prepared by melting the chloride under dry HCl atmosphere. The melt was saturated with CO gas by bubbling at the rate of 3-5 lit/h. It was established that saturation was attained in 50-60 min. Argon was bubbled at the rate of 6-9 lit/h through the saturated melt to liberate the dissolved CO gas. In order to determine the amount of dissolved CO, it was oxidized to CO₂ by passing over powdered CuO at 800 - 900 K. The resulting CO₂ was absorbed in 0.0175M Ba(OH)₂ solution excess of which was titrated against potassium bipthalate.
The experiment was repeated 4 - 5 times.

SOURCE AND PURITY OF MATERIALS:

High purity BaCl₂ was recrystallized twice from doubly distilled water and dried in a vacuum oven without permitting melting of the hydrated salt. Argon gas was purified to remove H₂O and O₂ by passing through columns containing P₂O₅ and titanium sponge heated at 1200 K. CO₂ was purified to remove moisture and O₂ by passing over P₂O₅ and heated copper shavings.

ESTIMATED ERROR:

Not specified.

REFERENCES:
COMPONENTS:

(1) Carbon dioxide; CO$_2$; [124-38-9]
(2) Zinc chloride; ZnCl$_2$; [7646-85-7]

EVALUATOR:

N. P. Bansal
National Aeronautic and Space Administration.
Lewis Research Center
Cleveland, Ohio, 44135, U.S.A.
December, 1989.

CRITICAL EVALUATION:

Two studies are available (1, 2) for the solubility of carbon dioxide in molten ZnCl$_2$. Sada et al. (1) used the elution technique while Borodzinski et al. (2) employed a volumetric method. The results at different temperatures from the two investigations are compared in Fig. 1.

At higher temperatures, Fig. 1 shows an excellent agreement between the results of the two studies. However, Sada et al. (1) reported a negative value for $\Delta$H, in contrast to a positive value given by Borodzinski, et al. Tentative solubilities based on the results of Sada et al. (1) are given in Table 1. However, additional studies are needed in order to advance recommended values of solubility for this system.

Table 1

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^6$ $K_\beta$/mol cm$^{-3}$ atm$^{-2}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>580</td>
<td>1.82</td>
</tr>
<tr>
<td>600</td>
<td>1.74</td>
</tr>
<tr>
<td>620</td>
<td>1.67</td>
</tr>
<tr>
<td>640</td>
<td>1.61</td>
</tr>
<tr>
<td>660</td>
<td>1.55</td>
</tr>
<tr>
<td>680</td>
<td>1.50</td>
</tr>
<tr>
<td>700</td>
<td>1.45</td>
</tr>
<tr>
<td>720</td>
<td>1.41</td>
</tr>
<tr>
<td>740</td>
<td>1.37</td>
</tr>
<tr>
<td>760</td>
<td>1.33</td>
</tr>
<tr>
<td>780</td>
<td>1.30</td>
</tr>
</tbody>
</table>

References:

COMPONENTS:

1. Carbon dioxide; CO₂; [124-38-9]
2. Zinc chloride; ZnCl₂; [7646-85-7]

ORIGINAL MEASUREMENTS:

Sada, E.; Katoh, S.; Beniko, H.; Yoshii, H.; Kayano, M.

VARIABLES:

P/kPa: 101.325 (1 atm.)
T/K = 573 - 723

EXPERIMENTAL VALUES:

The gas solubilities at 1 atmosphere pressure are given as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁶ K_H/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>1.76</td>
</tr>
<tr>
<td>325</td>
<td>1.80</td>
</tr>
<tr>
<td>350</td>
<td>1.71</td>
</tr>
<tr>
<td>375</td>
<td>1.65</td>
</tr>
<tr>
<td>400</td>
<td>1.47</td>
</tr>
<tr>
<td>450</td>
<td>1.38</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of K_H is given by the expression:

\[
\log(K_H/\text{mol cm}^{-3}\text{ atm}^{-1}) = -6.31 + \frac{330.6}{T/\text{K}}
\]

std. dev. = 1.8% (compiler)

The heat of solution, ΔH, is estimated to be:

\[
\Delta H/\text{kJ mol}^{-1} = -6.3
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Elution method.
Diagram and details of the solubility apparatus are given in the original paper. The melt was saturated with CO₂ by bubbling the gas through the melt for about 50 min. Carbon dioxide dissolved in the melt was eluted by bubbling nitrogen. The amount of CO₂ in the eluted mixture was determined with an infrared carbon dioxide analyzer (Shimadzu, Type URA-25).

SOURCE AND PURITY OF MATERIALS:

Carbon dioxide (99.96%) was superpure grade and free from water. Zinc chloride was of reagent grade. It was dried in a desiccator for a few days and also in a vacuum oven at 150 - 250°C for several hours. It was further dried by bubbling anhydrous nitrogen through the salt in the molten state.

ESTIMATED ERROR:

std. error in solubility: < ± 10%

REFERENCES:
COMPONENTS:
(1) Carbon dioxide; CO₂; [124-38-9]
(2) Zinc chloride; ZnCl₂; [7646-85-7]

ORIGINAL MEASUREMENTS:
Borodzinski, A.; Sokolowski, A.; Suski, L.

VARIABLES:
P/kPa = 10 - 100
T/K = 709 - 778

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
Solubilities of CO₂ in the melt at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁻¹⁰ x₀/mol fraction Pa⁻¹</th>
<th>10⁻⁶ K_H/mol ml⁻¹ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>709</td>
<td>6.52 ± 0.06</td>
<td>1.127</td>
</tr>
<tr>
<td>719</td>
<td>6.41 ± 0.20</td>
<td>1.106</td>
</tr>
<tr>
<td>721</td>
<td>7.04 ± 0.21</td>
<td>1.214</td>
</tr>
<tr>
<td>723</td>
<td>7.27 ± 0.50</td>
<td>1.253</td>
</tr>
<tr>
<td>753</td>
<td>7.40 ± 0.30</td>
<td>1.268</td>
</tr>
<tr>
<td>778</td>
<td>7.46 ± 0.50</td>
<td>1.271</td>
</tr>
</tbody>
</table>


Smoothed Data:
Temperature dependence of the Henry's law constant is given by the equations:
\[
\log(x₀/mol fraction Pa⁻¹) = -8.535 - 454/(T/K) \quad \text{(compiler)}
\]
\[
\log(K_H/mol ml⁻¹ atm⁻¹) = -5.357 - 411.6/(T/K) \quad \text{(compiler)}
\]
std. dev. = 2.1% (compiler)

The standard enthalpy, ΔH°, and standard entropy, ΔS°, of solution of the gas are:
\[
ΔH°/kJ mol⁻¹ = 8.74 ± 3.68
\]
\[
ΔS°/J K⁻¹ mol⁻¹ = -9.58 ± 5.02 \quad \text{(at 720 K)}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Volumetric method.
Diagram and details of the arrangement used are given in the original paper. The melt was saturated with the gas. The saturation process was enhanced by a magnetic stirrer. The change in the volume of the gas caused by its dissolution in the melt was determined. The temperature was controlled within ± 1 K.

SOURCE AND PURITY OF MATERIALS:
Carbon dioxide was 99.99% pure. Zinc chloride p.a. was distilled under vacuum prior to its distillation directly into the apparatus.

ESTIMATED ERROR:
solubility = ± 5% (authors)

REFERENCES:
COMPONENTS:

(1) Carbon dioxide; CO₂; [124-38-9]
(2) Stannous chloride; SnCl₂; [7772-99-8]

VARIABLES:
P/kPa: 101.325 (1 atm.)
T/K = 543 - 673

EXPERIMENTAL VALUES:

The gas solubilities at one atmosphere pressure are given as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁷ Kₚ/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>270</td>
<td>3.86</td>
</tr>
<tr>
<td>300</td>
<td>4.01</td>
</tr>
<tr>
<td>350</td>
<td>3.96</td>
</tr>
<tr>
<td>400</td>
<td>3.75</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of Kₚ is expressed by the relation:

\[ \log(10^{7} K_p/mol \text{ cm}^{-3} \text{ atm}^{-2}) = -6.474 + \frac{38.296}{(T/K)} \]  

std. dev. = 1.4%  
(compiler)

The heat of solution, ΔH, is estimated to be:

ΔH/kJ mol⁻¹ = -0.73  
(compiler)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Elution technique. Diagram and details of the solubility apparatus are described in the original publication. The melt was saturated with carbon dioxide by bubbling the gas through the melt for about 50 min. Carbon dioxide dissolved in the melt was eluted by bubbling nitrogen. The amount of carbon dioxide in the eluted mixture was determined with an infrared carbon dioxide analyzer (Shimadzu, Type URA-25).

SOURCE AND PURITY OF MATERIALS:

Carbon dioxide (99.96%) was superpure grade and free from water. Stannous chloride was of reagent grade. It was dried in a desiccator for a few days followed by in a vacuum oven at 150 - 200°C for several hours. It was further dried by bubbling anhydrous nitrogen through the salt in the molten state.

ESTIMATED ERROR:

std. error in solubility: < ± 10%
COMPONENTS:

(1) Carbon dioxide; CO₂; [124-38-9]
(2) Sodium fluoride; NaF; [7681-49-4]

ORIGINAL MEASUREMENTS:

Bratland, D.; Krohn, C.

VARIABLES:

T/K = 1270 - 1380
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:

The authors reported the solubilities of CO₂ in the melt in the temperature interval 1270 - 1380 K in graphical form only. The values of Henry's law constants, K_H, extracted from the graph, at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10^6 K_H/mol ml⁻¹ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>1273</td>
<td>1.88*</td>
</tr>
<tr>
<td>1281</td>
<td>1.99</td>
</tr>
<tr>
<td>1313</td>
<td>2.59</td>
</tr>
<tr>
<td>1383</td>
<td>5.01</td>
</tr>
</tbody>
</table>

* Value from thermogravimetric technique; rest by chilling method.

Smoothed Data:

Temperature dependence of K_H is expressed by the relation:

\[
\log(K_H/\text{mol ml}^{-1} \text{ atm}^{-1}) = -0.3436 - 6863.4/(T/\text{K})
\]

std. dev. = 1.4% (compiler)

The heat of solution, ΔH, is estimated to be:

\[\Delta H/\text{kJ mol}^{-1} = 131.4\] (compiler)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chilling method.

The experimental method has been described in detail elsewhere (1,2). The melt is saturated with the gas. The dissolved gas is separated from the salt by freezing the melt. The expelled carbon dioxide is measured by transporting it by a stream of pure argon into absorption vessels containing Ascarite/Dehydrite.

SOURCE AND PURITY OF MATERIALS:

Carbon dioxide (99.95%) was obtained from Oslo Kulsyrefabrik A/S. Sodium fluoride was of pro analysis and suprapur grades from E. Merck A. G. It was vacuum dried at 450°C for 12 hrs.

ESTIMATED ERROR:

Presence of oxide impurity in molten NaF may react with CO₂ to form CO₃²⁻.

REFERENCES:

COMPONENTS:
(1) Carbon dioxide; CO$_2$; [124-38-9]
(2) Potassium fluoride; KF; [7789-23-3]

ORIGINAL MEASUREMENTS:
Bratland, D.; Krohn, C.

VARIABLES:
T/K = 1150 - 1280
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:
The authors reported the solubilities of CO$_2$ in the melt in the temperature range 1150 - 1280 K, only in graphical form. The values of Henry's law constants, K$_H$, extracted from the graph, at different temperatures, are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^6$ K$_H$/mol ml$^{-1}$ atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1154</td>
<td>1.99</td>
</tr>
<tr>
<td>1220</td>
<td>2.24</td>
</tr>
<tr>
<td>1278</td>
<td>2.72</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of K$_H$ is expressed by the equation:

$$\log(K_H/\text{mol ml}^{-1} \text{ atm}^{-1}) = -4.334 - 1585/(T/\text{K})$$

(std. dev. = 2.1%)

The heat of solution, $\Delta H$, is estimated to be:

$$\Delta H/\text{kJ mol}^{-1} = 30.3$$

METHOD/APPARATUS/PROCEDURE:

Chilling method.
The experimental method has been described in detail elsewhere (1,2). The melt is saturated with the gas. The dissolved gas is separated from the salt by freezing the melt. The expelled carbon dioxide is measured by transporting it by a stream of pure argon into absorption vessels containing Ascarite/Dehydrite.

REFERENCES:
Components:

(1) Carbon dioxide; CO₂; [124-38-9]
(2) Potassium bromide; KBr; [7758-02-3]

Evaluators:

N. P. Bansal
National Aeronautics and Space Research.
Lewis Research Center
Cleveland, Ohio, 44135, U.S.A.
December, 1989.

Critical Evaluation:

Two independent studies (1,2) are available for the solubility of carbon dioxide in molten KBr. Smoothed data at different temperatures from the two investigations are compared below:

<table>
<thead>
<tr>
<th>T/K</th>
<th>Sada et al. (1)</th>
<th>Bratland et al. (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1100</td>
<td>(10.59)</td>
<td>9.12</td>
</tr>
<tr>
<td>1120</td>
<td>(10.48)</td>
<td>9.43</td>
</tr>
<tr>
<td>1140</td>
<td>10.37</td>
<td>9.73</td>
</tr>
<tr>
<td>1160</td>
<td>10.27</td>
<td>10.03</td>
</tr>
<tr>
<td>1180</td>
<td>10.17</td>
<td>10.33</td>
</tr>
<tr>
<td>1200</td>
<td>10.08</td>
<td>10.63</td>
</tr>
<tr>
<td>1220</td>
<td>9.99</td>
<td>(10.93)</td>
</tr>
</tbody>
</table>

Values in ( ) outside temperature interval of experimental measurement; extrapolated by the evaluator.

The results of the two studies are not in good agreement with each other. Bratland et al. (2) report a positive value of ΔH while the data of Sada et al. (1) suggest a negative value.

Further work needs to be done in order to advance recommended values of solubility for this gas - molten salt system.

References:

COMPONENTS:
(1) Carbon dioxide; CO₂; [124-38-9]
(2) Potassium bromide; KBr; [7758-02-3]

VARIABLES:
P/kPa: 101.325 (1 atm.)
T/K = 1123 - 1223

EXPERIMENTAL VALUES:

The gas solubilities at one atmosphere pressure are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10^-6 K_H/mol cm^-3 atm^-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>850</td>
<td>1.02</td>
</tr>
<tr>
<td>900</td>
<td>1.08</td>
</tr>
<tr>
<td>950</td>
<td>0.97</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of K_H is expressed by the equation:

\[
\log(K_H/mol \text{ cm}^{-3} \text{ atm}^{-1}) = -6.236 + \frac{287.2}{(T/K)} \quad \text{(compiler)}
\]

std. dev. = 3% (compiler)

The heat of solution, ΔH, is estimated to be:

\[
\Delta H/\text{kJ mol}^{-1} = -5.5 \quad \text{(compiler)}
\]

AUXILIARY INFORMATION

METHOD/APPROATUS/PROCEDURE:

Elution technique.
The apparatus and procedure used for solubility measurements was the same as described in (1). The melt was saturated with carbon dioxide by bubbling the gas through the melt. Carbon dioxide dissolved in the melt was eluted by bubbling nitrogen. The amount of carbon dioxide in the eluted mixture was determined with an infrared carbon dioxide analyzer.

SOURCE AND PURITY OF MATERIALS:

Carbon dioxide (99.96%) was of superpure grade and free from water. Potassium bromide was of reagent grade.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

**COMPONENTS:**

| (1) Carbon dioxide; CO₂; [124-38-9] |
| (2) Potassium bromide; KBr; [7758-02-3] |

**VARIABLES:**

| T/K = 1048 - 1200 |
| P/kPa: 101.325 (1 atm.) |

**EXPERIMENTAL VALUES:**

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁷ Kₜ/mol ml⁻¹ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>775</td>
<td>8.46 ± 0.14</td>
</tr>
<tr>
<td>829</td>
<td>9.36 ± 0.13</td>
</tr>
<tr>
<td>874</td>
<td>9.80 ± 0.20</td>
</tr>
<tr>
<td>927</td>
<td>10.89 ± 0.14</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of the Henry's law constant, Kₜ, is given by the equation:

\[
\log(Kₜ/mol \text{ ml}⁻¹ \text{ atm}⁻¹) = -5.24 - 880/(T/K)
\]

std. dev. = 0.7% (compiler)

The heat of dissolution, ΔH, and the entropy of dissolution, ΔS, are:

\[
\Delta H/\text{kJ mol}⁻¹ = 16.7
\]

\[
\Delta S/\text{J K}⁻¹ \text{ mol}⁻¹ = 14.6
\]

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Chilling method.

Detailed description and diagram of the apparatus is given in the original paper. It employs the separation of dissolved gas from the salt by freezing of the melt. The expelled carbon dioxide is carried into the absorption vessel by a stream of pure nitrogen.

**SOURCE AND PURITY OF MATERIALS:**

Carbon dioxide - not given.

Potassium bromide was of pro analysis grade from E. Merck A. G.

The salt was dried under vacuum at 450°C for 4 hours.

**ESTIMATED ERROR:**

solubility = ± 10% (authors)

**REFERENCES:**
COMPONENTS:

(1) Carbon dioxide; CO$_2$; [124-38-9]
(2) Potassium bromide; KBr; [7758-02-3]

ORIGINAL MEASUREMENTS:

Bratland, D.; Grjotheim, K.; Krohn, C.; Matzfeldt, K.

VARIABLES:

P/kPa: 101.325 (1 atm.)
T/K = 1048 - 1200

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

Solubilities of CO$_2$ in molten KBr are presented in the form of a log $K_H$ vs. 1/T plot. Values of $K_H$ derived from the graph, by the compiler, at various temperatures are given below:

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^7$ $K_H$/mol ml$^{-1}$ atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1048</td>
<td>8.5 ± 0.15</td>
</tr>
<tr>
<td>1103</td>
<td>9.4 ± 0.20</td>
</tr>
<tr>
<td>1145</td>
<td>9.8 ± 0.20</td>
</tr>
<tr>
<td>1199</td>
<td>10.9 ± 0.20</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of $K_H$ is expressed by the relation:

$$\log(K_H/mol \text{ ml}^{-1} \text{ atm}^{-1}) = -5.24 - 872.4/(T/K)$$

std. dev. = 0.7% (compiler)

The heat of solution, $\Delta H$, and entropy of solution, $\Delta S$, are:

$\Delta H$/kJ mol$^{-1} = 17.15$

$\Delta S$/J K$^{-1}$ mol$^{-1} = 15.06$ (at 1150 K)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Detailed descriptions of the apparatus and procedure for each method are given in the original paper.

Volumetric Method: The change in volume of gas (at constant pressure) caused by its dissolution in the melt is directly determined. This is not an accurate method, the estimated uncertainty being about 25%.

Thermogravimetric Method: The gain in weight of a melt sample due to the dissolution of the gas is measured using a thermobalance.

Chilling Method: The dissolved gas is separated from the melt by freezing of the melt. The expelled gas is carried into absorption vessels containing Ascarite/Dehydrdrite. Expelled gas is carried into absorption vessels containing dry Ascarite/Dehydrdrite, which are expelled gas is carried into absorption vessels containing by a stream of pure argon. This method is simpler and more expedient than the others but giving comparable or better accuracy.

SOURCE AND PURITY OF MATERIALS:

Potassium bromide, pro analysis quality, from Merck AG, Darmstadt, West Germany was used. It was either dried in situ (volumetric and thermogravimetric methods) or pre-dried in vacuum at 450°C for 4 hrs. (chilling method).

ESTIMATED ERROR:

solubility = ± 10% (authors)

REFERENCES:
COMPONENTS:

(1) Carbon dioxide; CO₂; [124-38-9]
(2) Zinc bromide; ZnBr₂; [7699-45-8]

ORIGINAL MEASUREMENTS:

Sada, E.; Katoh, S.; Beniko, H.; Yoshii, H.; Kayano, M.

VARIABLES:

P/kPa: 101.325 (1 atm.)
T/K = 673 - 748

EXPERIMENTAL VALUES:

The gas solubilities at a pressure of 1 atm are given as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁶ Kₑ/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>2.19</td>
</tr>
<tr>
<td>450</td>
<td>1.80</td>
</tr>
<tr>
<td>475</td>
<td>1.78</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of Kₑ is given by the expression:

\[ \log(Kₑ/mol cm⁻³ atm⁻¹) = -6.616 + 641.07/(T/K) \] (compiler)

std. dev. = 1.8% (compiler)

The heat of solution, ΔH, is estimated to be:

\[ ΔH/kJ mol⁻¹ = -12.3 \] (compiler)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Elution technique. Diagram and details of the solubility apparatus are described in the original publication. The melt was saturated with CO₂ by bubbling the gas through the melt for 50 min. Carbon dioxide dissolved in the melt was eluted by bubbling nitrogen. The amount of carbon dioxide in the eluted mixture was determined with an infrared carbon dioxide analyzer (Shimadzu, Type URA-25).

SOURCE AND PURITY OF MATERIALS:

Carbon dioxide (99.96%) was superpure grade and free from water. Zinc bromide was reagent grade. It was dried in a desiccator for a few days followed by in a vacuum oven at 150 - 200°C for several hours. It was further dried by bubbling anhydrous nitrogen through the salt in the molten state.

ESTIMATED ERROR:

std. error in solubility: < ± 10%

REFERENCES:
COMPONENTS:
(1) Carbon dioxide; $\text{CO}_2$; [124-38-9]
(2) Potassium iodide; KI; [7681-11-0]

ORIGINAL MEASUREMENTS:
Bratland, D.; Grjotheim, K.; Krohn, C.; Matzfeldt, K.

VARIABLES:
$P/\text{kPa}$: 101.325 (1 atm.)
$T/K = 973$

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
Solubility of $\text{CO}_2$ in molten KI in a very narrow temperature range is presented in the form of a log $K_w$ vs. $1/T$ plot. The value of $K_w$ derived from the graph, by the compiler, is given below:

<table>
<thead>
<tr>
<th>$T/K$</th>
<th>$10^7 K_w/\text{mol ml}^{-2} \text{ atm}^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>973</td>
<td>19.4 $\pm$ 0.6</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Detailed descriptions of the apparatus and procedure for each method are given in the original paper.

Volumetric Method: The change in volume of gas (at constant pressure) caused by its dissolution in the melt is directly determined. This is not an accurate method, uncertainty being about 25%.

Thermogravimetric Method: The gain in weight of a melt sample due to the dissolution of the gas is measured by a thermobalance.

Chilling Method: The dissolved gas is removed from the melt by freezing the melt. The expelled gas is carried into absorption vessels containing Ascarite/Dehydrite by a stream of pure argon. This method is simpler and more expedient than the others while giving comparable or better accuracy.

SOURCE AND PURITY OF MATERIALS:
Potassium iodide, pro analysi quality, from Merck AG, Darmstadt, West Germany was used. It was either dried in situ (volumetric and thermogravimetric methods) or pre-dried in vacuum at 450°C for 4 hrs. (chilling method).

ESTIMATED ERROR:
solubility = $\pm$ 10% (authors)

REFERENCES:
COMPONENTS:

(1) Carbon dioxide; CO$_2$; [124-38-9]
(2) Potassium iodide; KI; [7681-11-0]

ORIGINAL MEASUREMENTS:
Bratland, K.; Grjotheim, K.; Krohn, C.; Matzfeldt, K.

VARIABLES:
P/kPa: 101.325 (1 atm.)
T/K = 954 & 973

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:

Solubilities of CO$_2$ in molten KI at 1 atm. pressure at two temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>$10^7 K_r$/mol ml$^{-1}$ atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>681</td>
<td>9.8 ± 0.6$^a$</td>
</tr>
<tr>
<td>700</td>
<td>19.2 ± 0.6$^b$</td>
</tr>
</tbody>
</table>

$^a$ By volumetric method
$^b$ By chilling method

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two different techniques have been used: volumetric and chilling method. A detailed description of each technique is given in the original publication. Volumetric Method: The change in volume of the gas (at constant pressure) caused by its dissolution in the melt is directly determined. This is not a very accurate method and was finally abandoned. The established uncertainty in the results was about 25%.

Chilling Method: It employs the separation of the dissolved gas from the salt by freezing the melt. The expelled carbon dioxide is carried into the absorption vessel by a stream of pure nitrogen. This a less cumbersome and more expedient method than the other but the accuracy of the results is better.

SOURCE AND PURITY OF MATERIALS:
Carbon dioxide - not given.
Potassium iodide was of pro analysi grade from E. Merck A. G. In the volumetric and thermogravimetric measurements, the salt was dried in situ, whereas in the chilling method, the salt was dried under vacuum at 450°C for 4 hrs.

ESTIMATED ERROR:

solubility = ± 10%

REFERENCES:
**COMPONENTS:**

(1) Carbon dioxide; CO₂; [124-38-9]
(2) Sodium carbonate; Na₂CO₃; [497-19-8]

**ORIGINAL MEASUREMENTS:**

Andresen, R. E.
J. Electrochem. Soc. 1979, 126, 328 - 34.

**VARIABLES:**

P/kPa = 39.997 - 101.325
one temperature: T/K = 1153

**EXPERIMENTAL VALUES:**

For the solubility of CO₂ in molten Na₂CO₃, the value of Henry's law constant, Kₜ, is:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁶ Kₜ/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>880</td>
<td>9.6 ± 2.3*</td>
</tr>
</tbody>
</table>

* Value not corrected for the effect of the reaction:

Na₂CO₃ → Na₂O + CO₂(g)

**METHOD/APPARATUS/PROCEDURE:**

Manometric technique.
The diagram and details of the apparatus used are given in the original paper. The procedure followed has been described in detail elsewhere (1). In brief, the apparatus was first evacuated and then filled with CO₂ to a pressure of about 1 atm. Due to gas dissolution, the gas pressure dropped. Equilibrium was attained when the pressure did not change for about 1 hr. The volume of the gas dissolved was determined from the initial and final positions of the mercury meniscus in the manometer. The apparatus was earlier calibrated using argon. With a cathetometer, pressure changes as small as 0.05 torr could be read.

**SOURCE AND PURITY OF MATERIALS:**

CO₂ (99.6%) was used directly from the cylinder. Reagent grade Na₂CO₃ supplied by Baker was dried at about 445 K in an oven, then in the furnace at about 645 K under CO₂ pressure of 100 torr for about a day.

**ESTIMATED ERROR:**

solubility = ± 30%

**REFERENCES:**

COMPONENTS:
(1) Carbon dioxide; CO$_2$; [124-38-9]
(2) Lithium nitrate; LiNO$_3$; [7790-69-4]
(3) Sodium nitrate; NaNO$_3$; [7631-99-4]

VARIABLES:
one temperature: T/K = 623
melt comp./mol% NaN$_3$ = 0 - 100
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:
The solubilities of CO$_2$ at one atmosphere pressure and 623K in LiNO$_3$ - NaN$_3$ melts of different compositions are:

<table>
<thead>
<tr>
<th>Melt composition/ mol fraction of NaN$_3$</th>
<th>$10^4$ C$_s$/ mol cm$^{-3}$</th>
<th>$10^4$ x$_s$/ mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>3.86</td>
<td>1.54</td>
</tr>
<tr>
<td>0.07</td>
<td>4.70</td>
<td>1.89</td>
</tr>
<tr>
<td>0.20</td>
<td>3.68</td>
<td>1.52</td>
</tr>
<tr>
<td>0.25</td>
<td>4.67</td>
<td>1.93</td>
</tr>
<tr>
<td>0.50</td>
<td>2.79</td>
<td>1.19</td>
</tr>
<tr>
<td>0.52</td>
<td>3.18</td>
<td>1.37</td>
</tr>
<tr>
<td>0.66</td>
<td>2.34</td>
<td>1.03</td>
</tr>
<tr>
<td>1.00</td>
<td>1.04</td>
<td>0.468</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution technique.
The apparatus and procedure used for solubility measurements was the same as described in (1). The melt was saturated with carbon dioxide by bubbling the gas through the melt. Carbon dioxide dissolved in the melt was eluted by bubbling nitrogen. The amount of CO$_2$ in the eluted mixture was determined with an infrared carbon dioxide analyzer.

SOURCE AND PURITY OF MATERIALS:
Carbon dioxide (99.96%) was of superpure grade and free from water. Sodium nitrate and lithium nitrate were of reagent grade.

REFERENCES:
COMPONENTS:
(1) Carbon dioxide; CO₂; [124-38-9]
(2) Lithium nitrate; LiNO₃; [7790-69-4]
(3) Potassium nitrate; KNO₃; [7757-79-1]

ORIGINAL MEASUREMENTS:
Paniccia, F.; Zambonin, P. G.

VARIABLES:
P/kPa = 10²
T/K = 473 - 540

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The solubilities, x₁, of CO₂ in molten mixtures of LiNO₃ - KNO₃ (50 - 50, 66.67 - 33.33 mol%) at different temperatures are reported in graphical form in the original paper. The values of x₁, derived from the graph by the compiler, are:

<table>
<thead>
<tr>
<th>Melt composition/ mol% LiNO₃</th>
<th>10² x₁/ mol fraction bar⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.0</td>
<td></td>
</tr>
<tr>
<td>474</td>
<td>5.62</td>
</tr>
<tr>
<td>499</td>
<td>5.55</td>
</tr>
<tr>
<td>529</td>
<td>5.29</td>
</tr>
<tr>
<td>66.67</td>
<td></td>
</tr>
<tr>
<td>478</td>
<td>10.03</td>
</tr>
<tr>
<td>486</td>
<td>8.96</td>
</tr>
<tr>
<td>488</td>
<td>8.96</td>
</tr>
<tr>
<td>494</td>
<td>9.41</td>
</tr>
<tr>
<td>503</td>
<td>9.07</td>
</tr>
<tr>
<td>512</td>
<td>9.07</td>
</tr>
<tr>
<td>513</td>
<td>9.76</td>
</tr>
<tr>
<td>517</td>
<td>8.42</td>
</tr>
<tr>
<td>528</td>
<td>8.42</td>
</tr>
<tr>
<td>539</td>
<td>8.63</td>
</tr>
</tbody>
</table>

continued

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Manometric method.
The experimental procedure has been described in detail elsewhere (1,2). In brief, the apparatus was evacuated and then carbon dioxide was introduced into the system at about one bar pressure. The initial gas pressure was immediately noted. The melt was vigorously stirred and the fall in gas pressure due to its dissolution in the melt was continuously recorded till equilibrium was reached. The final gas pressure was noted and the Henry's constant was calculated.

SOURCE AND PURITY OF MATERIALS:
High purity quality carbon dioxide (S.I.O., Milan) was dried in dry ice.
Reagent grade lithium and potassium nitrates (Carlo Erba, Milan) were used without further purification.
The melt container was made of Teflon.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
1. Desimoni, E.; Paniccia, F.; Zambonin, P. G.
2. Zambonin, P. G.; Cardetta, V. L.; Signorile, G.
COMPONENTS:
(1) Carbon dioxide; CO$_2$; [124-38-9]
(2) Lithium nitrate; LiNO$_3$; [7790-69-4]
(3) Potassium nitrate; KNO$_3$; [7757-79-1]

VARIABLES:

EXPERIMENTAL VALUES:

continued

Smoothed Data:

Temperature dependence of $x_1$ could be expressed by equations of the form:

$$\log\left(\frac{x_1}{\text{mol fraction bar}^{-1}}\right) = a + \frac{b}{(T/K)}$$

The values of the coefficients $a$ and $b$ of the above equation for the two molten mixtures, along with the enthalpy of solution, $\Delta H$, and the standard entropy of solution, $\Delta S^*$, are:

<table>
<thead>
<tr>
<th>Melt composition/ mol% LiNO$_3$</th>
<th>$a$</th>
<th>$b$</th>
<th>$\Delta H$/ kJ mol$^{-1}$</th>
<th>$\Delta S^*$/ J K$^{-1}$ mol$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.0</td>
<td>-4.502</td>
<td>120.5</td>
<td>-3.0</td>
<td>-30.0</td>
</tr>
<tr>
<td>66.67</td>
<td>-4.446</td>
<td>203.06</td>
<td>-5.5</td>
<td>-30.0</td>
</tr>
</tbody>
</table>

* At 623 K

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:  

SOURCE AND PURITY OF MATERIALS:  

ESTIMATED ERROR:  

REFERENCES:
COMPONENTS:
(1) Carbon dioxide; CO₂; [124-38-9]
(2) Sodium nitrate; NaN₃; [7631-99-4]
(3) Potassium nitrate; KNO₃; [7757-79-1]

ORIGINAL MEASUREMENTS:
Paniccia, F.; Zambonin, P. G.

ORIGINAL MEASUREMENTS:
Paniccia, F.; Zambonin, P. G.

VARIABLES:  
P/kPa = 10²  
T/K = 510 - 610

PREPARED BY:  
N. P. Bansal

EXPERIMENTAL VALUES:
The solubilities, x₁, of CO₂ in the molten equimolar mixture NaN₃ - KNO₃ are reported in graphical form in the original paper. The values of x₁ at different temperatures, derived from the graph by the compiler, are:

<table>
<thead>
<tr>
<th>Melt composition/ mol% NaN₃</th>
<th>T/K</th>
<th>10⁵ x₁/ mol fraction bar⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.0</td>
<td>510</td>
<td>2.30</td>
</tr>
<tr>
<td></td>
<td>520</td>
<td>2.42</td>
</tr>
<tr>
<td></td>
<td>529</td>
<td>2.48</td>
</tr>
<tr>
<td></td>
<td>540</td>
<td>2.51</td>
</tr>
<tr>
<td></td>
<td>563</td>
<td>2.54</td>
</tr>
<tr>
<td></td>
<td>586</td>
<td>2.57</td>
</tr>
<tr>
<td></td>
<td>609</td>
<td>2.70</td>
</tr>
</tbody>
</table>

Smoothed Data:
The temperature dependence of x₁ is expressed by the relation:

\[
\log(x₁/mol \text{ fraction bar}^{-1}) = -4.284 - 174.5/(T/K) \quad \text{(compiler)}
\]

The enthalpy of solution, ΔH, and the standard entropy of solution, ΔS₀, are:

\[\Delta H/kJ \text{ mol}^{-1} = 3.0 \quad \Delta S/J K^{-1} \text{ mol}^{-1} = -26.0 \quad \text{at 623 K}\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Manometric technique.
The experimental details are given elsewhere (1,2). Briefly, the apparatus was evacuated and carbon dioxide was introduced into the system at about one bar pressure. The initial gas pressure was immediately recorded. The melt was vigorously stirred and the fall in gas pressure due to its dissolution in the melt was continuously recorded till equilibrium was attained. The final gas pressure was noted and the Henry's constant was evaluated.

SOURCE AND PURITY OF MATERIALS:
High purity quality carbon dioxide (S.I.O., Milan) was dried in dry ice.
Reagent grade sodium and potassium nitrates (Carlo Erba, Milan) were used without further purification.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
COMPONENTS:
(1) Carbon dioxide; CO₂; [124-38-9]
(2) Sodium nitrate; NaN₃; [7631-99-4]
(3) Rubidium nitrate; RbNO₃; [13126-12-0]

ORIGINAL MEASUREMENTS:
Sada, E.; Katoh, S.; Yoshii, H.; Takemoto, I.; Shiomi, N.

VARIABLES:
one temperature: T/K = 623
melt comp./mol% NaN₃ = 0 - 100
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:
The solubilities of CO₂ at one atmosphere pressure and 623K in NaN₃ - RbNO₃ melts of different compositions are:

<table>
<thead>
<tr>
<th>Melt composition/ mol fraction of NaN₃</th>
<th>10⁶ C₄/mol cm⁻³</th>
<th>10⁵ x₄/mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>1.88</td>
<td>11.30</td>
</tr>
<tr>
<td>0.25</td>
<td>1.36</td>
<td>7.66</td>
</tr>
<tr>
<td>0.50</td>
<td>1.18</td>
<td>6.15</td>
</tr>
<tr>
<td>0.75</td>
<td>1.07</td>
<td>5.27</td>
</tr>
<tr>
<td>1.00</td>
<td>1.04</td>
<td>4.68</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution technique.
The apparatus and procedure used for solubility measurements was the same as described in (1). The melt was saturated with carbon dioxide by bubbling the gas through the melt. Carbon dioxide dissolved in the melt was eluted by bubbling nitrogen. The amount of carbon dioxide in the eluted gas mixture was measured with an infrared carbon dioxide analyzer.

SOURCE AND PURITY OF MATERIALS:
Carbon dioxide (99.96%) was of superpure grade and free from water. Sodium nitrate and rubidium nitrate were of reagent grade.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
COMPONENTS:
(1) Carbon dioxide; CO₂; [124-38-9]
(2) Sodium fluoride; NaF; [7681-49-4]
(3) Beryllium fluoride; BeF₂; [7789-49-7]

ORIGINAL MEASUREMENTS:
Smith, N. V.; Sheil, R. J.; Evans, R. B.; Watson, G. M.

VARIABLES:
T/K = 688 - 1073
P/kPa: 101.325 (compiler)

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁻⁶ K_H/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>415</td>
<td>10.35</td>
</tr>
<tr>
<td>500</td>
<td>7.93</td>
</tr>
<tr>
<td>600</td>
<td>7.05</td>
</tr>
<tr>
<td>700</td>
<td>8.32</td>
</tr>
<tr>
<td>800</td>
<td>10.78</td>
</tr>
</tbody>
</table>

The values of Henry's law constant, K_H, for the solubility of carbon dioxide in the melt NaF - BeF₂ (54 - 43 mol%) as a solvent at different temperatures are given in graphical form. The values extracted from the graph, by the compiler, are:

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Stripping method.
Details not given.

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
COMPONENTS:  
(1) Carbon dioxide; CO₂; [124-38-9]  
(2) Lithium chloride; LiCl; [7447-41-8]  
(3) Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS:  
Sada, E.; Katoh, S.; Yoshii, H.; Yasuda, K.  

VARIABLES:  
T/K = 723 - 803  
P/kPa: 101.325 (compiler)

EXPERIMENTAL VALUES:  
The solubilities of CO₂ in the molten eutectic LiCl - KCl (58 - 48 mol%) are given as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁶ Kₓ/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>450</td>
<td>2.4</td>
</tr>
<tr>
<td>530</td>
<td>3.0</td>
</tr>
</tbody>
</table>

EXPERIMENTAL VALUES:

METHOD/APPARATUS/PROCEDURE:  
Elution technique.  
The diagram and details of the apparatus and procedure used are given in the original paper. The melt was saturated with carbon dioxide by bubbling the gas through the melt. Dissolved carbon dioxide was eluted by bubbling nitrogen. The amount of carbon dioxide in the eluted gas mixture was measured with an infrared carbon dioxide analyzer.

SOURCE AND PURITY OF MATERIALS:  
Carbon dioxide (99.96%) was of superpure grade and free from water. Lithium chloride and potassium chloride were of reagent grade and were dried in a desiccator for a few days followed by in a vacuum oven at 150 - 200°C for several hours.

ESTIMATED ERROR:  
Nothing specified.

REFERENCES:
COMPONENTS:
(1) Carbon dioxide; CO$_2$; [124-38-9]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS:
Sada, E.; Katoh, S.; Yoshii, H.; Takemoto, I.; Shiomi, N.

VARIABLES:
one temperature: T/K = 1273
melt comp./mol% NaCl = 0 - 100
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:
The gas solubilities at one atmosphere pressure and 1000°C in NaCl - KCl melts of different compositions are:

<table>
<thead>
<tr>
<th>Melt Composition/ mol fraction of NaCl</th>
<th>10$^7$ C$_2$/ mol cm$^{-3}$</th>
<th>10$^5$ x$_1$/ mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>9.08</td>
<td>4.85</td>
</tr>
<tr>
<td>0.25</td>
<td>7.24</td>
<td>3.65</td>
</tr>
<tr>
<td>0.50</td>
<td>8.17</td>
<td>3.86</td>
</tr>
<tr>
<td>0.75</td>
<td>9.66</td>
<td>4.23</td>
</tr>
<tr>
<td>1.00</td>
<td>10.1</td>
<td>4.07</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution technique.
The apparatus and procedure used for solubility measurements was the same as described in (1). The melt was saturated with carbon dioxide by bubbling the gas through the melt. Carbon dioxide dissolved in the melt was eluted by bubbling nitrogen. The amount of carbon dioxide in the eluted gas mixture was measured with an infrared carbon dioxide analyzer.

SOURCE AND PURITY OF MATERIALS:
Carbon dioxide (99.96%) was of superpure grade and free from water. Sodium chloride and potassium chloride were of reagent grade.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
COMPONENTS:
(1) Carbon dioxide; CO\textsubscript{2}; [124-38-9]
(2) Potassium chloride; KCl; [7447-40-7]
(3) Magnesium chloride; MgCl\textsubscript{2}; [7786-30-3]

ORIGINAL MEASUREMENTS:
Lukmanova, T. L.; Vil'nyanskii, Ya. E.

VARIABLES:
T/K = 773 - 1173
P/kPa = 30.398 - 103.352

EXPERIMENTAL VALUES:
The solubilities of CO\textsubscript{2} in molten equimolar KCl - MgCl\textsubscript{2} at different
temperatures as a function of its partial pressure are reported as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>( P_{CO_2} )/atm</th>
<th>( x_1/\text{mol fraction} )</th>
<th>( 10^4 C_1/\text{wt}% )</th>
<th>( x_1/\text{mol atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>0.33</td>
<td>2.51</td>
<td>130</td>
<td>6.22</td>
</tr>
<tr>
<td></td>
<td>0.49</td>
<td>3.30</td>
<td>171</td>
<td>5.66</td>
</tr>
<tr>
<td></td>
<td>0.78</td>
<td>5.11</td>
<td>268</td>
<td>6.37</td>
</tr>
<tr>
<td></td>
<td>1.02</td>
<td>6.19</td>
<td>322</td>
<td>6.01</td>
</tr>
<tr>
<td>650</td>
<td>0.32</td>
<td>3.65</td>
<td>190</td>
<td>9.58</td>
</tr>
<tr>
<td></td>
<td>0.45</td>
<td>4.56</td>
<td>237</td>
<td>8.84</td>
</tr>
<tr>
<td></td>
<td>0.76</td>
<td>7.51</td>
<td>389</td>
<td>9.22</td>
</tr>
<tr>
<td></td>
<td>1.01</td>
<td>9.38</td>
<td>489</td>
<td>9.35</td>
</tr>
<tr>
<td>750</td>
<td>0.34</td>
<td>5.26</td>
<td>271</td>
<td>12.32</td>
</tr>
<tr>
<td></td>
<td>0.48</td>
<td>7.12</td>
<td>371</td>
<td>12.56</td>
</tr>
<tr>
<td></td>
<td>0.77</td>
<td>10.28</td>
<td>532</td>
<td>12.50</td>
</tr>
<tr>
<td></td>
<td>1.00</td>
<td>12.74</td>
<td>650</td>
<td>12.74 \text{cont'd.}</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution or stripping method. The apparatus and the method
used for gas solubility
measurements have been described
earlier (1). Dry CO\textsubscript{2} gas was
passed through about 100 g of the
melt at a rate of 10 l/hr. After
saturation, a portion of the melt
was transferred into the
desorber and flushed with
nitrogen. The nitrogen from the
desorber was passed through the
absorbent and the amount of
liberated CO\textsubscript{2} was determined by
weighing.

SOURCE AND PURITY OF MATERIALS:
The method of preparation of the
anhydrous melt from carnallite has
been described earlier (1).

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
1. Lukmanova, T. L.; Vil'nyanskii, Ya. E.
COMPONENTS:
(1) Carbon dioxide; CO₂; [124-38-9]
(2) Potassium chloride; KCl; [7447-40-7]
(3) Magnesium chloride; MgCl₂; [7786-30-3]

VARIABLES:
T/K = 773 - 1173
P/kPa = 30.398 - 103.352

ORIGINAL MEASUREMENTS:
Lukmanova, T. L.; Vil'nyanskii, Ya. E.

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>Temperature (K)</th>
<th>Mol Fraction</th>
<th>Pressure (kPa)</th>
<th>Experimental Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>850</td>
<td>0.34</td>
<td>6.88</td>
<td>376</td>
</tr>
<tr>
<td></td>
<td>0.48</td>
<td>7.86</td>
<td>409</td>
</tr>
<tr>
<td></td>
<td>0.74</td>
<td>10.69</td>
<td>554</td>
</tr>
<tr>
<td></td>
<td>1.01</td>
<td>13.45</td>
<td>699</td>
</tr>
<tr>
<td>900</td>
<td>0.30</td>
<td>7.77</td>
<td>401</td>
</tr>
<tr>
<td></td>
<td>0.47</td>
<td>9.41</td>
<td>469</td>
</tr>
<tr>
<td></td>
<td>0.78</td>
<td>12.43</td>
<td>648</td>
</tr>
<tr>
<td></td>
<td>1.00</td>
<td>13.90</td>
<td>740</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of x₁ in the range 773 - 1173 K, can be expressed by the equation:

\[
\log(\frac{x₁}{\text{mol fraction atm}^{-1}}) = -2.168 - \frac{795.6}{(T/K)}
\]

(std. dev. = 3% (compiler))

The heat of solution, \(\Delta H\), was calculated to be:

\[
\Delta H/\text{kJ mol}^{-1} = 15.2
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS: ORIGINAL MEASUREMENTS:

(1) Carbon dioxide; CO$_2$;[124-38-9]
(2) Calcium oxide; CaO;[1305-78-8]
(2) Calcium chloride; CaCl$_2$; [10043-52-4]

Maeda, M.; McLean, A.
Iron Steelmaker 1986, 13, 61 - 65;

VARIABLES:

T/K = 1173 - 1473
Melt comp./mol fraction of CaO = 0.06 - 0.20

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

Fig. Solubility of Carbon dioxide as a function of initial mole fraction of CaO in the melt at various temperatures; $P_{CO_2} = 0.2$

Fig. Temperature dependence of the solubility of CO$_2$ in melts of different compositions; $P_{CO_2} = 0.2$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gravimetric method.

The slag mixture was contained in a pure nickel combustion boat and placed inside a mullite reaction tube. CO($P_{CO} = 0.02$) was added to the CO$_2$ - Ar gas mixture to avoid oxidation of the nickel crucible. The gas mixture was passed over the melt at a rate of 60ml/min. After various time intervals, the melt was quenched and the weight change was recorded. Equilibrium was reached between the gas and the melt within 1hr. The equilibrium concentration of CO$_2$ was obtained from the difference in the absorption and desorption results. Experiment was repeated 4 - 5 times.

SOURCE AND PURITY OF MATERIALS:

Calcium carbonate and calcium chloride, both of reagent grade (99.9% purity) were vacuum dried for 12h at 120°C.

ESTIMATED ERROR:

Not specified.

REFERENCES:
COMPONENTS:
(1) Carbon Dioxide; CO₂; [124-38-9]
(2) Calcium Oxide; CaO; [1305-78-8]
(3) Calcium Chloride; CaCl₂; [10043-52-4]

VARIABLES:
T/K = 1173 - 1673
P/kPa = 25.331 - 101.325
X_{eao}/mole fraction = 6 - 20

EXPERIMENTAL VALUES:

The solubility of CO₂ in the CaO+CaCl₂ melts can be represented by the expression:

\[
\log \frac{X_{CO₂}(1 + R)}{R - (2R + 1) X_{CO₂}} = \log p_{CO₂} - (6.04 \pm 0.21) + \frac{(7630 \pm 270)}{T}
\]

where

\[
X_{CO₂} = \frac{n_{CO₂}}{n_{CO₂} + n_{CAO} + n_{CAC₁₂}}
\]

n denotes the number of moles of each species,

\[
R = \frac{X_{CAO}}{X_{CAC₁₂}}
\]

The correlation coefficient of fitting, r², was 0.905.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The details of the experimental apparatus consisting of a thermobalance, an SiC resistance furnace and the gas trains and the procedure have been described earlier(1).

A crucible containing 2-4g of the slag was suspended from the thermobalance and the weight change monitored with time. Temperature was controlled to ±1K. The slag was heated in a stream of purified Ar (200 - 300 ml/min). When the desired temperature was reached, the gas flow was changed to a (Ar+CO₂) gas mixture. In most cases, the dissolution of CO₂ was completed in 15 - 25 min. A longer time was needed for desorption of CO₂ in Ar.

Reproducibility of the measurements was checked by thermal cycling.

SOURCE AND PURITY OF MATERIALS:

Argon was purified by passing through silica gel, P₂O₅, sodium oxyhydrate, MgClO₄, and Mg chips (723K). (Ar+CO₂) gas mixture was purified over silica gel, MgClO₄ and P₂O₅.

ESTIMATED ERROR:

Not specified.

REFERENCES:

1. Iwase, M. et al.
   Iron Steel Maker 1987, 15, 77;
   Trans. Iron Steel Soc. 1988, 9, 139.
COMPONENTS:
(1) Carbon Dioxide; CO₂; [124-38-9]
(2) Strontium Oxide; SrO; [1314-11-0]
(3) Strontium Chloride; SrCl₂; [10476-85-4]

ORIGINAL MEASUREMENTS:
Iwase, M.; Iritani, H; Ichise, E.; Shibata, K.

VARIABLES:
T/K = 1173 - 1673
P/kPa = 25.331 - 101.325
X_{cao}/mole fraction = 10 - 50

EXPERIMENTAL VALUES:

The solubility of CO₂ in the SrO+SrCl₂ melts can be expressed by the relation:

\[
\log \frac{X_{CO₂}(1 + R)}{R - (2R + 1) X_{CO₂}} = \log \frac{P_{CO₂}}{T} - (5.60 \pm 0.17) + (8650 \pm 260) \log \frac{2}{2 - (2R + 1) X_{CO₂}}
\]

where \( R = \frac{X_{SrO}}{X_{SrCl₂}} \)

\[
X_{CO₂} = \frac{n_{CO₂}}{(n_{CO₂} + n_{SrO} + n_{SrCl₂})}
\]

where \( n \) denotes the number of moles of each species.

The correlation coefficient of fitting, \( r^2 \), was 0.926.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
The details of the experimental apparatus consisting of a thermobalance, an SiC resistance furnace and the gas trains and the procedure have been described earlier(1).
A crucible containing 2-4g of the slag was suspended from the thermobalance and the weight change monitored with time. Temperature was controlled to ±1K. The slag was heated in a stream of purified Ar (200 - 300 ml/min). When the desired temperature was reached, the gas flow was changed to a (Ar+CO₂) gas mixture. In most cases, the dissolution of CO₂ was completed in 15 - 25 min. A longer time was needed for desorption of CO₂ in Ar.
Reproducibility of the measurements was checked by thermal cycling.

SOURCE AND PURITY OF MATERIALS:
Argon was purified by passing through silica gel, P₂O₅, sodium oxyhydrate, MgClO₄, and Mg chips (723K). (Ar+CO₂) gas mixture was purified over silica gel, MgClO₄ and P₂O₅.

ESTIMATED ERROR:
Not specified.

REFERENCES:
1. Iwase, M. et al.
Iron Steel Maker 1987, 15, 77;
Trans. Iron Steel Soc. 1988, 9, 139.
COMPONENTS:
(1) Carbon Dioxide; CO₂; [124-38-9]
(2) Barium Oxide; BaO; [1304-28-5]
(3) Barium Chloride; BaCl₂; [10361-37-2]

ORIGINAL MEASUREMENTS:
Iwase, M.; Iritani, H; Ichise, E.; Shibata, K.

VARIABLES:
T/K = 1173 - 1673
P/kPa = 25.331 - 101.325
X_{sao}/mole fraction = 10 - 40

EXPERIMENTAL VALUES:
The solubility of CO₂ in the BaO+BaCl₂ melts can be expressed by the relation:

\[
\log \frac{X_{\text{CO}_2} (1 + R)}{R - (2R + 1) X_{\text{CO}_2}} = \log P_{\text{CO}_2} - \frac{(4.55 \pm 1.72) + (7240 \pm 270)}{T}
\]

where \( R = \frac{X_{\text{BaO}}}{X_{\text{BaCl}_2}} \)

\[
X_{\text{CO}_2} = \frac{n_{\text{CO}_2}}{n_{\text{CO}_2} + n_{\text{BaO}} + n_{\text{BaCl}_2}}
\]

where \( n \) denotes the number of moles of each species.

The correlation coefficient of fitting, \( r^2 \), was 0.805.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
The details of the experimental apparatus consisting of a thermobalance, an SiC resistance furnace and the gas trains and the procedure have been described earlier (1).
A crucible containing 2-4g of the slag was suspended from the thermobalance and the weight change monitored with time. Temperature was controlled to ±1K. The slag was heated in a stream of purified Ar (200 - 300 ml/min). When the desired temperature was reached, the gas flow was changed to a (Ar+CO₂) gas mixture. In most cases, the dissolution of CO₂ was completed in 15 - 25 min. A longer time was needed for desorption of CO₂ in Ar.

Reproducibility of the measurements was checked by thermal cycling.

SOURCE AND PURITY OF MATERIALS:
Argon was purified by passing through silica gel, P₂O₅, sodium oxyhydrate, MgCl₂ and Mg chips (723K). Ar+CO₂ gas mixture was purified over silica gel, MgCl₂ and P₂O₅. BaO powder (99.9% purity, Furu-Uchi Chemical Co.) was heated at 1573K until the weight was unchanged. BaCl₂ (99.9% purity, Nakarai Chemical Co. Japan) was mixed with BaO and heated for 10 - 15min. at 1573K and cooled on a water cooled copper plate.

ESTIMATED ERROR:
Not specified.

REFERENCES:
1. Iwase, M. et al.
Iron Steel Maker 1987, 15, 77;
Trans. Iron Steel Soc. 1988, 9, 139.
COMPONENTS:  
(1) Carbon dioxide; CO₂; [124-38-9]  
(2) Cryolite; Na₃AlF₆; [15096-52-3]  
(3) Alumina; Al₂O₃; [1344-28-1]  

ORIGINAL MEASUREMENTS:  
2. Bratland, D.; Krohn, C.  

VARIABLES:  
T/K = 1250 - 1380  
melt comp./mol% Al₂O₃ = 5 - 17.9  
P/kPa: 101.325 (1 atm.)  

EXPERIMENTAL VALUES:  
Solubilities of CO₂ at 1030°C in Na₃AlF₆ – Al₂O₃ melts of different compositions are presented in the form of log Kₜ vs. mol% Al₂O₃ graph. Values of Kₜ, derived from the plot at different melt compositions are given below:  

<table>
<thead>
<tr>
<th>t/°C</th>
<th>melt comp. mol% Al₂O₃</th>
<th>10⁶ Kₜ/mol ml⁻¹ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>1030</td>
<td>5.0</td>
<td>0.85 ± 0.08</td>
</tr>
<tr>
<td>1030</td>
<td>10.0</td>
<td>1.16 ± 0.07</td>
</tr>
<tr>
<td>1030</td>
<td>14.0</td>
<td>2.03 ± 0.21</td>
</tr>
<tr>
<td>1030</td>
<td>17.9</td>
<td>2.96 ± 0.14</td>
</tr>
</tbody>
</table>

Solubilities of CO₂ in cryolite – alumina (90 – 10 mol%) melts were also measured at 1030°C after the addition of various concentrations of NaF, CaF₂ and AlF₃ to the melt. These results are presented in graphical form. Values of Kₜ, derived from this plot, by the compiler, under different experimental conditions are given below:  

continued

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:  
Three techniques have been employed. Detailed description of the apparatus and procedure for each method are given in the original paper.  
Volumetric Method: The change in volume of gas (at constant pressure) caused by its dissolution in the melt is directly determined. This is not an accurate method, the estimated uncertainty being about 25%.  
Thermogravimetric Method: The gain in weight of a melt sample due to the dissolution of the gas is measured using a thermobalance.  
Chilling Method: The dissolved gas is removed from the melt by freezing the melt. The expelled gas is carried into absorption vessels containing Ascarite/Dehydrite by a stream of pure continued

SOURCE AND PURITY OF MATERIALS:  
Sodium fluoride and alumina were of pro analysis quality from Merck AG, Darmstadt, West Germany. Sublimed aluminum fluoride, purity > 99%, was used. The salts were either dried in situ or pre-dried in vacuum for 4 hrs. at 450°C.  

ESTIMATED ERROR:  
solubility = ± 10% (authors)  

REFERENCES:  
continued
COMPONENTS:

(1) Carbon dioxide; CO₂; [124-38-9]
(2) Cryolite; Na₃AlF₆; [15096-52-3]
(3) Alumina; Al₂O₃; [1344-28-1]

ORIGINAL MEASUREMENTS:


VARIABLES:

T/K = 1250 - 1380
melt comp./mol% Al₂O₃ = 5 - 17.9
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>conc. of added salt in the melt/mol%</th>
<th>10⁶ Kᵢ₇/ mol ml⁻¹ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>1030</td>
<td>0.0</td>
<td>1.16 ± 0.07</td>
</tr>
<tr>
<td>1030</td>
<td>5.0% NaF</td>
<td>1.09 ± 0.09</td>
</tr>
<tr>
<td></td>
<td>7.0% NaF</td>
<td>1.24 ± 0.04</td>
</tr>
<tr>
<td></td>
<td>10.0% NaF</td>
<td>1.30 ± 0.13</td>
</tr>
<tr>
<td>1030</td>
<td>5.0% CaF₂</td>
<td>1.25</td>
</tr>
<tr>
<td></td>
<td>7.0% CaF₂</td>
<td>1.43 ± 0.05</td>
</tr>
<tr>
<td></td>
<td>10.0% CaF₂</td>
<td>1.80 ± 0.09</td>
</tr>
<tr>
<td>1030</td>
<td>8.5% AlF₃</td>
<td>1.55</td>
</tr>
<tr>
<td></td>
<td>8.85% AlF₃</td>
<td>1.57</td>
</tr>
</tbody>
</table>

The values of Henry's law constant, Kᵢ₇, for the solubility of CO₂ in molten Na₃AlF₆ - Al₂O₃ (81.4 - 18.6 mol%) have also been reported at different temperatures in graphical form only. The values of Kᵢ₇, derived from this graph by the compiler are:

Auxiliary Information

METHOD/APPARATUS/PROCEDURE:

argon. This method is simpler and more expedient than the others while giving comparable or better accuracy.

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:
(1) Carbon dioxide; CO₂; [124-38-9]
(2) Cryolite; Na₃AlF₆; [15096-52-3]
(3) Alumina; Al₂O₃; [1344-28-1]

VARIABLES:
T/K = 1250 - 1380
melt comp./mol% Al₂O₃ = 5 - 17.9
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10^6 K_H/mol ml⁻¹ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>1252</td>
<td>3.50</td>
</tr>
<tr>
<td>1257</td>
<td>3.33</td>
</tr>
<tr>
<td>1289</td>
<td>2.98</td>
</tr>
<tr>
<td>1328</td>
<td>2.86</td>
</tr>
<tr>
<td>1378</td>
<td>2.62</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of K_H may be represented by the relation:

\[ \log(K_H/mol ml^{-1} \text{ atm}^{-1}) = -6.749 + 1600.8/(T/K) \]  

std. dev. = 1.4%  

The enthalpy of solution, \( \Delta H \), is estimated to be:

\[ \Delta H/\text{kJ mol}^{-1} = -30.6 \]  

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:
(1) Carbon dioxide; CO₂; [124-38-9]
(2) Lithium carbonate; Li₂CO₃; [554-13-2]
(3) Sodium carbonate; Na₂CO₃; [497-19-8]
(4) Potassium carbonate; K₂CO₃; [584-08-7]

VARIABLES:
T/K = 833
P/kPa = 1.013 - 101.325

EXPERIMENTAL VALUES:
The solubility of CO₂ in the molten eutectic Li₂CO₃ - Na₂CO₃ - K₂CO₃ has been measured at a single temperature. Its value has been reported as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>Solubility/ mol liter⁻¹ atm⁻¹</th>
<th>Solubility/ g liter⁻¹ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>560</td>
<td>0.09 ± 0.01</td>
<td>4.0 ± 0.4</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Thermogravimetric method. A thermogravimetric technique was used to measure the solubility of CO₂ in molten alkali metal carbonates. The device used allowed a direct reading of the variation of mass of the electrolyte contained in an enclosure, when the atmosphere was changed from one composition to another. The mass was recorded in the absence of any gas flow.

SOURCE AND PURITY OF MATERIALS:
Sodium and potassium carbonates were of pro analysi quality from Merck. Lithium carbonate was obtained from Fluka (purissimum).

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
### COMPONENTS:

1. Carbon dioxide; CO₂; [124-38-9]
2. Lithium carbonate; Li₂CO₃; [554-13-2]
3. Sodium carbonate; Na₂CO₃; [497-19-8]
4. Potassium carbonate; K₂CO₃; [584-08-7]

### ORIGINAL MEASUREMENTS:

Appleby, A. J.; Van Drunen, C.


### VARIABLES:

| T/K = 973 | P/kPa: 101.325 (1 atm.) |

### PREPARED BY:

N. P. Bansal

### EXPERIMENTAL VALUES:

The solubility of CO₂ in the melt Li₂CO₃ - Na₂CO₃ - K₂CO₃ (43.5 - 31.5 - 25.0 mol%) is reported as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10³ Solubility/mol dm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td>3.60ᵃ</td>
</tr>
</tbody>
</table>

ᵃ Mean value of six readings.

### AUXILIARY INFORMATION

**METHOD/APPARATUS/PROCEDURE:**

Quenching method.

The diagram and details of the apparatus used and procedure followed are described in the original paper. Briefly, the melt was saturated by bubbling the gas for 2 - 3 hr. A portion of the saturated melt was transferred into the chilling compartment where it was slowly quenched to allow all the gases to escape. The liberated gas was flushed with a stream of helium into a U - tube containing activated Linde 5A molecular sieve. The contents of the tube, after being allowed to come to room temperature, were flushed with a stream of carrier gas into a Fisher - Hamilton gas partitioner with Linde 5A column and Katharometer detector for analysis. About 8 - 10 independent measurements were made.

**SOURCE AND PURITY OF MATERIALS:**

Not described.

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**
**COMPONENTS:**

1. Carbon dioxide; CO₂; [124-38-9]
2. Lithium fluoride; LiF; [7789-24-4]
3. Aluminum fluoride; AlF₃; [7784-18-1]
4. Alumina; Al₂O₃; [7344-28-1]

**ORIGINAL MEASUREMENTS:**

Bratland, D.; Grjotheim, K.; Krohn, C.; Matzfeldt, K.

**PREPARED BY:**

N. P. Bansal

**VARIABLES:**

T/K = 1203
P/kPa: 101.325 (1 atm.)

**EXPERIMENTAL VALUES:**

Solubility of CO₂ in the molten mixture Li₃AlF₆ - Al₂O₃ (96.9 - 3.1 mol%) at a single temperature is presented in graphical form. Its value derived from the graph, by the compiler, is given below:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁶ Solubility/mol ml⁻¹ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>930</td>
<td>2.50 ± 0.15</td>
</tr>
</tbody>
</table>

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Detailed descriptions of the apparatus and procedure for each method are given in the original paper.

- **Volumetric Method:** The change in volume of gas (at constant pressure) caused by its dissolution in the melt is directly determined. This is not an accurate method, the estimated uncertainty being about 25%.

- **Thermogravimetric Method:** The gain in weight of a melt sample due to the dissolution of the gas is using a balance.

- **Chilling Method:** The dissolved gas is removed from the melt by freezing the melt. The expelled gas is carried into absorption vessels containing Ascarite/Dehydrite by a stream of pure argon. This method is simpler and more expedient than the others while giving comparable or better accuracy.

**SOURCE AND PURITY OF MATERIALS:**

Lithium fluoride was obtained from the Lithium Corp. of America. Sublimed aluminum fluoride, purity > 99%, was used. Alumina was of pro analysis quality from Merck AG, Darmstadt, West Germany.

The salts were either dried in situ or pre-dried in vacuum for 4 hrs. at 450°C.

**ESTIMATED ERROR:**

solubility = ±10% (authors)

**REFERENCES:**
<table>
<thead>
<tr>
<th>COMPONENTS:</th>
<th>ORIGINAL MEASUREMENTS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Nitrogen dioxide; NO₂; [10102-44-0]</td>
<td>Topol, L. E.; Osteryoung, R. A.; Christie, J. H.</td>
</tr>
<tr>
<td>(3) Potassium nitrate; KNO₃; [7757-79-1]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VARIABLES:</th>
<th>PREPARED BY:</th>
</tr>
</thead>
<tbody>
<tr>
<td>one temperature: T/K = 573</td>
<td>N. P. Bansal</td>
</tr>
</tbody>
</table>

**EXPERIMENTAL VALUES:**

The solubility of NO₂ in molten equimolar NaN0₃ - KNO₃ mixture at 300°C was calculated to be approximately equal to (5 ± 3) 10⁻⁶ mol cm⁻³.

**METHOD/APPARATUS/PROCEDURE:**

Cyclic voltammetry and chronopotentiometry.

**SOURCE AND PURITY OF MATERIALS:**

Matheson NO₂ (99.5% pure) was used without further purification. Sodium and potassium nitrates were dried at 150°C under vacuum.

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**
COMPONENTS:

(1) Sulfur dioxide; SO₂; [7446-09-5]
(2) Sodium sulfate; Na₂SO₄; [7757-82-6]

ORIGINAL MEASUREMENTS:

Andresen, R. E.
J. Electrochem. Soc. 1979, 126, 328 - 34.

VARIABLES:

T/K = 1174 - 1293
P/kPa: 101.325 (compiler)

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

For the solubility of SO₂ in molten sodium sulfate, the values of Henry's law constant, Kₜ, at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁶ Kₜ/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>901</td>
<td>0.63</td>
</tr>
<tr>
<td>901</td>
<td>0.91</td>
</tr>
<tr>
<td>902</td>
<td>1.62</td>
</tr>
<tr>
<td>902</td>
<td>1.21</td>
</tr>
<tr>
<td>961</td>
<td>1.88</td>
</tr>
<tr>
<td>961</td>
<td>2.36</td>
</tr>
<tr>
<td>961</td>
<td>2.64</td>
</tr>
<tr>
<td>955</td>
<td>3.18</td>
</tr>
<tr>
<td>1016</td>
<td>3.06</td>
</tr>
<tr>
<td>1018</td>
<td>3.23</td>
</tr>
<tr>
<td>1020</td>
<td>3.09</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature variation of Kₜ for the solubility of SO₂ in molten Na₂SO₄ is expressed by the relation:

continued

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Manometric technique.

The diagram and details of the apparatus used are given in the original paper. The procedure followed has been described in detail elsewhere (1). In brief, the apparatus was first evacuated and then filled with SO₂ to a pressure of about 1 atm. Due to gas dissolution, the gas pressure dropped. Equilibrium was attained when the pressure did not change for about one hour. The volume of the gas dissolved was determined from the initial and final positions of the mercury meniscus in the manometer. The apparatus was earlier calibrated using argon. With a cathetometer, pressure changes as small as 0.05 torr could be read.

SOURCE AND PURITY OF MATERIALS:

SO₂ (99.5%) supplied by Linde Gas Company was used directly from the cylinder using Teflon tubing. Na₂SO₄, Reagent grade, supplied by Matheson, Coleman and Bell was dried in an oven at about 200°C, then in the furnace at 400°C under vacuum.

ESTIMATED ERROR:

solubility: ± 20 - 30%

REFERENCES:

1. Andresen, R. E.; Paniccia, F.; Zambonin, P. G.; Oye, H. A.
<table>
<thead>
<tr>
<th>COMPONENTS:</th>
<th>ORIGINAL MEASUREMENTS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Sulfur dioxide; SO₂; [7446-09-5]</td>
<td>Andresen, R. E.</td>
</tr>
<tr>
<td>(2) Sodium sulfate; Na₂SO₄; [7757-82-6]</td>
<td>J. Electrochem. Soc. 1979, 126, 328-34.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VARIABLES:</th>
<th>PREPARED BY:</th>
</tr>
</thead>
<tbody>
<tr>
<td>T/K = 1174 - 1293</td>
<td>N. P. Bansal</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EXPERIMENTAL VALUES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>continued</td>
</tr>
<tr>
<td>[ \log(K_r/\text{mol cm}^{-3} \text{ atm}^{-1}) = -1.592 - 0.003/(T/K) ] (compiler)</td>
</tr>
<tr>
<td>std. dev. = 9.5% (compiler)</td>
</tr>
</tbody>
</table>

The standard enthalpy, \( \Delta H^\circ \), and standard entropy, \( \Delta S^\circ \), of dissolution are:

\[ \Delta H^\circ/\text{kJ mol}^{-1} = 124 \]
\[ \Delta S^\circ/\text{J K}^{-1} \text{ mol}^{-1} = 113.2 \] (at 1173 K)

<table>
<thead>
<tr>
<th>AUXILIARY INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>METHOD/APPARATUS/PROCEDURE:</td>
</tr>
<tr>
<td>SOURCE AND PURITY OF MATERIALS:</td>
</tr>
<tr>
<td>ESTIMATED ERROR:</td>
</tr>
<tr>
<td>REFERENCES:</td>
</tr>
<tr>
<td>COMPONENTS:</td>
</tr>
<tr>
<td>---------------------------------</td>
</tr>
<tr>
<td>(1) Hydrogen fluoride; HF;</td>
</tr>
<tr>
<td>(2) Cesium fluoride; CsF;</td>
</tr>
<tr>
<td>[13400-13-0]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VARIABLES:</th>
<th>PREPARED BY:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N. P. Bansal</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EXPERIMENTAL VALUES:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen fluoride reacts with cesium fluoride giving rise to formation of four compounds having the compositions: CsF·HF, CsF·2HF, CsF·3HF, and CsF·6HF.</td>
<td></td>
</tr>
</tbody>
</table>

**AUXILIARY INFORMATION**

<table>
<thead>
<tr>
<th>METHOD/APPARATUS/PROCEDURE:</th>
<th>SOURCE AND PURITY OF MATERIALS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling and warming curves.</td>
<td>HF was prepared in the vapor form by distillation of the anhydrous acid from a commercial cylinder.</td>
</tr>
<tr>
<td></td>
<td>Cesium fluoride was prepared by reaction between cesium carbonate and aqueous hydrofluoric acid followed by evaporation.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ESTIMATED ERROR:</th>
<th>REFERENCES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nothing specified.</td>
<td></td>
</tr>
</tbody>
</table>
COMPONENTS:

(1) Hydrogen fluoride; HF; [7664-39-3]
(2) Lithium fluoride; LiF; [7789-24-4]
(3) Beryllium fluoride; BeF₂; [7789-49-7]

VARIABLES:
T/K = 773 - 973
p/kPa = 101.325 - 202.650

EXPERIMENTAL VALUES:

Solubilities of HF in molten LiF - BeF₂ (66 - 34 mol%) at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>saturating press/atm</th>
<th>molar volume of melt/ mol ml⁻¹</th>
<th>10⁶ Solubility mol ml⁻¹</th>
<th>10⁴ Solubility mol ml⁻¹ atm⁻¹a</th>
<th>mol frac</th>
<th>mol frac atm⁻¹a</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>1.32</td>
<td>16.54</td>
<td>2.68</td>
<td>2.03</td>
<td>4.43</td>
<td>3.36</td>
</tr>
<tr>
<td>524</td>
<td>1.99</td>
<td>16.63</td>
<td>3.40</td>
<td>2.06</td>
<td>5.62</td>
<td>3.41</td>
</tr>
<tr>
<td>595</td>
<td>1.12</td>
<td>16.89</td>
<td>3.64</td>
<td>1.83</td>
<td>6.05</td>
<td>3.04</td>
</tr>
<tr>
<td>600</td>
<td>1.98</td>
<td>16.90</td>
<td>1.63</td>
<td>1.31</td>
<td>2.75</td>
<td>2.22</td>
</tr>
<tr>
<td>624</td>
<td>1.97</td>
<td>16.67</td>
<td>1.72</td>
<td>1.29</td>
<td>2.90</td>
<td>2.18</td>
</tr>
<tr>
<td>700</td>
<td>1.61</td>
<td>17.29</td>
<td>2.06</td>
<td>1.23</td>
<td>3.48</td>
<td>2.07</td>
</tr>
<tr>
<td></td>
<td>1.98</td>
<td></td>
<td>2.40</td>
<td>1.22</td>
<td>4.06</td>
<td>2.06</td>
</tr>
</tbody>
</table>

* Calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Elution technique.

The diagram and details of the apparatus used are given in the original paper. The procedure followed for solubility measurements has been described elsewhere (1). In brief, the melt was saturated with HF at constant pressure by bubbling the gas through it for about 6 hr. A part of the saturated melt was transferred into the stripping section and flushed with helium overnight to liberate the dissolved HF. The HF from the He - HF gas effluent was absorbed in a standard KOH solution and back titrated with a standard HCl solution.

ORIGINAL MEASUREMENTS:

Field, P. E.; Shaffer, J. H.

PREPARED BY:
N. P. Bansal

REFERENCE:

1. Shaffer, J. H.; Grimes, W. R.; Watson, G. M.
COMPONENTS: ORIGINAL MEASUREMENTS:

(1) Hydrogen fluoride; HF; [7664-39-3]
(2) Lithium fluoride; LiF; [7789-24-4]
(3) Beryllium fluoride; BeF₂; [7789-49-7]

Field, P. E.; Shaffer, J. H.

VARIABLES:

T/K = 773 - 973
P/kPa = 101.325 - 202.650

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES: continued

Values of Henry's law constant and x₁ at various temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁶ Kₜ/mol ml⁻¹ atm⁻¹</th>
<th>10⁴ x₁/mol fraction atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>2.04 ± 0.07</td>
<td>3.37 ± 0.13</td>
</tr>
<tr>
<td>600</td>
<td>1.28 ± 0.03</td>
<td>2.16 ± 0.05</td>
</tr>
<tr>
<td>700</td>
<td>0.87 ± 0.03</td>
<td>1.51 ± 0.06</td>
</tr>
</tbody>
</table>

* Calculated by the compiler using molar volume data of melt.

Smoothed Data:
Temperature dependence of Henry's law constant and x₁ is expressed by the relations:

\[
\log(K_\tau/\text{mol ml}^{-1} \text{ atm}^{-1}) = -6.496 + 1399.3/(T/K) \quad (\text{compiler})
\]

\[
\log(x_1/\text{mol fraction atm}^{-1}) = -5.176 + 1319.8/(T/K) \quad (\text{compiler})
\]

std. dev. = 0.3% (compiler)

The enthalpy, ΔH, and entropy, ΔS, of solution are:

\[\Delta H/\text{kcal mol}^{-1} = -5.98 ± 0.19 \quad \Delta S/\text{cal K}^{-1} \text{mol}^{-1} = -7.07 ± 0.26 \text{ (at 600°C)}\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: continued

alone at 700°C to remove the oxides, sulfides and other impurities.

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:
(1) Hydrogen fluoride; HF; [7664-39-3]
(2) Lithium fluoride; LiF; [7789-24-4]
(3) Beryllium fluoride; BeF₂; [7789-49-7]

VARIABLES:
T/K = 873 - 1073
melt comp./mol% LiF = 54 - 89
P/kPa = 50.663 - 303.975

ORIGINAL MEASUREMENTS:
Shaffer, J. H.; Watson, G. M.

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
Molten salt mixtures of LiF - BeF₂ of different compositions containing 54 - 89 mol% LiF were employed as solvents. The Henry's law constants, K_H, for the solubility of HF in various melts at different temperatures are:

<table>
<thead>
<tr>
<th>Melt Composition/ mol% LiF</th>
<th>10⁶ K_H/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>600°C</td>
</tr>
<tr>
<td>54</td>
<td>9.4</td>
</tr>
<tr>
<td>59</td>
<td>10.9</td>
</tr>
<tr>
<td>69</td>
<td>13.7</td>
</tr>
<tr>
<td>80</td>
<td>16.3a</td>
</tr>
<tr>
<td>89</td>
<td>17.3a</td>
</tr>
</tbody>
</table>

* Extrapolated from results at higher temperatures, by the authors.

Smoothed Data:
Temperature dependence of Henry's law constant, K_H, can be expressed by the relation:

\[
\log(K_H/mol \text{ cm}^{-3} \text{ atm}^{-1}) = a + b/(T/K)
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stripping method.

The procedure followed for determining the solubilities has been described earlier (1). Briefly, the method consisted in saturating the melt with HF at known pressure and temperature. A measured portion of the saturated melt was transferred to the stripping section of the apparatus. The HF dissolved in this melt was stripped by flushing with helium. The amount of HF evolved was determined by absorption in a standard solution of aqueous KOH and back titrating with a standard acid solution.

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
1. Shaffer, J. H.; Grimes, W. R. Watson, G. M.
The values of coefficients, $a$, and $b$ of the above equation (evaluated by the compiler) for the melts of different compositions along with the heats of solution, $\Delta H$, and entropies of solution, $\Delta S$, are given below:

<table>
<thead>
<tr>
<th>Melt Composition/ mol% LiF</th>
<th>$a$</th>
<th>$b$</th>
<th>$\Delta H$/kJ mol$^{-1}$</th>
<th>$\Delta S$/J K$^{-1}$ mol$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>54</td>
<td>-6.224</td>
<td>1049.5</td>
<td>-20.9</td>
<td>-45.2</td>
</tr>
<tr>
<td>59</td>
<td>-6.356</td>
<td>1215.9</td>
<td>-23.4</td>
<td>-46.9</td>
</tr>
<tr>
<td>69</td>
<td>-6.418</td>
<td>1361.8</td>
<td>-26.8</td>
<td>-48.5</td>
</tr>
<tr>
<td>80</td>
<td>-6.222</td>
<td>1253.5</td>
<td>-23.8</td>
<td>-43.9</td>
</tr>
<tr>
<td>89</td>
<td>-5.970</td>
<td>1055.2</td>
<td>-20.5</td>
<td>-39.3</td>
</tr>
</tbody>
</table>

*Entropies of solution calculated for equal concentrations of HF in gas and solution phases at 1000 K.

std. dev. = 0.007 - 1.3%  (compiler)
COMPONENTS:
(1) Hydrogen fluoride; HF; [7664-39-3]
(2) Sodium fluoride; NaF; [7681-49-4]
(3) Beryllium fluoride; BeF₂; [7789-49-7]

VARIABLES: \( T/K = 873 - 1073 \)
melt comp./mol% NaF = 49 - 75
\( P/kPa = 50.663 - 303.975 \)

EXPERIMENTAL VALUES:
Molten salt mixtures of NaF - BeF₂ of different compositions containing 49 - 75 mol% NaF were employed as solvents. The Henry's law constants, \( K_H \), for the solubility of HF in various melts at different temperatures are:

<table>
<thead>
<tr>
<th>Melt Composition/ mol% NaF</th>
<th>10⁶ ( K_H )/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>600°C</td>
</tr>
<tr>
<td>49</td>
<td>18.8</td>
</tr>
<tr>
<td>58</td>
<td>26.7</td>
</tr>
<tr>
<td>66</td>
<td>49.2</td>
</tr>
<tr>
<td>70</td>
<td>107.1</td>
</tr>
<tr>
<td>75</td>
<td>179.0*</td>
</tr>
</tbody>
</table>

* Values extrapolated from results at higher temperatures, by the authors.

Smoothed Data:

The temperature dependence of Henry's law constant, \( K_H \), can be expressed by the relation:

\[
\log(10^6 K_H / \text{mol cm}^{-3} \text{ atm}^{-1}) = a + b/(T/K)
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Stripping method.

The procedure followed for solubility measurements has been described in detail elsewhere (1). Briefly, the method consisted in saturating the melt with HF at known pressure and temperature. A measured portion of the saturated melt was transferred to the stripping section of the apparatus. The HF dissolved in this melt was stripped by flushing with helium. The amount of HF evolved was determined by absorption in a standard solution of aqueous KOH and back titrating with a standard acid solution.

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:

solubility = + 10%

REFERENCES:
1. Shaffer, J. H.; Grimes, W. R.; Watson, G. M.
COMPONENTS:
(1) Hydrogen fluoride; HF; [7664-39-3]
(2) Sodium fluoride; NaF; [7681-49-4]
(3) Beryllium fluoride; BeF₂; [7789-49-7]

ORIGINAL MEASUREMENTS:
Shaffer, J. H.; Watson, G. M.

VARIABLES:

EXPERIMENTAL VALUES:

Values of coefficients, a, and b of the above equation (evaluated by the compiler) for the melts of different composition along with the heats of solution, \( \Delta H \), and entropies of solution, \( \Delta S \), are given below:

<table>
<thead>
<tr>
<th>Melt Composition/ mol% NaF</th>
<th>a</th>
<th>b</th>
<th>( \Delta H )/kJ mol(^{-1})</th>
<th>( \Delta S )/J K(^{-1}) mol(^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>49</td>
<td>-6.201</td>
<td>1286.5</td>
<td>-22.2</td>
<td>-22.2</td>
</tr>
<tr>
<td>58</td>
<td>-6.105</td>
<td>1333.3</td>
<td>-23.0</td>
<td>-20.1</td>
</tr>
<tr>
<td>66</td>
<td>-6.207</td>
<td>1657.3</td>
<td>-28.5</td>
<td>-21.8</td>
</tr>
<tr>
<td>70</td>
<td>-6.634</td>
<td>2322.0</td>
<td>-40.2</td>
<td>-28.5</td>
</tr>
<tr>
<td>75</td>
<td>-6.495</td>
<td>2398.5</td>
<td>-42.3</td>
<td>-26.8</td>
</tr>
</tbody>
</table>

* Entropies of solution calculated for equal concentrations of HF in gas and solution phases at 1000 K.
  
  \( \text{std. dev.} = 0.007 - 1.2\% \) (compiler)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:
(1) Hydrogen fluoride; HF; [7664-39-3]
(2) Sodium fluoride; NaF; [7681-49-4]
(3) Zirconium fluoride; ZrF$_4$; [7783-64-4]

VARIABLES:
P/kPa = 50.663 - 303.975
T/K = 823 - 1073
melt comp./mol% NaF = 45 - 80.5

EXPERIMENTAL VALUES:
Solubilities of HF in molten NaF - ZrF$_4$ (53 - 47 mol%) at different temperatures and various saturating pressures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>saturating pressure/atm</th>
<th>$10^5$ Solubility mol cm$^{-3}$</th>
<th>$10^5$ $K_H$/mol cm$^{-3}$ atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>550</td>
<td>2.09</td>
<td>2.91</td>
<td>1.39</td>
</tr>
<tr>
<td></td>
<td>2.56</td>
<td>1.62</td>
<td>1.41</td>
</tr>
<tr>
<td></td>
<td>2.98</td>
<td>1.35</td>
<td>1.39</td>
</tr>
<tr>
<td></td>
<td>Avg = 1.38 ± 0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600</td>
<td>0.494</td>
<td>0.57</td>
<td>1.16</td>
</tr>
<tr>
<td></td>
<td>0.550</td>
<td>0.66</td>
<td>1.19</td>
</tr>
<tr>
<td></td>
<td>0.565</td>
<td>0.69</td>
<td>1.23</td>
</tr>
<tr>
<td></td>
<td>1.05</td>
<td>1.39</td>
<td>1.32</td>
</tr>
<tr>
<td></td>
<td>1.05</td>
<td>1.33</td>
<td>1.27</td>
</tr>
<tr>
<td></td>
<td>1.34</td>
<td>1.62</td>
<td>1.21</td>
</tr>
<tr>
<td></td>
<td>1.50</td>
<td>1.75</td>
<td>1.17</td>
</tr>
<tr>
<td></td>
<td>1.55</td>
<td>1.92</td>
<td>1.24</td>
</tr>
<tr>
<td></td>
<td>2.05</td>
<td>2.72</td>
<td>1.33</td>
</tr>
<tr>
<td></td>
<td>2.05</td>
<td>2.45</td>
<td>1.19</td>
</tr>
<tr>
<td></td>
<td>2.52</td>
<td>3.02</td>
<td>1.22</td>
</tr>
<tr>
<td></td>
<td>2.52</td>
<td>3.02</td>
<td>1.20</td>
</tr>
<tr>
<td></td>
<td>2.53</td>
<td>3.11</td>
<td>1.23</td>
</tr>
<tr>
<td></td>
<td>2.95</td>
<td>3.52</td>
<td>1.20</td>
</tr>
<tr>
<td></td>
<td>Avg = 1.23 ± 0.04</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Stripping method.
The details about the apparatus used and the procedure followed for solubility measurements are given in the original publication and also in (1,2). In brief, the melt was saturated by sparging with HF at the desired pressure for 6 hrs. About one - half of the melt was transferred from the saturator to the stripping section by destroying the frozen seal. The dissolved HF in the salt was stripped by bubbling helium and absorbed in a standard aqueous solution of KOH. The amount of absorbed HF was determined by back titration with a standard acid solution.

SOURCE AND PURITY OF MATERIALS:
Hydrogen fluoride (99.9%) from cylinders supplied by Harshaw Chemical Company, Cincinnati was used without further purification. The HF vapors contained less than 0.2 mol% gases insoluble in aqueous KOH.
Sodium fluoride was of reagent grade. ZrF$_4$ was prepared by continued

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
COMPONENTS:
(1) Hydrogen fluoride; HF; [7664-39-3]
(2) Sodium fluoride; NaF; [7681-49-4]
(3) Zirconium fluoride; ZrF₄; [7783-64-4]

VARIABLES:
\[ P/kPa = 50.663 - 303.975 \frac{T}{K} \]
\[ T/K = 823 - 1073 \]
melt comp./mol% NaF = 45 - 80.5

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>saturating pressure/atm</th>
<th>(10^5) Solubility mol cm(^{-3})</th>
<th>(10^5) K(_H) mol cm(^{-3}) atm(^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>650</td>
<td>0.43</td>
<td>0.47</td>
<td>1.10</td>
</tr>
<tr>
<td></td>
<td>1.03</td>
<td>1.02</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>1.47</td>
<td>1.49</td>
<td>1.01</td>
</tr>
<tr>
<td></td>
<td>2.14</td>
<td>2.20</td>
<td>1.03</td>
</tr>
<tr>
<td></td>
<td>2.36</td>
<td>2.41</td>
<td>1.02</td>
</tr>
<tr>
<td></td>
<td>2.74</td>
<td>2.81</td>
<td>1.03</td>
</tr>
<tr>
<td>700</td>
<td>0.62</td>
<td>0.58</td>
<td>0.93</td>
</tr>
<tr>
<td></td>
<td>1.16</td>
<td>1.08</td>
<td>0.93</td>
</tr>
<tr>
<td></td>
<td>1.40</td>
<td>1.32</td>
<td>0.95</td>
</tr>
<tr>
<td></td>
<td>1.79</td>
<td>1.68</td>
<td>0.94</td>
</tr>
<tr>
<td></td>
<td>1.86</td>
<td>1.80</td>
<td>0.97</td>
</tr>
<tr>
<td></td>
<td>2.75</td>
<td>2.42</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td>Avg = 1.03 ± 0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>750</td>
<td>0.83</td>
<td>0.73</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td>1.15</td>
<td>1.00</td>
<td>0.87</td>
</tr>
<tr>
<td></td>
<td>1.96</td>
<td>1.63</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>Avg = 0.86 ± 0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>800</td>
<td>0.42</td>
<td>0.31</td>
<td>0.74</td>
</tr>
<tr>
<td></td>
<td>0.84</td>
<td>0.62</td>
<td>0.74</td>
</tr>
<tr>
<td></td>
<td>1.51</td>
<td>1.14</td>
<td>0.75</td>
</tr>
<tr>
<td></td>
<td>2.18</td>
<td>1.54</td>
<td>0.73</td>
</tr>
<tr>
<td></td>
<td>2.48</td>
<td>1.75</td>
<td>0.71</td>
</tr>
<tr>
<td></td>
<td>Avg = 0.73 ± 0.01</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

continued

hydrofluorination of ZrCl₄ at 450°C in nickel equipment. The solvent mixture was purified as described elsewhere (1).

REFERENCES:
COMPONENTS:

(1) Hydrogen fluoride; HF; [7664-39-3]
(2) Sodium fluoride; NaF; [7681-49-4]
(3) Zirconium fluoride; ZrF₄; [7783-64-4]

VARIABLES: T/K = 823 - 1073
P/kPa = 50.663 - 303.975
Melt comp. NaF/mol% = 45 - 80.5

EXPERIMENTAL VALUES:

The values of Henry's law constant, $K_a$, in melts of different compositions are:

<table>
<thead>
<tr>
<th>Melt Composition/ mol% NaF</th>
<th>550</th>
<th>600</th>
<th>650</th>
<th>700</th>
<th>750</th>
<th>800</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>0.78</td>
<td></td>
<td></td>
<td>0.65</td>
<td></td>
<td>0.51</td>
</tr>
<tr>
<td>53</td>
<td>1.38*</td>
<td>1.23*</td>
<td>1.03*</td>
<td>0.93*</td>
<td>0.86*</td>
<td>0.73*</td>
</tr>
<tr>
<td>60</td>
<td>1.53</td>
<td></td>
<td></td>
<td>1.03</td>
<td></td>
<td>0.81</td>
</tr>
<tr>
<td>65</td>
<td>2.17*</td>
<td></td>
<td></td>
<td>1.46</td>
<td></td>
<td>1.06</td>
</tr>
<tr>
<td>80.5</td>
<td>12.80*</td>
<td></td>
<td></td>
<td>7.20*</td>
<td></td>
<td>4.43</td>
</tr>
</tbody>
</table>

* Value ± 0.02, * Value ± 0.04, " Value ± 0.01.
" Values extrapolated from measurements at higher temperatures, by the authors.

Smoothed Data:
Temperature dependence of the Henry's law constant, $K_a$, can be expressed by the equation:

$$\log(K_a/mol \text{ cm}^{-3} \text{ atm}^{-1}) = a + b/(T/K)$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
Values of parameters, a, and b of the above equation (evaluated by the compiler) for various melt compositions along with the enthalpies of solution, $\Delta H$ and entropies of solution, $\Delta S$, as calculated by the authors are:

<table>
<thead>
<tr>
<th>Melt Composition/ mol% NaF</th>
<th>a</th>
<th>b</th>
<th>$\Delta H$/ kcal mol$^{-1}$</th>
<th>$\Delta S$/ eu</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>-6.083</td>
<td>857.5</td>
<td>-3.85</td>
<td>-5.2</td>
</tr>
<tr>
<td>53</td>
<td>-6.013</td>
<td>954.4</td>
<td>-4.70</td>
<td>-5.4</td>
</tr>
<tr>
<td>60</td>
<td>-6.311</td>
<td>1300.6</td>
<td>-5.80</td>
<td>-6.2</td>
</tr>
<tr>
<td>65</td>
<td>-6.334</td>
<td>1458.3</td>
<td>-6.60</td>
<td>-6.4</td>
</tr>
<tr>
<td>80.5</td>
<td>-6.363</td>
<td>2158.0</td>
<td>-9.70</td>
<td>-6.5</td>
</tr>
</tbody>
</table>

* Entropies of solution calculated for equal concentrations of HF in gas and liquid phases at 1000 K (authors).

std. dev. = 0.05 - 2.5% (compiler)
The values of Henry's law constant, $K_H$, for the solubility of HF in the molten salt solvent LiF - BeF$_2$ - ZrF$_4$ - ThF$_4$ - UF$_4$ (65 - 28 - 5 - 1 - 1 mol%) at different temperatures and pressures ranging from 1.4 to 2.4 atm are:

<table>
<thead>
<tr>
<th>$t/°C$</th>
<th>$10^6 K_H/mmol cm^{-3} atm^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>17.0</td>
</tr>
<tr>
<td>550</td>
<td>13.3</td>
</tr>
<tr>
<td>600</td>
<td>10.8</td>
</tr>
<tr>
<td>700</td>
<td>8.0</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of $K_H$ can be expressed by the relation:

$$\log(K_H/mmol cm^{-3} atm^{-1}) = -6.365 + 1228.7/(T/K)$$  

std. dev. = 0.9% (compiler)

The enthalpy of solution, $\Delta H$, in the temperature range 500 - 700°C is:

$$\Delta H/kcal mol^{-1} = -5.65$$
COMPONENTS:
(1) Deuterium fluoride; DF;
(2) Lithium fluoride; LiF; [7789-24-4]
(3) Beryllium fluoride; BeF₂; [7789-49-7]

VARIABLES: P/kPa = 101.325 - 202.650
T/K = 773 - 973

ORIGINAL MEASUREMENTS:
Field, P. E.; Shaffer, J. H.

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:

Solubilities of DF in molten LiF - BeF₂ (66 - 34 mol%) at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>saturating pressure/atm</th>
<th>molar volume of melt/ml mol⁻¹</th>
<th>10⁵ solubility/ mol ml⁻¹</th>
<th>10⁴ solubility mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>1.24</td>
<td>16.54</td>
<td>2.21</td>
<td>3.66</td>
</tr>
<tr>
<td></td>
<td>1.62</td>
<td></td>
<td>2.88</td>
<td>4.76</td>
</tr>
<tr>
<td></td>
<td>1.93</td>
<td></td>
<td>3.52</td>
<td>5.81</td>
</tr>
<tr>
<td>600</td>
<td>1.27</td>
<td>16.90</td>
<td>1.37</td>
<td>2.32</td>
</tr>
<tr>
<td></td>
<td>1.61</td>
<td></td>
<td>1.70</td>
<td>2.87</td>
</tr>
<tr>
<td></td>
<td>1.96</td>
<td></td>
<td>2.13</td>
<td>3.60</td>
</tr>
<tr>
<td>700</td>
<td>1.70</td>
<td>17.29</td>
<td>1.25</td>
<td>2.15</td>
</tr>
<tr>
<td></td>
<td>1.99</td>
<td></td>
<td>1.48</td>
<td>2.54</td>
</tr>
</tbody>
</table>

continued.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution technique.
The diagram of the apparatus used has been given in the original paper. The procedure followed for solubility measurements has been described elsewhere(1). In brief, the melt was saturated with DF by bubbling the gas, at constant temperature, through it for about 6hrs. A part of the saturated melt was transferred into the stripping section and flushed with helium overnight to remove the dissolved effluent was absorbed in a standard KOH solution and back titrated with a standard HCl solution.

SOURCE AND PURITY OF MATERIALS:
Anhydrous DF was prepared by the Technical Division, Oak Ridge Gaseous Diffusion Plant, by reaction of elemental deuterium and fluorine. The LiF - BeF₂(66-34 mol%) mixture was prepared by the Oak Ridge National Laboratory. It was treated with a mixture of 10 mol% HF in H₂ at 600°C and with H₂ alone at 700°C to remove the oxides, sulfides and other impurities.

ESTIMATED ERROR:
Solubility = ± 5% (authors)

REFERENCES:
1. Shaffer, J. H.; Grimes, W. R.; Watson, G. M.
COMPONENTS:
(1) Deuterium fluoride; DF;
(2) Lithium fluoride; LiF; [7789-24-4]
(3) Beryllium fluoride; BeF$_2$; [7789-49-4]

VARIABLES:
T/K = 773 - 973
P/kPa = 101.325 - 202.650

ORIGINAL MEASUREMENTS:
Field, P. E.; Shaffer, J. H.

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
(Continued)
The values of Henry's law constant and solubility at various temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>$10^5 K_H$/mol cm$^{-3}$ atm$^{-1}$</th>
<th>$10^4 x_1$/mol fraction atm$^{-2}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>1.79 ± 0.04</td>
<td>2.96 ± 0.07</td>
</tr>
<tr>
<td>600</td>
<td>1.08 ± 0.02</td>
<td>1.83 ± 0.03</td>
</tr>
<tr>
<td>700</td>
<td>0.72 ± 0.02</td>
<td>1.25 ± 0.03</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of Henry's law constant and solubility is expressed by the relations:

- \[ \log(K_H/\text{mol cm}^{-3} \text{ atm}^{-1}) = -6.671 + 1487.8/(T/K) \] (compiler)
- \[ \log(x_1/\text{mol fraction atm}^{-1}) = -5.35 + 1405.8/(T/K) \] (compiler)

The enthalpy, $\Delta H$, and entropy, $\Delta S$, of solution are:

- $\Delta H$/kcal mol$^{-1} = -6.43 + 0.11$
- $\Delta S$/cal K$^{-1}$ mol$^{-1} = -7.92 + 0.16$ (at 600°C)

* Calculated by the compiler using molar volume data of melt.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
**COMPONENTS:**

(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Lithium chloride; LiCl; [7447-41-8]

**ORIGIANL MEASUREMENTS:**

Ukshe, E. A., Devyatkin, V. N.

**VARIABLES:**

P/kPa: 101.325 (1 atm.)
T/K = 973 - 1073

**PREPARED BY:**

N. P. Bansal

**EXPERIMENTAL VALUES:**

The solubilities of hydrogen chloride, at one atmosphere gas pressure, in molten LiCl at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10^6 x_1/(mol fraction) atm^-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td>9.86</td>
</tr>
<tr>
<td>750</td>
<td>14.72</td>
</tr>
<tr>
<td>800</td>
<td>20.33</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of x_1, in the range 700 - 800°C, is given by the expression:

\[ \log(\frac{x_1}{\text{mol fraction atm}^{-1}}) = -1.6276 - \frac{3285.4}{(T/\text{K})} \]  

(compiler)

std. dev. = 0.8%  
(compiler)

The heat of solution, \( \Delta H \), is given by:

\[ \Delta H/\text{kJ mol}^{-1} = +57.3 \]

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Elution or stripping technique.

The method used was essentially the same as reported by Ryabukhin (1). Argon was bubbled through the melt for 20 min. and then evacuated. Hydrogen chloride at 1 atm pressure was passed through the melt for 30 - 40 min. and allowed to equilibrate for 3 - 5 min. A part of the melt was isolated and flushed with argon. The liberated hydrogen chloride was absorbed in distilled water and titrated against a standard alkali solution.

**SOURCE AND PURITY OF MATERIALS:**

Hydrogen chloride was prepared by mixing hydrochloric and sulfuric acids. It was dried by passing through concentrated sulfuric acid. Grade A argon was passed over phosphorous pentoxide. Traces of moisture from the two gases were further removed by passing them through a trap cooled in a mixture of alcohol and solid carbon dioxide.

**ESTIMATED ERROR:**

Nothing specified

**REFERENCES:**

1. Ryabukhin, Yu. M.
## COMPONENTS:

1. Hydrogen chloride; HCl; [7647-01-0]
2. Sodium chloride; NaCl; [7647-14-5]

## CRITICAL EVALUATION:

Six investigations are available (1 - 6) for the solubility of hydrogen chloride in molten NaCl. Novozhilov et al. (3,4) employed a volumetric technique while an elution method was employed by the other investigators. Smoothed data at various temperatures from the different reports are compared below:

<table>
<thead>
<tr>
<th>T/K</th>
<th>Ref.1</th>
<th>Ref.2</th>
<th>Ref.3</th>
<th>Ref.4</th>
<th>Ref.5</th>
<th>Ref.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1100</td>
<td>7.17</td>
<td>12.94</td>
<td>(13.68)</td>
<td>(93.6)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>1120</td>
<td>7.64</td>
<td>13.17</td>
<td>13.58</td>
<td>79.49</td>
<td>(8.96)</td>
<td></td>
</tr>
<tr>
<td>1140</td>
<td>8.11</td>
<td>13.40</td>
<td>13.48</td>
<td>67.88</td>
<td>(9.32)</td>
<td></td>
</tr>
<tr>
<td>1160</td>
<td>8.60</td>
<td>13.62</td>
<td>13.39</td>
<td>58.26</td>
<td>9.67</td>
<td></td>
</tr>
<tr>
<td>1180</td>
<td>9.10</td>
<td>13.84</td>
<td>13.30</td>
<td>(50.28)</td>
<td>10.03</td>
<td></td>
</tr>
<tr>
<td>1200</td>
<td>9.60</td>
<td>(10.00)</td>
<td>14.05</td>
<td>13.22</td>
<td>(43.57)</td>
<td>10.38</td>
</tr>
<tr>
<td>1220</td>
<td>10.11</td>
<td>14.26</td>
<td>13.14</td>
<td>10.72</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1240</td>
<td>10.63</td>
<td>14.47</td>
<td>13.06</td>
<td>11.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1260</td>
<td>11.15</td>
<td>14.67</td>
<td>12.99</td>
<td>11.40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1280</td>
<td>11.68</td>
<td>(14.87)</td>
<td>12.91</td>
<td>11.74</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1300</td>
<td>12.20</td>
<td>(15.07)</td>
<td>(12.84)</td>
<td>(12.07)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \Delta H/\text{kJ mol}^{-1} = 36.0 \]

Values in ( ) outside temperature interval of experimental measurements; extrapolated by the evaluator.


\(^{b}\) At 1203 K

References:

An examination of the preceding table shows that the results of Lukmanova and Vil'nyanskii (5) are too high and are thus rejected. The values of Novozhilov et al. (3,4) also are about 10 - 50% higher than those of other workers (1,2,6) and the data in (3,4) are also rejected. The data from (1,2,6) are in good agreement with each other, and the mean values from (1,2,6) are designated as recommended values. These recommended values are given in Table 1 and Fig. 1.

Table 1 - Recommended Numerical Values

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^7 K_H$/mol cm$^{-3}$ atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1120</td>
<td>8.30</td>
</tr>
<tr>
<td>1140</td>
<td>8.72</td>
</tr>
<tr>
<td>1160</td>
<td>9.14</td>
</tr>
<tr>
<td>1180</td>
<td>9.57</td>
</tr>
<tr>
<td>1200</td>
<td>10.00</td>
</tr>
<tr>
<td>1220</td>
<td>10.42</td>
</tr>
<tr>
<td>1240</td>
<td>10.85</td>
</tr>
<tr>
<td>1260</td>
<td>11.28</td>
</tr>
<tr>
<td>1280</td>
<td>11.71</td>
</tr>
<tr>
<td>1300</td>
<td>12.14</td>
</tr>
</tbody>
</table>

Fig. 1
COMPONENTS:
(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Sodium chloride; NaCl; [7647-14-5]

ORIGINAL MEASUREMENTS:
Ukshe, E. A.; Devyatkin, V. N.
1965, 39, 1222 23. (*).

VARIABLES:
T/K = 1113 - 1300
P/kPa = 101.325 (atm)

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The solubilities of hydrogen chloride, at one atmosphere gas pressure, in molten NaCl at various temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10^6 x_1/(mol fraction) atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>840</td>
<td>32.0</td>
</tr>
<tr>
<td>880</td>
<td>32.81</td>
</tr>
<tr>
<td>915</td>
<td>30.50</td>
</tr>
<tr>
<td>925</td>
<td>36.50</td>
</tr>
<tr>
<td>963</td>
<td>42.19</td>
</tr>
<tr>
<td>995</td>
<td>46.75</td>
</tr>
<tr>
<td>1020</td>
<td>49.72</td>
</tr>
<tr>
<td>1030</td>
<td>52.35</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of x_1, in the interval 840 -1030°C, is expressed by the relation:

\[ \log(\frac{x_1}{mol \ fraction \ atm^{-1}}) = 2.8914 - 1836.9/(T/K) \]

(compiler)

std. dev. = 3.9% (compiler)

The heat of solution, ΔH, is:
ΔH/kJ mol⁻¹ = +36.0

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution or stripping technique.
The method used was essentially the same as reported by Ryabukhin (1). Argon was bubbled through the melt for 20 min. and then evacuated. Hydrogen chloride at 1 atm. pressure was passed through the melt for 30 - 40 min. and allowed to equilibrate for 3 - 5 min. A part of the melt was separated and sparged with argon. The liberated hydrogen chloride was absorbed in distilled water and titrated against an alkali solution.

SOURCE AND PURITY OF MATERIALS:
Hydrogen chloride was prepared by mixing hydrochloric and sulfuric acids. It was dried by passing through concentrated sulfuric acid. Grade A argon was passed over phosphorous pentoxide. Traces of moisture from the two gases were further removed by passing them through a trap cooled in a mixture of alcohol and solid carbon dioxide.

ESTIMATED ERROR:
Nothing specified

REFERENCES:
1. Ryabukhin, Yu. M.
COMPONENTS:
(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Sodium chloride; NaCl; [7647-14-5]

VARIABLES:
one temperature: T/K = 1203
P/kPa = 25.331 - 101.325

EXPERIMENTAL VALUES:
The value of the Henry's law constant, $K_H$, for the solubility of HCl in molten NaCl at a single temperature is:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>$10^7 K_H$/mol cm$^{-3}$ atm$^{-3}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>930</td>
<td>10</td>
</tr>
</tbody>
</table>

ORIGINAL MEASUREMENTS:
Devyatkin, V. N.; Ukshe, E. A.
Zh. Prikl. Khim. 1965, 38, 1612 - 14;

PREPARED BY:
N. P. Bansal

METHOD/APPARATUS/PROCEDURE:
Elution Method.
The method used was essentially similar to that described by Ryabukhin (1). The melt was saturated with HCl by bubbling a mixture of hydrogen chloride and argon for 1/2 hour through the melt. After equilibration, the melt was purged with dry argon to liberate the dissolved HCl. The hydrogen chloride which was carried along with the argon was absorbed in distilled water.

SOURCE AND PURITY OF MATERIALS:
Hydrogen chloride and argon were dried by passing through strong sulfuric acid and over phosphorous pentoxide, respectively. The traces of moisture were further removed by passing the two gases through a coil cooled in a mixture of alcohol and solid carbon dioxide.

ESTIMATED ERROR:
Nothing specified

REFERENCES:
1. Ryabukhin, Yu. M.
### COMPONENTS:

1. Hydrogen chloride; HCl; [7647-01-0]
2. Sodium chloride; NaCl; [7647-14-5]

### ORIGINAL MEASUREMENTS:

Novozhilov, A. L.; Devyatkhin, V. N.; Gribova, E. I.

### VARIABLES:

<table>
<thead>
<tr>
<th>T/K</th>
<th>P/kPa = 101.325 (1 atm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1093 - 1270</td>
<td></td>
</tr>
</tbody>
</table>

### PREPARED BY:

N. P. Bansal

### EXPERIMENTAL VALUES:

The values of Henry's law constant, $K_H$, for the solubility of HCl in molten NaCl as a function of temperature are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^7 K_H$ (mol cm$^{-3}$ atm$^{-1}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1093</td>
<td>12.86</td>
</tr>
<tr>
<td>1113</td>
<td>13.07</td>
</tr>
<tr>
<td>1123</td>
<td>13.23</td>
</tr>
<tr>
<td>1167</td>
<td>13.67</td>
</tr>
<tr>
<td>1213</td>
<td>14.19</td>
</tr>
<tr>
<td>1255</td>
<td>13.11</td>
</tr>
<tr>
<td>1270</td>
<td>12.97</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of $K_H$ in the range 1093 - 1213 K is expressed by the relation:

$$\log(K_H \text{ mol cm}^{-3} \text{ atm}^{-1}) = -5.457 - 474.3/(T/\text{K})$$

std. dev. = 0.08% (compiler)

The enthalpy of solution, $\Delta H$, within the temperature interval 1093 - 1213 K, and the entropy change during dissolution, $\Delta S$, are:

$\Delta H$/kJ mol$^{-1}$ = 9.04

$\Delta S$/J K$^{-1}$ mol$^{-1}$ = 7.7 (at 1173 K)

### AUXILIARY INFORMATION

**METHOD/APPARATUS/PROCEDURE:**

Volumetric method.

A modification of the experimental method described by Bratland et al. (1) was used.

**SOURCE AND PURITY OF MATERIALS:**

HCl was prepared by reacting fused NaCl with concentrated sulfuric acid. The gas was purified by fractional condensation.

Recrystallized "chemically pure" grade NaCl was fused in a quartz container in a stream of dry chlorine. Chlorine was purged through the melt for about 2 hours. Then the melt was slowly crystallized under chlorine atmosphere. Only transparent crystals were used for the experiment.

**ESTIMATED ERROR:**

solubility = ± 1% (authors)

**REFERENCES:**


COMPONENTS:
(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Sodium chloride; NaCl; [7647-14-5]

ORIGINAL MEASUREMENTS:
Novozhilov, A. L.; Devyatkin, V. N.; Gribova, E. I.

VARIABLES:
T/K = 1123 - 1295
No information on pressure

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The solubilities of HCl in molten NaCl at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10^7 soly/mol cm^-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1123</td>
<td>13.42</td>
</tr>
<tr>
<td>1167</td>
<td>13.56</td>
</tr>
<tr>
<td>1213</td>
<td>12.97</td>
</tr>
<tr>
<td>1295</td>
<td>12.84</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of soly is given by the expression:

\[
\log(\text{soly/mol cm}^{-3}) = -6.042 + \frac{195.9}{(T/K)} \quad \text{(compiler)}
\]

std. dev. = 0.7% \quad \text{(compiler)}

The heat of solution, \(\Delta H\), is estimated to be:

\[\Delta H/\text{kJ mol}^{-1} = -3.7 \quad \text{(compiler)}\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Volumetric method.

The diagram and details of the apparatus used and procedure followed are described in the original publication. The melt is saturated with hydrogen chloride. A part of the saturated melt is either flushed with argon or the melt is solidified and the solid salt evacuated. The volume of liberated HCl is then measured with a gas burette.

SOURCE AND PURITY OF MATERIALS:
Condensation method was employed for drying gases.

ESTIMATED ERROR:

solvency = ± 1% \quad \text{(authors)}

REFERENCES:
COMPONENTS:

(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Sodium chloride; NaCl; [7647-14-5]

VARIABLES:

\[ T/K = 1113 - 1173 \]
\[ p/kPa: 101.325 \text{ (1 atm.)} \]

EXPERIMENTAL VALUES:

The solubilities of hydrogen chloride, under one atmosphere pressure, in molten NaCl at two temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>(10^4 x_1/\text{mol fraction atm}^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>840</td>
<td>3.15</td>
</tr>
<tr>
<td>900</td>
<td>1.89</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of \( x_1 \) in the range 840 - 900°C is expressed by the relation:

\[
\log(x_1/\text{mol fraction atm}^{-1}) = -7.25 + 4180/(T/K)
\]

The heat of solution, \( \Delta H \), is given as:

\[
\Delta H/\text{kJ mol}^{-1} = -79.9
\]

METHOD/APPARATUS/PROCEDURE:

Elution or stripping method.

The diagram and details of the apparatus used and procedure followed for gas solubility measurements have been described in the original paper. The apparatus used was similar to that described by Grimes et al. (1). Dry HCl gas was passed through the melt at a pressure close to atmospheric. After the melt was saturated, the gas supply was cut off. About half of the melt was transferred to the desorber and sparged with dry, deoxygenated N\(_2\). The liberated HCl was absorbed in water and determined by titration.

SOURCE AND PURITY OF MATERIALS:

C. P. grade Sodium chloride was used.

ESTIMATED ERROR:

Nothing specified

REFERENCES:

1. Grimes, W. R.; Smith, N. V.; Watson, G. M.
COMPONENTS:
(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Sodium chloride; NaCl; [7647-14-5]

VARIABLES:
P/kPa = 0.912
T/K = 1151 - 1283

EXPERIMENTAL VALUES:

Solubilities of hydrogen chloride in molten NaCl at different temperatures are reported to be:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10^4 x_1/(mol fraction) atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>878</td>
<td>40</td>
</tr>
<tr>
<td>888</td>
<td>44</td>
</tr>
<tr>
<td>900</td>
<td>42</td>
</tr>
<tr>
<td>920</td>
<td>44</td>
</tr>
<tr>
<td>925</td>
<td>46.5</td>
</tr>
<tr>
<td>930</td>
<td>41</td>
</tr>
<tr>
<td>950</td>
<td>47</td>
</tr>
<tr>
<td>963</td>
<td>48</td>
</tr>
<tr>
<td>986</td>
<td>51</td>
</tr>
<tr>
<td>1000</td>
<td>52</td>
</tr>
<tr>
<td>1010</td>
<td>53</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of x_1 is expressed by the relation:

\[ \log(x_1/\text{mol fraction atm}^{-1}) = -1.29 - 1261/(T/K) \]

The heat of solution, \( \Delta H \), and entropy of solution, \( \Delta S \), are:

\[ \Delta H/\text{kJ mol}^{-1} = 24.3 \quad \Delta S/\text{J K}^{-1} \text{mol}^{-1} = -24.7 \]

METHOD/APPARATUS/PROCEDURE:

Elution or stripping method.

Diagram and details of the apparatus used and procedure followed for gas solubility are given in the original publication. The salt was heated, fused and held under vacuum. The tube was filled with purified HCl gas. After saturation, the melt was flushed with argon. The HCl liberated was absorbed in distilled water and determined by measuring the pH of the solution.

SOURCE AND PURITY OF MATERIALS:

Sodium chloride was dried in vacuum for 10 hours with a gradual temperature rise from 200 - 400°C.

HCl gas was purified by passing through concentrated H₂SO₄ and an acetone dry ice trap.

Argon was dried and purified to remove oxygen and other impurities.

ESTIMATED ERROR:

Nothing specified

REFERENCES:
Components:

(1) Hydrogen chloride; HCl; [7647-01-0]

(2) Potassium chloride; KCl; [7447-40-7]

Evaluators:

N. P. Bansal
National Aeronautics and Space Administration
Lewis Research Center
Cleveland, Ohio, 44135. U.S.A.
December, 1989.

Critical Evaluation:

Five studies have been reported (1 - 5) for the solubility of hydrogen chloride in molten KCl. Novozhilov et al. (3) used a volumetric method while the other investigations were carried out employing the elution technique. Smoothed data at various temperatures from the different studies are compared below:

\[
\begin{array}{cccccc}
T/K & \text{Ref. 1}\text{a} & \text{Ref. 2} & \text{Ref. 3} & \text{Ref. 4}\text{a} & \text{Ref. 5}\text{a} \\
1060 & 23.12 & 35.90 & (53.67) & & \\
1080 & 23.54 & 35.82 & 49.24 & & \\
1100 & 23.94 & & 45.30 & & \\
1120 & 24.32 & 34.78 & 38.65 & & \\
1140 & 24.69 & & & & \\
1160 & 25.04 & 35.82 & (21.82) & & \\
1180 & 25.37 & 24.0b & 33.75 & (33.28) & 22.74 \\
1200 & 25.69 & & (30.98) & 23.66 & \\
1220 & 26.00 & 34.10 & 24.58 & & \\
1240 & 26.29 & & 25.50 & & \\
1260 & 26.56 & 33.88 & 26.40 & & \\
1270 & 26.69 & & 26.86 & & \\
\end{array}
\]

\[
AH/kJ \text{ mol}^{-1} \quad 12.1 \quad - \quad -3.8 \quad -33.9 \quad 26.8
\]


b At 1173 K

Values in ( ) outside temperature interval of experimental measurements; extrapolated by the evaluator.

References:


continued
Component:

1. Hydrogen chloride; HCl; [7647-01-0]
2. Potassium chloride; KCl; [7447-40-7]

Critical Evaluation:

An examination of the preceding table shows that the values of Lukmanova and Vil'nyanskii (4) are too high and are thus rejected. The results of Novozhilov et al. (3) also are 30 - 70% higher than those of references (1) and (5) and the data of (3) are also rejected. The results of Ukshe and Devyatkin (1) are in agreement with those of Krasilnikova et al. (5), with a maximum difference of 12% at 1180 K. However, the heat of solution of Krasilnikova (5) is more than twice the value reported by Ukshe and Devyatkin (1). The mean values from (1,5) are designated as tentative values. These tentative values are given in Table 1:

Table 1 - Tentative Solubilities as a Function of Temperature

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^7 K_u$/mol cm$^{-3}$ atm$^{-2}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1140</td>
<td>22.8</td>
</tr>
<tr>
<td>1160</td>
<td>23.4</td>
</tr>
<tr>
<td>1180</td>
<td>24.1</td>
</tr>
<tr>
<td>1200</td>
<td>24.7</td>
</tr>
<tr>
<td>1220</td>
<td>25.3</td>
</tr>
<tr>
<td>1240</td>
<td>25.9</td>
</tr>
<tr>
<td>1260</td>
<td>26.5</td>
</tr>
<tr>
<td>1270</td>
<td>26.8</td>
</tr>
</tbody>
</table>
COMPONENTS:
(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Potassium chloride; KCl; [7447-40-7]

VARIABLES:
P/kPa: 101.325 (1 atm.)
T/K = 1113 - 1273

EXPERIMENTAL VALUES:
The solubilities of hydrogen chloride, under one atmosphere gas pressure, in molten KCl at various temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>(10^6 \frac{X_1}{\text{mol fraction atm}^{-1}})</th>
</tr>
</thead>
<tbody>
<tr>
<td>840</td>
<td>125.5</td>
</tr>
<tr>
<td>870</td>
<td>117.3</td>
</tr>
<tr>
<td>900</td>
<td>120.3</td>
</tr>
<tr>
<td>950</td>
<td>130.0</td>
</tr>
<tr>
<td>970</td>
<td>138.3</td>
</tr>
<tr>
<td>1000</td>
<td>145.5</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of \(X_1\), in the interval 1113 - 1273 K, is given by the expression:

\[
\log(\frac{X_1}{\text{mol fraction atm}^{-1}}) = -3.3138 - \frac{685.5}{(T/K)}
\]

(std. dev. = 2.2%)

The heat of solution, \(\Delta H\), is:

\[
\Delta H/\text{kJ mol}^{-1} = +12.1
\]

REFERENCES:
1. Ryabukhin, Yu. M.
<table>
<thead>
<tr>
<th>COMPONENTS:</th>
<th>ORIGINAL MEASUREMENTS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Hydrogen chloride; HCl; [7647-01-0]</td>
<td>Devyatkin, V. N. Ukshe, E. A.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VARIABLES:</th>
<th>PREPARED BY:</th>
</tr>
</thead>
<tbody>
<tr>
<td>P/kPa = 20.265 - 101.325</td>
<td>N. P. Bansal</td>
</tr>
<tr>
<td>one temperature: T/K = 1173</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EXPERIMENTAL VALUES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>The value of Henry's law constant, $K_H$, for the solubility of HCl in molten KCl at a single temperature is:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>t/°C</th>
<th>$10^7 K_H$/mol cm$^{-3}$ atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>900</td>
<td>24</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AUXILIARY INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>METHOD/APPARATUS/PROCEDURE:</td>
</tr>
<tr>
<td>Elution method.</td>
</tr>
</tbody>
</table>

The method used was essentially similar to that described by Ryabukhin (1). The melt was saturated with HCl by bubbling a mixture of hydrogen chloride and argon. After equilibration, the melt was flushed with dry argon to liberate the dissolved HCl. The freed HCl, which was carried along with the argon, was absorbed in distilled water.

<table>
<thead>
<tr>
<th>SOURCE AND PURITY OF MATERIALS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen chloride was dried by passing through concentrated sulfuric acid and argon by passing over phosphorous pentoxide. The traces of moisture were further removed by passing the two gases through a coil cooled in alcohol - solid carbon dioxide mixture.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ESTIMATED ERROR:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nothing specified</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REFERENCES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ryabukhin, Yu. M.</td>
</tr>
</tbody>
</table>
COMPONENTS:

(1) Hydrogen chloride; HCl; [7647-01-0]

(2) Potassium chloride; KCl; [7447-40-7]

VARIABLES:

\[
T/K = 1062 - 1260 \\
P/kPa = 101.325 \text{ (1 atm)}
\]

EXPERIMENTAL VALUES:

The values of Henry's law constant, \( K_H \), for the solubility of HCl in molten KCl at various temperatures are:

<table>
<thead>
<tr>
<th>( T/K )</th>
<th>( 10^7 K_H / \text{mol cm}^{-3} \text{ atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1062</td>
<td>35.87</td>
</tr>
<tr>
<td>1078</td>
<td>35.83</td>
</tr>
<tr>
<td>1109</td>
<td>35.80</td>
</tr>
<tr>
<td>1144</td>
<td>34.75</td>
</tr>
<tr>
<td>1181</td>
<td>33.77</td>
</tr>
<tr>
<td>1223</td>
<td>34.06</td>
</tr>
<tr>
<td>1260</td>
<td>33.88</td>
</tr>
</tbody>
</table>

Smoothed Data:

The enthalpy of solution, \( \Delta H \), and the change in entropy during dissolution, \( \Delta S \), are:

\[
\Delta H/\text{kJ mol}^{-1} = -3.8 \\
\Delta S/\text{J K}^{-1} \text{ mol}^{-1} = -3.5 \text{ (at 1150 K)}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method.

A modification of the experimental method described by Bratland et al. (1) was used for solubility measurements.

SOURCE AND PURITY OF MATERIALS:

HCl was prepared by reacting molten NaCl with concentrated sulfuric acid. The gas was purified by fractional condensation.

Recrystallized "chemically pure" grade KCl was fused in a stream of dry chlorine. The melt was purged with chlorine for about 2 hours. Then the melt was slowly crystallized under chlorine atmosphere. Only transparent crystals were used for the experiment.

ESTIMATED ERROR:

solubility = ± 1% (authors)

REFERENCES:


COMPONENTS:
(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Potassium chloride; KCl; [7447-40-7]

VARIABLES:
T/K = 1073 - 1173
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:
The solubilities of hydrogen chloride, under one atmosphere pressure, in molten KCl at various temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10^4 x_(i)/(mol fraction) atm^-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>800</td>
<td>2.50</td>
</tr>
<tr>
<td>840</td>
<td>2.15</td>
</tr>
<tr>
<td>900</td>
<td>1.75</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of x_i, in the range 800 - 900°C, is expressed by the equation:

\[
\log(x_i/m\text{ol fraction atm}^{-1}) = -5.419 + 1950.4/(T/K) \quad \text{(compiler)}
\]

\[
\text{std. dev.} = 0.05\% \quad \text{(compiler)}
\]

The heat of solution, \(\Delta H\), is given as:

\[
\Delta H/kJ \text{ mol}^{-1} = -33.89
\]

METHOD/APPARATUS/PROCEDURE:
Elution or stripping method.

The diagram and details of the apparatus used and the procedure followed for the gas solubility measurements have been described in the original publication. The apparatus used was similar to that described by Grimes et al. [1]. Dry HCl gas was passed through the melt at a pressure close to atmospheric. After the melt was saturated, the gas supply was turned off. About half of the melt was transferred to the desorber and sparged with dry, deoxygenated N_2. The liberated HCl was absorbed in water and determined by titration.

SOURCE AND PURITY OF MATERIALS:
C. P. grade Potassium chloride was used.

REFERENCES:
1. Grimes, W. R.; Smith, N. V.; Watson, G. M.
COMPONENTS:
(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Potassium chloride; KCl; [7447-40-7]

VARIABLES:
T/K = 1173 - 1273
P/kPa = 0.912

EXPERIMENTAL VALUES:
Solubilities of hydrogen chloride in molten KCl at different temperatures are reported as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10^4 x_1/(mol fraction) atm(^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>900</td>
<td>126.2</td>
</tr>
<tr>
<td>912</td>
<td>129.7</td>
</tr>
<tr>
<td>925</td>
<td>135.2</td>
</tr>
<tr>
<td>958</td>
<td>145.2</td>
</tr>
<tr>
<td>980</td>
<td>151.6</td>
</tr>
<tr>
<td>1000</td>
<td>158.2</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of x_1 is expressed by the relation:
\[
\log(x_1/{\text{mol fraction atm}^{-1}}) = -0.71 - 1392/(T/K)
\]

The heat of solution, \(\Delta H\), and the entropy of solution, \(\Delta S\), are:
\[
\Delta H/kJ\ mol^{-1} = 26.8
\]
\[
\Delta S/J\ K^{-1}\ mol^{-1} = -13.6
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution or stripping method.
Diagram and details of the apparatus used and procedure followed for gas solubility measurements are given in the original publication. The salt was heated, fused and held under vacuum. The tube was filled with purified HCl gas. After saturation, the melt was sparged with argon. The HCl liberated was absorbed in distilled water and determined by measuring the pH of the solution.

SOURCE AND PURITY OF MATERIALS:
Potassium chloride was dried in vacuum for 10 hours with a gradual temperature rise from 200 - 400°C.
HCl gas was purified by passing through concentrated sulfuric acid and an acetone - dry ice trap.
Argon was dried and purified to remove oxygen and other impurities.

ESTIMATED ERROR:
Nothing specified

REFERENCES:
**COMPONENTS:**

(1) Hydrogen chloride; HCl; [7647-01-0]

(2) Rubidium chloride; RbCl; [7791-11-9]

**EVALUATOR:**

N. P. Bansal
National Aeronautics and Space Administration.
Lewis Research Center
Cleveland, Ohio, 44135, U.S.A.
December, 1989.

**CRITICAL EVALUATION:**

Four investigations (1 - 4) have been reported for the solubility of hydrogen chloride in molten RbCl. Novozhilov et al. (3) used a volumetric method while the elution technique was employed in the other studies (1,2,4). Smoothed data at different temperatures from the various reports are compared below:

<table>
<thead>
<tr>
<th>T/K</th>
<th>Ref. 1</th>
<th>Ref. 2</th>
<th>Ref. 3</th>
<th>Ref. 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>(47.0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1030</td>
<td>45.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1060</td>
<td>43.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1100</td>
<td>40.9</td>
<td>42.0*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1120</td>
<td>39.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1150</td>
<td>38.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1180</td>
<td>36.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1200</td>
<td>36.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1230</td>
<td>34.8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(10^7 K_H/\text{mol cm}^{-3} \text{ atm}^{-1}\)

| ΔH/kJ mol\(^{-1}\) | -9.2 | -    | -9.3 | 32.6 |

* At 1103 K


Values outside temperature interval of experimental measurements; extrapolated by the evaluator.

The value of ΔH reported by Krasilnikova et al. (4) is not only quite high, but also opposite in sign than the other two studies (1,3) whose values are in excellent agreement with each other. But the values of \(K_H\) of Ukshe et al. (1) are 20 - 25% smaller in comparison to those of Novozhilov et al. (3).

Further careful work is needed before recommended values can be advanced for this system.

**References:**

COMPONENTS:
(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Rubidium chloride; RbCl; [7791-11-9]

ORIGINAL MEASUREMENTS:
Ukshe, E. A.; Devyatkin, V. N.
1965, 39, 1222 - 23. (*).

VARIABLES:
T/K = 1033 - 1233
P/kPa: 101.325 (1 atm.)

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The solubilities of hydrogen chloride, at one atmosphere gas pressure, in molten RbCl at various temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10^6 x_1/(mol fraction) atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>760</td>
<td>240.5</td>
</tr>
<tr>
<td>825</td>
<td>232.0</td>
</tr>
<tr>
<td>880</td>
<td>221.4</td>
</tr>
<tr>
<td>940</td>
<td>202.8</td>
</tr>
<tr>
<td>960</td>
<td>202.0</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of x_1, in the range 760 - 960°C, is expressed by the equation:

\[ \log(x_1/\text{mol fraction atm}^{-1}) = -4.1108 + 515.4/(T/K) \]  
(compiler)

std. dev. = 0.9%  
(compiler)

The heat of solution, ΔH, is:

ΔH/kJ mol⁻¹ = -9.2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution or stripping method.

The method employed was essentially the same as described by Ryabukhin (1). Argon was bubbled through the melt for 20 min. and then evacuated. Hydrogen chloride at 1 atm. pressure was bubbled through the melt for 30 - 40 min. and then allowed to equilibrate for 3 - 5 min. A part of the melt was separated and purged with argon. The liberated hydrogen chloride was absorbed in distilled water and then titrated against a standard alkali solution.

SOURCE AND PURITY OF MATERIALS:
Hydrogen chloride was prepared by mixing hydrochloric and sulfuric acids. It was dried by passing through concentrated sulfuric acid. Quality A argon was passed over phosphorous pentoxide. Traces of moisture from the two gases were further removed by passing them through a trap cooled in a mixture of alcohol and solid carbon dioxide.

ESTIMATED ERROR:
Nothing specified

REFERENCES:
1. Ryabukhin, Yu. M.
COMPONENTS:

(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Rubidium chloride; RbCl; [7791-11-9]

VARIABLES:

one temperature: T/K = 1103
P/kPa: 101.325 (compiler)

EXPERIMENTAL VALUES:

The value of the Henry's law constant, $K_H$, for the solubility of HCl in molten RbCl at one temperature is:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>$10^7 K_H$/mol cm$^{-3}$ atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>830</td>
<td>42</td>
</tr>
</tbody>
</table>

PREPARED BY:

N. P. Bansal

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Elution technique.

The method employed was basically similar to that described by Ryabukhin (1). The melt was saturated with HCl by bubbling a mixture of hydrogen chloride and argon. After equilibration, the melt was sparged with dry argon to liberate the dissolved HCl. The freed HCl, which was carried along with argon, was absorbed in distilled water.

SOURCE AND PURITY OF MATERIALS:

Hydrogen chloride was dried by passing through concentrated sulfuric acid and argon by passing over phosphorous pentoxide. Traces of moisture were further removed by passing the two gases through a coil cooled in alcohol - solid carbon dioxide mixture.

ESTIMATED ERROR:

Nothing specified

REFERENCES:

1. Ryabukhin, Yu. M.
COMPONENTS:
(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Rubidium chloride; RbCl; [7791-11-9]

ORIGINAL MEASUREMENTS:
Novozilov, A. L.; Devyatkin, V. N.; Gribova, E. I.
1972, 46, 1066 - 67. (*)

VARIABLES:
T/K = 995 - 1245
P/kPa = 101.325 (1 atm)

EXPERIMENTAL VALUES:
The values of Henry's law constant, \( K_H \), for the solubility of HCl in molten RbCl at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>( 10^7 K_H /\text{mol cm}^{-3}\text{ atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>995</td>
<td>56.32</td>
</tr>
<tr>
<td>1041</td>
<td>56.15</td>
</tr>
<tr>
<td>1078</td>
<td>55.75</td>
</tr>
<tr>
<td>1113</td>
<td>52.82</td>
</tr>
<tr>
<td>1132</td>
<td>49.86</td>
</tr>
<tr>
<td>1166</td>
<td>47.81</td>
</tr>
<tr>
<td>1245</td>
<td>46.88</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of \( K_H \) is expressed by the relation:

\[
\log(K_H/\text{mol cm}^{-3}\text{ atm}^{-1}) = -5.711 + 472.1/(T/K) \quad \text{(compiler)}
\]

std. dev. = 1.4% (compiler)

The enthalpy of solution, \( \Delta H \), and the entropy change of dissolution, \( \Delta S \), are:

\[
\Delta H/\text{kJ mol}^{-1} = -9.3 \quad \Delta S/\text{J K}^{-1}\text{ mol}^{-1} = -8.4 \quad \text{(at 1110 K)}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Volumetric method.

A modification of the experimental technique described by Bratland (1) was used for solubility measurements.

SOURCE AND PURITY OF MATERIALS:
HCl was prepared by reacting molten NaCl with concentrated sulfuric acid. The gas was purified by fractional condensation. Recrystallized "chemically pure" grade RbCl was fused in a stream of dry chlorine. The melt was purged with chlorine for about 2 hours. Then the melt was slowly crystallized under chlorine atmosphere. Only transparent crystals were used for the experiment.

ESTIMATED ERROR:

solubility = ± 1% (authors)

REFERENCES:
**COMPONENTS:**

1. Hydrogen chloride; HCl; [7647-01-0]
2. Rubidium chloride; RbCl; [7791-11-9]

**ORIGINAL MEASUREMENTS:**

Krasilnikova, N. A.; Smirnov, M. V.; Ozeryanya, I. M.


**VARIABLES:**

<table>
<thead>
<tr>
<th>P/kPa</th>
<th>T/K</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.912</td>
<td>991 - 1215</td>
</tr>
</tbody>
</table>

**PREPARED BY:**

N. P. Bansal

**EXPERIMENTAL VALUES:**

Solubilities of hydrogen chloride in molten RbCl at different temperatures are reported as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10^a x_1/(mol fraction) atm^-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>718</td>
<td>111.0</td>
</tr>
<tr>
<td>754</td>
<td>127.5</td>
</tr>
<tr>
<td>800</td>
<td>153.8</td>
</tr>
<tr>
<td>840</td>
<td>174.7</td>
</tr>
<tr>
<td>850</td>
<td>191.2</td>
</tr>
<tr>
<td>942</td>
<td>226.4</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of x_1 is expressed by the relation:

\[ \log(x_1/mol\ fraction\ atm^{-1}) = -0.24 - 1705/(T/K) \]

The heat of solution, ΔH, and the entropy of solution, ΔS, are:

ΔH/kJ mol⁻¹ = 32.6

ΔS/J K⁻¹ mol⁻¹ = -4.5

**METHOD/APPARATUS/PROCEDURE:**

Elution or stripping technique.

Diagram and details of the apparatus used and procedure followed for gas solubility measurements are given in the original paper. The salt was heated, fused and held under vacuum. The tube was filled with purified HCl gas. After saturation, the melt was sparged with argon. The HCl liberated was absorbed in distilled water and estimated by measuring the pH of the solution.

**SOURCE AND PURITY OF MATERIALS:**

Rubidium chloride was dried in vacuum for 10 hours with a gradual temperature rise from 200 - 400°C.

HCl gas was purified by passing through concentrated sulfuric acid and an acetone - dry ice trap.

Argon was dried and purified to remove oxygen and other impurities.

**ESTIMATED ERROR:**

Nothing specified

**REFERENCES:**
COMPONENTS:

(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Cesium chloride; CsCl; [7647-17-8]

EVALUATOR:

N. P. Bansal
National Aeronautics and Space Administration
Lewis Research Center
Cleveland, Ohio, 44135. U.S.A.
December, 1989.

CRITICAL EVALUATION:

Two investigations (1,2) are available for the solubility of hydrogen chloride in molten CsCl. Novozhilov et al. (1) used a volumetric method while Krasilnikova (2) employed an elution technique. The values of thermodynamic parameters, \( \Delta H \) and \( \Delta S \), for the dissolution process, reported by the two groups are not only quite different in magnitude but also opposite in sign. Smoothed data at different temperatures from the two sources are compared below:

<table>
<thead>
<tr>
<th>T/K</th>
<th>Novozhilov et al. (1)</th>
<th>Krasilnikova et al. (2)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>940</td>
<td>104.3</td>
<td>16.0</td>
</tr>
<tr>
<td>970</td>
<td>96.0</td>
<td>19.0</td>
</tr>
<tr>
<td>1000</td>
<td>88.8</td>
<td>22.3</td>
</tr>
<tr>
<td>1030</td>
<td>82.5</td>
<td>26.0</td>
</tr>
<tr>
<td>1060</td>
<td>77.0</td>
<td>29.9</td>
</tr>
<tr>
<td>1100</td>
<td>70.6</td>
<td>35.7</td>
</tr>
<tr>
<td>1130</td>
<td>66.5</td>
<td>40.4</td>
</tr>
<tr>
<td>1160</td>
<td>62.8</td>
<td>45.3</td>
</tr>
<tr>
<td>1190</td>
<td>59.4</td>
<td>(50.5)</td>
</tr>
<tr>
<td>1220</td>
<td>56.4</td>
<td>(56.0)</td>
</tr>
</tbody>
</table>

* Values in (mol cm\(^{-3}\) atm\(^{-1}\)) calculated by the evaluator using density data from Janz, G. J., Molten Salts Handbook\(^{1}\), Academic Press, New York, 1967.

Values in ( ) outside temperature interval of experimental measurement; extrapolated by the evaluator.

Results of the two studies are seen to be quite different. Further investigations are needed before recommended values can be advanced.

References:

COMPONENTS:

(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Cesium chloride; CsCl; [7647-17-8]

ORIGINAL MEASUREMENTS:

VARIABLES:

P/kPa = 23.305
T/K = 942 - 1218

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:

The values of Henry's law constant, $K_H$, for the solubility of HCl in molten CsCl at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^7 K_H$/mol cm$^{-3}$ atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>942</td>
<td>103.19</td>
</tr>
<tr>
<td>978</td>
<td>95.36</td>
</tr>
<tr>
<td>1038</td>
<td>84.32</td>
</tr>
<tr>
<td>1073</td>
<td>71.65</td>
</tr>
<tr>
<td>1130</td>
<td>64.92</td>
</tr>
<tr>
<td>1167</td>
<td>61.07</td>
</tr>
<tr>
<td>1218</td>
<td>58.63</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of $K_H$ is given by the equation:

$$\log(K_H/$mol cm$^{-3}$ atm$^{-1}$) = -6.145 + 1093.5/(T/K)$$

std. dev. = 1.5% (compiler)

The enthalpy of solution, $\Delta H$, and the entropy change of solution, $\Delta S$, are:

$\Delta H$/kJ mol$^{-1}$ = -20.9
$\Delta S$/J K$^{-1}$ mol$^{-1}$ = -19.4 (at 1078 K)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Volumetric method.
A modification of the experimental technique described by Bratland et al. (1) was used for solubility measurements.

SOURCE AND PURITY OF MATERIALS:
HCl was prepared by reacting molten NaCl with concentrated sulfuric acid. The gas was purified by fractional condensation.
Recrystallized "chemically pure" CsCl was fused in a stream of dry chlorine. The melt was purged with chlorine for about 2 hours. Then the melt was slowly crystallized under chlorine atmosphere. Only transparent crystals were used for the experiment.

ESTIMATED ERROR:
solubility = ± 1% (authors)

REFERENCES:
COMPONENTS:
(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Cesium chloride; CsCl; [7647-17-8]

VARIABLES: P/kPa = 0.912
T/K = 937 - 1158

EXPERIMENTAL VALUES:

Solubilities of hydrogen chloride in molten CsCl at different temperatures are reported to be:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>$10^4 x_1/(\text{mol fraction}) \text{ atm}^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>664</td>
<td>100</td>
</tr>
<tr>
<td>710</td>
<td>139</td>
</tr>
<tr>
<td>750</td>
<td>180</td>
</tr>
<tr>
<td>784</td>
<td>211</td>
</tr>
<tr>
<td>816</td>
<td>248</td>
</tr>
<tr>
<td>850</td>
<td>278</td>
</tr>
<tr>
<td>885</td>
<td>315</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of $x_1$ is expressed by the relation:

$$\log(x_1/\text{mol fraction atm}^{-1}) = 0.71 - 2517/(T/K)$$

The heat of solution, $\Delta H$, and entropy of solution, $\Delta S$, are:

$$\Delta H/\text{kJ mol}^{-1} = 48.1$$

$$\Delta S/\text{J K}^{-1} \text{ mol}^{-1} = +13.6$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution or stripping method. Diagram and details of the apparatus used and procedure followed for gas solubility measurements are given in the original paper. The salt was heated, fused and held under vacuum. The tube was filled with purified HCl gas. After saturation, the melt was flushed with argon. The HCl liberated was absorbed in distilled water and determined by measuring the pH of the solution.

SOURCE AND PURITY OF MATERIALS:
Cesium chloride was dried in vacuum for 10 hours with a gradual temperature rise from 200 - 400°C. HCl gas was purified by passing through concentrated H$_2$SO$_4$ and an acetone - dry ice trap. Argon was dried and purified to remove oxygen and other impurities.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
### COMPONENTS:

1. Hydrogen chloride; HCl; [7647-01-0]
2. Magnesium chloride; MgCl₂; [7786-30-3]

### ORIGINAL MEASUREMENTS:

Novozhilov, A. L.

### VARIABLES:

- $P/kPa = 62.822$
- $T/K = 990 - 1177$

### PREPARED BY:

N. P. Bansal

### EXPERIMENTAL VALUES:

Applicability of Henry's law was checked at only one value of $P_{HCl} = 0.62$ atm. Values of Henry's Law constant $K_H$ (mol cm⁻³ atm⁻¹) at various temperatures are listed below. The data obeyed the equation:

\[
\frac{-\log K_H R'T}{2.303RT} = \frac{\Delta H}{2.303RT} - \frac{\Delta S}{2.303}
\]

as the plot of $-\log K_H R'T$ against $1/T$ was linear. Here $R$ and $R'$ are the gas constants in J K⁻¹ mol⁻¹ and in cm³ atm⁻¹ K⁻¹ mol⁻¹, respectively and $\Delta H$ and $\Delta S$ are the changes in enthalpy and entropy caused by the introduction of HCl molecules in the melt.

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^7 K_H$/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>990</td>
<td>6.94</td>
</tr>
<tr>
<td>1026</td>
<td>7.25</td>
</tr>
<tr>
<td>1078</td>
<td>7.67</td>
</tr>
<tr>
<td>1136</td>
<td>8.10</td>
</tr>
<tr>
<td>1177</td>
<td>8.38</td>
</tr>
</tbody>
</table>

Values of $\Delta H$ and $\Delta S$ of the dissolution process, evaluated from linear least-squares, are:

\[
\Delta H/kJ \text{ mol}^{-1} = 18.7
\]
\[
\Delta S/JK^{-1} \text{ mol}^{-1} = -5.02
\]

### AUXILIARY INFORMATION

**METHOD/APPARATUS/PROCEDURE:**

Gas solubilities were determined using a volumetric method as described earlier(1).

**SOURCE AND PURITY OF MATERIALS:**

MgCl₂ was prepared from sublimed magnesium and doubly distilled "chemically pure" grade hydrochloric acid and purified in the molten state using a special procedure as described in the original paper.

**ESTIMATED ERROR:**

Solubility = ± 1.5 - 2% (authors)

**REFERENCES:**

1. Novozhilov, A. L; Devyatkin, V. P; Gribova, E. I.
COMPONENTS:

(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Magnesium chloride; MgCl₂; [7786-30-3]

ORIGINAL MEASUREMENTS:

Lukmanova, T. L.; Vilnyanskii, Ya. E.

VARIABLES:

P/kPa: 101.325 (1 atm.)
T/K = 1023 - 1113

EXPERIMENTAL VALUES:

The solubilities of hydrogen chloride, under one atmosphere pressure, in molten MgCl₂ at various temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁴ x₁/(mol fraction) atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>750</td>
<td>28.1</td>
</tr>
<tr>
<td>800</td>
<td>27.0</td>
</tr>
<tr>
<td>840</td>
<td>25.0</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of x₁, in the interval 750 - 840°C, is expressed by the relation:

\[ \log(x₁/\text{mol fraction atm}^{-1}) = -3.162 + 627.8/(T/K) \]  
(compiler)

\[ \text{std. dev.} = 1.0\% \]  
(compiler)

The heat of solution, ΔH, is given as:

\[ \Delta H/\text{kJ mol}^{-1} = -8.41 \]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Elution or stripping method.

The diagram and details of the apparatus used and procedure followed for the gas solubility measurements have been described in the original paper. The apparatus used was similar to that described by Grimes et al. (1). Dry HCl gas was passed through the melt at a pressure close to atmospheric. After the melt was saturated, the gas supply was cut off. About half of the melt was transferred to the desorber and sparged with dry, deoxygenated N₂. The liberated HCl was absorbed in water and determined by titration.

SOURCE AND PURITY OF MATERIALS:

MgCl₂ was C. P. grade and was dehydrated in two steps; first in the drying oven at 280°C in the presence of C. P. NH₄Cl and then in a quartz tube by heating to 800°C in a stream of HCl gas until the basicity of the melt, as determined by titration, was equal to zero.

ESTIMATED ERROR:

Nothing specified

REFERENCES:

1. Grimes, W. R.; Smith, N. V.; Watson, G. M.
COMPONENTS:

(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Calcium chloride; CaCl₂; [10043-52-4]

ORIGINAL MEASUREMENTS:


VARIABLES:

P/kPa = 60.795 - 101.325
T/K = 1093 - 1275

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

The values of Henry's law constant, Kₖ, for the solubility of HCl in molten CaCl₂ at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁷ Kₖ/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>1093</td>
<td>2.82</td>
</tr>
<tr>
<td>1143</td>
<td>3.45</td>
</tr>
<tr>
<td>1190</td>
<td>3.72</td>
</tr>
<tr>
<td>1275</td>
<td>4.42</td>
</tr>
</tbody>
</table>

Smoothed Data:

The temperature dependence of Kₖ is given by the expression:

\[ \log(Kₖ/\text{mol cm}^{-3} \text{ atm}^{-1}) = -5.216 - 1445/(T/K) \] (compiler)

std. dev. = 1.6% (compiler)

The heat of solution, ΔH, and the entropy change during dissolution, ΔS, are:

\[ \Delta H/\text{kJ mol}^{-1} = 27.9 \]
\[ \Delta S/\text{J K}^{-1} \text{ mol}^{-1} = 25.4 \] (at 1097 K)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method (1).

SOURCE AND PURITY OF MATERIALS:

HCl was prepared by the reaction of fused NaCl with concentrated sulfuric acid. It was purified by fractional condensation.

Recrystallized "chemically pure" grade calcium chloride was dried for several days by gradual heating. Then it was melted and treated with chlorine and transferred to the saturation vessel under a stream of dried and purified argon.

ESTIMATED ERROR:

solubility = ± 3% (authors)

REFERENCES:

COMPONENTS:

(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Strontium chloride; SrCl$_2$; [10476-85-4]

ORIGINAL MEASUREMENTS:


VARIABLES:

P/kPa = 60.795 - 101.325

T/K = 1163 - 1295

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

The values of Henry's law constant, $K_H$, for the solubility of HCl in molten SrCl$_2$ at various temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^7 K_H/mol cm^{-3} atm^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1163</td>
<td>1.85</td>
</tr>
<tr>
<td>1204</td>
<td>2.14</td>
</tr>
<tr>
<td>1238</td>
<td>2.38</td>
</tr>
<tr>
<td>1295</td>
<td>2.78</td>
</tr>
</tbody>
</table>

Smoothened Data:

The temperature dependence of $K_H$ is expressed by the relation:

$log(K_H/mol cm^{-3} atm^{-1}) = -4.997 - 2016/(T/K)$ (compiler)

std. dev. = 0.3% (compiler)

The heat of solution, $\Delta H$, and the entropy change during dissolution, $\Delta S$, are:

$\Delta H/kJ mol^{-1} = 37.9$

$\Delta S/J K^{-1} mol^{-1} = 31.4$ (at 1198 K)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric technique (1).

SOURCE AND PURITY OF MATERIALS:

HCl was prepared by the reaction of fused NaCl with concentrated sulfuric acid. It was purified by fractional condensation. Recrystallized "chemically pure" grade strontium chloride was dried for several days by gradual heating. It was melted and treated with chlorine and transferred to the saturation vessel under a stream of dry and pure argon.

ESTIMATED ERROR:

solubility = ± 3% (authors)

REFERENCES:

COMPONENTS:

(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Barium chloride; BaCl₂; [10361-37-2]

ORIGINAL MEASUREMENTS:
Novozhilov, A. L.; Gribova, E. I.; Devyatkin, V. N.
1972, 17, 1345 - 46. (*).

VARIABLES:
P/kPa = 60.795 - 101.325
T/K = 1253 - 1351

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:

The values of Henry's law constant, \( K_H \), for the solubility of HCl in molten BaCl₂ at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>( 10^7 K_H /\text{mol cm}^{-3} \text{ atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1253</td>
<td>1.59</td>
</tr>
<tr>
<td>1295</td>
<td>1.88</td>
</tr>
<tr>
<td>1351</td>
<td>2.17</td>
</tr>
</tbody>
</table>

Smoothed Data:

The temperature dependence of \( K_H \) is given by the relation:

\[
\log(10^7 K_H /\text{mol cm}^{-3} \text{ atm}^{-1}) = -4.941 - 2319/(T/K) \quad \text{(compiler)}
\]

std. dev. = 1.1% \quad \text{(compiler)}

The heat of solution, \( \Delta H \), and the entropy change during dissolution, \( \Delta S \), are:

\[
\Delta H /\text{kJ mol}^{-1} = 42.1
\]

\[
\Delta S /J K^{-1} \text{ mol}^{-1} = 32.5 \quad \text{(at 1295 K)}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric technique (1).

SOURCE AND PURITY OF MATERIALS:

HCl was prepared by reaction of fused NaCl with concentrated sulfuric acid. It was purified by fractional condensation.

Recrystallized "chemically pure" grade barium chloride was dried for several days by gradual heating. It was melted and treated with chlorine and transferred to the saturation vessel under a stream of dried and purified argon.

ESTIMATED ERROR:

solubility = ± 3% \quad \text{(authors)}

REFERENCES:

COMPONENTS:
(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Tin chloride; SnCl₄; [7646-78-8]

ORIGINAL MEASUREMENTS:
Howald, R. A.; Willard, J. E.

VARIABLES:
T/K = 273 - 300
P/kPa: 101.325 (compiler)

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The solubilities of HCl in SnCl₄ liquid at two temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁵ x₁/mol fraction mm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>6.6 ± 0.5</td>
</tr>
<tr>
<td>27</td>
<td>5.2 ± 1.0</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Pressure measurement.
The solubility of HCl in SnCl₄ was measured by determining the the pressure exerted by a known amount of HCl metered into a flask of definite volume containing a known amount of SnCl₄.

SOURCE AND PURITY OF MATERIALS:
Tank HCl from Matheson was was passed through a column containing phosphorous pentoxide. C. P. analyzed anhydrous SnCl₄ was distilled through a P₂O₅ column under vacuum and stored.

ESTIMATED ERROR:
Nothing specified

REFERENCES:
COMPONENTS:

(1) Hydrogen chloride; HCl; [7647-01-0]
(2) N-Methylpyridinium chloride; CH₃C₅H₅N·Cl; [7680-73-1]

ORIGINAL MEASUREMENTS:

Claes, P. F; Coppe, C. R; Simonis, L. A; Glibert, J. E.


VARIABLES:

T/K = 443
p/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:

Solubility of HCl at 1 atm pressure is given below

<table>
<thead>
<tr>
<th>T/K</th>
<th>C_{HCl}/mol lit⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>443</td>
<td>7.47 ± 0.28</td>
</tr>
</tbody>
</table>

PREPARED BY:

N. P. Bansal

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solubility was determined by saturating the melt by bubbling HCl for 3h. The saturated melt was quenched, dissolved in distilled water, and the excess of KI and KIO₃ were added to the solution which generated an equivalent amount of I₂ according to the reaction:

6H₃O⁺+IO⁻₃+5I⁻ → 9H₂O+3I₂.

The liberated I₂ was estimated by titration with a standard solution of Na₂S₂O₃.

SOURCE AND PURITY OF MATERIALS:

Purum grade hydrogen chloride from Fluka was used. In some cases, HCl was prepared by reacting H₂SO₄ (96% from Carlo Erba) of RPE grade with NaCl and bubbled through sulfuric acid.

N-Methylpyridinium chloride was synthesized as described earlier(1).

ESTIMATED ERROR:

Not specified.

REFERENCES:

1. Simonis, L; Coppe, C; Glibert, J; Claes, P.
COMPONENTS:

(1) Hydrogen chloride; HCl;
   [7647-01-0]
(2) N-Ethylpyridinium bromide;
   C2H5·C2H5N·Br; [1906-79-2]

ORIGINAL MEASUREMENTS:

Claes, P. F; Coppe, C. R; Simonis, L. A; Gilbert, J. E.

VARIABLES:

T/K = 393
P/kPa: 101.325 (1 atm.)

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:

Solubility of HCl at 1 atm pressure is given below

<table>
<thead>
<tr>
<th>T/K</th>
<th>C_{HCl}/mol l^{-1}</th>
</tr>
</thead>
<tbody>
<tr>
<td>393</td>
<td>6.10</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solubility was determined by saturating the melt by bubbling HCl for 3h. The saturated melt was quenched, dissolved in distilled water, and the excess of KI and KIO3 were added to the solution which generated an equivalent amount of I2 according to the reaction:

\[ 6\text{H}_3\text{O}^+ + \text{IO}_3^- + 5\text{I}^- \rightarrow 9\text{H}_2\text{O} + 3\text{I}_2. \]

The liberated I2 was estimated by titration with a standard solution of Na2S2O3.

SOURCE AND PURITY OF MATERIALS:

- Purum grade hydrogen chloride from Fluka was used. In some cases, HCl was prepared by reacting H2SO4 (96% from Carlo Erba) of RPE grade with NaCl and bubbled through sulfuric acid.
- N-Ethylpyridinium bromide was synthesized from 99.6% pyridine (Carlo Erba) and 99% ethyl bromide (U. C. B) of P. A grade. For details see the original paper.

ESTIMATED ERROR:

Not specified.

REFERENCES:
Two investigations have been reported for the solubility of hydrogen chloride in molten LiCl - KCl eutectic, using the elution technique. Smoothed data from the two studies at different temperatures are compared below:

<table>
<thead>
<tr>
<th>T/K</th>
<th>Ref. 1</th>
<th>Ref. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>680</td>
<td>(9.5)</td>
<td>10.5</td>
</tr>
<tr>
<td>710</td>
<td>(10.4)</td>
<td>11.8</td>
</tr>
<tr>
<td>740</td>
<td>(11.3)</td>
<td>13.1</td>
</tr>
<tr>
<td>770</td>
<td>12.2</td>
<td>14.4</td>
</tr>
<tr>
<td>800</td>
<td>13.1</td>
<td>(15.8)</td>
</tr>
<tr>
<td>830</td>
<td>14.0</td>
<td>(17.2)</td>
</tr>
<tr>
<td>860</td>
<td>14.9</td>
<td>(18.6)</td>
</tr>
<tr>
<td>890</td>
<td>15.7</td>
<td>(20.0)</td>
</tr>
<tr>
<td>920</td>
<td>16.6</td>
<td>(21.5)</td>
</tr>
<tr>
<td>950</td>
<td>17.4</td>
<td>(22.9)</td>
</tr>
</tbody>
</table>

Values in ( ) outside temperature interval of experimental measurement; extrapolated by the evaluator.

There is good agreement between the values of $\Delta H$ of the two studies, but the solubility values of Van Norman and Tivers (1) are 10 - 30% lower than those of Minh and Welch (2). Further experimental studies are needed before recommended values can be advanced for this system.

References:
COMPONENTS:
(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Lithium chloride; LiCl; [7447-41-8]
(3) Potassium chloride; KCl; [7447-40-7]

ORIGIONAL MEASUREMENTS:
Van Norman, J. D.; Tivers, R. J.

VARIABLES:
T/K = 763 - 948
P/kPa: 101.325 (1 atm.)

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The values of Henry's law constant, $K_H$, for the solubility of hydrogen chloride in molten eutectic LiCl - KCl, under gas pressure of 1 atm., at three temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>$10^6 K_H$/mol cm$^{-3}$ atm$^{-1}$</th>
<th>$10^5 X_1$/(mol fraction) atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>490</td>
<td>1.20 ± 0.14</td>
<td>4.11</td>
</tr>
<tr>
<td>570</td>
<td>1.44 ± 0.10</td>
<td>5.05</td>
</tr>
<tr>
<td>675</td>
<td>1.74 ± 0.11</td>
<td>6.31</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of $K_H$ is expressed by the relation:

$$\log(K_H$/mol cm$^{-3}$ atm$^{-1}$) = -5.094 - 631.1/(T/K)$$

std. dev. = 0.06%

The heat of solution, $\Delta H$, is given as:

$$\Delta H/kJ \text{ mol}^{-1} = 14.64$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution or stripping method.
The method employed for gas solubility measurements was the same as described elsewhere (2). The melt was first saturated with hydrogen chloride by bubbling the gas through it at a particular gas pressure. A known part of the saturated melt is isolated and flushed with argon to free the dissolved HCl which is collected in water. The HCl solution in water is titrated with a standard NaOH solution.

SOURCE AND PURITY OF MATERIALS:
Reagent grade LiCl and KCl were used.
The LiCl - KCl molten eutectic was prepared by following the method of Laitinen et al. (1).

ESTIMATED ERROR:

solubility ± 10% (authors)

REFERENCES:
1. Laitinen, H. A.; Ferguson, W. S.; Osteryoung, R. A.
2. Van Norman, J. D.; Tivers, R. J.
COMPONENTS:  
(1) Hydrogen chloride; HCl;  
[7647-01-0]  
(2) Lithium chloride; LiCl;  
[7447-41-8]  
(3) Potassium chloride; KCl;  
[7447-40-7]  

ORIGINAL MEASUREMENTS:  
Minh, N. Q.; Welch, B. J.  

VARIABLES:  
\[ T/K = 677 - 793 \]  

PREPARED BY:  
N. P. Bansal  

EXPERIMENTAL VALUES:  
The solubilities of HCl in molten LiCl - KCl eutectic (59 - 41 mol%) for an HCl pressure of 101.3kPa at three temperatures are:  

<table>
<thead>
<tr>
<th>T/K</th>
<th>( 10^a \times K_h \text{ mol cm}^{-3} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>677</td>
<td>1.04</td>
</tr>
<tr>
<td>735</td>
<td>1.27</td>
</tr>
<tr>
<td>793</td>
<td>1.56</td>
</tr>
</tbody>
</table>

Smoothed Data:  
The temperature dependence of \( K_h \) is given by the expression:  
\[
\log(K_h/\text{mol cm}^{-3} \text{ atm}^{-1}) = -4.783 - \frac{814.3}{(T/K)}
\]  
(compiler)  

std. dev. = 0.7%  
(compiler)  
The heat of solution, \( \Delta H \), is estimated to be:  
\[
\Delta H/\text{kJ mol}^{-1} = 15.6
\]  
(compiler)  

AUXILIARY INFORMATION  

METHOD/APPARATUS/PROCEDURE:  
Elution technique.  

The melt was saturated with hydrogen chloride by bubbling the gas through it. A known portion of the saturated melt was isolated and sparged with argon to liberate the dissolved HCl. The HCl, which was carried out along with argon, was absorbed in water and determined by titration with a standard NaOH solution.  

SOURCE AND PURITY OF MATERIALS:  
HCl gas was prepared by the action of concentrated sulfuric acid on concentrated HCl solution. It was dried by passing through concentrated sulfuric acid scrubbers and demisted by passing through a glass wool filter.  

ESTIMATED ERROR:  
solubility = \( \pm \) 10%  
(authors)  

REFERENCES:  

COMPONENTS:
(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Potassium chloride; KCl; [7447-40-7]

CRITICAL EVALUATION:

All the three studies for the solubility of hydrogen chloride in molten NaCl - KCl have employed the same experimental (elution) technique. Ukshe and Devyatkin (1) have studied three melt compositions containing 25, 50, 75 mol% KCl while Lukmanova et al. (3) have used only the equimolar melt. Smoothed data at different temperatures from the three investigations in the equimolar melt are compared below:

<table>
<thead>
<tr>
<th>T/K</th>
<th>Ref. 1</th>
<th>Ref. 2</th>
<th>Ref. 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>980</td>
<td>8.89</td>
<td></td>
<td>(98.0)</td>
</tr>
<tr>
<td>1020</td>
<td>8.53</td>
<td>8.98*</td>
<td>(66.7)</td>
</tr>
<tr>
<td>1060</td>
<td>8.21</td>
<td>46.7</td>
<td></td>
</tr>
<tr>
<td>1100</td>
<td>7.93</td>
<td></td>
<td>33.6</td>
</tr>
<tr>
<td>1140</td>
<td>7.67</td>
<td>(24.7)</td>
<td></td>
</tr>
<tr>
<td>1180</td>
<td>7.43</td>
<td>(18.6)</td>
<td></td>
</tr>
<tr>
<td>1220</td>
<td>7.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1250</td>
<td>7.08</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\( \Delta H / \text{kJ mol}^{-1} \)

-8.6

* At 1023 K

Values in ( ) outside temperature interval of experimental measurement; extrapolated by the evaluator.

Results of Ukshe and Devyatkin (1,2) are quite different than those of Lukmanova et al. (3). Further experimental measurements are required before recommended values can be advanced for this system.

References:
COMPONENTS:

(1) Hydrogen chloride; HCl; [76-01-0]
(2) Sodium chloride; NaCl; [76-47-14-5]
(3) Potassium chloride; KCl; [7447-40-7]

ORIGINALL MEASUREMENTS:

Ukshe, E. A.; Devyatkin, V. N.
Zh. Fiz. Khim. 1965, 39, 3074 - 75;
1965, 39, 1641 - 42. (*).

VARIABLES:

T/K = 973 - 1273
Melt composition/mol% KCl = 25-75
P/kPa: 101.325 (1 atm.)

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

The solubilities of HCl in the molten mixtures NaCl - KCl (25, 50, 75 mol% KCl) at different temperatures are:

<table>
<thead>
<tr>
<th>Melt Composition/mol% KCl</th>
<th>t/°C</th>
<th>10° Soly/mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>800</td>
<td>37.7</td>
</tr>
<tr>
<td></td>
<td>845</td>
<td>40.0</td>
</tr>
<tr>
<td></td>
<td>875</td>
<td>42.1</td>
</tr>
<tr>
<td></td>
<td>920</td>
<td>42.4</td>
</tr>
<tr>
<td></td>
<td>950</td>
<td>45.0</td>
</tr>
<tr>
<td></td>
<td>990</td>
<td>46.6</td>
</tr>
<tr>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>700</td>
<td>88.0</td>
</tr>
<tr>
<td></td>
<td>725</td>
<td>86.5</td>
</tr>
<tr>
<td></td>
<td>800</td>
<td>83.3</td>
</tr>
<tr>
<td></td>
<td>850</td>
<td>83.9</td>
</tr>
<tr>
<td></td>
<td>900</td>
<td>76.1</td>
</tr>
<tr>
<td></td>
<td>945</td>
<td>67.9</td>
</tr>
<tr>
<td></td>
<td>970</td>
<td>74.4</td>
</tr>
<tr>
<td></td>
<td>980</td>
<td>68.7</td>
</tr>
</tbody>
</table>

continued

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Elution or stripping technique.

The method used was the same as described earlier (1). Argon was bubbled through the melt followed by evacuation. Hydrogen chloride at 1 atm. pressure was then passed through the melt and allowed to equilibrate. A part of the molten solution was isolated and purged with argon. The liberated hydrogen chloride was absorbed in distilled water and titrated against an alkali solution.

SOURCE AND PURITY OF MATERIALS:

Hydrogen chloride, prepared by mixing hydrochloric and sulfuric acids, was dried by passing through concentrated sulfuric acid. Grade A argon was passed over phosphorous pentoxide. Traces of moisture from the two gases were further removed by passing through a cooled trap immersed in a mixture of alcohol and solid carbon dioxide.

ESTIMATED ERROR:

std. dev. = ± 0.7, ± 2.1, ± 1.0%
for 25, 50 and 75 mol % KCl,
respectively (compiler)

REFERENCES:

1. Ukshe, E. A.; Devyatkin, Yu. M.
COMPONENTS: ORIGINAL MEASUREMENTS:
(1) Hydrogen chloride; HCl; [7647-01-0]
Ukshe, E. A.; Devyatkin, V. N.
Zh. Fiz. Khim. 1965, 39, 3074 - 75;
(2) Sodium chloride; NaCl; [7647-14-5]
Russia J. Phys. Chem. (Eng. Transl.)
1965, 39, 1641 - 42. (*).
(3) Potassium chloride; KCl; [7447-40-7]

VARIABLES: PREPARED BY:

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>Melt Composition/mol% KCl</th>
<th>t/°C</th>
<th>10^6 Soly/mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>75</td>
<td>750</td>
<td>109.8</td>
</tr>
<tr>
<td></td>
<td>825</td>
<td>110.8</td>
</tr>
<tr>
<td></td>
<td>875</td>
<td>109.8</td>
</tr>
<tr>
<td></td>
<td>906</td>
<td>106.6</td>
</tr>
<tr>
<td></td>
<td>1000</td>
<td>112.8</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature variation of solubility in the ranges studied, obeyed the equation: log(soly/mol fraction) = a + b/(T/K)

Values of the coefficients a and b, along with the enthalpies of dissolution, ΔH, in the three molten mixtures (calculated by the compiler) are:

<table>
<thead>
<tr>
<th>Melt composition/mol% KCl</th>
<th>a</th>
<th>b</th>
<th>ΔH/kJ mol⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>-3.8279</td>
<td>-637.5</td>
<td>12.2</td>
</tr>
<tr>
<td>50</td>
<td>-4.5062</td>
<td>448.7</td>
<td>-8.6</td>
</tr>
<tr>
<td>75</td>
<td>-3.9335</td>
<td>-28.56</td>
<td>0.55</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:
(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS:
Devyatkin, V. N.; Ukshe, E. A.
Zh. Prikl. Khim. 1965, 38, 1612 - 14;
1965, 38, 1574 - 75. (*).

VARIABLES:
P/kPa = 20.265 - 101.325
one temperature: T/K = 1023

EXPERIMENTAL VALUES:
The value of Henry's law constant, \( K_H \), for the solubility of HCl in molten NaCl - KCl (50 - 50 mol%) at one temperature is:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>( 10^7 K_H \text{ mol cm}^{-3} \text{ atm}^{-1} )</th>
<th>( 10^8 x_1 \text{ mol fraction atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>750</td>
<td>21</td>
<td>8.98*</td>
</tr>
</tbody>
</table>


AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution technique.
The method employed was essentially similar to that described by Ryabukhin (1). The melt was saturated with HCl by bubbling a mixture of hydrogen chloride and argon. After equilibration, the melt was purged with dry argon to liberate the dissolved HCl. The freed HCl, which was carried along with argon, was absorbed in distilled water.

SOURCE AND PURITY OF MATERIALS:
Hydrogen chloride was dried by passing through concentrated sulfuric acid and argon by passing over phosphorous pentoxide. Traces of moisture were further removed by passing the two gases through a coil cooled in alcohol - solid carbon dioxide mixture.

ESTIMATED ERROR:
Nothing specified

REFERENCES:
1. Ryabukhin, Yu. M.
COMPONENTS:
(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Potassium chloride; KCl; [7447-40-7]

VARIABLES:
T/K = 1023 - 1113
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:
The solubilities of hydrogen chloride, under one atmosphere pressure, in molten mixture, NaCl - KCl (50 - 50 mol%) at different temperatures are:

<table>
<thead>
<tr>
<th>T/°C</th>
<th>10^4 x_1/(mol fraction) atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>750</td>
<td>6.24 ± 0.36</td>
</tr>
<tr>
<td>800</td>
<td>4.56 ± 0.43</td>
</tr>
<tr>
<td>840</td>
<td>2.88 ± 0.24</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of x_1, in the range 750 - 840°C, is expressed by the relation:
\[
\log(x_1/\text{mol fraction atm}^{-1}) = -7.273 + 4179/(T/K)
\]
(compiler)
std. dev. = 4.7% (compiler)

The heat of solution, \( \Delta H \), is given as:
\[
\Delta H/\text{kJ mol}^{-1} = -78.45
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution or stripping method.
The diagram and details of the apparatus used and procedure followed for gas solubility measurements have been described in the original paper. The apparatus used was similar to that described by Grimes et al. (1). Dry HCl gas was passed through the melt at a pressure close to atmospheric. After the melt was saturated, the gas supply was cut off. About half of the melt was transferred to the desorber and sparged with dry, deoxygenated N₂. The liberated HCl was absorbed in water and determined by titration.

SOURCE AND PURITY OF MATERIALS:
C. P. grade sodium and potassium chlorides were used.

ESTIMATED ERROR:
Nothing specified

REFERENCES:
COMPONENTS:
(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Potassium chloride; KCl; [7447-40-7]
(3) Magnesium chloride; MgCl₂; [7786-30-3]

ORIGINAL MEASUREMENTS:

VARIABLES:
T/K = 773 - 1113
P/kPa: 101.325 (1 atm.)

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The solubilities of hydrogen chloride, under one atmosphere pressure, in the molten mixture KCl - MgCl₂ (50 -50 mol%) at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁻⁴ x₁/(mol fraction) atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>27.65 ± 0.25</td>
</tr>
<tr>
<td>550</td>
<td>24.73 ± 0.27</td>
</tr>
<tr>
<td>600</td>
<td>24.10 ± 0.10</td>
</tr>
<tr>
<td>650</td>
<td>22.25</td>
</tr>
<tr>
<td>700</td>
<td>20.96 ± 0.01</td>
</tr>
<tr>
<td>750</td>
<td>20.10</td>
</tr>
<tr>
<td>800</td>
<td>18.98 ± 0.02</td>
</tr>
<tr>
<td>840</td>
<td>17.95 ± 0.65</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of x₁, in the range 500 - 840°C, is expressed by the relation:

\[
\log(x₁/(mol fraction atm⁻¹)) = -3.143 + 450.5/(T/K) \quad \text{(compiler)}
\]

std. dev. = 0.7% \quad \text{(compiler)}

The heat of solution, \( \Delta H \), is given as:

\[\Delta H/\text{kJ mol}⁻¹ = -9.08\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution or stripping method.

The diagram and details of the apparatus used and procedure followed for gas solubility measurements have been described in the original publication. The apparatus used was similar to that described by Grimes et al. (1). Dry HCl was passed through the melt at a pressure close to atmospheric. After the melt was saturated, the gas supply was turned off. About half of the melt was transferred to the desorber and sparged with dry, deoxygenated \( \text{N}_2 \). The liberated HCl was absorbed in water and determined by titration.

SOURCE AND PURITY OF MATERIALS:
Potassium and magnesium chlorides were of C. P. grade. Magnesium chloride was first dried in an oven at 280°C in the presence of C. P. \( \text{NH}_4\text{Cl} \) and then in a quartz tube by heating to 800°C in a stream of HCl gas until the basicity of the melt, as determined by titration, was equal to zero.

ESTIMATED ERROR:
Nothing specified

REFERENCES:
**COMPONENTS:**

1. Hydrogen chloride; HCl; [7647-01-0]
2. Potassium chloride; KCl; [7447-40-7]
3. Magnesium chloride; MgCl₂; [7786-30-3]

**ORIGINAL MEASUREMENTS:**

Lukmanova, T. L.; Vilnyanskii, Ya. E.

**VARIABLES:**

\[ T/K = 773 - 1113 \]
\[ P/kPa = 30.398 - 103.352 \]

**PREPARED BY:**

N. P. Bansal

**EXPERIMENTAL VALUES:**

The solubilities of HCl in molten equimolar KCl - MgCl₂ at 500, 600, 700 and 840°C are presented in the form of a figure as a function of pressure. It is not possible to read precise values of solubility from the figure. The solubility values are approximately the same as reported elsewhere by the same workers (1).

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Elution or stripping method.

The apparatus and the method used for gas solubility measurements have been described earlier (1). Dry HCl gas was passed through about 120g of the melt at a rate of 10 l/hr. After saturation, a portion of the melt was transferred into the desorber and flushed with nitrogen. The HCl gas liberated was absorbed in distilled water and determined by titration.

**SOURCE AND PURITY OF MATERIALS:**

The method of preparation of the anhydrous melt from carnallite has been described earlier (1).

**ESTIMATED ERROR:**

Nothing specified

**REFERENCES:**

1. Lukmanova, T. L.; Vilnyanskii, Ya. E.
COMPONENTS:

(1) Hydrogen chloride; HCl;
[7647-01-0]
(2) Potassium chloride; KCl;
[7447-40-7]
(3) Magnesium chloride; MgCl₂;
[7786-30-3]

ORIGINAL MEASUREMENTS:

Novozhilov, A. L.

COMPONENTS:

(1) Hydrogen chloride; HCl;
[7647-01-0]
(2) Potassium chloride; KCl;
[7447-40-7]
(3) Magnesium chloride; MgCl₂;
[7786-30-3]

VARIABLES:

\[ \frac{T}{K} = 778 - 1180 \]
\[ \text{MgCl}_2/\text{mol}\% = 13 - 73 \]

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES: Applicability of Henry's law was checked at \( P_{\text{HCl}} = 0.62 \text{atm} \).

Values of Henry's Law Constant at various temperatures are listed below.

The data obeyed the equation:

\[ -\log K_{HR'T} = \frac{\Delta H}{2.303R} - \frac{\Delta S}{2.303R} \]

as the plot of \(-\log K_{HR'T}\) against \(1/T\) was linear. Here \( R \) and \( R' \) are the gas constants in \( \text{JK}^{-1}\text{mol}^{-1} \) and in \( \text{cm}^3\text{atm}^{-1}\text{mol}^{-1} \), respectively and \( \Delta H \) and \( \Delta S \) are the changes in enthalpy and entropy caused by the introduction of HCl molecules in the melt.

Composition of KCl - MgCl₂ melt/mol % MgCl₂

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁷ ( K_{HR'T} ) mol cm⁻³ atm⁻¹</th>
<th>T/K</th>
<th>10⁷ ( K_{HR'T} ) mol cm⁻³ atm⁻¹</th>
<th>T/K</th>
<th>10⁷ ( K_{HR'T} ) mol cm⁻³ atm⁻¹</th>
<th>T/K</th>
<th>10⁷ ( K_{HR'T} ) mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>999</td>
<td>34.86</td>
<td>1035</td>
<td>34.20</td>
<td>1068</td>
<td>33.60</td>
<td>1126</td>
<td>32.62</td>
</tr>
<tr>
<td>1035</td>
<td>34.20</td>
<td>833</td>
<td>31.50</td>
<td>896</td>
<td>30.09</td>
<td>1028</td>
<td>27.46</td>
</tr>
<tr>
<td>1068</td>
<td>33.60</td>
<td>896</td>
<td>30.09</td>
<td>1015</td>
<td>21.76</td>
<td>1074</td>
<td>20.75</td>
</tr>
<tr>
<td>1126</td>
<td>32.62</td>
<td>1028</td>
<td>27.46</td>
<td>1074</td>
<td>20.75</td>
<td>1073</td>
<td>13.00</td>
</tr>
<tr>
<td>1180</td>
<td>31.72</td>
<td>1077</td>
<td>26.58</td>
<td>1108</td>
<td>20.20</td>
<td>1124</td>
<td>13.03</td>
</tr>
<tr>
<td>1123</td>
<td>25.81</td>
<td>1123</td>
<td>25.81</td>
<td>1148</td>
<td>19.60</td>
<td>1153</td>
<td>13.10</td>
</tr>
</tbody>
</table>

Values of \( \Delta H \) and \( \Delta S \) of the dissolution process, evaluated from linear least squares are:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>13 mol% MgCl₂</th>
<th>33 mol% MgCl₂</th>
<th>50 mol% MgCl₂</th>
<th>73 mol% MgCl₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Delta H / \text{kJ mol}^{-1} )</td>
<td>3.93</td>
<td>2.67</td>
<td>1.35</td>
<td>9.45</td>
</tr>
<tr>
<td>( \Delta S / \text{JK}^{-1}\text{mol}^{-1} )</td>
<td>-6.48</td>
<td>-9.58</td>
<td>-12.88</td>
<td>-9.20</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas solubilities were determined using a volumetric method as described earlier(1).

SOURCE AND PURITY OF MATERIALS:

MgCl₂ was prepared from sublimed magnesium metal and doubly distilled "chemically pure" grade hydrochloric acid and purified in the molten state using a special procedure. For details see the original paper.

ESTIMATED ERROR:

Solubility = \( \pm 1.5 - 2\% \) (authors)

REFERENCES:

1. Novozhilov, A. L.; Devyatkin, V. P.; Gribova, E. I.
COMPONENTS:
(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Zinc chloride; ZnCl₂; [7646-85-7]
(3) N-Methylpyridinium Chloride; CH₃-C₅H₅N·Cl; [7680-73-1]

VARIABLES:
T/K = 443
P/kPa: 101.325 (1 atm.)
ZnCl₂/mol fraction = 0.0 - 0.703

ORIGINAL MEASUREMENTS:
Claes, P. F; Coppe, C. R; Simonis, L. A; Glibert, J. E.

EXPERIMENTAL VALUES:
Solubilities of HCl in melts of various compositions measured at 443K and 1 atm pressure are listed below:

<table>
<thead>
<tr>
<th>Melt composition/ mole frac. of ZnCl₂</th>
<th>C_HCl/mol lit⁻¹</th>
<th>Melt composition/ mole frac. of ZnCl₂</th>
<th>C_HCl/mol lit⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000</td>
<td>7.47 ± 0.28</td>
<td>0.000</td>
<td>0.445</td>
</tr>
<tr>
<td>0.025</td>
<td>6.75 ± 0.25</td>
<td>0.025</td>
<td>0.448</td>
</tr>
<tr>
<td>0.050</td>
<td>6.22 ± 0.23</td>
<td>0.050</td>
<td>0.475</td>
</tr>
<tr>
<td>0.067</td>
<td>6.01 ± 0.23</td>
<td>0.067</td>
<td>0.501</td>
</tr>
<tr>
<td>0.086</td>
<td>5.90 ± 0.22</td>
<td>0.086</td>
<td>0.526</td>
</tr>
<tr>
<td>0.100</td>
<td>5.68 ± 0.21</td>
<td>0.100</td>
<td>0.548</td>
</tr>
<tr>
<td>0.101</td>
<td>5.38 ± 0.20</td>
<td>0.101</td>
<td>0.579</td>
</tr>
<tr>
<td>0.121</td>
<td>4.96 ± 0.19</td>
<td>0.121</td>
<td>0.601</td>
</tr>
<tr>
<td>0.152</td>
<td>4.46 ± 0.17</td>
<td>0.152</td>
<td>0.649</td>
</tr>
<tr>
<td>0.192</td>
<td>3.76 ± 0.14</td>
<td>0.192</td>
<td>0.677</td>
</tr>
<tr>
<td>0.212</td>
<td>2.95 ± 0.11</td>
<td>0.212</td>
<td>0.693</td>
</tr>
<tr>
<td>0.250</td>
<td>2.18 ± 0.082</td>
<td>0.250</td>
<td>0.703</td>
</tr>
<tr>
<td>0.273</td>
<td>1.78 ± 0.067</td>
<td>0.273</td>
<td>0.29 ± 0.08</td>
</tr>
<tr>
<td>0.367</td>
<td>0.17 ± 0.08</td>
<td>0.367</td>
<td>0.30 ± 0.08</td>
</tr>
<tr>
<td>0.392</td>
<td>0.24 ± 0.08</td>
<td>0.392</td>
<td>0.33 ± 0.08</td>
</tr>
<tr>
<td>0.401</td>
<td>0.28 ± 0.08</td>
<td>0.401</td>
<td>0.35 ± 0.08</td>
</tr>
<tr>
<td>0.419</td>
<td>0.32 ± 0.08</td>
<td>0.419</td>
<td>0.40 ± 0.08</td>
</tr>
</tbody>
</table>

METHOD/APPARATUS/PROCEDURE:
Solubility was determined by saturating the melt by bubbling HCl for 3h. The saturated melt was quenched, dissolved in distilled water, and the excess of KI and KIO₃ were added to the solution which generated an equivalent amount of I₂ according to the reaction:

6H₃O⁺+IO₃⁻+5I⁻ → 9H₂O+3I₂.

The liberated I₂ was estimated by titration with a standard solution of Na₂S₂O₃.

SOURCE AND PURITY OF MATERIALS:
Purum grade hydrogen chloride from Fluka was used. In some cases, HCl was prepared by reacting H₂SO₄ (96% from Carlo Erba) of RPE grade with NaCl and bubbled through sulfuric acid.
The origin of ZnCl₂ was described elsewhere(l).
The synthesis of N-Methylpyridinium chloride was described earlier(l).

ESTIMATED ERROR:
Not specified.

REFERENCES:
1. Simonis, L; Coppe, C.; Glibert, J.; Claes, P.
COMPONENTS:
(1) Hydrogen chloride; HCl; [7647-01-0]
(2) Zinc chloride; ZnCl$_2$; [7646-85-7]
(3) N-Ethylpyridinium bromide; C$_5$H$_4$·C$_5$H$_5$N·Br; [1906-79-2]

ORIGINAL MEASUREMENTS:
Claes, P. F; Coppe, C. R; Simonis, L. A; Glibert, J. E.

VARIABLES:
T/K = 393
P/kPa: 101.325 (1 atm.)
ZnCl$_2$/mol fraction = 0.0 - 0.70

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
Solubilities of HCl in melts of various compositions measured at 393K and 1 atm pressure are listed below:

<table>
<thead>
<tr>
<th>Melt composition/ mole frac. of ZnCl$_2$</th>
<th>C$_{HCl}$/mol lit$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000</td>
<td>6.10</td>
</tr>
<tr>
<td>0.061</td>
<td>5.63</td>
</tr>
<tr>
<td>0.100</td>
<td>4.77</td>
</tr>
<tr>
<td>0.187</td>
<td>3.25</td>
</tr>
<tr>
<td>0.200</td>
<td>3.29</td>
</tr>
<tr>
<td>0.249</td>
<td>2.32</td>
</tr>
<tr>
<td>0.300</td>
<td>1.37</td>
</tr>
<tr>
<td>0.380</td>
<td>0.39</td>
</tr>
<tr>
<td>0.400</td>
<td>0.34</td>
</tr>
<tr>
<td>0.500</td>
<td>0.22</td>
</tr>
<tr>
<td>0.600</td>
<td>0.21</td>
</tr>
<tr>
<td>0.700</td>
<td>0.09</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Solubility was determined by saturating the melt by bubbling HCl for 3h. The saturated melt was quenched, dissolved in distilled water, and the excess of KI and KIO$_3$ were added to the solution which generated an equivalent amount of I$_2$ according to the reaction:

$$6H_2O^+ + IO_3^- + 5I^- \rightarrow 9H_2O + 3I_2.$$  

The liberated I$_2$ was estimated by titration with a standard solution of Na$_2$S$_2$O$_3$.

SOURCE AND PURITY OF MATERIALS:
Purum grade hydrogen chloride from Fluka was used. In some cases, HCl was prepared by reacting H$_2$SO$_4$ (96% from Carlo Erba) of RPE grade with NaCl and bubbled through sulfuric acid. The origin of ZnCl$_2$ was described elsewhere(1).

N-Ethylpyridinium bromide was synthesized from 99.6% pyridine (Carlo Erba) and 99% ethyl bromide(U.C.B) of P. A. grade. For details see the original paper.

ESTIMATED ERROR:
Not specified.

REFERENCES:
1. Simonis, L; Coppe, C; Glibert, J; Claes, P.
COMPONENTS: ORIGINAL MEASUREMENTS:

(1) Hydrogen chloride; HCl; [7647-01-0]

Minh, N. Q.; Welch, B. J.

(2) Lithium chloride; LiCl; [7447-41-8]

continued

VARIABLES: T/K = 668 - 773
Melt comp./mol% ZnCl₂ = 0 - 17.4
P/kPa: 101.325 (1 atm.)

PREPARED BY: N. P. Bansal

EXPERIMENTAL VALUES:

The solubilities of HCl in LiCl - KCl - ZnCl₂ melts of different compositions at 723 K, for an HCl pressure of 101.3 kPa (1 atm.) are:

<table>
<thead>
<tr>
<th>Melt Composition/mol% ZnCl₂</th>
<th>10⁶ soly/mol cm⁻³</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.24</td>
</tr>
<tr>
<td>3.4</td>
<td>1.49</td>
</tr>
<tr>
<td>4.7</td>
<td>1.63</td>
</tr>
<tr>
<td>8.2</td>
<td>1.78</td>
</tr>
<tr>
<td>11.9</td>
<td>2.03</td>
</tr>
<tr>
<td>13.5</td>
<td>2.10</td>
</tr>
<tr>
<td>17.4</td>
<td>2.19</td>
</tr>
</tbody>
</table>

Values of soly in the melt containing 11.9 mol% ZnCl₂ at three temperatures for the HCl pressure of 101.3 kPa are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁶ soly/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>668</td>
<td>2.14</td>
</tr>
<tr>
<td>723</td>
<td>2.03</td>
</tr>
<tr>
<td>773</td>
<td>1.83</td>
</tr>
</tbody>
</table>

continued

AUXILIARY INFORMATION

METHOD/Apparatus/PROCEDURE:

Elution technique.

The melt was saturated with hydrogen chloride by bubbling the gas through it. A known portion of the saturated melt was isolated and flushed with argon to liberate the dissolved HCl. The HCl, which was carried out along with argon, was absorbed in water and determined by titration against a standard NaOH solution.

SOURCE AND PURITY OF MATERIALS:

Analytical grade ZnCl₂ from May and Baker Limited was used. Great care was taken in preparing the melts. Purity of the melts was checked voltammetrically.

ESTIMATED ERROR:

solubility = ± 10% (authors)

REFERENCES:
Smoothed Data:

Temperature dependence of soly in the melt containing 11.9 mol% ZnCl₂ is expressed by the relation:

$$\log(\text{soly/mol cm}^{-3} \text{ atm}^{-1}) = -6.154 + \frac{326.9}{(T/\text{K})} \quad \text{(compiler)}$$

std. dev. = 1.2% \hspace{1cm} \text{(compiler)}

The heat of solution, $\Delta H$, is estimated to be:

$$\frac{\Delta H}{\text{kJ mol}^{-1}} = -6.3 \quad \text{(compiler)}$$
COMPONENTS:

(1) Nitric acid, HNO₃; [7697-37-2]
(2) Sodium nitrate, NaNO₃; [7631-99-4]
(3) Potassium nitrate, KNO₃; [7757-79-1]

VARIABLES:

P/kPa: 101.325 (1 atm.)
T/K = 480 - 523

EXPERIMENTAL VALUES:

The simultaneous solubilities of nitric acid and water at 1 atm. total vapor pressure under different partial pressures of nitric acid in the vapor phase have been measured in the molten mixture NaNO₃ - KNO₃ (54.3 - 45.7 mol%). The results are reported in graphical form only. The values derived from the graph at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>Partial Pressure of HNO₃ in Vapor Phase/torr</th>
<th>10² Solubility/mol fraction H₂O</th>
<th>10⁵ K_H/mol fraction torr⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>480</td>
<td>152</td>
<td>0.54</td>
<td>3.55</td>
</tr>
<tr>
<td>523</td>
<td>152</td>
<td>0.27</td>
<td>1.76</td>
</tr>
<tr>
<td>485</td>
<td>289</td>
<td>0.98</td>
<td>3.39</td>
</tr>
<tr>
<td>523</td>
<td>289</td>
<td>0.40</td>
<td>1.38</td>
</tr>
</tbody>
</table>

Smoothed Data:
The temperature dependence of x₁ is given by the expression:

\[
\log(x₁/mol fraction torr⁻¹) = -8.92 + 2152/(T/K) \quad \text{(compiler)}
\]

The heat of solution, \( \Delta H \), is:

\[
\Delta H/kJ mol⁻¹ = -41.2 \quad \text{(compiler)}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stripping method.
The melt was saturated with vapors of nitric acid. The vapors dissolved in the melt were stripped with a stream of nitrogen and absorbed in tubes containing sodium hydroxide solution.

SOURCE AND PURITY OF MATERIALS:

Not described.

ESTIMATED ERROR:

Data not very precise because of the decomposition of nitric acid.

REFERENCES:
Two experimental studies are available (1,2) for the solubility of water in molten lithium nitrate. Data from the two reports are compared below, at the same temperatures:

<table>
<thead>
<tr>
<th>T/K</th>
<th>Peleg (1)</th>
<th>Bertozzi (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>538</td>
<td>(19.3)</td>
<td>23.2</td>
</tr>
<tr>
<td>553</td>
<td>14.6</td>
<td>16.5</td>
</tr>
</tbody>
</table>

Value in ( ) outside temperature interval of experimental measurement; extrapolated by the evaluator.

The results of Peleg (1) are about 15 - 20% lower than those of Bertozzi (2). The former worker has employed the rotating microelectrode voltammetric technique which is not as accurate as the gravimetric method used by the latter. In view of this, the results of Bertozzi (2) may be preferred at least tentatively. However, further studies are needed to resolve this system.

References:
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Lithium nitrate; LiNO₃; [7790-69-4]

VARIABLES:

<table>
<thead>
<tr>
<th>T/K</th>
<th>548 - 608</th>
</tr>
</thead>
<tbody>
<tr>
<td>P/kPa</td>
<td>4.00</td>
</tr>
</tbody>
</table>

EXPERIMENTAL VALUES:

The solubility of water in molten LiNO₃ at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁵ x₁/mol fraction mm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>275</td>
<td>16.1</td>
</tr>
<tr>
<td>295</td>
<td>11.0</td>
</tr>
<tr>
<td>310</td>
<td>8.7</td>
</tr>
<tr>
<td>335</td>
<td>5.9</td>
</tr>
</tbody>
</table>

Smoothed Data:

The temperature dependence of x₁ can be expressed by the relation:

\[ \log(x_1/\text{mol fraction mm}^{-1}) = -8.188 + 2407/(T/K) \]  
std. dev. = 0.6%  

The enthalpy of solution, \( \Delta H \), is given as:

\[ \Delta H/\text{kJ mol}^{-1} = -39.1 \]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Voltammetric method. The melt was obtained in a dry state by evacuation for a long time at a temperature above the experimental temperature. Water vapors at a known pressure were then allowed to enter the system and the melt stirred. The concentration of water in the melt was determined by running a voltammogram.

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:

solubility: ± 2% (author)

REFERENCES:
### COMPONENTS:

1. Water; \( H_2O \); [7732-18-5]
2. Lithium nitrate; \( LiNO_3 \); [7790-69-4]

### VARIABLES:

- \( T/K = 538 - 553 \)
- \( P/kPa = 0.667 - 4.000 \)

### EXPERIMENTAL VALUES:

The solubility of water vapor in molten \( LiNO_3 \) at two different temperatures are:

<table>
<thead>
<tr>
<th>( t/\degree C )</th>
<th>( 10^5 x_1/\text{mol fraction torr}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>265</td>
<td>23.2</td>
</tr>
<tr>
<td>280</td>
<td>16.5</td>
</tr>
</tbody>
</table>

### METHOD/APPARATUS/PROCEDURE:

Gravimetric method. A crucible containing 3 - 5 g of the salt is placed on the balance and the system evacuated. The temperature of the salt is slowly raised beyond its melting point and brought to the desired temperature. The melt is kept under high vacuum for many hours. The vacuum is removed and water vapors are allowed to enter into the system. The system is allowed to equilibrate for a few hours and weighed. The increase in weight directly gives the amount of water dissolved in the melt.

### SOURCE AND PURITY OF MATERIALS:

Not described.

### ESTIMATED ERROR:

Nothing specified.
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Sodium nitrate; NaNO₃; [7631-99-4]

VARIABLES:

<table>
<thead>
<tr>
<th>T/K</th>
<th>P/kPa</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>583 - 615</td>
<td>4.00</td>
<td></td>
</tr>
</tbody>
</table>

EXPERIMENTAL VALUES:

The solubility of water vapor in molten NaNO₃ at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁵ x₁/mol fraction mm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>310</td>
<td>2.2</td>
</tr>
<tr>
<td>333</td>
<td>1.7</td>
</tr>
<tr>
<td>342</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Smoothed Data:
The temperature dependence of x₁ can be expressed by the relation:

\[
\log(x₁/mol \text{ fraction mm}^{-1}) = -7.80 + \frac{1838}{T/K} \\
\text{std. dev.} = 1.4\%
\]

The enthalpy of solution, ΔH, is given as:

\[
\Delta H/\text{kJ mol}^{-1} = -34.1
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Voltammetric method.
The melt was prepared in a dry state by evacuation for a long time at a temperature above the experimental temperature. Water vapors at a known pressure were then allowed to enter the system and the melt stirred. The water concentration in the melt was determined by recording a voltammogram.

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:
solubility: ± 20% (author)

REFERENCES:
COMPONENTS:

(1) Water; H₂O; [7732-18-5]
(2) Sodium nitrate; NaN₃; [7631-99-4]

VARIABLES:

P/kPa = 2.133 - 2.800
one temperature: T/K = 579.8

ORIGINAL MEASUREMENTS:

Frame, J. P.; Rhodes, E.; Ubbelohde, A. R.

EXPERIMENTAL VALUES:

The solubility of water in molten NaN₃ under the water vapor pressure of 16 - 21 mm Hg is given as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁴ x₁/mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>306.8</td>
<td>14.1 ± 1.0</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Cryoscopic method.
A modified form of the previously reported (2) cryoscopic apparatus was used. Nitrogen was employed as the carrier gas for water vapors. Freezing point of the same melt sample was determined, first with pure nitrogen, and then with nitrogen containing known partial pressures of water. Solubility of water in the melt was evaluated from the freezing point depression.

SOURCE AND PURITY OF MATERIALS:

NaN₃ containing less than 0.0003% of cation and 0.001% of anion impurities was air dried at 240°C for several days and then by the thermal shock technique (1). The salt was melted and the system evacuated or a slow stream of dry nitrogen was passed through the melt for 24 hr.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

Four experimental studies (1 - 4) are available for the solubility of water in molten KNO₃. Their results are compared below:

<table>
<thead>
<tr>
<th>T/K</th>
<th>Ref. 1 (mol fraction torr⁻¹)</th>
<th>Ref. 2</th>
<th>Ref. 3 (mol fraction torr⁻¹)</th>
<th>Ref. 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>608</td>
<td>2.1 ± 0.5</td>
<td></td>
<td>2.1</td>
<td></td>
</tr>
<tr>
<td>610</td>
<td>0.20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>619</td>
<td>0.70 ± 0.04</td>
<td>1.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>633</td>
<td>0.51 ± 0.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>638</td>
<td>0.51 ± 0.04</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Peleg (2) has pointed out that the results of their study are not correct. Details of the method used by Pchelina and Novozhilov (3) are not available. Although the work of Frame et al. (1) is only of preliminary nature, their results are in good agreement with those of Haug and Albright (4).

The values of ref. (4) may be preferred at least tentatively. However, additional detailed studies are needed to evaluate this system properly.

References:
COMPONENTS:

(1) Water; H₂O; [7732-18-5]
(2) Potassium nitrate; KNO₃; [7757-79-1]

ORIGINAL MEASUREMENTS:

Frame, J. P.; Rhodes, E.; Ubbelohde, A. R.

VARIABLES:

P/kPa = 2.133 - 2.800
one temperature: T/K = 605.05

EXPERIMENTAL VALUES:

The solubility of water in molten KNO₃ under the water vapor pressure of 16 - 21 mm Hg is given as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁴ x₅/mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>335.05</td>
<td>3.9 ± 1.0</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Cryoscopic method. A modified form of the previously described (2) cryoscopic apparatus was used. Nitrogen was employed as the carrier gas for water vapors. Freezing point of the same melt sample was determined, first with pure nitrogen, and then with nitrogen containing known partial pressures of water. Solubility of water in the melt was calculated from the freezing point depression.

SOURCE AND PURITY OF MATERIALS:

KNO₃ containing less than 0.0003% of cation and less than 0.001% of anion impurities was air dried at 240°C for several days and then by the thermal shock technique (1). The salt was melted and the system evacuated or a slow stream of dry nitrogen was passed through the melt for 24 hr.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Potassium nitrate; KNO₃; [7757-79-1]

ORIGINAL MEASUREMENTS:
Peleg, M.

VARIABLES:
P/kPa = 4.00
one temperature: T/K = 610

EXPERIMENTAL VALUES:
The solubility of water in molten KNO₃ at a single temperature is:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁵ x₁/mol fraction mm⁻²</th>
</tr>
</thead>
<tbody>
<tr>
<td>337</td>
<td>0.20</td>
</tr>
</tbody>
</table>

PREPARED BY:
N. P. Bansal

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Voltammetric method.
The melt was obtained in a dry state by evacuation for a long time at a temperature above the experimental value. Water vapors at a known pressure were then allowed to enter the system and the melt stirred. The water concentration in the melt was determined by recording a voltammogram.

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:
The results are incorrect (authors).

REFERENCES:
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Potassium nitrate; KNO₃; [7757-79-1]

ORIGINAL MEASUREMENTS:
Pchelina, E. I.; Novozhilov, A. L.

VARIABLES:
T/K = 619 - 638
P/kPa = 6.666

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The solubility of water vapors in molten KNO₃ at two different temperatures are given as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10^5 x₁/mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>346</td>
<td>0.70 ± 0.04</td>
</tr>
<tr>
<td>365</td>
<td>0.51 ± 0.04</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
The method was based on the displacement of the dissolved water vapors with an inert gas. Details of the method are not available.

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:
solubility: ± 2% (authors)

REFERENCES:
COMPONENTS:

(1) Water; H₂O; [7732-18-5]
(2) Potassium nitrate; KNO₃; [7757-79-1]

ORIGINAL MEASUREMENTS:

Haug, H.; Albright, L. F.

VARIABLES:

P/kPa: 101.325 (1 atm.)
T/K = 608 & 633

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

The solubilities of water vapor at 1 atm. pressure in molten KNO₃ at two different temperatures are reported in graphical form only. The values derived from the graph by the compiler are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10² x₁/mol fraction atm⁻¹</th>
<th>10⁵ x₁/mol fraction torr⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>608</td>
<td>1.6</td>
<td>2.1</td>
</tr>
<tr>
<td>633</td>
<td>1.2</td>
<td>1.6</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stripping method. The melt was saturated with pure steam. The water dissolved in the melt was stripped with a stream of nitrogen and absorbed in tubes containing concentrated H₂SO₄.

SOURCE AND PURITY OF MATERIALS:

Not described.

ESTIMATED ERROR:

solubility: ± 2% (authors)

REFERENCES:
COMPONENTS:
(1) Water, \(\text{H}_2\text{O}; [7732-18-5]\)
(2) Cesium nitrate; \(\text{CsNO}_3; [7789-18-6]\)

VARIABLES:
\[P/\text{kPa} = 2.133 - 2.800\]
one temperature: \(T/K = 679\)

EXPERIMENTAL VALUES:
The solubility of water in molten \(\text{CsNO}_3\) under the water vapor pressure of 16 - 21 mm Hg is given as:

<table>
<thead>
<tr>
<th>(t/\degree\text{C})</th>
<th>(10^4 x_1/\text{mol fraction})</th>
</tr>
</thead>
<tbody>
<tr>
<td>405.74</td>
<td>9.2 \pm 1.0</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Cryoscopic method.
A modified version of the previously described (2) cryoscopic apparatus was used.
Nitrogen was employed as the carrier gas for water vapors.
Freezing point of the same melt sample was determined, first with pure nitrogen, and then with nitrogen containing known partial pressures of water. Solubility of water in the melt was calculated from the freezing point lowering.

SOURCE AND PURITY OF MATERIALS:
\(\text{CsNO}_3\) containing less than 0.1% of all impurities was dried for several days in air at 240\degree\text{C} and then by the thermal shock technique (1). The salt was melted and the system evacuated or a slow stream of dry nitrogen was passed through the melt for 24 hr.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
1. Rhodes, E.; Ubbelohde, A. R.
   Proc. Royal Soc. 1959, 251A, 156.
2. Rhodes, E.; Ubbelohde, A. R.
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Sodium nitrite; NaN₃; [7632-00-0]

ORIGINAL MEASUREMENTS:
Kozlowski, T. R.; Bartholomew, R. F.

VARIABLES:
water vapor pressure/mm Hg)
= 0.143 - 5.053

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The solubility of water in molten sodium nitrite at the freezing point of NaN₃ is given as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁵ x₁/mol fraction mm Hg⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>281.5°</td>
<td>8.0</td>
</tr>
</tbody>
</table>

* Freezing point of NaN₃.
The maximum solubility of water in sodium nitrite at 281.5°C was 31.4 x 10⁻⁴ mol fraction.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Cryoscopic method.
The diagram and details of the arrangement and procedure employed are given in the original paper.
Depression in the freezing point of sodium nitrite was measured at various vapor pressures of water above the melt. Freezing points were obtained using the cooling curve method.

SOURCE AND PURITY OF MATERIALS:
Baker's "Analyzed" reagent grade sodium nitrite was dried to constant weight in a vacuum oven at 110°C for 7 - 10 days.

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:

(1) Water; H₂O; [7732-18-5]
(2) Sodium chloride; NaCl; [7647-14-5]

ORIGINAL MEASUREMENTS:


VARIABLES:

P/kPa = 6.666
T/K = 1095 - 1265

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

Values of Henry's Law constant Kₜ (mol cm⁻³ atm⁻¹), for the solubility of water vapors, at various temperatures are given below. The data obeyed the equation:

\[-\log KₜR'T = \frac{\Delta H}{2.303RT} - \frac{\Delta S}{2.303R}\]

as the plot of -logKₜR'T against 1/T was linear. Here R and R' are the gas constants in JK⁻¹ mol⁻¹ and in cm³ atm⁻¹ K⁻¹ mol⁻¹, respectively and ΔH and ΔS are the changes in enthalpy and entropy caused by the introduction of water molecules in the melt.

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁻⁷ Kₜ/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>1095</td>
<td>127.4</td>
</tr>
<tr>
<td>1116</td>
<td>115.6</td>
</tr>
<tr>
<td>1174</td>
<td>94.7</td>
</tr>
<tr>
<td>1220</td>
<td>84.3</td>
</tr>
<tr>
<td>1265</td>
<td>74.4</td>
</tr>
</tbody>
</table>

Values of the thermodynamic parameters of the dissolution process, evaluated from linear least squares, are

- ΔH/kJ mol⁻¹ = 25.2
- ΔS/JK⁻¹ mol⁻¹ = 22.0

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method of purification of the salt and the experimental technique were the same as described elsewhere (1,2). Special care was taken to allow for possible hydrolysis effects on the measured solubility. The strong interaction between the dissolved water molecules and products of hydrolysis could lead to erroneously high solubilities. To suppress hydrolysis, hydrogen chloride was introduced into the vapor - gas mixture of the experiments (Ar - H₂O at P₁₂ = 50 mm Hg)

SOURCE AND PURITY OF MATERIALS:

Not specified.

ESTIMATED ERROR:

Not specified.

REFERENCES:

### COMPONENTS:
1. Water; H₂O; [7732-18-5]
2. Sodium chloride, NaCl; [7647-14-5]

### ORIGINAL MEASUREMENTS:
Bretsznajder, S.
Rocz. Chem. 1930, 10, 729 - 35.

### VARIABLES:
one temperature: T/K = 1023

### PREPARED BY:
N. P. Bansal

### EXPERIMENTAL VALUES:
Water reacted with molten NaCl according to the reaction, NaCl + H₂O = NaOH + HCl. The value of the equilibrium constant, $K_p$, for this reaction at 750°C is $1.6 \times 10^{-7}$, where $K_p$ is defined as:

$$K_p = \frac{P_{\text{HCl}} \times P_{\text{NaOH}}}{P_{\text{NaCl}} \times P_{\text{H}_2\text{O}}}$$

### AUXILIARY INFORMATION

#### METHOD/APPARATUS/PROCEDURE:
Equilibrium study.

#### SOURCE AND PURITY OF MATERIALS:
Not described.

#### ESTIMATED ERROR:
Nothing specified.

#### REFERENCES:
COMPONENTS:

(1) Water; H₂O; [7732-18-5]
(2) Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS:

VARIABLES:
P/kPa = 6.666
T/K = 1086 - 1222

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁷ Kₜ/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>1086</td>
<td>137.4</td>
</tr>
<tr>
<td>1098</td>
<td>132.1</td>
</tr>
<tr>
<td>1125</td>
<td>120.2</td>
</tr>
<tr>
<td>1170</td>
<td>108.3</td>
</tr>
<tr>
<td>1222</td>
<td>93.6</td>
</tr>
</tbody>
</table>

EXPERIMENTAL VALUES:

Values of Henry's Law constant Kₜ (mol cm⁻³ atm⁻¹), for the solubility of water vapors, at various temperatures are given below.

The data obeyed the equation:

- log KₜR'T = \frac{\Delta H}{2.303RT} - \frac{\Delta S}{2.303R}

as the plot of -logKₜR'T against 1/T was linear. Here R and R' are the gas constants in JK⁻¹mol⁻¹ and in cm³atm K⁻¹mol⁻¹, respectively and ΔH and ΔS are the changes in enthalpy and entropy caused by the introduction of water molecules in the melt.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method of purification of the salt and the experimental technique were the same as described elsewhere(1,2). Special care was taken to allow for possible hydrolysis effects on the measured solubility. The strong interaction between the dissolved water molecules and products of hydrolysis could lead to erroneously high solubilities. To suppress hydrolysis, hydrogen chloride was introduced into the vapor-gas mixture of the experiments (Ar - H₂O at Pₜ = 50mm Hg)

SOURCE AND PURITY OF MATERIALS:

Not specified.

ESTIMATED ERROR:

Not specified.

REFERENCES:

**COMPONENTS:**

1. Water; H$_2$O; [7732-18-5]
2. Rubidium chloride; RbCl; [7791-11-9]

**ORIGINAL MEASUREMENTS:**


**VARIABLES:**

\[ P/kPa = 6.666 \]
\[ T/K = 1026 - 1198 \]

**PREPARED BY:**

N. P. Bansal

**EXPERIMENTAL VALUES:**

Values of Henry's Law constant \( K_H \) (mol cm\(^{-3}\) atm\(^{-1}\)), for the solubility of water vapors, at various temperatures are given below. The data obeyed the equation:

\[
-\log K_R'R'T = \frac{\Delta H}{2.303RT} - \frac{\Delta S}{2.303R}
\]

as the plot of \(-\log K_R'R'T\) against \(1/T\) was linear. Here \( R \) and \( R' \) are the gas constants in J K\(^{-1}\) mol\(^{-1}\) and in cm\(^3\) atm K\(^{-1}\) mol\(^{-1}\), respectively and \( \Delta H \) and \( \Delta S \) are the changes in enthalpy and entropy caused by the introduction of HCl molecules in the melt.

<table>
<thead>
<tr>
<th>( T/K )</th>
<th>( 10^7 K_H/mol \text{ cm}^{-3} \text{ atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1026</td>
<td>171.8</td>
</tr>
<tr>
<td>1075</td>
<td>151.6</td>
</tr>
<tr>
<td>1124</td>
<td>136.3</td>
</tr>
<tr>
<td>1161</td>
<td>126.3</td>
</tr>
<tr>
<td>1198</td>
<td>109.2</td>
</tr>
</tbody>
</table>

Values of the thermodynamic parameters of the dissolution process, evaluated from linear least squares, are

\(-\Delta H/\text{kJ mol}^{-1} = 16.2\)

\(-\Delta S/\text{JK}^{-1} \text{ mol}^{-1} = 12.6\)

**METHOD/APPARATUS/PROCEDURE:**

The method of purification of the salt and the experimental technique were the same as described elsewhere (1,2). Special care was taken to allow for possible hydrolysis effects on the measured solubility. The strong interaction between the dissolved water molecules and products of hydrolysis could lead to erroneously high solubilities. To suppress hydrolysis, hydrogen chloride was introduced into the vapor - gas mixture of the experiments (Ar - H$_2$O at P$_{H_2}$ = 50 mm Hg)

**SOURCE AND PURITY OF MATERIALS:**

Not specified.

**AUXILIARY INFORMATION**

**ESTIMATED ERROR:**

Not specified.

**REFERENCES:**


COMPONENTS:

(1) Water; H₂O; [7732-18-5]
(2) Cesium chloride; CsCl; [7647-17-8]

ORIGINAL MEASUREMENTS:


VARIABLES:

P/kPa = 6.666
T/K = 974 - 1173

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

Values of Henry's Law constant Kₘ (mol cm⁻³ atm⁻¹), for the solubility of water vapors, at various temperatures are given below. The data obeyed the equation:

\[
- \log KₘR'T = \frac{ΔH}{2.303RT} - \frac{ΔS}{2.303R}
\]

as the plot of \(-\log KₘR'T\) against \(1/T\) was linear. Here R and R' are the gas constants in \(\text{JK}^{-1}\text{mol}^{-1}\) and in \(\text{cm}^3\text{atm K}^{-1}\text{mol}^{-1}\), respectively and \(ΔH\) and \(ΔS\) are the changes in enthalpy and entropy caused by the introduction of water molecules in the melt.

<table>
<thead>
<tr>
<th>T/K</th>
<th>(10^7 Kₘ/\text{mol cm}^{-3} \text{atm}^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>974</td>
<td>195.2</td>
</tr>
<tr>
<td>1023</td>
<td>178.4</td>
</tr>
<tr>
<td>1078</td>
<td>159.1</td>
</tr>
<tr>
<td>1124</td>
<td>147.1</td>
</tr>
<tr>
<td>1173</td>
<td>134.9</td>
</tr>
</tbody>
</table>

Values of the thermodynamic parameters of the dissolution process, evaluated from linear least-squares, are

\[-ΔH/\text{kJ mol}^{-1} = 8.8\]
\[-ΔS/\text{JK}^{-1}\text{mol}^{-1} = 5.3\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method of purification of the salt and the experimental technique were the same as described elsewhere(1,2). Special care was taken to allow for possible hydrolysis effects on the measured solubility. The strong interaction between the dissolved water molecules and products of hydrolysis could lead to erroneously high solubilities. To suppress hydrolysis, hydrogen chloride was introduced into the vapor - gas mixture of the experiments (Ar - H₂O at P_H₂O = 50mm Hg)

SOURCE AND PURITY OF MATERIALS:

Not specified.

ESTIMATED ERROR:

Not specified.

REFERENCES:

COMPONENTS:

(1) Water; H$_2$O; [7732-18-5]
(2) Sodium Bromide; NaBr; [7647-15-6]

VARIABLES:

\[ \frac{T}{K} = 1053 - 1220 \]

EXPERIMENTAL VALUES:

Solubility of water in the melt was directly proportional to its partial pressure in the gaseous mixture indicating the applicability of Henry's law under the experimental conditions. Henry's Law constants $K_H$ (mole cm$^{-3}$ atm$^{-1}$) at various temperatures, measured at $P_{H_2O} = 187.5$ mm Hg, are given below.

The data obeyed the equation:

\[
\log K_H R' T = \frac{-\Delta H^0}{2.303RT} + \frac{\Delta S^0}{2.303R}
\]

where $R$ and $R'$ are the gas constants in JK$^{-1}$mol$^{-1}$ and in cm$^3$ atm K$^{-1}$ mol$^{-1}$, respectively and $\Delta H^0$ and $\Delta S^0$ are the standard enthalpy and entropy changes accompanying the transfer of 1 mole of water vapors from the gas phase to the bromide melt.

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^7 K_H$/mol cm$^{-3}$ atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1053</td>
<td>187.1</td>
</tr>
<tr>
<td>1097</td>
<td>152.7</td>
</tr>
<tr>
<td>1132</td>
<td>138.9</td>
</tr>
<tr>
<td>1181</td>
<td>113.6</td>
</tr>
<tr>
<td>1220</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Values of the thermodynamic parameters are:

\[-\Delta H^0$/kJ mol$^{-1} = 30.9 \]
\[-\Delta S^0$/JK$^{-1}$ mol$^{-1} = 25.3\]

METHOD/APPARATUS/PROCEDURE:

Water solubility was determined by a procedure involving displacement by an inert gas, as described earlier(1).

A gaseous mixture of H$_2$O + Ar($P_{H_2O} = 50 - 200$ mm Hg) was bubbled through the melt. To prevent hydrolysis of the melt, HBr was introduced into the gas mixture to a partial pressure of 15 mm Hg.

SOURCE AND PURITY OF MATERIALS:

"Chemically pure" or "analytical grade salt was recrystallized twice from doubly distilled water, dried in vacuum at a steadily increasing temperature and then fused. The last operations were repeated twice immediately before the measurements. HBr was prepared as described earlier(2), and was sublimed in vacuum at liquid nitrogen temperature.

ESTIMATED ERROR:

Solubility = 3 - 5% (authors)

REFERENCES:

**COMPONENTS:**

(1) Water; H_2O; [7732-18-5]

(2) Potassium Bromide; KBr; [7758-02-3]

**ORIGINAL MEASUREMENTS:**

Novozhilov, A. L.

**VARIABLES:**

\[ T/K = 1041 - 1211 \]

**PREPARED BY:**

N. P. Bansal

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**EXPERIMENTAL VALUES:**

Solubility of water in the melt was directly proportional to its partial pressure in the gaseous mixture indicating the applicability of Henry's law under the experimental conditions. Henry's Law constants \( K_H \) (mole cm\(^{-3}\)atm\(^{-1}\)) at various temperatures, measured at PH\(_0\) = 187.5mm Hg, are given below.

The data obeyed the equation

\[
\log K_H R' T = \frac{-\Delta H^o}{2.303RT} + \frac{\Delta S^o}{2.303R}
\]

where \( R \) and \( R' \) are the gas constants in JK\(^{-1}\)mol\(^{-1}\) and in cm\(^3\)atm K\(^{-1}\)mol\(^{-1}\), respectively and \( \Delta H^o \) and \( \Delta S^o \) are the standard enthalpy and entropy changes accompanying the transfer of 1 mole of water vapors from the gas phase to the bromide melt.

<table>
<thead>
<tr>
<th>T/K</th>
<th>( 10^7 K_H /\text{mol cm}^{-3} \text{ atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1041</td>
<td>206.9</td>
</tr>
<tr>
<td>1086</td>
<td>183.3</td>
</tr>
<tr>
<td>1123</td>
<td>162.9</td>
</tr>
<tr>
<td>1176</td>
<td>129.0</td>
</tr>
<tr>
<td>1211</td>
<td>115.9</td>
</tr>
</tbody>
</table>

Values of the thermodynamic parameters are:

\(- \Delta H^o / \text{kJ mol}^{-1} = 26.0\)

\(- \Delta S^o / \text{JK}^{-1} \text{mol}^{-1} = 20.3\)

**Auxiliary Information**

**METHOD/APPARATUS/PROCEDURE:**

Water solubility was determined by a procedure involving displacement by an inert gas, as described earlier(1). A gaseous mixture of H\(_2\)O + Ar(P\(_H_2O\) = 50 - 200mm Hg) was bubbled through the melt.

To prevent hydrolysis of the melt, HBr was introduced into the gas mixture to a partial pressure of 15mm Hg.

**SOURCE AND PURITY OF MATERIALS:**

"Chemically pure" or "analytical grade salt was recrystallized twice from doubly distilled water, dried in vacuum at a steadily increasing temperature and then fused. The last two operations were repeated twice immediately before the measurements.

HBr was prepared as described earlier(2), and was sublimed in vacuum at liquid nitrogen temperature.

**ESTIMATED ERROR:**

Solubility = 3-5 % (authors)

**REFERENCES:**

1. Pchelina, E. I.; Novozhilov, A. L.
2. Muller, G.; Gnauk, G.
COMPONENTS:

(1) Water; H$_2$O; [7732-18-5]
(2) Rubidium Bromide; RbBr; [7789-39-1]

VARIABLES:

T/K = 1001 - 1204

EXPERIMENTAL VALUES:

Solubility of water in the melt was directly proportional to its partial pressure in the gaseous mixture indicating the applicability of Henry's law under the experimental conditions. Henry's Law constants $K_m$ mole cm$^{-3}$ atm$^{-1}$) at various temperatures, measured at P$_{H_2O}$ = 187.5 mm Hg, are given below.

The data obeyed the equation:

$$\log K_m R'T = \frac{-\Delta H^o}{2.303RT} + \frac{\Delta S^o}{2.303R}$$

where $R$ and $R'$ are the gas constants in JK$^{-1}$mol$^{-1}$ and in cm$^3$atm K$^{-1}$mol$^{-1}$, respectively and $\Delta H^o$ and $\Delta S^o$ are the standard enthalpy and entropy changes accompanying the transfer of 1 mole of water vapors from the gas phase to the bromide melt.

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^7 K_m$/mol cm$^{-3}$ atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1001</td>
<td>241.1</td>
</tr>
<tr>
<td>1043</td>
<td>208.9</td>
</tr>
<tr>
<td>1118</td>
<td>165.4</td>
</tr>
<tr>
<td>1177</td>
<td>140.1</td>
</tr>
<tr>
<td>1204</td>
<td>130.5</td>
</tr>
</tbody>
</table>

Values of the thermodynamic parameters are:

- $\Delta H^o$/kJ mol$^{-1}$ = 21.2
- $\Delta S^o$/JK$^{-1}$ mol$^{-1}$ = 15.5

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Water solubility was determined by a procedure involving displacement by an inert gas, as described earlier(1). A gaseous mixture of H$_2$O + Ar (P$_{H_2O}$ = 50 - 200 mm Hg) was bubbled through the melt.

To prevent hydrolysis of the melt, HBr was introduced into the gas mixture to a partial pressure of 15 mm Hg.

SOURCE AND PURITY OF MATERIALS:

"Chemically pure" or "analytical grade salt was recrystallized twice from doubly distilled water, dried in vacuum at a steadily increasing temperature and then fused. The last two operations were repeated twice immediately before the measurements.

HBr was prepared as described earlier(2), and was sublimed in vacuum at liquid nitrogen temperature.

ESTIMATED ERROR:

Solubility = 3-5 % (authors)

REFERENCES:

COMPONENTS:

(1) Water; H₂O; [7732-18-5]
(2) Cesium Bromide; CsBr; [7787-69-1]

VARIABLES:

\[ T/K = 923 - 1173 \]

EXPERIMENTAL VALUES:

Solubility of water in the melt was directly proportional to its partial pressure in the gaseous mixture indicating the applicability of Henry's law under the experimental conditions. Henry's Law constants \( K_H \) mol cm⁻³ atm⁻¹ at various temperatures, measured at \( P_{H_2O} = 187.5 \text{mm Hg} \), are given below.

The data obeyed the equation:

\[
\log K_H R' T = \frac{-\Delta H^\circ}{2.303RT} + \frac{\Delta S^\circ}{2.303R}
\]

where \( R \) and \( R' \) are the gas constants in \( \text{JK}^{-1}\text{mol}^{-1} \) and in \( \text{cm}^3\text{atm}^{-1}\text{mol}^{-1} \), respectively and \( \Delta H^\circ \) and \( \Delta S^\circ \) are the standard enthalpy and entropy changes accompanying the transfer of 1 mole of water vapors from the gas phase to the bromide melt.

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁷ K_H/mol cm⁻³ atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>923</td>
<td>318.7</td>
</tr>
<tr>
<td>981</td>
<td>289.0</td>
</tr>
<tr>
<td>1027</td>
<td>225.0</td>
</tr>
<tr>
<td>1108</td>
<td>178.3</td>
</tr>
<tr>
<td>1173</td>
<td>150.9</td>
</tr>
</tbody>
</table>

Values of the thermodynamic parameters are:

\[
-\frac{\Delta H^\circ}{\text{kJ mol}^{-1}} = 18.3
\]

\[
-\frac{\Delta S^\circ}{\text{JK}^{-1}\text{mol}^{-1}} = 12.5
\]

METHOD/APPARATUS/PROCEDURE:

Water solubility was determined by a procedure involving displacement by an inert gas, as described earlier. A gaseous mixture of \( H_2O + Ar(P_{H_2O} = 50 - 200 \text{mm Hg}) \) was bubbled through the melt. To prevent hydrolysis of the melt, \( HBr \) was introduced into the gas mixture to a partial pressure of 15mm Hg.

SOURCE AND PURITY OF MATERIALS:

"Chemically pure" or "analytical grade salt was recrystallized twice from doubly distilled water, dried in vacuum at a steadily increasing temperature and then fused. The last two operations were repeated twice immediately before the measurements. \( HBr \) was prepared as described earlier, and was sublimed in vacuum at liquid nitrogen temperature.

ESTIMATED ERROR:

Solubility = 3-5 % (authors)

REFERENCES:

COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Lithium perchlorate; LiClO₄; [7791-03-9]

ORIGINAL MEASUREMENTS:
Duke, F. R.; Doan, Jr., A. S.

VARIABLES:
T/K = 513 - 563
P/kPa = 7.999 (max)

EXPERIMENTAL VALUES:

The solubility of water vapor was a linear function of its pressure. The solubility of water vapors in molten LiClO₄ at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁶ x₁/mol(mol of Li⁺)-¹ mm of Hg⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>240</td>
<td>54.9</td>
</tr>
<tr>
<td>260</td>
<td>28.5</td>
</tr>
<tr>
<td>290</td>
<td>20.2</td>
</tr>
</tbody>
</table>

Smoothed Data:
The temperature dependence of x₁ can be expressed by the relation:

\[ \log(x₁/\text{mol(mol of Li⁺)}^{-1} \text{ mm Hg}^{-1}) = -9.067 + 2447.3/(T/K) \] (compiler)

std. dev. = 8.2% (compiler)

The enthalpy of solution, ΔH, for the solubility of water vapors is:

\[ \Delta H / \text{kJ mol}^{-1} = -37.66 \pm 14.6 \]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Manometric method. 
Water vapors at the desired pressure were introduced into the apparatus above the molten salt. The fall in pressure, due to the solubility of water vapors in the melt, was measured as a function of time until the equilibrium was attained. The amount of water dissolved in the melt was evaluated from the initial and final values of the pressure.

SOURCE AND PURITY OF MATERIALS:
Not described.
About 10 g of the salt was taken and vacuum dried. The temperature was raised slowly above the melting point and brought to the working temperature. Evacuation of the melt was continued for several hours to ensure complete drying.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Sodium hydroxide; NaOH; [1310-73-2]

ORIGINAL MEASUREMENTS:
Hoyt, E. B.

VARIABLES:
T/K = 630 - 688
P/kPa = 1.013 - 59.595

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
Solubilities of water, C₅₅₀ (wt%), in molten NaOH measured at three different temperatures under various vapor pressures of water, P₅₅₀ (mm of Hg), in molten NaOH are given below:

<table>
<thead>
<tr>
<th>Temperature °C</th>
<th>PH₂O/mm Hg</th>
<th>CH₂O/wt%</th>
</tr>
</thead>
<tbody>
<tr>
<td>367°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>147</td>
<td>0.528</td>
<td></td>
</tr>
<tr>
<td>136.7</td>
<td>0.500</td>
<td></td>
</tr>
<tr>
<td>127.1</td>
<td>0.474</td>
<td></td>
</tr>
<tr>
<td>123.0</td>
<td>0.450</td>
<td></td>
</tr>
<tr>
<td>117.7</td>
<td>0.426</td>
<td></td>
</tr>
<tr>
<td>110.7</td>
<td>0.404</td>
<td></td>
</tr>
<tr>
<td>100.6</td>
<td>0.386</td>
<td></td>
</tr>
<tr>
<td>99.7</td>
<td>0.366</td>
<td></td>
</tr>
<tr>
<td>92.3</td>
<td>0.347</td>
<td></td>
</tr>
<tr>
<td>84.8</td>
<td>0.321</td>
<td></td>
</tr>
<tr>
<td>80.8</td>
<td>0.316</td>
<td></td>
</tr>
<tr>
<td>75.8</td>
<td>0.295</td>
<td></td>
</tr>
<tr>
<td>67.1</td>
<td>0.269</td>
<td></td>
</tr>
<tr>
<td>60.4</td>
<td>0.241</td>
<td></td>
</tr>
<tr>
<td>52.0</td>
<td>0.212</td>
<td></td>
</tr>
<tr>
<td>44.7</td>
<td>0.183</td>
<td></td>
</tr>
<tr>
<td>36.3</td>
<td>0.155</td>
<td></td>
</tr>
<tr>
<td>31.6</td>
<td>0.129</td>
<td></td>
</tr>
</tbody>
</table>

| 390°C          |             |           |
| 147            | 0.830       |           |
| 136.7          | 0.772       |           |
| 127.1          | 0.720       |           |
| 123.0          | 0.678       |           |
| 117.7          | 0.640       |           |
| 110.7          | 0.607       |           |
| 100.6          | 0.565       |           |
| 99.7           | 0.532       |           |
| 92.3           | 0.496       |           |
| 84.8           | 0.466       |           |
| 80.8           | 0.433       |           |
| 75.8           | 0.397       |           |
| 67.1           | 0.364       |           |
| 60.4           | 0.310       |           |
| 52.0           | 0.287       |           |
| 44.7           | 0.222       |           |
| 36.3           | 0.187       |           |
| 31.6           | 0.129       |           |

| 415°C          |             |           |
| 147            | 0.774       |           |
| 136.7          | 0.715       |           |
| 127.1          | 0.660       |           |
| 123.0          | 0.607       |           |
| 117.7          | 0.558       |           |
| 110.7          | 0.513       |           |
| 100.6          | 0.473       |           |
| 99.7           | 0.438       |           |
| 92.3           | 0.402       |           |
| 84.8           | 0.362       |           |
| 80.8           | 0.324       |           |
| 75.8           | 0.289       |           |
| 67.1           | 0.258       |           |
| 60.4           | 0.231       |           |
| 52.0           | 0.207       |           |
| 44.7           | 0.179       |           |
| 36.3           | 0.147       |           |
| 31.6           | 0.117       |           |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
A gas saturation method was used for measurement of the solubility of water under various vapor pressures of water in the gas phase. For details of the apparatus and the procedure used, see the original publication.

SOURCE AND PURITY OF MATERIALS:
Sodium hydroxide (97.6%) of commercial grade having = 2.4% total impurities on a dry basis (Na₂CO₃, 1.0; NaCl, 0.4; Na₂SO₄, 0.3; and Na₂SiO₃, 0.7%) was used.

ESTIMATED ERROR:
Not specified.

REFERENCES:
1. Al-Muslih, E.; Iredale, P. J.; Maund, J. K.
COMPONENTS:

(1) Water; H$_2$O; [7732-18-5]
(2) Sodium hydroxide; NaOH; [1310-73-2]

VARIABLES:

T/K = 630 - 688
P/kPa = 1.013 - 59.595

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>$P_{H_2O}$/mm Hg</th>
<th>$C_{H_2O}$/wt%</th>
<th>$P_{H_2O}$/mm Hg</th>
<th>$C_{H_2O}$/wt%</th>
<th>$P_{H_2O}$/mm Hg</th>
<th>$C_{H_2O}$/wt%</th>
</tr>
</thead>
<tbody>
<tr>
<td>21.3</td>
<td>0.087</td>
<td>59.7</td>
<td>0.187</td>
<td>39.5</td>
<td>0.089</td>
</tr>
<tr>
<td>11.5</td>
<td>0.045</td>
<td>44.6</td>
<td>0.149</td>
<td>28.6</td>
<td>0.063</td>
</tr>
<tr>
<td>7.6</td>
<td>0.031</td>
<td>31.1</td>
<td>0.114</td>
<td>13.7</td>
<td>0.033</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24.0</td>
<td>0.083</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>16.7</td>
<td>0.058</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10.6</td>
<td>0.037</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From the above data, Al-Muslih(1) et. al, determined Henry's Law constants ($\text{atm mol}^{-1} \text{Kg}$) at 367 and 415°C to be 0.63 and 1.20.

REFERENCES:


PREPARED BY:

N. P. Bansal
**COMPONENTS:**

1. Water; H₂O; [7732-18-5]
2. Sodium hydroxide; NaOH; [1310-73-2]

**ORIGINAL MEASUREMENTS:**


**VARIABLES:**

\[ T/K = 623 - 773 \]

no information on pressure

**EXPERIMENTAL VALUES:**

Temperature dependence of the Henry's law constant \( k \) in \( mg \cdot g^{-1} \cdot Torr^{-1} \) for the solubility of water in molten NaOH is given as:

\[
\log k = -6.54 + \frac{3210}{T}
\]

Where \( T \) is the temperature in kelvin.

The above results have also been expressed[1] as:

\[
\log K = 4.88 - \frac{3210}{T}
\]

Where \( K \) is the Henry's law constant in \( atm \cdot mol^{-1} \cdot kg \), and \( T \) is the temperature in kelvin.

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Gravimetry.

The amount of water dissolved in the melt was measured as a function of vapor pressure of water in the gas phase.

**SOURCE AND PURITY OF MATERIALS:**

**ESTIMATED ERROR:**

**REFERENCES:**

COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Lithium nitrate; LiNO₃; [7790-69-4]
(3) Sodium nitrate; NaNO₃; [7631-99-4]

VARIABLES:
T/K = 503 - 553
P/kPa = 0.667 - 4.000
melt comp./mol% LiNO₃ = 25 - 75

EXPERIMENTAL VALUES:
The solubility of water vapors in molten LiNO₃ - NaNO₃ mixtures of various compositions at different temperatures are:

<table>
<thead>
<tr>
<th>Melt Composition/mol% LiNO₃</th>
<th>230</th>
<th>265</th>
<th>280</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>-</td>
<td>8.4</td>
<td>6.4</td>
</tr>
<tr>
<td>50</td>
<td>24.2</td>
<td>11.0</td>
<td>8.1</td>
</tr>
<tr>
<td>75</td>
<td>35.4</td>
<td>16.5</td>
<td>11.8</td>
</tr>
</tbody>
</table>

Smoothed Data:
The temperature dependence of x₁ in molten LiNO₃ - NaNO₃ mixtures containing 50 and 75 mol% LiNO₃ are expressed, by the equations:

50 mol% LiNO₃: log(x₁/mol frac. torr⁻¹) = -8.871 + 2645/(T/K) (compiler)
75 mol% LiNO₃: log(x₁/mol frac. torr⁻¹) = -8.687 + 2636/(T/K) (compiler)

The heat of solution, ΔH, in both melts is estimated to be:

ΔH/kJ mol⁻¹ = -50.5 (compiler)

METHOD/APPARATUS/PROCEDURE:
Gravimetric method.
A crucible containing 3 - 5 g of the salt mixture is placed on the balance and the system evacuated. The temperature of the salt is raised slowly beyond its melting point and set to the working temperature. The melt is kept under high vacuum for many hours. The vacuum is disconnected and water vapors are allowed to enter the system to a definite pressure. After equilibrium is attained, the salt is weighed again. The increase in weight directly gives the amount of water dissolved in the melt.

REFERENCES:
Bertozzi, G.

PREPARED BY:
N. P. Bansal
COMPONENTS:

(1) Water; H₂O; [7732-18-5]
(2) Lithium nitrate; LiNO₃; [7790-69-4]
(3) Potassium nitrate; KNO₃; [7757-79-1]

EVALUATOR:

N. P. Bansal
National Aeronautics and Space Administration.
Lewis Research Center
Cleveland, Ohio, 44135, U.S.A.
December, 1989.

CRITICAL EVALUATION:

Four investigations have been reported (1 - 4) for the solubility of water in molten LiNO₃ - KNO₃. Aganesova et al. (4) have used polarography which is not a very reliable method for solubility determinations. Also, their values are not in line with the other studies (1 - 3) and are rejected.

Bertozzi (3) has carried out measurements in three melt compositions, containing 25, 50 and 75 mol% LiNO₃, using a gravimetric method. His results for equimolar melt composition are in excellent agreement with those reported by Tripp et al. (1,2) who employed an indirect technique of vapor pressure measurements.

The recommended numerical values for the equimolar melt composition, based on the data sets of refs. (1 - 3), are given in Table 1 and also shown in Fig. 1. Tentative values for solubilities in melts containing 25 and 75 mol% LiNO₃ are also presented in Fig. 1.

Table 1
Recommended Solubilities in Equimolar LiNO₃ - KNO₃ Melt as a Function of Temperature

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁴ xₛ/mol fraction torr⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>380</td>
<td>45.0</td>
</tr>
<tr>
<td>400</td>
<td>22.5</td>
</tr>
<tr>
<td>420</td>
<td>12.0</td>
</tr>
<tr>
<td>440</td>
<td>6.8</td>
</tr>
<tr>
<td>460</td>
<td>4.0</td>
</tr>
<tr>
<td>480</td>
<td>2.5</td>
</tr>
<tr>
<td>500</td>
<td>1.6</td>
</tr>
<tr>
<td>520</td>
<td>1.1</td>
</tr>
<tr>
<td>540</td>
<td>0.74</td>
</tr>
</tbody>
</table>

References:
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Lithium nitrate; LiNO₃; [7790-69-4]
(3) Potassium nitrate; KNO₃; [7757-79-1]

CRITICAL EVALUATION:

EVALUATOR:
N. P. Bansal
National Aeronautics and Space Administration
Lewis Research Center
Cleveland, Ohio, 44135, U.S.A.
December, 1989.

-2.0
-2.5
-3.0
-3.5
-4.0

log[X₁ / mol fraction torr⁻¹]

1 25 mol % LiNO₃
2 50 mol % LiNO₃
3 75 mol % LiNO₃

Fig. 1

1.8 2.0 2.2 2.4 2.6 2.8
10³K/T
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Lithium nitrate; LiNO₃; [7790-69-4]
(3) Potassium nitrate; KNO₃; [7757-79-1]

VARIABLES:
T/K = 392 - 423
melt comp./mol% LiNO₃ = 50.0
P/kPa: 101.325 (compiler)

EXPERIMENTAL VALUES:
The solubilities of water in the molten mixture LiNO₃ - KNO₃ (50 - 50 mol%) have been reported in the temperature range 392 - 423 K in the form of a linear graph.

The values of \( x_1 \) derived from the graph at different temperatures by the compiler are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>( 10^4 x_1/\text{mol(mol of NO}_3^-)\text{-1 torr}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>392</td>
<td>29.6</td>
</tr>
<tr>
<td>403</td>
<td>20.5</td>
</tr>
<tr>
<td>413</td>
<td>15.1</td>
</tr>
<tr>
<td>423</td>
<td>10.9</td>
</tr>
</tbody>
</table>

Smoothed Data:
The temperature dependence of \( K_w \) can be expressed by the equation:

\[
\log\left( x_1/\text{mol(mol of NO}_3^-)\text{-1 torr}^{-1} \right) = -8.416 + \frac{2308}{(T/K)} \quad (\text{compiler})
\]

std. dev. = 0.5% (compiler)

The enthalpy of solution, \( \Delta H \), is given as:

\[
\Delta H/\text{kJ mol}^{-1} = -43.1 \pm 0.84
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Vapor pressure measurements.
The solubility data have been indirectly derived from vapor pressure measurements of the system LiNO₃ - KNO₃ - H₂O using a differential transpiration method.

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
Tripp, T. B.; Braunstein, J.
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Lithium nitrate; LiNO₃; [7790-69-4]
(3) Potassium nitrate; KNO₃; [7757-79-1]

ORIGINAL MEASUREMENTS:
Tripp, T. B.

VARIABLES:
T/K = 383 - 423
melt comp./mol% LiNO₃ = 50.0
P/kPa: 101.325 (compiler)

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:

The solubilities of water in molten LiNO₃ - KNO₃ (50 - 50 mol%) mixture at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁴ x₁/mol fraction torr⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>383.15</td>
<td>40.1</td>
</tr>
<tr>
<td>392.15</td>
<td>29.3</td>
</tr>
<tr>
<td>402.15</td>
<td>20.5</td>
</tr>
<tr>
<td>413.15</td>
<td>14.8</td>
</tr>
<tr>
<td>423.15</td>
<td>10.9</td>
</tr>
</tbody>
</table>

Smoothed Data:
The temperature dependence of Kₓ can be expressed by the relation:

\[
\log(x₁/mol fraction torr⁻¹) = -8.376 + 2291/(T/K) \quad \text{(compiler)}
\]

std. dev. = 0.14% (compiler)

The enthalpy of solution, ΔH, is:

\[
\Delta H/kJ mol⁻¹ = -43.9 ± 0.4
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Vapor pressure measurements. The solubilities of water have been indirectly derived from vapor pressure measurements of LiNO₃ - KNO₃ - H₂O system using a differential transpiration method described elsewhere (1).

SOURCE AND PURITY OF MATERIALS:
Lithium and potassium nitrates, Mallinckrodt AR grade, were dried at 520 K.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
1. Tripp, T. B.; Braunstein, J.
COMPONENTS:
(1) Water; H_2O; [7732-18-5]
(2) Lithium nitrate; LiNO_3; [7790-69-4]
(3) Potassium nitrate; KNO_3; [7757-79-1]

VARIABLES:
T/K = 402.1
Melt composition/mol Li^+ per mol NO_3^- = 0.4493 - 0.7000

EXPERIMENTAL VALUES:
Vapor pressures of LiNO_3 - KNO_3 - H_2O melts over a wide range of water concentrations and melt compositions have been measured at 129.51°C. The water mole ratio, R_H (mol H_2O/mol NO_3^-), was varied from 0.2 to 1.0 mol H_2O/mol NO_3^- and the salt mole fraction, R_L (mol Li^+/mol NO_3^-), was varied from 0.4493 to 0.7000 mol Li^+/mol NO_3^-.

The results can be expressed in terms of the relation:

P = A + B R_H

Where P is the vapor pressure in torr, and A and B are constants. Values of the coefficients A and B for various melt compositions expressed in terms of R_L are given below:

<table>
<thead>
<tr>
<th>R_L/mol Li^+ per mol NO_3^-</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.45</td>
<td>2.68</td>
<td>524.8</td>
</tr>
<tr>
<td>0.50</td>
<td>-1.24</td>
<td>491.3</td>
</tr>
<tr>
<td>0.55</td>
<td>-4.94</td>
<td>453.9</td>
</tr>
<tr>
<td>0.60</td>
<td>-10.35</td>
<td>418.9</td>
</tr>
<tr>
<td>0.65</td>
<td>-11.96</td>
<td>392.1</td>
</tr>
<tr>
<td>0.70</td>
<td>-12.8</td>
<td>359.5</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
A differential transpiration method, details of which have been described previously(1,2), was used for measurements of the vapor pressure of water.

SOURCE AND PURITY OF MATERIALS:
LiNO_3 and KNO_3 both from Mallinckrodt (AR grade) were finely ground, dried for 24h. at 150°C and stored over anhydrous magnesium perchlorate.

ESTIMATED ERROR:
Not specified.

REFERENCES:
COMPONENTS:

(1) Water; H₂O; [7732-18-5]
(2) Lithium nitrate; LiNO₃; [7790-69-4]
(3) Potassium nitrate; KNO₃; [7757-79-1]

ORIGINAl MEASUREMENTS:

Bertozzi, G.

VARIABLES:

T/K = 503 - 538
P/kPa = 0.667 - 4.000
water vapor pressure/torr = 5 - 30

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

The solubilities of water vapors in molten LiNO₃ - KNO₃ mixtures of different compositions at two different temperatures are:

<table>
<thead>
<tr>
<th>melt composition/mol% LiNO₃</th>
<th>230</th>
<th>265</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>9.9</td>
<td>5.4</td>
</tr>
<tr>
<td>50</td>
<td>16.2</td>
<td>8.2</td>
</tr>
<tr>
<td>75</td>
<td>27.8</td>
<td>13.7</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gravimetric method.
A crucible containing 3 - 5 g of the salt mixture is placed on the balance and the system evacuated. The temperature of the salt is raised slowly beyond its melting point and set to the desired temperature. The melt is kept under high vacuum for many hours. The vacuum is disconnected and water vapors are allowed to enter the system to a definite pressure. After equilibrium is reached, the salt is weighed again. The increase in weight directly gives the amount of water dissolved in the melt.

SOURCE AND PURITY OF MATERIALS:

Not described.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Lithium nitrate; LiNO₃; [7790-69-4]
(3) Potassium nitrate; KNO₃; [7757-79-1]

ORIGINAL MEASUREMENTS:
Aganesova, S. B.; Ladani, P.; Yurkinskii, V. P.; Morachevskii, A. G.

ORIGINAL MEASUREMENTS:

VARIABLES:
T/K = 420 - 603
P/kPa = 2.026

EXPERIMENTAL VALUES:
The solubility of water in the molten eutectic LiNO₃ - KNO₃ has been studied in the temperature range 420 - 603 K. Henry's law was obeyed only in the temperature interval 513 - 603 K and the results have been reported in the form of a plot. Values of solubility derived from the plot at some experimental temperatures, by the compiler, are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10^5 x₁/mol fraction torr⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>516</td>
<td>34.7</td>
</tr>
<tr>
<td>542</td>
<td>17.4</td>
</tr>
<tr>
<td>559</td>
<td>14.3</td>
</tr>
<tr>
<td>585</td>
<td>8.5</td>
</tr>
<tr>
<td>606</td>
<td>7.4</td>
</tr>
</tbody>
</table>

Some results are also reported for the water concentration in the melt saturated with water in the temperature range 420 - 463 K. However, for these solubilities the water content in the vapor phase is not known.

Smoothed Data:
The temperature dependence of x₁ is expressed by the relation:

\[
\log(x₁/mol \text{ fraction } \text{torr}^{-1}) = -8.052 + 2351/(T/K) \quad (\text{compiler})
\]

std. dev. = 4.6% (compiler)

The enthalpy of solution, ΔH, in the temperature range 513 - 603 K is:

\[
\Delta H/\text{kJ mol}^{-1} = -43.9
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Voltammetric method.
A known amount of the mixed salt was fused and dried by bubbling dry nitrogen through the melt for one hour. The melt was saturated with water by sparging it with nitrogen saturated with vapor (water vapor pressure = 15.20 torr). Then the voltammogram was recorded. The method of standard additions was employed for determining the amount of water present in the melt corresponding to the wave height recorded. The additive used was (NH₄)₂CO₃.H₂O.

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
Three studies (1 - 3) are available for the solubility of water in molten NaNO₃ - KNO₃. Haug and Albright (3) used the melt composition containing 54.3 mol% NaNO₃. The results of the other two investigations, which employed equimolar melts, are compared in Fig. 1. It may be noted that the results of White and Twardoch (2), obtained by using the cyclic voltammetric technique, are in reasonable agreement with those of Zambonin et al. (1) who employed the pressure measuring technique.

---

**Fig. 1**

- **ref. (1)**
- **ref. (2)**
COMPONENTS:

(1) Water; H$_2$O; [7732-18-5]
(2) Sodium nitrate; NaNO$_3$; [7631-99-4]
(3) Potassium nitrate; KNO$_3$; [7757-79-1]

CRITICAL EVALUATION:

The recommended values, obtained from the two data sets (1,2), in the equimolar melt are given in Table 1:

Table 1
Recommended Solubilities in the Equimolar NaNO$_3$ - KNO$_3$ Melt as a Function of Temperature

<table>
<thead>
<tr>
<th>T/K</th>
<th>10$^4$ C/mol kg$^{-1}$ torr$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>9.29</td>
</tr>
<tr>
<td>510</td>
<td>7.87</td>
</tr>
<tr>
<td>520</td>
<td>6.72</td>
</tr>
<tr>
<td>530</td>
<td>5.76</td>
</tr>
<tr>
<td>540</td>
<td>4.97</td>
</tr>
<tr>
<td>550</td>
<td>4.32</td>
</tr>
<tr>
<td>560</td>
<td>3.76</td>
</tr>
<tr>
<td>570</td>
<td>3.30</td>
</tr>
<tr>
<td>580</td>
<td>2.90</td>
</tr>
<tr>
<td>590</td>
<td>2.57</td>
</tr>
<tr>
<td>600</td>
<td>2.28</td>
</tr>
</tbody>
</table>

References:

COMPONENTS:

(1) Water; H_2O; [7732-18-5]
(2) Sodium nitrate; NaN_3; [7631-99-4]
(3) Potassium nitrate; KNO_3; [7757-79-1]

VARIABLES:

T/K = 500 - 567
P/kPa = 1.320 - 2.740

EXPERIMENTAL VALUES:

The solvent employed was an equimolar molten mixture of sodium nitrate and potassium nitrate. The data for the solubility of water in the melt at various temperatures and water vapor pressures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>P_{H_2O}/torr</th>
<th>10^3 x_1/mol kg^{-1}</th>
<th>10^4 K_P/mol kg^{-1} torr^{-1}</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>9.90</td>
<td>9.40</td>
<td>9.50</td>
</tr>
<tr>
<td>501</td>
<td>10.30</td>
<td>9.30</td>
<td>9.05</td>
</tr>
<tr>
<td>503</td>
<td>10.50</td>
<td>9.25</td>
<td>8.80</td>
</tr>
<tr>
<td>506</td>
<td>10.95</td>
<td>9.15</td>
<td>8.35</td>
</tr>
<tr>
<td>514</td>
<td>11.95</td>
<td>8.95</td>
<td>7.50</td>
</tr>
<tr>
<td>527</td>
<td>13.95</td>
<td>8.50</td>
<td>6.10</td>
</tr>
<tr>
<td>537</td>
<td>15.75</td>
<td>8.10</td>
<td>5.15</td>
</tr>
<tr>
<td>547</td>
<td>17.40</td>
<td>7.75</td>
<td>4.45</td>
</tr>
<tr>
<td>556</td>
<td>18.80</td>
<td>7.45</td>
<td>3.95</td>
</tr>
<tr>
<td>563</td>
<td>20.05</td>
<td>7.20</td>
<td>3.60</td>
</tr>
<tr>
<td>567</td>
<td>20.55</td>
<td>7.10</td>
<td>3.45</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Pressure measuring technique.
The diagram and details of the apparatus and procedure used for solubility measurements are described in the original paper. Briefly, the melt was evacuated for a long time for degassing. The vacuum was disconnected and water vapors at a known pressure were introduced. The melt was stirred vigorously and the system allowed to attain equilibrium. The number of moles of water dissolved in the melt was calculated from the equilibrium pressure.

SOURCE AND PURITY OF MATERIALS:

Not described.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:
**COMPONENTS:**

1. Water; H₂O; [7732-18-5]
2. Sodium nitrate; NaNO₃; [7631-99-4]
3. Potassium nitrate; KNO₃; [7757-79-1]

**VARIABLES:**

<table>
<thead>
<tr>
<th>T/K</th>
<th>P/kPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 - 567</td>
<td>1.320 - 2.740</td>
</tr>
</tbody>
</table>

**EXPERIMENTAL VALUES:**

Smoothed Data:

The temperature dependence of the constant $K_p$ is given by the relation:

$$\log(K_p/\text{mol kg}^{-1}\text{torr}^{-1}) = -6.716 + \frac{1843}{(T/\text{K})}$$

std. dev. = 0.5% (compiler)

The heat of solution, $\Delta H$, and entropy of solution, $\Delta S$, are:

$\Delta H/\text{kJ mol}^{-1} = -35.1$

$\Delta S/\text{J K}^{-1}\text{mol}^{-1} = -37.2$ (at 523 K)

**ORIGINAL MEASUREMENTS:**

Zambonin, P. G.; Cardetta, V. L.; Signorile, G.


**PREPARED BY:**

N. P. Bansal

**REFERENCES:**
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Sodium nitrate; NaNO₃; [7631-99-4]
(3) Potassium nitrate; KNO₃; [7757-79-1]

VARIABLES:
T/K = 523 - 623
P/kPa = 1.072 - 4.242

EXPERIMENTAL VALUES:
Solubilities of water in molten equimolar NaNO₃ - KNO₃ mixture were measured at different temperatures under various partial pressures of water. The values of the solubility constant, K, are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>P₉₂O/torr</th>
<th>10⁴ K/mol kg⁻¹ torr⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>523</td>
<td>20.94</td>
<td>4.6</td>
</tr>
<tr>
<td>573</td>
<td>9.21</td>
<td>3.4</td>
</tr>
<tr>
<td>573</td>
<td>19.35</td>
<td>3.1</td>
</tr>
<tr>
<td>573</td>
<td>20.82</td>
<td>2.5</td>
</tr>
<tr>
<td>573</td>
<td>31.82</td>
<td>2.4</td>
</tr>
<tr>
<td>598</td>
<td>8.04</td>
<td>1.1</td>
</tr>
<tr>
<td>598</td>
<td>20.94</td>
<td>2.0</td>
</tr>
<tr>
<td>623</td>
<td>20.94</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of K is expressed by the relation:

\[ \log(K/\text{mol kg}^{-1}\ \text{torr}^{-1}) = -6.723 + 1780.1/(T/K) \]  

std. dev. = 6.9%  

The heat of the solution, ΔH, is ΔH/kJ mol⁻¹ = -34.1  

METHOD/APPARATUS/PROCEDURE:
Cyclic voltammetry.

SOURCE AND PURITY OF MATERIALS:
Sodium and potassium nitrates were either ultrapure or P₂O₅ dried ACS grade. These were further dried under vacuum at temperatures up to 200°C. To prepare the melt, the salt mixture was melted under pure oxygen, evacuated and filtered.

Water added was in the form of LiNO₃·3H₂O or saturated argon gas at a known partial pressure.

ESTIMATED ERROR:
Nothing specified.
COMPONENTS: (1) Water; H₂O; [7732-18-5] (2) Sodium nitrate; NaN₃; [7631-99-4] (3) Potassium nitrate; KNO₃; [7757-79-1]


VARIABLES: T/K = 473 - 623 water vapor press./torr = 80 - 750

EXPERIMENTAL VALUES:

Henry's law was obeyed up to a vapor pressure of 1 atm. for the solubility of water vapor in molten NaN₃ - KNO₃ (54.3 - 45.7 mol%). Values of water solubility at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10^2 x_mol fraction atm⁻¹</th>
<th>10^5 x_mol fraction torr⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>473</td>
<td>11.60</td>
<td>15.3</td>
</tr>
<tr>
<td>523</td>
<td>4.79</td>
<td>6.3</td>
</tr>
<tr>
<td>573</td>
<td>2.43</td>
<td>3.2</td>
</tr>
<tr>
<td>623</td>
<td>1.41</td>
<td>1.9</td>
</tr>
</tbody>
</table>

* Values derived from the graph by the compiler.

Smoothed Data:
The temperature dependence of x_mol fraction atm⁻¹ and x_mol fraction torr⁻¹ can be expressed by the relations:

\[ \log(x_mol\ fraction\ atm^{-1}) = -4.747 + 1798.5/(T/K) \] (compiler)

\[ \log(x_mol\ fraction\ torr^{-1}) = -7.596 + 1783/(T/K) \] (compiler)

std. dev. = 1.5% (compiler)

The heat of solution, ΔH, is reported to be:

ΔH/kJ mol⁻¹ = -34.94

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stripping method. The melt was saturated with pure steam at a particular pressure. The steam dissolved in the melt was stripped with a stream of nitrogen and absorbed in tubes containing concentrated H₂SO₄

SOURCE AND PURITY OF MATERIALS:

Not described.

ESTIMATED ERROR:

solubility: ± 2% (authors)

REFERENCES:
### Experimental Values:

The solubility of water in the molten mixture NaNO₃ - Ca(NO₃)₂ (95.98 - 4.02 mol%) under the water vapor pressure 16 - 21 mm Hg is given as:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10^4 x₁/mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>298.67</td>
<td>20.0 ± 2.0</td>
</tr>
</tbody>
</table>

### Method/Apparatus/Procedure:

Cryoscopic method.

A modified version of the previously described (2) cryoscopic apparatus was used. Nitrogen was employed as the carrier gas for water vapors. Freezing point of the same melt sample was determined, first with pure nitrogen, and then with nitrogen containing known partial pressures of water. Solubility of water in the melt was calculated from the freezing point depression.
**COMPONENTS:**

1. Water; \( \text{H}_2\text{O} \); [7732-18-5]
2. Potassium nitrate; \( \text{KNO}_3 \); [7757-79-1]
3. Barium nitrate; \( \text{Ba(NO}_3)_2 \); [10022-31-8]

**ORIGINAL MEASUREMENTS:**

Frame, J. P.; Rhodes, E.; Ubbelohde, A. R.


**VARIABLES:**

\[ P/\text{kPa} = 2.133 - 2.800 \]

melt comp./mol\% \( \text{Ba(NO}_3)_2 \) = 0.94 & 4.17

**PREPARED BY:**

N. P. Bansal

**EXPERIMENTAL VALUES:**

The solubilities of water in the molten mixtures \( \text{KNO}_3 - \text{Ba(NO}_3)_2 \) at two different compositions under the water vapor pressure of 16 - 21 mm Hg are given as:

<table>
<thead>
<tr>
<th>Melt composition/mol% ( \text{Ba(NO}_3)_2 )</th>
<th>t/°C</th>
<th>( 10^4 x_1/\text{mol fraction} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.94</td>
<td>332.13</td>
<td>6.0 ± 2.0</td>
</tr>
<tr>
<td>4.17</td>
<td>321.64</td>
<td>4.2 ± 2.0</td>
</tr>
</tbody>
</table>

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Cryoscopic method.

A modified form of the previously reported (2) cryoscopic apparatus was used. Nitrogen was employed as the carrier gas for water vapors. Freezing point of the same melt sample was determined, first with pure nitrogen, and then with nitrogen containing known partial pressures of water. Solubility of water in the melt was calculated from the freezing point depression.

**SOURCE AND PURITY OF MATERIALS:**

\( \text{KNO}_3 \) containing less than 0.0003% of cation and less than 0.001% of anion impurities was air dried at 240°C for several days and then by the thermal shock technique (1).  
\( \text{Ba(NO}_3)_2 \) (Analytical Reagent) was air dried as above. The two salts were mixed in proper ratio and melted. The melt was dried either by evacuation or by passing a slow stream of dry \( \text{N}_2 \) through the melt for 24 hr.

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**

1. Rhodes, E.; Ubbelohde, A. R.
   Proc. Royal Soc. 1959, 251A, 156.
2. Rhodes, E.; Ubbelohde, A. R.
COMPONENTS:
(1) Water; H\textsubscript{2}O; \([7732-18-5]\)
(2) Cesium nitrate; CsNO\textsubscript{3}; \([7789-18-6]\)
(3) Barium nitrate; Ba(NO\textsubscript{3})\textsubscript{2}; \([10022-31-8]\)

VARIABLES:
\[ P/\text{kPa} = 2.133 - 2.800 \]
one temperature: \( T/K = 664 \)

EXPERIMENTAL VALUES:
The solubility of water in the molten mixture CsNO\textsubscript{3} - Ba(NO\textsubscript{3})\textsubscript{2} (95.67 - 4.33 mol\%) under the water vapor pressure of 16 - 21 mm Hg is given as:

<table>
<thead>
<tr>
<th>( t/°C )</th>
<th>( 10^4 x_1/\text{mol fraction} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>391.00</td>
<td>6.3 ± 2.0</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Cryoscopic method.
A modified form of the previously described (2) cryoscopic apparatus was used. Nitrogen was employed as the carrier gas for water vapors. Freezing point of the same melt sample was determined, first with pure nitrogen, and then with nitrogen containing known partial pressures of water. Solubility of water in the melt was calculated from the freezing point lowering.

SOURCE AND PURITY OF MATERIALS:

CsNO\textsubscript{3} having less than 0.1\% of all impurities was dried for several days in air at 240°C and then by the thermal shock technique.
Ba(NO\textsubscript{3})\textsubscript{2} (Analytical Reagent) was air dried as above. The two salts were mixed in proper amounts and melted. The melt was dried either by evacuation or by passing a slow stream of dry nitrogen through the melt for 24 hr.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

### COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Silver nitrate; AgNO₃; [7761-88-8]
(3) Thallium nitrate; TlNO₃; [10102-45-1]

### ORIGINAL MEASUREMENTS:
Trudelle, M. C.; Abraham, M.; Sangster, J.

### VARIABLES:
T/K = 371.5

### PREPARED BY:
N. P. Bansal

### EXPERIMENTAL VALUES:

Henry's law constant, $K_H$, was calculated from the equation:

$$ f = f^{\circ}_\omega \cdot x_\omega = K_H \cdot x_\omega $$

Where $f$ is the fugacity of vapor, $f^{\circ}_\omega$ is the fugacity of pure water, $x_\omega$ is the activity coefficient of water at infinite dilution in the melt, and $x_\omega$ is the mole fraction of water in the melt solution.

The value of $K_H$ for water in the AgNO₃ - TlNO₃ melt ($\text{mol H}_2\text{O})^{-1}$ with Ag/Tl mole ratio of 1.14 at 100°C was calculated to be 1.3 atm. mol melt.

### AUXILIARY INFORMATION

### METHOD/APPARATUS/PROCEDURE:
A static technique was used for vapor pressure measurement. For a description of the apparatus and the procedure, see the original paper.

### SOURCE AND PURITY OF MATERIALS:
Not given.

### ESTIMATED ERROR:
Not specified.

### REFERENCES:
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Potassium nitrate; KNO₃; [7757-79-1]
(3) Sodium nitrite; NaNO₂; [7632-00-0]

VARIABLES:
T/K = 416 - 551.6
P/kPa = 0.667 - 3.200

ORIGINAL MEASUREMENTS:
Hull, H. S.; Turnbull, A. G.

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
Henry's law was obeyed for the solubility of water. The solubilities of water in molten KNO₃ - NaNO₂ (46 - 54 mol%) mixture as a function of temperature are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁵ x₁/mol fraction torr⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>142.9</td>
<td>61.0</td>
</tr>
<tr>
<td>149.8</td>
<td>52.4</td>
</tr>
<tr>
<td>160.1</td>
<td>38.1</td>
</tr>
<tr>
<td>180.8</td>
<td>24.2</td>
</tr>
<tr>
<td>201.0</td>
<td>16.7</td>
</tr>
<tr>
<td>220.9</td>
<td>11.3</td>
</tr>
<tr>
<td>239.8</td>
<td>8.12</td>
</tr>
<tr>
<td>260.1</td>
<td>5.92</td>
</tr>
<tr>
<td>278.5</td>
<td>4.62</td>
</tr>
</tbody>
</table>

Smoothed Data:
The temperature dependence of x₁ can be expressed by the relation:
\[ \log(x₁/mol \text{ fraction torr}^{-1}) = -7.782 + 1897/(T/K) \] (compiler)
std. dev. = 1.2% (compiler)

The heat of solution, ΔH, and entropy of solution, ΔS, are:
\[ \Delta H/kJ \text{ mol}^{-1} = -36.3 \] (compiler)
\[ \Delta S/J K^{-1} \text{ mol}^{-1} = -38.5 \] (compiler) at 523K.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Elution method.
At a fixed temperature, a known amount of the melt was saturated with water by bubbling a stream of nitrogen which was presaturated with water to a known pressure. After saturation, the melt was sparged with dry nitrogen to strip water from the melt. The eluted gas mixture of nitrogen and water was passed through two drying tubes containing magnesium perchlorate and the amount of water absorbed was determined by the increase in weight of the drying tubes.

SOURCE AND PURITY OF MATERIALS:
Analar reagent grade KNO₃ and NaNO₂, air dried at 150°C, were used.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
COMPONENTS:
(1) Water; H$_2$O; [7732-18-5]
(2) Lithium nitrate; LiNO$_3$; [7790-69-4]
(3) Potassium nitrite; KNO$_2$; [7757-79-1]

ORIGINAl MEASUREMENTS:
Tripp, T. B.

VARIABLES:
P/kPa: 101.325 (compiler)
T/K = 383.15 - 402.66

EXPERIMENTAL VALUES:
Vapor pressures of the melt system LiNO$_3$ - KNO$_2$ - H$_2$O were measured at three different temperatures for three melt compositions and expressed as R$_L$ (moles Li$^+$ per mole of salt) as a function of the water mole ratio.

Values of the Henry's law constant $k_H$ for the composition R$_L$ = 0.5 are given below at various temperatures

<table>
<thead>
<tr>
<th>T/K</th>
<th>$k_H$/kPa·mol salt·(mol H$_2$O)$^{-2}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>383.15</td>
<td>36.18</td>
</tr>
<tr>
<td>391.91</td>
<td>47.98</td>
</tr>
<tr>
<td>402.66</td>
<td>70.65</td>
</tr>
</tbody>
</table>

The enthalpy of vaporization of water from the melt with R$_L$ = 0.5 was calculated to be 44.4 kJmol$^{-1}$.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
A differential transpiration method, details of which have been described earlier(1), was used for vapor pressure measurements.

SOURCE AND PURITY OF MATERIALS:
Reagent grade Lithium nitrate was dried at 423K for several days.
Reagent grade Potassium nitrite was dried at 363K, pulverized, and redried at 373K.

ESTIMATED ERROR:
Not specified.

REFERENCES:
1. Tripp, T. B.; Braunstein, J.
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Lithium chloride; LiCl; [7447-41-8]
(3) Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS:
Burkhard, W. J.; Corbett, J. D.

VARIABLES:
T/K = 663 - 753
p/kPa = 0.400 - 3.466
water vapor press./mm = 3 - 26

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The solubility of water in molten LiCl - KCl mixtures of different compositions at two temperatures are:

<table>
<thead>
<tr>
<th>Melt Composition/mol% LiCl</th>
<th>390°C</th>
<th>480°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.0</td>
<td>30.0</td>
<td>14.0*</td>
</tr>
<tr>
<td>53.0</td>
<td>--</td>
<td>11.8</td>
</tr>
<tr>
<td>60.0</td>
<td>30.5</td>
<td>11.3</td>
</tr>
<tr>
<td>68.6</td>
<td>--</td>
<td>10.8</td>
</tr>
</tbody>
</table>

* Value doubtful

Henry's law was obeyed upto a water vapor pressure of 14 mm at 390°C and 18 mm at 480°C.

Smoothed Data:
The values of heats of solution, ΔH, are:

<table>
<thead>
<tr>
<th>Melt Composition/mol% LiCl</th>
<th>ΔH/kJ mol⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.0</td>
<td>-33.47</td>
</tr>
<tr>
<td>60.0</td>
<td>-46.02</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Manometric method.
Water vapors at a known pressure were introduced into the system above the melt. The fall in pressure of water vapors due to the solubility in the melt was noted. The solubility was calculated from initial and final equilibrium values of the pressure.

SOURCE AND PURITY OF MATERIALS:
LiCl from Baker or Baker and Adamson, and KCl from Baker were used.
The LiCl - KCl mixed melts were prepared in the dry state by using a modification of the procedure described by Laitinen et al. (1), which involved alternate evacuation and flushing with HCl gas a number of times.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
1. Laitinen, H. A.; Ferguson, W. S.; Osteryoung, R. A.
COMPONENTS:

(1) Water; H₂O; [7732-18-5]
(2) Potassium nitrate; KNO₃; [7757-79-1]
(3) Potassium chloride; KCl; [7447-40-7]

VARIABLES:

one temperature: T/K = 598
P/kPa: 101.325 (1 atm.)

EXPERIMENTAL VALUES:

The solubility of water vapor at 1 atm. pressure in molten KN0₃ in the presence of 6 mol% Cl⁻ ions at a single temperature, read from the graph in the original paper, is:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10² x₁/ mol fraction atm⁻¹</th>
<th>10⁵ x₁/ mol fraction torr⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>598</td>
<td>1.8*</td>
<td>2.36*</td>
</tr>
</tbody>
</table>

* Values derived from graph by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stripping method.
The melt was saturated with pure steam at a particular pressure. Steam dissolved in the melt was stripped with a stream of nitrogen and absorbed in tubes containing concentrated H₂SO₄.

SOURCE AND PURITY OF MATERIALS:

Not described.

ESTIMATED ERROR:

solubility: ± 2% (authors)

REFERENCES:

Haug, H.; Albright, L. F.
COMPONENTS:
(1) Water; H\textsubscript{2}O; [7732-18-5]
(2) Sodium hydroxide; NaOH; [1310-73-2]
(3) Potassium hydroxide; KOH; [1310-58-3]

ORIGNIAL MEASUREMENTS:
Al-Muslih, E; Iredale, P. J; Maund, J. K

VARIABLES:
T/K = 523 - 723
KOH/ mol\%= 36.9
P/kPa: 101.325 (compiler)

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
Values of Henry's Law constant for the solubility of water in a melt consisting of 63.1 mole\% NaOH and 36.9 mole\% KOH were determined from Henry's Law:
\[ P_{H_2O} = k N_{H_2O} \]

Where \( P_{H_2O} \) is the partial pressure of H\textsubscript{2}O in nitrogen, \( N_{H_2O} \) is the amount of H\textsubscript{2}O dissolved in the melt (mol kg\textsuperscript{-1}), and \( k \) is the Henry's Law constant (atm mol\textsuperscript{-1} kg). The values of \( k \) at various temperatures are given below:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10\textsuperscript{-7} k/atm mol\textsuperscript{-1} Kg</th>
<th>Std. dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>523</td>
<td>0.0095</td>
<td>0.001</td>
</tr>
<tr>
<td>573</td>
<td>0.0290</td>
<td>0.002</td>
</tr>
<tr>
<td>623</td>
<td>0.1200</td>
<td>0.030</td>
</tr>
<tr>
<td>673</td>
<td>0.3500</td>
<td>0.090</td>
</tr>
<tr>
<td>723</td>
<td>0.6600</td>
<td>0.200</td>
</tr>
</tbody>
</table>

Temperature dependence of \( k \) is given by the relation:
\[ \ln k = 10.8 - \frac{8081}{T} \]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Water solubilities in the NaOH - KOH melt of eutectic composition were determined at various temperatures using a gravimetric method. For a diagram of the apparatus and details of the procedure used see the original paper.

SOURCE AND PURITY OF MATERIALS:
AnalaR-grade NaOH and KOH were used. Cylinder N\textsubscript{2} was passed through a column of NaOH pellets (to remove CO\textsubscript{2}) followed by another column containing Union Carbide "Type 4A" molecular sieve and self-indicating silica gel to remove H\textsubscript{2}O.

ESTIMATED ERROR:
Std. dev. 0.001 - 0.20(authors).

REFERENCES:
**COMPONENTS:**

1. Water; H₂O; [7732-18-5]
2. Potassium nitrate; KNO₃; [7757-79-1]
3. Potassium dichromate; K₂Cr₂O₇; [7778-50-9]

**ORIGINAL MEASUREMENTS:**

Frame, J. P.; Rhodes, E.; Ubbelohde, A. R.


**VARIABLES:**

\[
P/kPa = 2.133 - 2.800
\]

One temperature: \(T/K = 602\)

**EXPERIMENTAL VALUES:**

The solubility of water in the molten mixture KNO₃ - K₂Cr₂O₇ (98.1 - 1.9 mol%) at water vapor pressure of 16 - 21 mm Hg is given to be:

<table>
<thead>
<tr>
<th>(t/°C)</th>
<th>(10^4 x_1/\text{mol fraction})</th>
</tr>
</thead>
<tbody>
<tr>
<td>329.05</td>
<td>6.0 (\pm) 2.0</td>
</tr>
</tbody>
</table>

**METHOD/APPARATUS/PROCEDURE:**

Cryoscopic method.
A modified version of the previously described (2) cryoscopic apparatus was used. Nitrogen was employed as the carrier gas for water vapors. Freezing point of the same melt sample was determined, first with pure nitrogen, and then with nitrogen containing known partial pressures of water. Solubility of water in the melt was calculated from the freezing point depression.

**SOURCE AND PURITY OF MATERIALS:**

KNO₃ containing less than 0.0003% of cation and less than 0.001% of anion impurities was air dried at 240°C for several days and then by the thermal shock technique (1). Potassium dichromate was Analytical Reagent grade. The two salts were mixed in proper amounts and melted. The melt was dried either by evaporation or by passing a slow stream of dry nitrogen through the melt for 24 hr.

**ESTIMATED ERROR:**

Nothing specified

**REFERENCES:**

1. Rhodes, E.; Ubbelohde, A. R.

2. Rhodes, E.; Ubbelohde, A. R.
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Sodium acetate; CH₃COONa; [127-09-3]
(3) Potassium acetate; CH₃COOK; [127-08-2]

ORIGINAL MEASUREMENTS:
Marassi, R.; Bartocci, V.; Pucciarelli, F. Cescon, P.

VARIABLES:
T/K = 527 - 561
melt comp./mol% CH₃COONa = 46.3
P/kPa = 0.267 - 2.000

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
For the solubility of water vapors in molten sodium acetate - potassium acetate mixture (46.3 - 53.7 mol%), Henry's law was obeyed for water vapor pressures up to 20 torr in the temperature range 527 - 561 K. The values of solubility, C₁, at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10³ C₁/mol kg⁻１ torr⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>526.9</td>
<td>1.13</td>
</tr>
<tr>
<td>531.2</td>
<td>1.04</td>
</tr>
<tr>
<td>537.8</td>
<td>0.94</td>
</tr>
<tr>
<td>545.9</td>
<td>0.81</td>
</tr>
<tr>
<td>552.2</td>
<td>0.73</td>
</tr>
<tr>
<td>554.5</td>
<td>0.69</td>
</tr>
<tr>
<td>560.9</td>
<td>0.63</td>
</tr>
</tbody>
</table>

Smoothed Data:
The temperature dependence of C is given by the expression:

\[
\log(C₁/mol \text{ kg}^{-1} \text{ torr}^{-1}) = -7.148 + 2213.7/(T/K) \quad (\text{compiler})
\]
std. dev. = 0.37% (compiler)

The heat of solution, ΔH, and the entropy of solution, ΔS, are:

\[
\Delta H/\text{kJ mol}^{-1} = -42.7 \pm 1.26
\]
\[
\Delta S/\text{J K}^{-1} \text{ mol}^{-1} = -48.5 \quad (\text{at } 523 \text{ K})
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Pressure measuring technique.
The diagram of the apparatus, which is a slight modification of the one described earlier (1), is given in the original paper. The melt was evacuated for a long time for degassing. The vacuum was disconnected and water vapors at a known pressure were introduced. The melt was stirred vigorously and the system allowed to come to equilibrium. The number of moles of water dissolved in the melt was calculated from the equilibrium pressure.

SOURCE AND PURITY OF MATERIALS:
Reagent grade sodium acetate and potassium acetate from Carlo Erba (Milan) were used without further purification.
The salt mixture was melted in a N₂ atmosphere, dried with liquid air and molecular sieves and freed from oxygen. N₂ was bubbled through the melt overnight and then evacuated for several hours. A clear water free melt was obtained.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
1. Zambonin, P. G.; Cardetta, V. L.; Signorile, G.
COMPONENTS:
(1) Water; H₂O; \([7732-18-5]\)
(2) Lithium nitrate; LiNO₃; \([7790-69-4]\)
(3) Sodium nitrate; NaNO₃; \([7631-99-4]\)
(4) Potassium nitrate; KNO₃; \([7757-79-1]\)

VARIABLES: \(P/kPa = 7.999 \) (max)
\(T/K = 418 - 13\)
melt comp./mol% LiNO₃ = 12.5 - 86.9

EXPERIMENTAL VALUES:
The solubilities of water vapors in molten LiNO₃ - NaNO₃ - KNO₃ mixtures of different compositions and at different temperatures are given as:

<table>
<thead>
<tr>
<th>Composition of LiNO₃ - NaNO₃ - KNO₃ Melt/mol%</th>
<th>t/°C</th>
<th>(10^6 x_o/) mol/mol of Li⁺, ((mm \text{ Hg})^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.5 - 46.4 - 41.1</td>
<td>240</td>
<td>1.02</td>
</tr>
<tr>
<td>24.8 - 39.9 - 35.3</td>
<td>240</td>
<td>2.07</td>
</tr>
<tr>
<td>30.0 - 37.1 - 32.9</td>
<td>240</td>
<td>2.50</td>
</tr>
<tr>
<td>46.7 - 28.2 - 25.1</td>
<td>240</td>
<td>10.0</td>
</tr>
<tr>
<td>67.0 - 17.5 - 15.5</td>
<td>240</td>
<td>27.4</td>
</tr>
<tr>
<td>86.9 - 6.9 - 6.2</td>
<td>240</td>
<td>49.7</td>
</tr>
<tr>
<td>30.0 - 23.0 - 47.0</td>
<td>145</td>
<td>23.8</td>
</tr>
<tr>
<td></td>
<td>170</td>
<td>13.0</td>
</tr>
<tr>
<td></td>
<td>175</td>
<td>8.8</td>
</tr>
<tr>
<td></td>
<td>205</td>
<td>3.2</td>
</tr>
</tbody>
</table>

continued

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Manometric method. Water vapors at the desired pressure were let into the apparatus above the melt. The fall in the pressure of water vapors, due to its solubility in the melt, was recorded as a function of time till equilibrium was reached. The amount of water dissolved in the melt was calculated from the initial and final values of the pressure.

SOURCE AND PURITY OF MATERIALS:
Not described. About 10 g of the salt mixture was taken and vacuum dried. The temperature was slowly raised above the melting point and brought to the working temperature. Evacuation of the melt was continued for several hours to ensure complete drying.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
COMPONENTS:
(1) Water; \( H_2O; [7732-18-5] \)
(2) Lithium nitrate; \( LiNO_3; [7790-69-4] \)
(3) Sodium nitrate; \( NaNO_3; [7631-99-4] \)
(4) Potassium nitrate; \( KNO_3; [7757-79-1] \)

VARIABLES:

EXPERIMENTAL VALUES:
continued

Smoothed Data:

Temperature dependence of \( x_1 \) for the solubility of water in molten \( LiNO_3 - NaNO_3 - KNO_3 \) (30 - 23 - 47 mol\%) can be expressed by the relation:

\[
\log(\frac{x_1}{\text{mol/mol of Li}^+})(\text{mm Hg})^{-1} = -11.592 + \frac{2932}{(T/\text{K})}
\]

std. dev. = 7.5% (compiler)

The enthalpy of solution, \( \Delta H \), of water in molten \( LiNO_3 - NaNO_3 - KNO_3 \) (30 - 23 - 47 mol\%) is:

\[
\Delta H / \text{kJ mol}^{-1} = -54.39 \pm 16.7
\]

ORIGINAL MEASUREMENTS:
Duke, F. R.; Doan, Jr., A. S.

PREPARED BY:
N. P. Bansal

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Lithium nitrate; LiNO₃; [7790-69-4]
(3) Potassium nitrate; KNO₃; [7757-79-1]
(4) Sodium nitrate; NaNO₃; [7631-99-4]

ORIGINAL MEASUREMENTS:
Tripp, T. B.

VARIABLES:
P/kPa: 101.325 (compiler)
T/K = 383.15 - 412.77

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
Vapor pressures of the melt system 0.41 LiNO₃ - 0.41 KNO₃ - 0.18 NaNO₃ - H₂O were measured at four temperatures as a function of the water mole ratio in the melt.

Values of the Henry's law constant are given below:

<table>
<thead>
<tr>
<th>T/K</th>
<th>k₉/Pₐ·mol salt·(mol H₂O)⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>383.15</td>
<td>34.69</td>
</tr>
<tr>
<td>391.91</td>
<td>46.92</td>
</tr>
<tr>
<td>402.66</td>
<td>66.87</td>
</tr>
<tr>
<td>412.77</td>
<td>91.89</td>
</tr>
</tbody>
</table>

The enthalpy of vaporization of water from the melt was calculated to be 43.1 kJ mol⁻¹.

METHOD/APPARATUS/PROCEDURE:
A differential transpiration method, details of which have been described earlier(1), was used for vapor pressure measurements.

SOURCE AND PURITY OF MATERIALS:
Reagent grade lithium nitrate was dried at 423K for several days. NaNO₃ and KNO₃, both of reagent grades, were dried at 383K for at least 24h.

ESTIMATED ERROR:
Not specified.

REFERENCES:
1. Tripp, T. B.; Braunstein, J.
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Lithium nitrate; LiNO₃; [7790-69-4]
(3) Potassium nitrate; KNO₃; [7757-79-1]
(4) Cesium nitrate; CsNO₃; [7789-18-6]

ORIGINAL MEASUREMENTS:
Tripp, T. B.

VARIABLES:
P/kPa: 101.325 (compiler)
T/K = 402.6

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
Vapor pressures of the melt system 0.41LiNO₃ - 0.41KNO₃ - 0.18CsNO₃ - H₂O were measured as a function of the water mole ratio in the melt at 402.66K are as shown in the Fig.

![Graph: WATER VAPOR PRESSURE VS. WATER MOLE RATIO 402.66 K](image)

Fig. Vapor pressures of the melt system 0.41LiNO₃ - 0.41KNO₃ - 0.18CsNO₃ - H₂O at 402.66K as a function of water mol ratio in the melt.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
A differential transpiration method, details of which have been described earlier(1), was used for vapor pressure measurements.

SOURCE AND PURITY OF MATERIALS:
Reagent grade lithium nitrate was dried at 423K for several days. KNO₃ of reagent grade was dried at 383K for at least 24h. Reagent grade CsNO₃ was used as received except for drying.

ESTIMATED ERROR:
Not specified.

REFERENCES:
1. Tripp, T. B.; Braunstein, J.
### COMPONENTS:

1. Water; H₂O; [7732-18-5]
2. Lithium nitrate; LiNO₃; [7790-69-4]
3. Potassium nitrate; KNO₃; [7757-79-1]
4. Magnesium nitrate; Mg(NO₃)₂; [10377-60-3]

### VARIABLES:

P/kPa: 101.325 (compiler)

T/K = 402.66

### EXPERIMENTAL VALUES:

Vapor pressures of the melt system 0.472LiNO₃ - 0.472KNO₃ - 0.056Mg(NO₃)₂ - H₂O as a function of water mole ratio in the melt at 402.66K are shown in Fig.

![Vapor pressures of the melt system 0.472LiNO₃ - 0.472KNO₃ - 0.056Mg(NO₃)₂ - H₂O at 402.66K as a function of water mole ratio.](image)

**FIG.** Vapor pressures of the melt system 0.472LiNO₃ - 0.472KNO₃ - 0.056Mg(NO₃)₂ - H₂O at 402.66K as a function of water mole ratio.

### METHOD/APPARATUS/PROCEDURE:

A differential transpiration method, details of which have been described earlier(1), was used for vapor pressure measurements.

### SOURCE AND PURITY OF MATERIALS:

Reagent grade lithium nitrate was dried at 423K for several days. KNO₃ of reagent grade was dried at 383K for at least 24h. Reagent grade Mg(NO₃)₂·6H₂O was dried at 363K for 24h.

### ESTIMATED ERROR:

Not specified.

### REFERENCES:

COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Lithium nitrate; LiNO₃; [7790-69-4]
(3) Potassium nitrate; KNO₃; [7757-79-1]
(4) Calcium nitrate; Ca(NO₃)₂; [10124-37-5]

VARIABLES:
P/kPa: 101.325 (compiler)
T/K = 402.66

EXPERIMENTAL VALUES:
Vapor pressures of the melt system 0.472LiNO₃ - 0.472KNO₃ - 0.056Ca(NO₃)₂ - H₂O as a function of water mole ratio in the melt are presented in Fig.

![Graph showing vapor pressures of the melt system 0.472LiNO₃ - 0.472KNO₃ - 0.056Ca(NO₃)₂ - H₂O at 402.66K as a function of water mole ratio in the melt.]

FIG. Vapor pressures of the melt system 0.472LiNO₃ - 0.472KNO₃ - 0.056Ca(NO₃)₂ - H₂O at 402.66K as a function of water mole ratio in the melt.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
A differential transpiration method, details of which have been described earlier(1), was used for vapor pressure measurements.

SOURCE AND PURITY OF MATERIALS:
Reagent grade lithium nitrate was dried at 423K for several days. KNO₃ of reagent grade was dried at 383K for at least 24h. Reagent grade calcium nitrate tetrahydrate was stored in a desiccator over magnesium perchlorate for several weeks.

ESTIMATED ERROR:
Not specified.

REFERENCES:
### COMPONENTS:

1. Water; H$_2$O; [7732-18-5]
2. Silver nitrate; AgNO$_3$; [7761-88-8]
3. Thallium nitrate; TlNO$_3$; [10102-45-1]
4. Sodium nitrate; Na(NO$_3$); [7631-99-4]

### VARIABLES:
- T/K = 371.5
- P/kPa: 101.325 (compiler)

### EXPERIMENTAL VALUES:

In the AgNO$_3$ - TlNO$_3$ - NaN$_3$ melts, the Ag/Tl mol ratio was fixed at 1.06. Various melt compositions were prepared by adding 0, 2.5, 5.0, 7.5 and 10.1 mol% of NaN$_3$ to the melt.

Henry's law constant, $K_H$, was calculated from the equation:

$$ f = f_w^\circ \cdot r_w^\circ \cdot x_w = K_H \cdot x_w $$

Where $f$ is the fugacity of vapor, $f_w^\circ$ is the fugacity of pure water, $r_w^\circ$ is the activity coefficient of water at infinite dilution in the melt, and $x_w$ is the mole fraction of water in the melt solution.

Values of $K_H$ at 98.5 °C for various melt compositions are given below:

<table>
<thead>
<tr>
<th>Melt comp*/mol % NaN$_3$</th>
<th>$K_H$/atm. mol melt (mol H$_2$O)$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.25</td>
</tr>
<tr>
<td>2.5</td>
<td>1.18</td>
</tr>
<tr>
<td>5</td>
<td>1.12</td>
</tr>
<tr>
<td>7.5</td>
<td>1.07</td>
</tr>
<tr>
<td>10.1</td>
<td>1.02</td>
</tr>
</tbody>
</table>

* Ag/Tl mol ratio = 1.06

### AUXILIARY INFORMATION

**METHOD/APPARATUS/PROCEDURE:**

A static method was used for vapor pressure measurements details of which have been described earlier(1).

**SOURCE AND PURITY OF MATERIALS:**

NaNO$_3$ (Anachemia Reagent) was used without further treatment. Details of salt mixture preparation has been reported earlier(2).

**ESTIMATED ERROR:**

Not specified.

**REFERENCES:**

COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Silver nitrate; AgNO₃; [7761-88-8]
(3) Thallium nitrate; TlNO₃; [10102-45-1]
(4) Cadmium nitrate; Cd(NO₃)₂; [10325-94-7]

VARIABLES:
T/K = 371.5
P/kPa: 101.325 (compiler)

EXPERIMENTAL VALUES:

Henry's law constant, Kₜ, was calculated from the equation:

\[ f = f_w \omega \phi_w = K_t \phi_w \]

Where \( f \) is the fugacity of vapor, \( f_w \) is the fugacity of pure water at temperature, \( \omega \) is the activity coefficient of water at infinite dilution in the melt, and \( \phi_w \) is the mole fraction of water in the melt solution.

Values of \( K_t \) at 98.5 °C for various melt compositions are given below:

<table>
<thead>
<tr>
<th>Melt comp*/mol % Cd(NO₃)₂</th>
<th>Kₜ/atm. mol melt (mol H₂O)⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.25</td>
</tr>
<tr>
<td>5</td>
<td>0.770</td>
</tr>
<tr>
<td>7.5</td>
<td>0.662</td>
</tr>
<tr>
<td>10</td>
<td>0.514</td>
</tr>
<tr>
<td>12.5</td>
<td>0.442</td>
</tr>
</tbody>
</table>

* Ag/Tl mol ratio = 1.06

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
A static technique was used for vapor pressure measurements. Details of which have been described earlier(1).

In the melt, Ag/Tl mole ratio was fixed at 1.06 and the mole fractions of Cd, Cd/(Ag+Tl+Cd), of Cd in the melt were varied 0, 0.05, 0.075, 0.10, and 0.125 by adding cadmium nitrate.

SOURCE AND PURITY OF MATERIALS:
Cd(NO₃)₂·4H₂O (Fisher, 99.9%) was used.

ESTIMATED ERROR:
Not specified.

REFERENCES:
COMPONENTS:
(1) Water; H\textsubscript{2}O; [7732-18-5]
(2) Silver nitrate; AgNO\textsubscript{3}; [7761-88-8]
(3) Thallium nitrate; TlNO\textsubscript{3}; [10102-45-1]
(4) Cesium nitrate; CsNO\textsubscript{3}; [7789-18-6]

VARIABLES:
T/K = 371.5
P/kPa: 101.325 (compiler)

EXPERIMENTAL VALUES:

Henry's law constant, K\textsubscript{H}, was calculated from the equation:

\[ f = f^{\circ}_{w} r^{\circ}_{w} x_{w} = K_{H} x_{w} \]

Where \( f \) is the fugacity of vapor, \( f^{\circ}_{w} \) is the fugacity of pure water \( r^{\circ}_{w} \) is the activity coefficient of water at infinite dilution in the melt, and \( x_{w} \) is the mole fraction of water in the melt solution.

Value of \( K_{H} \) at 98.5 °C for various melt compositions are given below:

<table>
<thead>
<tr>
<th>Melt comp*/mol % CsNO\textsubscript{3}</th>
<th>( K_{H} )/atm. mol melt (mol H\textsubscript{2}O)\textsuperscript{-1}</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.25</td>
</tr>
<tr>
<td>2.45</td>
<td>1.28</td>
</tr>
<tr>
<td>5</td>
<td>1.30</td>
</tr>
<tr>
<td>7.5</td>
<td>1.33</td>
</tr>
<tr>
<td>10</td>
<td>1.36</td>
</tr>
</tbody>
</table>

* Ag/Tl mol ratio = 1.06

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
A static technique was used for vapor pressure measurements details of which have been described earlier(1).

In the melt, Ag/Tl mole ratio was fixed at 1.06 and the mole fractions of Cs, Cs/(Ag+Tl+Cs), in the melt were 0, 2.45, 5, 7.5, and 10.

The salt mixture was prepared by weighing and dried at 200 °C in vacuo. The melt was filtered through sintered glass, and stored in a closed vessel in an air oven at 120 °C.

SOURCE AND PURITY OF MATERIALS:
AgNO\textsubscript{3} (99.99% Macco or 99.98% Engelhard was used without further treatment.
TlNO\textsubscript{3} (Alfa) was recrystallized from water and dried at 120°C.
CsNO\textsubscript{3} (99.9% K&K Laboratories) was used as received.

ESTIMATED ERROR:
Not specified.

REFERENCES:
1. Truddelle, M. C.; Abraham, M.; Sangster, J.
COMPONENTS:

1. Water; H₂O; [7732-18-5]
2. Lithium nitrate; LiNO₃; [7790-69-4]
3. Potassium nitrite; KNO₂; [7758-09-0]
4. Sodium nitrite; NaNO₂; [7632-00-0]

VARIABLES:
P/kPa: 101.325 (compiler)
T/K = 383.00 - 422.51

ORIGINAL MEASUREMENTS:
Tripp, T. B.

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The Henry's law constant, kₜ, was calculated from:

\[ kₜ = \frac{P_{H₂O}}{Rₜ} \]

Where \( P_{H₂O} \) is the vapor pressure (torr) of water in the gas phase, \( Rₜ \) is the water mole ratio in the melt. Values of \( kₜ \) for the solubility of water in 0.52LiNO₃ - 0.17KNO₂ - 0.31NaNO₂ melt at various temperatures are given below:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>kₜ/torr (mol of water)⁻¹·mole of cation</th>
</tr>
</thead>
<tbody>
<tr>
<td>110.00</td>
<td>212.8</td>
</tr>
<tr>
<td>118.76</td>
<td>292.5</td>
</tr>
<tr>
<td>129.51</td>
<td>408.9</td>
</tr>
<tr>
<td>139.61</td>
<td>578.2</td>
</tr>
<tr>
<td>149.51</td>
<td>761.3</td>
</tr>
</tbody>
</table>

From the temperature dependence of \( kₜ \), the enthalpy of vaporization of water from the melt was calculated to be 10.4 kcal/mol

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
A differential transpiration method, the details of which have been described previously(1,2).

SOURCE AND PURITY OF MATERIALS:
LiNO₃ (Alfa Products Co.) was dried for 24h. at 150°C.
KNO₂ and NaNO₂ both from Alfa Products Co. were dried at 850°C for a minimum of 48h.

ESTIMATED ERROR:
Uncertainty in \( P_{H₂O} \) = ± 1 torr.

REFERENCES:
1. Tripp, T. B.; Braunstein, J.
2. Tripp, T. B.
### COMPONENTS:

1. Water; \( \text{H}_2\text{O} \); [7732-18-5]
2. Lithium nitrate; \( \text{LiNO}_3 \); [7790-69-4]
3. Potassium nitrite; \( \text{KNO}_2 \); [7758-09-0]
4. Sodium nitrite; \( \text{NaN}_2\text{O}_3 \); [7632-00-0]

### ORIGINAL MEASUREMENTS:

Tripp, T. B.

### VARIABLES:

- \( P/\text{kPa} \): 101.325 (compiler)
- \( T/\text{K} = 383.15 - 422.66 \)

### EXPERIMENTAL VALUES:

Vapor pressures of the melt system 0.52\( \text{LiNO}_3 \)-0.31\( \text{KNO}_2 \)-0.17\( \text{NaN}_2\text{O}_3 \)-\( \text{H}_2\text{O} \) were measured at five temperatures as a function of water mole ratio.

Values of the Henry's law constant \( k_H \) at various temperatures are given below:

<table>
<thead>
<tr>
<th>( T/\text{K} )</th>
<th>( k_H/\text{kPa} \cdot \text{mol salt} \cdot (\text{mol H}_2\text{O})^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>383.15</td>
<td>28.06</td>
</tr>
<tr>
<td>391.91</td>
<td>38.56</td>
</tr>
<tr>
<td>402.66</td>
<td>54.00</td>
</tr>
<tr>
<td>412.77</td>
<td>76.45</td>
</tr>
<tr>
<td>422.66</td>
<td>100.60</td>
</tr>
</tbody>
</table>

The enthalpy of vaporization of water from the melt was calculated to be 43.5 kJ mol\(^{-1}\).

### SOURCE AND PURITY OF MATERIALS:

Reagent grade lithium nitrate was dried at 423K for several days.

Reagent grade \( \text{KNO}_2 \) was dried overnight at 363K, pulverized, and redried at 373K.

\( \text{NaN}_2\text{O}_3 \), reagent grade, was dried at 383K for at least 24h.

### ESTIMATED ERROR:

Not specified.

### REFERENCES:

1. Tripp, T. B.; Braunstein, J.
### COMPONENTS:

1. Water; H₂O; [7732-18-5]
2. Sodium nitrate; NaN₃; [7631-99-4]
3. Potassium nitrate; KNO₃; [7757-79-1]
4. Potassium chloride; KCl; [7447-40-7]

### ORIGINAL MEASUREMENTS:

Haug, H.; Albright, L. F.


### VARIABLES:

- T/K = 489 & 523
- mol% Cl⁻ in the melt = 2 - 5
- P/kPa: 101.325 (1 atm.)

### EXPERIMENTAL VALUES:

The solubilities of water vapor at 1 atm. pressure in the molten mixture NaN₃ - KNO₃ (54.3 - 45.7 mol%) containing various concentrations of Cl⁻ ions (2 - 5 mol%) have been reported in a graphical form. The values derived from the graph, by the compiler, are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>conc. of Cl⁻ in the melt/mol%</th>
<th>10² x₂/mol fraction atm⁻¹</th>
<th>10⁵ x₂/mol fraction torr⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>523</td>
<td>2.0</td>
<td>5.0</td>
<td>6.6</td>
</tr>
<tr>
<td>489</td>
<td>5.0</td>
<td>8.5</td>
<td>11.2</td>
</tr>
</tbody>
</table>

### AUXILIARY INFORMATION

**METHOD/APPARATUS/PROCEDURE:**

Stripping method.

The melt was saturated with steam at a particular pressure. The steam dissolved in the melt was stripped with a stream of nitrogen and absorbed in tubes containing concentrated H₂SO₄.

**SOURCE AND PURITY OF MATERIALS:**

Not described.

**ESTIMATED ERROR:**

solubility: ± 2% (authors)

**REFERENCES:**

Haug, H.; Albright, L. F.
**COMPONENTS:**

1. Deuterium oxide; D$_2$O; [1105-15-0]
2. Lithium nitrate; LiNO$_3$; [7790-69-4]
3. Potassium nitrate; KNO$_3$; [7757-79-1]

**ORIGINAL MEASUREMENTS:**

Tripp, T. B.

**VARIABLES:**

- T/K = 383 - 422
- P/kPa: 101.325 (compiler)

**EXPERIMENTAL VALUES:**

Henry's law was obeyed for the solubility of D$_2$O. The solubilities of D$_2$O in molten LiNO$_3$ - KNO$_3$ (50 - 50 mol%) mixture at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10$^4$ $x_1$/mol fraction torr$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>383.15</td>
<td>41.9</td>
</tr>
<tr>
<td>391.91</td>
<td>30.5</td>
</tr>
<tr>
<td>402.66</td>
<td>21.4</td>
</tr>
<tr>
<td>412.76</td>
<td>15.4</td>
</tr>
<tr>
<td>422.66</td>
<td>11.4</td>
</tr>
</tbody>
</table>

Smoothed Data:
The temperature dependence of $x_1$ can be expressed by the equation:

$$\log(x_1$/mol fraction torr$^{-1}$) = -8.414 + 2311.9/(T/K)$$

std. dev. = 0.2% (compiler)

The enthalpy of solution, $\Delta H$, is:

$$\Delta H/kJ/mol^{-1} = -44.4 \pm 0.4$$

**METHOD/APPARATUS/PROCEDURE:**

Vapor pressure measurements. The solubilities of D$_2$O have been indirectly derived from vapor pressure measurements of the LiNO$_3$ - KNO$_3$ - D$_2$O system using a differential transpiration method described elsewhere (1).

**SOURCE AND PURITY OF MATERIALS:**

Lithium and potassium nitrates, Mallinckrodt AR grade, were dried at 520 K. D$_2$O (99.9 mol%) was provided by Oak Ridge National Lab.

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**

1. Tripp, T. B.; Braunstein, J.
<table>
<thead>
<tr>
<th>COMPONENTS:</th>
<th>ORIGINAL MEASUREMENTS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Hydrogen sulfide; H$_2$S; [7783-06-4]</td>
<td>Allulli, S.</td>
</tr>
<tr>
<td>(3) Potassium nitrate; KNO$_3$; [7757-79-1]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VARIABLES:</th>
<th>PREPARED BY:</th>
</tr>
</thead>
<tbody>
<tr>
<td>one temperature: T/K = 433</td>
<td>N. P. Bansal</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EXPERIMENTAL VALUES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>The solubility of H$_2$S in molten LiNO$_3$ – KNO$_3$ eutectic at 160°C was too small (&lt;10^{-7} mol(mol of melt)$^{-1}$ torr$^{-1}$) to be measured with the experimental method employed.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AUXILIARY INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>METHOD/APPARATUS/PROCEDURE:</td>
</tr>
<tr>
<td>Manometric technique.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SOURCE AND PURITY OF MATERIALS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>H$_2$S (98%) from Rivoira was used without further purification. LiNO$_3$ (ERBA RP) was dehydrated at 70°C to avoid hydrolysis. KNO$_3$ (ERBA RP) was finely powdered and vacuum dried at 110°C for 24 hr.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ESTIMATED ERROR:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nothing specified.</td>
</tr>
</tbody>
</table>

| REFERENCES: |
Two independent studies (1,2) have been reported for the solubility of ammonia in molten lithium nitrate. Results from the two investigations, compared below in Fig. 1, are seen to be quite different. Tentative solubilities based on ref. (2) are given in Table 1. Further Studies are needed to evaluate this system.
COMPONENTS:
(1) Ammonia; NH₃; [7664-41-7]
(2) Lithium nitrate; LiNO₃; [7790-69-4]

CRITICAL EVALUATION:

Table 1
Tentative Solubilities as a Function of Temperature

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁶ Kᵣ/mol cm⁻³ torr⁻¹</th>
<th>10⁵ x₁/mol fraction torr⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>530</td>
<td>(3.6)</td>
<td>(13.8)</td>
</tr>
<tr>
<td>540</td>
<td>2.7</td>
<td>10.5</td>
</tr>
<tr>
<td>550</td>
<td>2.1</td>
<td>8.0</td>
</tr>
<tr>
<td>560</td>
<td>1.6</td>
<td>6.2</td>
</tr>
<tr>
<td>570</td>
<td>1.2</td>
<td>4.8</td>
</tr>
<tr>
<td>580</td>
<td>0.96</td>
<td>3.8</td>
</tr>
<tr>
<td>590</td>
<td>(0.76)</td>
<td>(3.0)</td>
</tr>
</tbody>
</table>

Values in ( ) outside temperature interval of experimental measurement; extrapolated by the evaluator.

References:
**COMPONENTS:**

1. Ammonia; NH\(_3\); [7664-41-7]
2. Lithium nitrate; LiNO\(_3\); [7790-69-4]

**ORIGINAL MEASUREMENTS:**

- Paniccia, F.; Zambonin, P. G.

**VARIABLES:**

- T/K = 523 & 623
- P/kPa = 10 - 40

**EXPERIMENTAL VALUES:**

Solubilities of ammonia were measured in molten LiNO\(_3\) - KNO\(_3\) mixtures of various compositions. A linear relationship was observed between the logarithm of x\(_1\) and the melt compositions. The extrapolated values of x\(_1\) in pure molten LiNO\(_3\) at two temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10(^2) x(_1)/mol fraction bar(^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>523</td>
<td>6.6</td>
</tr>
<tr>
<td>623</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Smoothed Data:

The enthalpy of solution, \(\Delta H\), and the standard entropy of solution, \(\Delta S^o\), are reported to be:

\[\Delta H/\text{kJ mol}^{-1} = -55.0\]

\[\Delta S^o/J \text{K}^{-1} \text{mol}^{-1} = -65.0 \quad \text{(at 623 K)}\]

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Extrapolated from the solubility data of ammonia in lithium nitrate - potassium nitrate mixtures. Gas solubilities in the mixed nitrates were measured by the manometric technique (1,2).

**SOURCE AND PURITY OF MATERIALS:**

- Anhydrous ammonia (Matheson) was used without further treatment.
- Reagent grade lithium nitrate (Carlo Erba, Milan) was used without further purification.

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**

1. Desimoni, E.; Paniccia, F.; Zambonin, P. G.
2. Zambonin, P. G.; Cardetta, V. L.; Signorile, G.
COMPONENTS:
(1) Ammonia; NH₃; [7664-41-7]
(2) Lithium nitrate; LiN0₃; [7790-69-4]

ORIGINAL MEASUREMENTS:
Allulli, S.

VARIABLES: 
T/K = 533 - 588 
P/kPa = 0.667 - 6.666

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The solubility of ammonia in molten LiN0₃ obeyed Henry's law. The values of Henry's law constant, Kₜ, at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁶ x₁/mol fraction mm⁻²</th>
<th>10⁶ Kₜ/mol cm⁻³ mm⁻²</th>
</tr>
</thead>
<tbody>
<tr>
<td>260</td>
<td>12.5</td>
<td>3.22</td>
</tr>
<tr>
<td>283</td>
<td>7.05</td>
<td>1.80</td>
</tr>
<tr>
<td>303</td>
<td>4.1</td>
<td>1.04</td>
</tr>
<tr>
<td>315</td>
<td>3.1</td>
<td>0.79</td>
</tr>
</tbody>
</table>


Smoothed Data:
The temperature dependences of Kₜ and x₁ are given by the expressions:
\[
\log(Kₜ/mol cm⁻³ mm⁻²) = -12.08 + 3516/(T/K) \quad \text{(compiler)}
\]
\[
\log(x₁/mol fraction mm⁻²) = -10.41 + 3472/(T/K) \quad \text{(compiler)}
\]
std. dev. = 1.2% \quad \text{(compiler)}

The enthalpy of solution, ΔH, and entropy of solution, ΔS, are:
\[
\Delta H/kJ mol⁻¹ = -69.04
\]
\[
\Delta S/J K⁻¹ mol⁻¹ = -127.2 \quad \text{(at 543 K)}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Manometric method.

The details of the procedure employed for solubility measurements have been given in the original paper. In brief, ammonia was let into the system above the melt to the desired pressure. The drop in gas pressure due to its solubility in the melt was recorded as a function of time till a stable equilibrium pressure was attained. The number of moles of the gas dissolved in the melt was calculated.

SOURCE AND PURITY OF MATERIALS:
Ammonia supplied by Matheson Co. was used without further purification. Its purity, checked by mass spectroscopy, was better than 99.5%.
LiN0₃ (ERBA RP) was dehydrated at 70°C to avoid hydrolysis.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
COMPONENTS:

(1) Ammonia; NH3; [7664-41-7]
(2) Sodium nitrate; NaN03; [7631-99-4]

ORIGINAL MEASUREMENTS:

Paniccia, F.; Zambonin, P. G.

VARIABLES:

T/K = 588 - 653
P/kPa = 10 - 40

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

The solubilities of ammonia in molten sodium nitrate as a function of temperature are presented in graphical form in the original paper. The values of $x_1$ derived from this graph by the compiler are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>$10^4 x_1$/mol fraction bar$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>588</td>
<td>14.1</td>
</tr>
<tr>
<td>591</td>
<td>13.4</td>
</tr>
<tr>
<td>612</td>
<td>11.6</td>
</tr>
<tr>
<td>624</td>
<td>10.9</td>
</tr>
<tr>
<td>637</td>
<td>9.5</td>
</tr>
<tr>
<td>653</td>
<td>8.5</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of $x_1$ may be expressed by the equation:

$$\log(x_1/\text{mol fraction bar}^{-1}) = -4.988 + 1254.3/(T/K)$$  (compiler)

std. dev. = 0.9%  (compiler)

The enthalpy of solution, $\Delta H$, and the standard entropy of solution, $\Delta S^\circ$, are:

$$\Delta H/\text{kJ mol}^{-1} = -23.0$$  
$$\Delta S^\circ/\text{J K}^{-1} \text{mol}^{-1} = -34.0$$  (at 623 K)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Manometric method.

The experimental details have been described elsewhere (1,2). In brief, the apparatus was evacuated and then ammonia gas was introduced into the system at about one bar pressure. The initial gas pressure was immediately noted. The melt was vigorously stirred and the fall in gas pressure due to its solubility in the melt was continuously recorded till equilibrium was attained. The final gas pressure was noted and the Henry's law constant was evaluated.

SOURCE AND PURITY OF MATERIALS:

Anhydrous ammonia (Matheson) was used without further treatment.

Reagent grade sodium nitrate (Carlo Erba, Milan) was used as received.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

1. Desimoni, E.; Paniccia, F.; Zambonin, P. G.
2. Zambonin, P. G.; Cardette, V. L.; Signorile, G.
COMPONENTS:

(1) Ammonia; $\text{NH}_3$; [7664-41-7]

(2) Potassium nitrate; $\text{KNO}_3$; [7757-79-1]

ORIGINAL MEASUREMENTS:

Paniccia, F.; Zambonin, P. G.

VARIABLES:

$T/\text{K} = 619 - 680$
$P/\text{kPa} = 10 - 40$

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

The solubilities of ammonia in molten potassium nitrate as a function of temperature are presented in graphical form in the original publication. The values of $x_1$ derived from this graph by the compiler are:

<table>
<thead>
<tr>
<th>$T/\text{K}$</th>
<th>$10^4 x_1/\text{mol fraction bar}^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>619</td>
<td>5.9</td>
</tr>
<tr>
<td>623</td>
<td>5.6</td>
</tr>
<tr>
<td>640</td>
<td>5.2</td>
</tr>
<tr>
<td>654</td>
<td>5.3</td>
</tr>
<tr>
<td>673</td>
<td>4.9</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of $x_1$ could be given by the expression:

$$\log(x_1/\text{mol fraction bar}^{-1}) = -4.117 + 542.9/(T/\text{K})$$

(compiler)

std. dev. = 1.3% (compiler)

The enthalpy of solution, $\Delta H$, and the standard entropy of solution, $\Delta S^\circ$, are:

$$\Delta H/\text{kJ mol}^{-1} = -11.0$$

$$\Delta S^\circ/\text{J K}^{-1} \text{ mol}^{-1} = -23.0$$ (at 623 K)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Manometric method.
The details of the experimental procedure are given elsewhere (1,2). In brief, the apparatus was evacuated and then ammonia gas was introduced into the system at about one bar pressure. The initial gas pressure was quickly noted. The melt was vigorously stirred and the fall in gas pressure due to its dissolution in the melt was continuously recorded until equilibrium was attained. The final gas pressure was noted and Henry's law constant was computed.

SOURCE AND PURITY OF MATERIALS:

Anhydrous ammonia (Matheson) was used without further treatment.
Reagent-grade potassium nitrate (Carlo Erba, Milan) was used without further purification.

REFERENCES:

1. Desimoni, E.; Paniccia, F.; Zambonin, P. G.
2. Zambonin, P. G.; Cardette, V. L.; Signorile, G.
**COMPONENTS:**

1. Ammonia; \( \text{NH}_3; [7664-41-7] \)
2. Lithium nitrate; \( \text{LiNO}_3; [7790-69-4] \)
3. Potassium nitrate; \( \text{KNO}_3; [7757-79-1] \)

**ORIGINAL MEASUREMENTS:**

Paniccia, F.; Zambonin, P. G.


**VARIABLES:**

\[ \frac{T}{K} = 475 - 560 \]
\[ P/\text{kPa} = 10 - 40 \]

**PREPARED BY:**

N. P. Bansal

**EXPERIMENTAL VALUES:**

The solubility of ammonia in the molten \( \text{LiNO}_3 - \text{KNO}_3 \) (50 - 50, 66.67 - 33.33, 85-15 mol\%) mixtures as a function of temperature are presented in graphical form in the original paper. The values of \( x_1 \) derived from this graph by the compiler are:

<table>
<thead>
<tr>
<th>Melt Composition/ mol% ( \text{LiNO}_3 )</th>
<th>( \frac{T}{K} )</th>
<th>( 10^3 x_1/ \text{mol fraction bar}^{-2} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.0</td>
<td>475</td>
<td>18.7</td>
</tr>
<tr>
<td></td>
<td>488</td>
<td>15.5</td>
</tr>
<tr>
<td></td>
<td>522</td>
<td>9.2</td>
</tr>
<tr>
<td></td>
<td>527</td>
<td>8.5</td>
</tr>
<tr>
<td></td>
<td>530</td>
<td>8.2</td>
</tr>
<tr>
<td></td>
<td>539</td>
<td>7.2</td>
</tr>
<tr>
<td>66.67</td>
<td>495</td>
<td>26.0</td>
</tr>
<tr>
<td></td>
<td>496</td>
<td>27.9</td>
</tr>
<tr>
<td></td>
<td>515</td>
<td>18.9</td>
</tr>
<tr>
<td></td>
<td>517</td>
<td>18.9</td>
</tr>
<tr>
<td></td>
<td>529</td>
<td>15.5 ( \pm 0.6 )</td>
</tr>
<tr>
<td>85.0</td>
<td>522</td>
<td>30.8</td>
</tr>
<tr>
<td></td>
<td>534</td>
<td>23.9</td>
</tr>
<tr>
<td></td>
<td>543</td>
<td>21.1</td>
</tr>
<tr>
<td></td>
<td>547</td>
<td>19.6 ( \pm 0.7 )</td>
</tr>
<tr>
<td></td>
<td>554</td>
<td>17.1</td>
</tr>
<tr>
<td></td>
<td>558</td>
<td>16.1</td>
</tr>
<tr>
<td></td>
<td>560</td>
<td>15.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>continued</td>
</tr>
</tbody>
</table>

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Manometric method.

The experimental procedure has been described in detail elsewhere (1,2). Briefly, the apparatus was evacuated and then ammonia gas was introduced into the system at about one bar pressure. The initial gas pressure was quickly noted. The melt was vigorously stirred and the fall in gas pressure due to its solubility in the melt was continuously recorded until equilibrium was reached. The final gas pressure was noted and the Henry's law constant was evaluated.

**SOURCE AND PURITY OF MATERIALS:**

Anhydrous ammonia (Matheson) was used without further treatment.

Reagent-grade lithium and potassium nitrates (Carlo Erba, Milan) were used as received.

The melt container was made of Teflon.

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**

1. Desimoni, E.; Paniccia, F.; Zambonin, P. G.
2. Zambonin, P. G.; Cardette, V. L.; Signorile, G.
**COMPONENTS:**

1. Ammonia; NH₃; [7664-41-7]
2. Lithium nitrate; LiNO₃; [7790-69-4]
3. Potassium nitrate; KNO₃; [7757-79-1]

**ORIGINAL MEASUREMENTS:**

Paniccia, F.; Zambonin, P. G.


**VARIABLES:**

**EXPERIMENTAL VALUES:**

continued

Smoothed Data:

The temperature dependence of \( x_1 \) could be expressed by equations of the form:

\[
\log(x_1/\text{mol fraction bar}^{-1}) = a + b/(T/K)
\]

The values of the coefficients \( a \) and \( b \) of the above equation for various molten salts mixtures, along with the enthalpy of solution, \( \Delta H \), and the standard entropy of solution, \( \Delta S^\circ \), are:

<table>
<thead>
<tr>
<th>Melt Composition/ mol% LiNO₃</th>
<th>a</th>
<th>b</th>
<th>std. dev.</th>
<th>( \Delta H )/kJ mol⁻¹</th>
<th>( \Delta S^\circ/J K^{-1} \text{ mol}^{-1} ) (at 623 K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.0</td>
<td>-5.232</td>
<td>1667.3</td>
<td>0.5%</td>
<td>-31.9</td>
<td>-43.0</td>
</tr>
<tr>
<td>66.67</td>
<td>-5.354</td>
<td>1874.6</td>
<td>1.7%</td>
<td>-35.9</td>
<td>-47.0</td>
</tr>
<tr>
<td>85.0</td>
<td>-5.869</td>
<td>2273.0</td>
<td>0.6%</td>
<td>-43.5</td>
<td>-53.0</td>
</tr>
</tbody>
</table>

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

**SOURCE AND PURITY OF MATERIALS:**

**ESTIMATED ERROR:**

**REFERENCES:**
COMPONENTS:
(1) Ammonia; NH₃; [7664-41-7]
(2) Lithium nitrate; LiNO₃; [7790-69-4]
(3) Potassium nitrate; KNO₃; [7757-79-1]

ORIGINAL MEASUREMENTS:
Allulli, S.

VARIABLES:
melt comp./mol% LiNO₃ := 43 and 75
P/kPa = 0.667 - 6.666
T/K = 433 - 598

EXPERIMENTAL VALUES:
The solubility of ammonia in the molten mixtures LiNO₃ - KNO₃ (43 - 57, 75 - 25 mol%) obeyed Henry's law. The solubility values at various temperatures are:

<table>
<thead>
<tr>
<th>Melt Composition/mol% LiNO₃</th>
<th>t/°C</th>
<th>10⁵ x₁/mol fraction mm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>43</td>
<td>160</td>
<td>4.1</td>
</tr>
<tr>
<td></td>
<td>190</td>
<td>2.45</td>
</tr>
<tr>
<td></td>
<td>210</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td>250</td>
<td>1.05</td>
</tr>
<tr>
<td>75</td>
<td>242</td>
<td>4.2</td>
</tr>
<tr>
<td></td>
<td>275</td>
<td>2.05</td>
</tr>
<tr>
<td></td>
<td>292</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>325</td>
<td>0.85</td>
</tr>
</tbody>
</table>

continued

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Manometric method. The details of the procedure employed for solubility measurements are given in the original paper. Briefly, ammonia was let into the system above the melt to the desired pressure. The fall in gas pressure due to its solubility in the melt was noted as a function of time until a stable equilibrium pressure was attained. The number of moles of the gas dissolved in the melt was calculated.

SOURCE AND PURITY OF MATERIALS:
Ammonia supplied by Matheson Co. was used without further purification. Its purity, checked by mass spectrometry, was better than 99.5%
KNO₃ (ERBA RP) was finely powdered and vacuum dried at 110°C for 24 hr. LiNO₃ was dehydrated at 70°C to avoid hydrolysis.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
COMPONENTS:

(1) Ammonia; NH₃; [7664-41-7]
(2) Lithium nitrate; LiNO₃; [7790-69-4]
(3) Potassium nitrate; KNO₃; [7757-79-1]

ORIGINAL MEASUREMENTS:

Allulli, S.

VARIABLES:

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:

The temperature dependence of $x_1$ is given by the relations:

LiNO₃ - KNO₃ (43 - 57 mol%)

$$\log(x_1/\text{mol fraction mm}^{-1}) = -7.86 + 1501.6/(T/K)$$

(compiler)

std. dev. = 1.6% (compiler)

LiNO₃ - KNO₃ (75 - 25 mol%)

$$\log(x_1/\text{mol fraction mm}^{-1}) = -9.37 + 2571.7/(T/K)$$

(compiler)

std. dev. = 0.63% (compiler)

The enthalpies of solution, $\Delta H$, and entropies of solution, $\Delta S$, are:

<table>
<thead>
<tr>
<th>Melt Composition/ mol% LiNO₃</th>
<th>$\Delta H$/kJ mol⁻¹</th>
<th>$\Delta S$/J K⁻¹ mol⁻¹ (at 523 K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>43</td>
<td>-29.29</td>
<td>-56.07</td>
</tr>
<tr>
<td>75</td>
<td>-49.37</td>
<td>-95.40</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPROATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:
(1) Ammonia; NH_3; [7664-41-7]
(2) Sodium nitrate; NaN_3; [7631-99-4]
(3) Potassium nitrate; KNO_3; [7757-79-1]

ORIGINAL MEASUREMENTS:
Paniccia, F.; Zambonin, P. G.

VARIABLES: T/K = 538 - 585
P/kPa = 10 - 40

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The solubilities of ammonia in the molten equimolar NaN_3 - KNO_3 mixture are reported in graphical form in the original paper. The values of x_1 at different temperatures, derived from this graph by the compiler, are:

<table>
<thead>
<tr>
<th>Melt Composition/ mol% NaN_3</th>
<th>T/K</th>
<th>10^4 x_1/ mol fraction bar^-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.0</td>
<td>538</td>
<td>14.6</td>
</tr>
<tr>
<td></td>
<td>565</td>
<td>11.5 ± 0.7</td>
</tr>
<tr>
<td></td>
<td>585</td>
<td>10.3 ± 0.6</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of x_1 is expressed by the relation:
\[ \log(\text{x}_1/\text{mol fraction bar}^{-1}) = -4.744 + 1025.0/(T/K) \] (compiler)
std. dev. = 1.1% (compiler)

The enthalpy of solution, \( \Delta H \), and the standard entropy of solution, \( \Delta S^\circ \), are:
\[ \Delta H/\text{kJ mol}^{-1} = -18.0 \]
\[ \Delta S^\circ/\text{J K}^{-1} \text{ mol}^{-1} = -30.0 \] (at 623 K)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Manometric method.
Details of the experimental technique are given elsewhere (1,2). In brief, the apparatus was evacuated and then ammonia gas was introduced into the system at about one bar pressure. The initial gas pressure was quickly noted. The melt was vigorously stirred and the fall in gas pressure due to its solubility in the melt was continuously recorded until equilibrium was attained. The final gas pressure was noted and Henry's constant was calculated.

SOURCE AND PURITY OF MATERIALS:
Anhydrous ammonia (Matheson) was used without further treatment.
Reagent-grade sodium and potassium nitrates (Carlo Erba, Milan) were used as received.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
1. Desimoni, E.; Paniccia, F.; Zambonin, P. G.
2. Zambonin, P. G.; Cardette, V. L.; Signorile, G.
COMPONENTS:
(1) Ammonia; NH₃; [7664-41-7]
(2) Lithium perchlorate; LiClO₄; [7791-03-9]
(3) Potassium perchlorate; KCIO₄; [7778-74-7]

ORIGINAL MEASUREMENTS:
Allulli, S.

VARIABLES: T/K = 507 - 583
P/kPa = 0.667 - 6.666

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:
The solubility of ammonia in the molten mixture LiClO₄ - KCIO₄ (76 - 24 mol%) obeyed Henry's law. The values of solubility and Henry's law constant at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10^6 x₁/mol fraction mm⁻¹</th>
<th>10^6 Kₗ/mol cm⁻³ mm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>234</td>
<td>128</td>
<td>23.56</td>
</tr>
<tr>
<td>251</td>
<td>84</td>
<td>15.46</td>
</tr>
<tr>
<td>266</td>
<td>61.5</td>
<td>11.32</td>
</tr>
<tr>
<td>288</td>
<td>37</td>
<td>6.81</td>
</tr>
<tr>
<td>311</td>
<td>23</td>
<td>4.23</td>
</tr>
</tbody>
</table>

* Values calculated by the compiler using appropriate value of density as 2.1 g ml⁻¹ at 523 K from Allulli, S.; J. Phys. Chem. 1969, 73, 1084.

Smoothed Data:
The temperature dependences of Kₗ and x₁ are expressed by the relations:

\[
\log(Kₗ/mol cm⁻³ mm⁻¹) = -10.27 + 2862.6/(T/K) \quad \text{compiler}
\]

\[
\log(x₁/mol fraction mm⁻¹) = -8.53 + 2862.6/(T/K) \quad \text{compiler}
\]

std. dev. = 1.1% (compiler)

The enthalpy of solution, ΔH, and the entropy of solution, ΔS, are:

ΔH/KJ mol⁻¹ = -57.74
ΔS/J K⁻¹ mol⁻¹ = -110.46 (at 523 K)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Manometric technique.
The details of the procedure used for solubility measurements have been described in the original publication. In brief, ammonia was let into the system above the melt to the desired pressure. The fall in gas pressure due to its solubility in the melt was noted with time until a stable equilibrium value was reached. The number of moles of the gas dissolved in the melt was calculated.

SOURCE AND PURITY OF MATERIALS:
Ammonia supplied by Matheson Co. was used without further purification. Its purity, checked by mass spectrometry, was better than 99.5%.

KCIO₄ (ERBA RP) was dried under vacuum at 110°C for 24 hr. LiClO₄ (RUDI PONT) was dehydrated at 70°C to avoid hydrolysis.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
COMPONENTS:

(1) Ammonia; NH₃; [7664-41-7]
(2) Lithium nitrate; LiNO₃; [7790-69-4]
(3) Sodium nitrate; NaN₃; [7631-99-4]
(4) Potassium nitrate; KNO₃; [7757-79-1]

VARIABLES:

\[ T/K = 433 - 523 \]
\[ P/kPa = 0.667 - 6.666 \]

EXPERIMENTAL VALUES:

The solubility of ammonia in molten LiNO₃ - NaN₃ - KNO₃ (27 - 18 - 55 mol%) obeyed Henry's law. The solubilities at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10⁶ x₁/mol fraction mm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>160</td>
<td>2.1</td>
</tr>
<tr>
<td>185</td>
<td>1.5</td>
</tr>
<tr>
<td>202</td>
<td>1.15</td>
</tr>
<tr>
<td>250</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Smoothed Data:

The temperature dependence of solubility, \( x₁ \), is given by the relation:

\[
\log(x₁/mol fraction \text{ mm}⁻¹) = -7.47 + 1208.4/(T/K) \quad \text{(compiler)}
\]

std. dev. = 1.2% \quad \text{(compiler)}

The enthalpy of solution, \( \Delta H \), and entropy of solution, \( \Delta S \), are:

\[
\Delta H/kJ \text{ mol}⁻¹ = -24.27
\]
\[
\Delta S/J \text{ K}⁻¹ \text{ mol}⁻¹ = -46.44 \quad \text{(at 523 K)}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Manometric method.
The details of the procedure employed for solubility measurements have been given in the original paper. In brief, ammonia was let into the system above the melt to the desired pressure. The fall in gas pressure due to its solubility in the melt was noted with time until a stable equilibrium value was reached. The number of moles of the gas dissolved in the melt was calculated.

SOURCE AND PURITY OF MATERIALS:

Ammonia supplied by Matheson Co. was used without further purification. Its purity, checked by mass spectrometry, was better than 99.5%.

NaNO₃ and KNO₃ both from ERBA RP were vacuum dried at 110°C for 24 hr. LiNO₃ (ERBA RP) was dehydrated at 70°C to avoid hydrolysis.

REFERENCES:

Allulli, S.
**COMPONENTS:**

1. Silicon tetrachloride; SiCl₄; [10026-04-7]
2. Sodium chloride; NaCl; [7647-14-5]

**VARIABLES:**

T/K = 1093 - 1173

**EXPERIMENTAL VALUES:**

Solubilities of SiCl₄ in molten NaCl at different temperatures are reported to be:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>C₁/mass%</th>
<th>10ⁿ x₁⁻¹/mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>820</td>
<td>0.37</td>
<td>1.27</td>
</tr>
<tr>
<td>850</td>
<td>0.31</td>
<td>1.07</td>
</tr>
<tr>
<td>880</td>
<td>0.23</td>
<td>0.79</td>
</tr>
<tr>
<td>900</td>
<td>0.16</td>
<td>0.55</td>
</tr>
</tbody>
</table>

* Calculated by the compiler.
Pressure of SiCl₄ was the vapor pressure of liquid SiCl₄ at 160°C.

**Smoothed Data:**

Temperature dependence of C₁ is expressed by the relation:

\[ \log(C₁/mass%) = -5.583 + \frac{5661.9}{(T/K)} \]  

(compiler)

std. dev. = 4.8% (compiler)

**METHOD/APPARATUS/PROCEDURE:**

Isothermal method.
Vapors of silicon tetrachloride were passed through the molten NaCl, kept at a constant temperature, for about 10 - 15 min. The melt became saturated with the tetrachloride within 2 - 3 min. The saturated melt was solidified and analyzed for silicon by the gravimetric sulfate method.

**SOURCE AND PURITY OF MATERIALS:**

Silicon tetrachloride was of 99% purity.
Sodium chloride was of "chemically pure" grade.

**REFERENCES:**


PREPARED BY: N. P. Bansal'
COMPONENTS:

(1) Silicon tetrachloride; SiCl₄; [10026-04-7]
(2) Potassium chloride; KCl; [7447-40-7]

VARIABLES:

\[ T/K = 1123 - 1173 \]

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>T/°C</th>
<th>C₁/mass%</th>
<th>(10^3 x_1^a)/mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>850</td>
<td>0.95</td>
<td>4.16</td>
</tr>
<tr>
<td>880</td>
<td>0.80</td>
<td>3.51</td>
</tr>
<tr>
<td>900</td>
<td>0.67</td>
<td>2.94</td>
</tr>
</tbody>
</table>

\( C_1 \) is the mass percent of SiCl₄, \( x_1 \) is the mol fraction of SiCl₄.

\( a \) Calculated by the compiler.

Pressure of SiCl₄ was the vapor pressure of liquid SiCl₄ at 160°C.

Smoothed Data:

Temperature dependence of \( C_1 \) is expressed by the relation:

\[
\log(C_1/\text{mass%}) = -3.52 + 3933.7/(T/K) \quad \text{(compiler)}
\]

\[ \text{std. dev.} = 1.5\% \quad \text{(compiler)} \]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isothermal method.
Vapors of silicon tetrachloride were passed through the molten KCl, kept at a constant temperature, for about 10 - 15 min. The melt became saturated with the tetrachloride within 2 - 3 min. The saturated melt was solidified and analyzed for silicon by the gravimetric sulfate method.

SOURCE AND PURITY OF MATERIALS:

Silicon tetrachloride was of 99.99% purity.
Potassium chloride was of "chemically pure" grade.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:
**COMPONENTS:**

(1) Silicon tetrachloride; SiCl₄; [10026-04-7]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Potassium chloride; KCl; [7447-40-7]

**VARIABLES:**

T/K = 973 - 1173

**EXPERIMENTAL VALUES:**

Solubilities of SiCl₄ in molten NaCl - KCl (50 - 50 mol%) mixture at different temperatures are reported to be:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>C₁/mass%</th>
<th>10⁻³ x₁⁻⁻⁻mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td>0.56</td>
<td>2.19</td>
</tr>
<tr>
<td>750</td>
<td>0.54</td>
<td>2.11</td>
</tr>
<tr>
<td>800</td>
<td>0.53</td>
<td>2.07</td>
</tr>
<tr>
<td>820</td>
<td>0.53</td>
<td>2.07</td>
</tr>
<tr>
<td>850</td>
<td>0.52</td>
<td>2.03</td>
</tr>
<tr>
<td>880</td>
<td>0.51</td>
<td>1.99</td>
</tr>
<tr>
<td>900</td>
<td>0.51</td>
<td>1.99</td>
</tr>
</tbody>
</table>

* Calculated by the compiler.

Pressure of SiCl₄ was the vapor pressure of liquid SiCl₄ at 160°C.

Smoothed Data:

Temperature dependence of C₁ is expressed by the equation:

\[
\log(C₁/\text{mass%}) = -0.489 + 229.2/(T/K) \quad \text{(compiler)}
\]

\[
\text{std. dev.} = 0.3\% \quad \text{(compiler)}
\]

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Isothermal method.

Vapors of silicon tetrachloride were passed through the molten NaCl - KCl mixture, kept at a constant temperature, for 10 - 15 min. The melt became saturated with the tetrachloride within 2 - 3 min. The saturated melt was solidified and analyzed for silicon by the gravimetric sulfate method.

**SOURCE AND PURITY OF MATERIALS:**

Silicon tetrachloride was of 99.99% purity.

Sodium and potassium chlorides were of "chemically pure" grade.

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**
COMPONENTS:

(1) Titanium tetrachloride; TiCl₄; [7550-45-0]
(2) Sodium chloride; NaCl; [7647-14-5]

VARIABLES:

T/K = 1093 - 1173

EXPERIMENTAL VALUES:

Solubilities of TiCl₄ in molten NaCl at different temperatures are reported to be:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>C₁/mass%</th>
<th>10³ x₄*²/mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>820</td>
<td>1.20</td>
<td>3.70</td>
</tr>
<tr>
<td>850</td>
<td>0.89</td>
<td>2.74</td>
</tr>
<tr>
<td>880</td>
<td>0.52</td>
<td>1.60</td>
</tr>
<tr>
<td>900</td>
<td>0.38</td>
<td>1.17</td>
</tr>
</tbody>
</table>

* Calculated by the compiler.
Pressure of TiCl₄ was the vapor pressure of liquid TiCl₄ at 160°C.

Smoothed Data:

Temperature dependence of C₁ is given by the relation:

\[
\log(C₁/mass%) = -7.366 - 8167.5/(T/K) \quad \text{(compiler)}
\]

\[
\text{std. dev.} = 3.8\% \quad \text{(compiler)}
\]

AUXILIARY INFORMATION

METHOD/APPRATUS/PROCEDURE:

Isothermal method. Vapors of titanium tetrachloride were passed through the molten NaCl, kept at a constant temperature, for about 10 - 15 min. The melt became saturated with the tetrachloride within 2 - 3 min. The saturated melt was solidified and titanium was determined volumetrically.

SOURCE AND PURITY OF MATERIALS:

Titanium tetrachloride was of 99.99% purity.
Sodium chloride was of "chemically pure" grade.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:


PREPARED BY:

N. P. Bansal
COMPONENTS:
(1) Titanium tetrachloride; TiCl₄; [7550-45-0]
(2) Sodium chloride; NaCl; [7647-14-5]

VARIABLES:

\[
\begin{align*}
T/K & = 1089 - 1224 \\
P/kPa & = 17.124 - 54.412
\end{align*}
\]

ORIGINAL MEASUREMENTS:

1. Maksimov, V. S.; Smirnov, M. V.
   Electrochem. Molten Solid
   Electrolytes 1968, 6, 30 - 36.

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

Henry's law was obeyed up to \( P_{TiCl₄} = 0.54 \) atm. Values of solubility \((x_1)\) and the constant \( k = \frac{x_1}{P} \) at various temperatures are given as:

<table>
<thead>
<tr>
<th>T/K</th>
<th>P/atm</th>
<th>(10^4 x_1/\text{mol fraction} )</th>
<th>(10^4 k/\text{mol fraction atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1089</td>
<td>0.296</td>
<td>22</td>
<td>74</td>
</tr>
<tr>
<td>1089</td>
<td>0.537</td>
<td>30</td>
<td>56</td>
</tr>
<tr>
<td>1089</td>
<td>0.537</td>
<td>35</td>
<td>65</td>
</tr>
<tr>
<td>1092</td>
<td>0.498</td>
<td>32</td>
<td>64</td>
</tr>
<tr>
<td>1097</td>
<td>0.470</td>
<td>32</td>
<td>68</td>
</tr>
<tr>
<td>1099</td>
<td>0.456</td>
<td>25</td>
<td>55</td>
</tr>
<tr>
<td>1099</td>
<td>0.456</td>
<td>30</td>
<td>66</td>
</tr>
<tr>
<td>1114</td>
<td>0.409</td>
<td>26</td>
<td>64</td>
</tr>
<tr>
<td>1129</td>
<td>0.266</td>
<td>16</td>
<td>60</td>
</tr>
<tr>
<td>1139</td>
<td>0.169</td>
<td>11</td>
<td>65</td>
</tr>
<tr>
<td>1139</td>
<td>0.298</td>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td>1139</td>
<td>0.298</td>
<td>17</td>
<td>57</td>
</tr>
<tr>
<td>1139</td>
<td>0.353</td>
<td>18</td>
<td>51</td>
</tr>
<tr>
<td>1139</td>
<td>0.353</td>
<td>22</td>
<td>62</td>
</tr>
<tr>
<td>1139</td>
<td>0.470</td>
<td>25</td>
<td>53</td>
</tr>
<tr>
<td>1139</td>
<td>0.470</td>
<td>28</td>
<td>60</td>
</tr>
<tr>
<td>1139</td>
<td>0.316</td>
<td>28</td>
<td>51</td>
</tr>
<tr>
<td>1159</td>
<td>0.316</td>
<td>20</td>
<td>63</td>
</tr>
<tr>
<td>1176</td>
<td>0.296</td>
<td>20</td>
<td>68</td>
</tr>
<tr>
<td>1176</td>
<td>0.470</td>
<td>25</td>
<td>63</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Equilibrium at fixed vapor pressure. Method used for solubility measurements has been described earlier (1). A known amount of the melt, at a constant temperature, was kept in contact with the vapor phase consisting of a mixture of argon and titanium tetrachloride for about 8 hr. The partial pressure of titanium tetrachloride, at a fixed temperature, was calculated from an equation (2). The saturated melt was solidified and analyzed for titanium using a calorimetric method.

SOURCE AND PURITY OF MATERIALS:

Not given

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

1. Smirnov, M. V.; Maksimov, V. S.
   Electrochem. Molten Solid
   Electrolytes 1967, 5, 33.

continued
COMPONENTS:

(1) Titanium tetrachloride; 
\( \text{TiCl}_4; [7550-45-0] \)

(2) Sodium chloride; \( \text{NaCl}; [7647-14-5] \)

VARIABLES:

\[ T/K = 1089 - 1224 \]
\[ P/\text{kPa} = 17.124 - 54.412 \]

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>T/K</th>
<th>P/atm</th>
<th>10^4 x_1/mol fraction</th>
<th>10^4 k/mol fraction atm^{-1}</th>
</tr>
</thead>
<tbody>
<tr>
<td>1176</td>
<td>0.470</td>
<td>27</td>
<td>57</td>
</tr>
<tr>
<td>1194</td>
<td>0.409</td>
<td>22</td>
<td>54</td>
</tr>
<tr>
<td>1209</td>
<td>0.266</td>
<td>14</td>
<td>53</td>
</tr>
<tr>
<td>1209</td>
<td>0.266</td>
<td>16</td>
<td>60</td>
</tr>
<tr>
<td>1209</td>
<td>0.298</td>
<td>17</td>
<td>57</td>
</tr>
<tr>
<td>1224</td>
<td>0.296</td>
<td>17</td>
<td>57</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of \( k \) is expressed by the relation:

\[
\log(k/\text{mol fraction atm}^{-1}) = -2.73 + 580/(T/K) \pm 0.04
\]

The solubility of \( \text{TiCl}_4 \) as a function of temperature and the partial pressure of \( \text{TiCl}_4 \) in the gas phase is given by:

\[
\log(x_1/\text{mol fraction}) = \log(p/\text{atm}) - 2.73 + 580/(T/K) \pm 0.04
\]

The enthalpy of solution is:

\[
\Delta H/\text{kJ mol}^{-1} = -11.3
\]

SOURCE AND PURITY OF MATERIALS:

REFERENCES:

continued

2. Pike, F. P.; Foster, C. T.

COMPONENTS:

(1) Titanium tetrachloride; TiCl₄; [7550-45-0]
(2) Potassium chloride; KCl; [7447-40-7]

VARIABLES:

\[ T/K = 1096 - 1213 \]
\[ P/kPa = 34.248 - 65.456 \]

EXPERIMENTAL VALUES:

Henry's law was obeyed up to \( P_{\text{TiCl}_4} = 0.7 \, \text{atm} \). Values of solubility \( x_1 \) and the constant \( k \) (\( = x_1/P \)) at various temperatures are given as:

<table>
<thead>
<tr>
<th>T/K</th>
<th>P/atm</th>
<th>( 10^3 x_1 )/mol fraction</th>
<th>( 10^3 k/\text{mol fraction atm}^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1096</td>
<td>0.338</td>
<td>30</td>
<td>90</td>
</tr>
<tr>
<td>1096</td>
<td>0.338</td>
<td>34</td>
<td>99</td>
</tr>
<tr>
<td>1096</td>
<td>0.479</td>
<td>44</td>
<td>92</td>
</tr>
<tr>
<td>1096</td>
<td>0.479</td>
<td>44</td>
<td>92</td>
</tr>
<tr>
<td>1096</td>
<td>0.479</td>
<td>46</td>
<td>96</td>
</tr>
<tr>
<td>1096</td>
<td>0.479</td>
<td>47</td>
<td>98</td>
</tr>
<tr>
<td>1096</td>
<td>0.646</td>
<td>60</td>
<td>93</td>
</tr>
<tr>
<td>1114</td>
<td>0.338</td>
<td>29</td>
<td>85</td>
</tr>
<tr>
<td>1114</td>
<td>0.479</td>
<td>42</td>
<td>88</td>
</tr>
<tr>
<td>1114</td>
<td>0.479</td>
<td>43</td>
<td>90</td>
</tr>
<tr>
<td>1114</td>
<td>0.479</td>
<td>43</td>
<td>90</td>
</tr>
<tr>
<td>1114</td>
<td>0.646</td>
<td>54</td>
<td>84</td>
</tr>
<tr>
<td>1135</td>
<td>0.338</td>
<td>26</td>
<td>77</td>
</tr>
<tr>
<td>1135</td>
<td>0.338</td>
<td>27</td>
<td>79</td>
</tr>
<tr>
<td>1135</td>
<td>0.338</td>
<td>28</td>
<td>84</td>
</tr>
<tr>
<td>1135</td>
<td>0.479</td>
<td>36</td>
<td>76</td>
</tr>
<tr>
<td>1135</td>
<td>0.479</td>
<td>38</td>
<td>80</td>
</tr>
<tr>
<td>1135</td>
<td>0.646</td>
<td>50</td>
<td>78</td>
</tr>
<tr>
<td>1135</td>
<td>0.646</td>
<td>51</td>
<td>79</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Equilibrium at fixed vapor pressure.
A known amount of the melt was kept in contact with argon containing vapors of titanium tetrachloride with a specific partial pressure. It was allowed to come to equilibrium for at least 10 hr. The saturated melt was solidified and analyzed for titanium.

SOURCE AND PURITY OF MATERIALS:

Pure KCl, TiCl₄ and argon were used.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:
COMPONENTS:

1) Titanium tetrachloride; TiCl₄; [7550-45-0]
2) Potassium chloride; KCl; [7447-40-7]

VARIABLES:

T/K = 1096 - 1213
P/kPa = 34.248 - 65.456

EXPERIMENTAL VALUES: continued

<table>
<thead>
<tr>
<th>T/K</th>
<th>P/atm</th>
<th>10³ x₄/mol fraction</th>
<th>10³ k/mol fraction atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>1174</td>
<td>0.338</td>
<td>23</td>
<td>69</td>
</tr>
<tr>
<td>1174</td>
<td>0.338</td>
<td>24</td>
<td>70</td>
</tr>
<tr>
<td>1174</td>
<td>0.338</td>
<td>26</td>
<td>77</td>
</tr>
<tr>
<td>1174</td>
<td>0.479</td>
<td>32</td>
<td>66</td>
</tr>
<tr>
<td>1174</td>
<td>0.646</td>
<td>45</td>
<td>70</td>
</tr>
<tr>
<td>1174</td>
<td>0.646</td>
<td>48</td>
<td>74</td>
</tr>
<tr>
<td>1213</td>
<td>0.338</td>
<td>22</td>
<td>64</td>
</tr>
<tr>
<td>1213</td>
<td>0.338</td>
<td>24</td>
<td>72</td>
</tr>
<tr>
<td>1213</td>
<td>0.479</td>
<td>29</td>
<td>60</td>
</tr>
<tr>
<td>1213</td>
<td>0.574</td>
<td>35</td>
<td>61</td>
</tr>
<tr>
<td>1213</td>
<td>0.646</td>
<td>37</td>
<td>58</td>
</tr>
<tr>
<td>1213</td>
<td>0.646</td>
<td>39</td>
<td>60</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of k is expressed by the relation:

\[
\log(k/mol \text{ fraction atm}^{-1}) = -2.86 + 2000/(T/K) \pm 0.02
\]

The solubility of TiCl₄ as a function of temperature and the partial pressure of TiCl₄ in the gas phase is given by:

\[
\log(x₄/mol \text{ fraction}) = \log(P/atm) - 2.86 + 2000/(T/K) \pm 0.02
\]

The enthalpy of solution is:

\[
\Delta H/kJ \text{ mol}^{-1} = -38.1
\]
COMPONENTS:

(1) Titanium tetrachloride; TiCl₄; [7550-45-0]

(2) Potassium chloride; KCl; [7447-40-7]

VARIABLES:

\[ T/K = 1123 - 1173 \]

EXPERIMENTAL VALUES:

Solubilities of TiCl₄ in molten KCl at different temperatures are reported to be:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>C₁/mass%</th>
<th>(10² x₁) mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>850</td>
<td>3.87</td>
<td>1.52</td>
</tr>
<tr>
<td>880</td>
<td>3.15</td>
<td>1.24</td>
</tr>
<tr>
<td>900</td>
<td>2.94</td>
<td>1.15</td>
</tr>
</tbody>
</table>

* Calculated by the compiler.
Pressure of TiCl₄ was the vapor pressure of liquid TiCl₄ at 160°C.

Smoothed Data:

Temperature dependence of \(C₁\) is expressed by the equation:

\[ \log(C₁/mass\%) = -2.278 + 3214/(T/K) \]

(compiler)

std. dev. = 1.3% (compiler)

SOURCE AND PURITY OF MATERIALS:

Titanium tetrachloride was of 99.99% purity.
Potassium chloride was of "chemically pure" grade.

REFERENCES:
COMPONENTS:

(1) Titanium tetra chloride; TiCl₄; [7550-45-0]
(2) Rubidium chloride; RbCl; [7791-11-9]

ORIGINAL MEASUREMENTS:


VARIABLES:

T/K = 1000 - 1170
P/kPa = 10.234 - 45.191

EXPERIMENTAL VALUES:

Henry's law was obeyed up to \( P_{\text{TiCl}_4} = 0.5 \) atm. Values of solubility \( x_1 \) and the constant \( k = x_1/P \) at various temperatures are given as:

\[
\begin{array}{cccc}
T/K & P/\text{atm} & 10^3 x_1/\text{mol fraction} & 10^2 k/\text{mol fraction atm}^{-1} \\
1000 & 0.226 & 81 & 35.8 \\
1000 & 0.226 & 86 & 38.1 \\
1008 & 0.423 & 127 & 30.0 \\
1010 & 0.101 & 30 & 29.7 \\
1015 & 0.173 & 54 & 31.2 \\
1015 & 0.173 & 51 & 29.5 \\
1043 & 0.226 & 61 & 27.0 \\
1048 & 0.240 & 70 & 29.2 \\
1051 & 0.423 & 92 & 21.7 \\
1051 & 0.423 & 98 & 23.2 \\
1053 & 0.446 & 118 & 26.4 \\
1060 & 0.173 & 43 & 26.9 \\
1062 & 0.263 & 63 & 24.9 \\
1063 & 0.242 & 53 & 24.0 \\
1065 & 0.251 & 68 & 21.9 \\
1070 & 0.313 & 61 & 27.1 \\
1070 & 0.313 & 69 & 19.5 \\
1072 & 0.260 & 55 & 22.0 \\
1072 & 0.260 & 60 & 21.2 \\
\end{array}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Equilibrium at fixed vapor pressure.
A known amount of the melt was kept in contact with argon containing vapors of titanium tetrachloride with a specific partial pressure. It was allowed to reach equilibrium for at least 8 hrs. The saturated melt was solidified and analyzed for titanium using a calorimetric method.

SOURCE AND PURITY OF MATERIALS:

Titanium tetrachloride and rubidium chloride were of "pure" grade.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

continued
Components:

(1) Titanium tetrachloride; TiCl₄; [7550-45-0]
(2) Rubidium chloride; RbCl; [7791-11-9]

Variables:

T/K = 1000 - 1170
P/kPa = 10.234 - 45.191

Experimental Values:

<table>
<thead>
<tr>
<th>T/K</th>
<th>P/atm</th>
<th>10² x₁/mol fraction</th>
<th>10² k/mol fraction atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>1078</td>
<td>0.232</td>
<td>54</td>
<td>23.3</td>
</tr>
<tr>
<td>1089</td>
<td>0.226</td>
<td>43</td>
<td>19.0</td>
</tr>
<tr>
<td>1089</td>
<td>0.240</td>
<td>52</td>
<td>21.7</td>
</tr>
<tr>
<td>1107</td>
<td>0.101</td>
<td>20</td>
<td>19.8</td>
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<tr>
<td>1107</td>
<td>0.242</td>
<td>42</td>
<td>17.4</td>
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<td>1107</td>
<td>0.242</td>
<td>45</td>
<td>18.6</td>
</tr>
<tr>
<td>1107</td>
<td>0.232</td>
<td>46</td>
<td>19.8</td>
</tr>
<tr>
<td>1107</td>
<td>0.356</td>
<td>68</td>
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</tr>
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<td>0.260</td>
<td>51</td>
<td>19.6</td>
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<td>1107</td>
<td>0.263</td>
<td>51</td>
<td>19.4</td>
</tr>
<tr>
<td>1107</td>
<td>0.423</td>
<td>73</td>
<td>17.3</td>
</tr>
<tr>
<td>1107</td>
<td>0.446</td>
<td>88</td>
<td>19.7</td>
</tr>
<tr>
<td>1115</td>
<td>0.313</td>
<td>55</td>
<td>17.6</td>
</tr>
<tr>
<td>1136</td>
<td>0.232</td>
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<td>16.8</td>
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<tr>
<td>1136</td>
<td>0.232</td>
<td>42</td>
<td>18.1</td>
</tr>
<tr>
<td>1141</td>
<td>0.240</td>
<td>44</td>
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<td>1156</td>
<td>0.263</td>
<td>42</td>
<td>16.0</td>
</tr>
<tr>
<td>1169</td>
<td>0.260</td>
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<td>14.6</td>
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</tr>
<tr>
<td>1170</td>
<td>0.446</td>
<td>60</td>
<td>13.5</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of k is expressed by the relation:

\[ \log(k/\text{mol fraction atm}^{-1}) = -2.92 + \frac{2430}{(T/K)} \pm 0.03 \]

Auxiliary Information:

Method/Apparatus/Procedure:

Source and Purify of Materials:

Estimated Error:

References:
**COMPONENTS:**

1. Titanium tetrachloride; TiCl₄; [7550-45-0]
2. Rubidium chloride; RbCl; [7791-11-9]

**ORIGINAL MEASUREMENTS:**


**VARIABLES:**

<table>
<thead>
<tr>
<th>T/K</th>
<th>P/kPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 - 1170</td>
<td>10.234 - 45.191</td>
</tr>
</tbody>
</table>

**EXPERIMENTAL VALUES:**

continued

The solubility of TiCl₄ as a function of temperature and the partial pressure of TiCl₄ in the gas phase is given by:

\[
\log(x_1/\text{mol fraction}) = \log(P/\text{atm}) - 2.92 + 2430/(T/K)
\]

The enthalpy of solution is:

\[
\Delta H/\text{kJ mol}^{-1} = -46.4
\]
**COMPONENTS:**

1. Titanium tetrachloride; TiCl₄; [7550-45-0]
2. Cesium chloride; CsCl; [7647-17-8]

**VARIABLES:**

\[
\begin{align*}
T/K &= 934 - 1163 \\
P/kPa &= 7.903 - 70.826
\end{align*}
\]

**ORIGINAL MEASUREMENTS:**


**EXPERIMENTAL VALUES:**

Henry's law was obeyed up to \( P_{\text{TiCl}_4} = 0.7 \) atm. Values of solubility \( (x_1) \) and the constant \( k = x_1/P \) at various temperatures are given as:

<table>
<thead>
<tr>
<th>T/K</th>
<th>P/atm</th>
<th>( 10^2 x_1 )</th>
<th>Fraction</th>
<th>( 10^2 k/\text{mol fraction atm}^{-1} )</th>
</tr>
</thead>
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<tr>
<td>934</td>
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<td>27.6</td>
<td></td>
<td>110.0</td>
</tr>
<tr>
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<td>0.251</td>
<td>28.0</td>
<td></td>
<td>111.6</td>
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<tr>
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<td>29.5</td>
<td></td>
<td>110.5</td>
</tr>
<tr>
<td>934</td>
<td>0.329</td>
<td>34.9</td>
<td></td>
<td>--</td>
</tr>
<tr>
<td>934</td>
<td>0.359</td>
<td>33.5</td>
<td></td>
<td>--</td>
</tr>
<tr>
<td>943</td>
<td>0.585</td>
<td>33.8</td>
<td></td>
<td>--</td>
</tr>
<tr>
<td>943</td>
<td>0.585</td>
<td>33.7</td>
<td></td>
<td>--</td>
</tr>
<tr>
<td>948</td>
<td>0.303</td>
<td>26.9</td>
<td></td>
<td>88.8</td>
</tr>
<tr>
<td>948</td>
<td>0.303</td>
<td>28.1</td>
<td></td>
<td>92.7</td>
</tr>
<tr>
<td>965</td>
<td>0.236</td>
<td>17.1</td>
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<td>72.5</td>
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<tr>
<td>971</td>
<td>0.383</td>
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<td>981</td>
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<td>1000</td>
<td>0.328</td>
<td>24.2</td>
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<tr>
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<td>0.236</td>
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<td></td>
<td>70.3</td>
</tr>
</tbody>
</table>

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Equilibrium at fixed vapor pressure.

Details and diagram of the apparatus used for solubility measurements are given in the original paper. A known amount of the melt was kept in contact with argon containing vapors of titanium tetrachloride with a specific partial pressure. It was allowed to attain equilibrium for about 8 hrs. The saturated melt was solidified and analyzed for titanium using a calorimetric method.

**SOURCE AND PURITY OF MATERIALS:**

"Pure" titanium tetrachloride which was further purified by double distillation over copper shavings in a stream of pure argon was used. Cesium chloride was "chemically pure" grade.

Argon was freed from oxygen and moisture by passing over anhydrous \( \text{P}_2\text{O}_5 \), Cu shavings heated to 450°C and titanium shavings heated to 850°C.

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**
COMPONENTS:

(1) Titanium tetrachloride; TiCl₄; [7550-45-0]

(2) Cesium chloride; CsCl; [7647-17-8]

ORIGINAL MEASUREMENTS:


VARIABLES:

T/K = 934 - 1163
P/kPa = 7.903 - 70.826

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>T/K</th>
<th>P/atm</th>
<th>10² xₐ/mol fraction</th>
<th>10² k/mol fraction atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>1005</td>
<td>0.267</td>
<td>17.8</td>
<td>66.7</td>
</tr>
<tr>
<td>1005</td>
<td>0.329</td>
<td>19.2</td>
<td>58.4</td>
</tr>
<tr>
<td>1005</td>
<td>0.329</td>
<td>19.5</td>
<td>59.3</td>
</tr>
<tr>
<td>1005</td>
<td>0.329</td>
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<td>62.6</td>
</tr>
<tr>
<td>1005</td>
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<td>66.1</td>
</tr>
<tr>
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</tr>
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<td>61.3</td>
</tr>
<tr>
<td>1021</td>
<td>0.257</td>
<td>14.2</td>
<td>55.3</td>
</tr>
<tr>
<td>1035</td>
<td>0.249</td>
<td>13.2</td>
<td>53.0</td>
</tr>
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<td>51.4</td>
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<td>1041</td>
<td>0.395</td>
<td>20.5</td>
<td>51.9</td>
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<td>1046</td>
<td>0.359</td>
<td>17.7</td>
<td>49.3</td>
</tr>
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<td>1053</td>
<td>0.375</td>
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<td>45.9</td>
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<td>45.9</td>
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<td>47.8</td>
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<td>34.0</td>
</tr>
<tr>
<td>1101</td>
<td>0.153</td>
<td>5.6</td>
<td>36.6</td>
</tr>
<tr>
<td>1101</td>
<td>0.153</td>
<td>6.1</td>
<td>39.9</td>
</tr>
<tr>
<td>1101</td>
<td>0.326</td>
<td>11.2</td>
<td>34.4</td>
</tr>
<tr>
<td>1101</td>
<td>0.326</td>
<td>11.5</td>
<td>35.3</td>
</tr>
<tr>
<td>1101</td>
<td>0.395</td>
<td>14.1</td>
<td>35.7</td>
</tr>
<tr>
<td>1101</td>
<td>0.648</td>
<td>23.1</td>
<td>35.6</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:

(1) Titanium tetrachloride; 
TiCl₄; [7550-45-0]

(2) Cesium chloride; CsCl; 
[7647-17-8]

ORIGINAL MEASUREMENTS:

1. Smirnov, M. V.; Maksimov, V. S. 
Electrochem. Molten Solid 

2. Smirnov, M. V.; Maksimov, V. S.; 
Khaimenov, A. P. 
Russ. J. Inorg. Chem. 1966, 11, 
945 - 48.

VARIABLES:

T/K = 934 - 1163

P/kPa = 7.903 - 70.826

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES: continued

<table>
<thead>
<tr>
<th>T/K</th>
<th>P/atm</th>
<th>10² x₁/mol fraction</th>
<th>10² k/mol fraction atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>1101</td>
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<td>36.3</td>
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<td>35.5</td>
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<td>31.4</td>
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<td>28.1</td>
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<td>26.9</td>
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<tr>
<td>1163</td>
<td>0.294</td>
<td>8.2</td>
<td>27.9</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of k is expressed by the relation:

\[ \log(k/\text{mol fraction atm}^{-1}) = -2.95 + \frac{2770}{(T/\text{K})} \pm 0.027 \]

The solubility of TiCl₄ as a function of temperature and the partial pressure of TiCl₄ in the gas phase is given by:

\[ \log(x₁/\text{mol fraction}) = \log(P/\text{atm}) - 2.95 + \frac{2770}{(T/\text{K})} \pm 0.027 \]

The enthalpy of solution is:

\[ \Delta H/\text{kJ mol}^{-1} = -53.1 \]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:
(1) Titanium tetrachloride; TiCl₄; [7550-45-0]
(2) Magnesium chloride; MgCl₂; [7786-30-3]

VARIABLES:
T/K = 993 - 1204
P/kPa = 15.807 - 95.448

EXPERIMENTAL VALUES:

Henry's law was obeyed up to \( P_{\text{TiCl}_4} = 0.94 \) atm. Values of solubility \( x_1 \) and the constant \( k ( = \frac{x_1}{P}) \) at various temperatures are given as:

<table>
<thead>
<tr>
<th>T/K</th>
<th>P/atm</th>
<th>( 10^4 x_1 )/mol fraction</th>
<th>( 10^4 k )/mol fraction atm(^{-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>993</td>
<td>0.249</td>
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<td>40</td>
</tr>
<tr>
<td>1000</td>
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<td>1110</td>
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</tr>
<tr>
<td>1110</td>
<td>0.507</td>
<td>38</td>
<td>75</td>
</tr>
<tr>
<td>1117</td>
<td>0.893</td>
<td>54</td>
<td>60</td>
</tr>
<tr>
<td>1123</td>
<td>0.156</td>
<td>8</td>
<td>51</td>
</tr>
<tr>
<td>1145</td>
<td>0.778</td>
<td>48</td>
<td>62</td>
</tr>
<tr>
<td>1155</td>
<td>0.759</td>
<td>64</td>
<td>84</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Equilibrium at fixed vapor pressure.
The method used for solubility measurements was the same as described earlier (1). A known amount of the melt was kept in contact with argon containing vapors of titanium tetrachloride with a specific partial pressure. It was allowed to reach equilibrium for at least 8 hrs. The saturated melt was solidified and analyzed for titanium using a calorimetric method.

SOURCE AND PURITY OF MATERIALS:
Anhydrous MgCl₂ was obtained from Magnesium and very pure TiCl₄ and triply distilled in vacuo.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
1. Smirnov, M. V.; Maksimov, V. S.
COMPONENTS:

(1) Titanium tetrachloride; TiCl$_4$; [7550-45-0]

(2) Magnesium chloride; MgCl$_2$; [7786-30-3]

ORIGINAL MEASUREMENTS:
Smirnov, M. V.; Maksimov, V. S.

VARIABLES:

T/K = 993 - 1204
P/kPa = 15.807 - 95.448

EXPERIMENTAL VALUES: continued

<table>
<thead>
<tr>
<th>T/K</th>
<th>P/atm</th>
<th>$10^4$ $x_4$/mol fraction</th>
<th>$10^4$ k/mol fraction atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1175</td>
<td>0.942</td>
<td>90</td>
<td>96</td>
</tr>
<tr>
<td>1181</td>
<td>0.893</td>
<td>62</td>
<td>69</td>
</tr>
<tr>
<td>1191</td>
<td>0.925</td>
<td>76</td>
<td>82</td>
</tr>
<tr>
<td>1191</td>
<td>0.925</td>
<td>82</td>
<td>89</td>
</tr>
<tr>
<td>1204</td>
<td>0.898</td>
<td>78</td>
<td>87</td>
</tr>
<tr>
<td>1204</td>
<td>0.898</td>
<td>82</td>
<td>91</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of $k$ is expressed by the relation:

$$\log(k/\text{mol fraction atm}^{-1}) = -0.50 - 1890/(T/K) \pm 0.05$$

The solubility of TiCl$_4$ as a function of temperature and the partial pressure of TiCl$_4$ in the gas phase is given by:

$$\log(x_4/\text{mol fraction}) = \log(P/\text{atm}) - 0.50 - 1890/(T/K)$$

The enthalpy of solution is:

$$\Delta H/\text{kJ mol}^{-1} = 36.2$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:
(1) Titanium tetrachloride; TiCl$_4$; [7550-45-0]
(2) Lithium chloride; LiCl; [7447-41-8]
(3) Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS:

VARIABLES:
T/K = 823 - 1023
P/kPa = 20.265 - 88.355

EXPERIMENTAL VALUES:
Henry’s law was obeyed up to P$_{TiCl_4}$ = 0.9 atm. in the molten eutectic 3 LiCl − 2 KCl. Values of solubility $x_1$ and the constant k ($= x_1/P$) at various temperatures are given as:

<table>
<thead>
<tr>
<th>T/K</th>
<th>P/atm</th>
<th>10$^4$ $x_1$/mol fraction</th>
<th>10$^4$ k/mol fraction atm$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>823</td>
<td>0.804</td>
<td>21</td>
<td>26</td>
</tr>
<tr>
<td>824</td>
<td>0.299</td>
<td>9</td>
<td>30</td>
</tr>
<tr>
<td>838</td>
<td>0.821</td>
<td>22</td>
<td>27</td>
</tr>
<tr>
<td>850</td>
<td>0.804</td>
<td>29</td>
<td>36</td>
</tr>
<tr>
<td>853</td>
<td>0.299</td>
<td>7</td>
<td>23</td>
</tr>
<tr>
<td>859</td>
<td>0.404</td>
<td>12</td>
<td>30</td>
</tr>
<tr>
<td>863</td>
<td>0.200</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>870</td>
<td>0.810</td>
<td>27</td>
<td>33</td>
</tr>
<tr>
<td>877</td>
<td>0.821</td>
<td>30</td>
<td>37</td>
</tr>
<tr>
<td>888</td>
<td>0.404</td>
<td>9</td>
<td>22</td>
</tr>
<tr>
<td>906</td>
<td>0.200</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>906</td>
<td>0.547</td>
<td>12</td>
<td>22</td>
</tr>
<tr>
<td>906</td>
<td>0.547</td>
<td>15</td>
<td>27</td>
</tr>
<tr>
<td>906</td>
<td>0.648</td>
<td>14</td>
<td>22</td>
</tr>
<tr>
<td>906</td>
<td>0.810</td>
<td>21</td>
<td>26</td>
</tr>
<tr>
<td>916</td>
<td>0.404</td>
<td>15</td>
<td>37</td>
</tr>
<tr>
<td>932</td>
<td>0.872</td>
<td>21</td>
<td>24</td>
</tr>
<tr>
<td>943</td>
<td>0.810</td>
<td>24</td>
<td>30</td>
</tr>
<tr>
<td>943</td>
<td>0.810</td>
<td>29</td>
<td>36</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Equilibrium at fixed vapor pressure.
A known amount of the melt was kept in contact with argon containing vapors of titanium tetrachloride with a specific partial pressure. It was allowed to reach equilibrium for at least 8 hrs. The saturated melt was solidified and analyzed for titanium using a calorimetric method.

SOURCE AND PURITY OF MATERIALS:
Titanium tetrachloride was of "pure" grade.
LiCl and KCl were of c.p. grade.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
## COMPONENTS:

1. Titanium tetrachloride; TiCl₄; [7550-45-0]
2. Lithium chloride; LiCl; [7447-41-8]
3. Potassium chloride; KCl; [7447-40-7]

## EXPERIMENTAL VALUES: continued

<table>
<thead>
<tr>
<th>T/K</th>
<th>P/atm</th>
<th>10⁴ x₁/mol fraction</th>
<th>10⁴ k/mol fraction atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>951</td>
<td>0.547</td>
<td>13</td>
<td>24</td>
</tr>
<tr>
<td>952</td>
<td>0.648</td>
<td>20</td>
<td>31</td>
</tr>
<tr>
<td>970</td>
<td>0.872</td>
<td>27</td>
<td>31</td>
</tr>
<tr>
<td>982</td>
<td>0.547</td>
<td>17</td>
<td>31</td>
</tr>
<tr>
<td>991</td>
<td>0.648</td>
<td>23</td>
<td>35</td>
</tr>
<tr>
<td>1023</td>
<td>0.872</td>
<td>28</td>
<td>32</td>
</tr>
</tbody>
</table>

Smoothed Data:

Temperature dependence of k is expressed by the relation:

\[
\log(k/\text{mol fraction atm}^{-1}) = -2.29 - 230/(T/\text{K})
\]

The solubility of TiCl₄ as a function of temperature and the partial pressure of TiCl₄ in the gas phase is given by:

\[
\log(x₁/\text{mol fraction}) = \log(P/\text{atm}) - 2.29 - 230/(T/\text{K})
\]

The enthalpy of solution is:

\[
\Delta H/\text{kJ mol}^{-1} = 4.2
\]
COMPONENTS:
(1) Titanium tetrachloride; TiCl₄; [7550-45-0]
(2) Lithium chloride; LiCl; [7447-41-8]
(3) Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS:
Mui, J. H.; Flengas, S. N.

VARIABLES:
P/kPa: 101.325 (compiler)
T/K = 693 - 773

EXPERIMENTAL VALUES:

The solubilities (wt%) of titanium tetrachloride in the molten eutectic LiCl - KCl (59 - 41 mol%) at different temperatures are given in graphical form. The solubilities derived from the graph, by the compiler, are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>C₁mass%</th>
<th>10³ x₁/mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>420</td>
<td>1.5</td>
<td>4.39</td>
</tr>
<tr>
<td>443</td>
<td>1.8</td>
<td>5.27</td>
</tr>
<tr>
<td>456</td>
<td>2.0</td>
<td>5.86</td>
</tr>
<tr>
<td>478</td>
<td>2.9</td>
<td>8.49</td>
</tr>
<tr>
<td>490</td>
<td>3.95</td>
<td>11.57</td>
</tr>
<tr>
<td>500</td>
<td>5.0</td>
<td>14.64</td>
</tr>
</tbody>
</table>

a Reaction solubilities, TiCl₄ reacts with KCl of the melt to give K₂TiCl₆.

b Calculated by the compiler.

Smoothed Data:
Temperature dependence of C₁ is expressed by the equation:

$$\log(C₁\text{mass%}) = 5.179 - 3508.6/(T/K) \quad (\text{compiler})$$

std. dev. = 5.9% \quad (\text{compiler})

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Equilibrium vapor pressure measurements.
For diagram and details of the apparatus and procedure employed for solubility measurements refer to the original publication.

SOURCE AND PURITY OF MATERIALS:
Commercially pure TiCl₄ was further purified by refluxing in the presence of Cu filings for about 2 hours and by fractional distillation in a dry atmosphere. Reagent grade LiCl and KCl were used for the preparation of the eutectic melt. The melt was purified by HCl treatment following the method of Boston and Smith (1).

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
1. Boston, C. R.; Smith, G. P.
### EXPERIMENTAL VALUES:

For the solubility of TiCl₄ in equimolar NaCl - KCl melt, Henry's law was obeyed up to $P_{\text{TiCl}_4} = 0.7$ atm. Values of solubility ($x_1$) and the constant $k (= x_1/P)$ at various temperatures are given as:

<table>
<thead>
<tr>
<th>T/K</th>
<th>P/atm</th>
<th>$10^4 x_1$/mol fraction</th>
<th>$10^4 k$/mol fraction atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>961</td>
<td>0.433</td>
<td>134</td>
<td>31</td>
</tr>
<tr>
<td>985</td>
<td>0.492</td>
<td>164</td>
<td>33</td>
</tr>
<tr>
<td>1003</td>
<td>0.433</td>
<td>118</td>
<td>27</td>
</tr>
<tr>
<td>1003</td>
<td>0.433</td>
<td>156</td>
<td>36</td>
</tr>
<tr>
<td>1018</td>
<td>0.503</td>
<td>147</td>
<td>29</td>
</tr>
<tr>
<td>1036</td>
<td>0.433</td>
<td>108</td>
<td>25</td>
</tr>
<tr>
<td>1041</td>
<td>0.405</td>
<td>129</td>
<td>32</td>
</tr>
<tr>
<td>1041</td>
<td>0.405</td>
<td>148</td>
<td>37</td>
</tr>
<tr>
<td>1055</td>
<td>0.276</td>
<td>84</td>
<td>30</td>
</tr>
<tr>
<td>1070</td>
<td>0.492</td>
<td>129</td>
<td>26</td>
</tr>
<tr>
<td>1070</td>
<td>0.492</td>
<td>147</td>
<td>30</td>
</tr>
<tr>
<td>1079</td>
<td>0.503</td>
<td>120</td>
<td>24</td>
</tr>
<tr>
<td>1083</td>
<td>0.405</td>
<td>108</td>
<td>27</td>
</tr>
<tr>
<td>1083</td>
<td>0.405</td>
<td>115</td>
<td>28</td>
</tr>
<tr>
<td>1085</td>
<td>0.401</td>
<td>125</td>
<td>31</td>
</tr>
<tr>
<td>1111</td>
<td>0.492</td>
<td>109</td>
<td>22</td>
</tr>
<tr>
<td>1111</td>
<td>0.492</td>
<td>111</td>
<td>23</td>
</tr>
<tr>
<td>1111</td>
<td>0.552</td>
<td>151</td>
<td>27</td>
</tr>
<tr>
<td>1111</td>
<td>0.552</td>
<td>166</td>
<td>30</td>
</tr>
</tbody>
</table>

### AUXILIARY INFORMATION

**METHOD/APPROATUS/PROCEDURE:**

Equilibrium at fixed vapor pressure.

Method employed for solubility measurements was the same as described elsewhere (1). A known amount of the melt was kept in contact with the vapor phase consisting of argon and titanium tetrachloride for about 8 hrs. The saturated melt was solidified and analyzed for titanium using a calorimetric method.

**SOURCE AND PURITY OF MATERIALS:**

Not given.

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**

1. Smirnov, M. V.; Maksimov, V. S.

COMPONENTS:
(1) Titanium tetrachloride; TiCl₄; [7550-45-0]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS: continued
2. Smirnov, M. V.; Maksimov, V. S.; Khaimenov, A. P.

VARIABLES:
T/K = 961 - 1214
P/kPa = 25.939 - 70.826

PREPARED BY:
N. P. Bansal

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>T/K</th>
<th>P/kPa</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1126</td>
<td>0.256</td>
<td>61</td>
</tr>
<tr>
<td>1126</td>
<td>0.405</td>
<td>83</td>
</tr>
<tr>
<td>1126</td>
<td>0.405</td>
<td>93</td>
</tr>
<tr>
<td>1126</td>
<td>0.503</td>
<td>104</td>
</tr>
<tr>
<td>1126</td>
<td>0.699</td>
<td>157</td>
</tr>
<tr>
<td>1126</td>
<td>0.699</td>
<td>188</td>
</tr>
<tr>
<td>1131</td>
<td>0.401</td>
<td>95</td>
</tr>
<tr>
<td>1131</td>
<td>0.401</td>
<td>103</td>
</tr>
<tr>
<td>1155</td>
<td>0.552</td>
<td>113</td>
</tr>
<tr>
<td>1171</td>
<td>0.401</td>
<td>71</td>
</tr>
<tr>
<td>1194</td>
<td>0.552</td>
<td>97</td>
</tr>
<tr>
<td>1194</td>
<td>0.552</td>
<td>111</td>
</tr>
<tr>
<td>1196</td>
<td>0.699</td>
<td>131</td>
</tr>
<tr>
<td>1196</td>
<td>0.699</td>
<td>144</td>
</tr>
<tr>
<td>1214</td>
<td>0.256</td>
<td>45</td>
</tr>
</tbody>
</table>

Smoothed Data:
Temperature dependence of k is expressed by the relation:

\[
\log(\text{k/mol fraction atm}^{-1}) = -2.79 + \frac{1300}{(T/K)} \pm 0.05
\]

The dependence of solubility on temperature and the partial pressure of TiCl₄ in the gas phase is given by:

\[
\log(x_1/\text{mol fraction}) = \log(P/\text{atm}) - 2.79 + \frac{1300}{(T/K)} \pm 0.05
\]

The enthalpy of dissolution is: \(\Delta H/kJ \text{ mol}^{-1} = -25.1\)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:
(1) Titanium tetrachloride; TiCl₄; [7550-45-0]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS:

VARIABLES:
T/K = 973 - 1173

EXPERIMENTAL VALUES:
Solubilities of TiCl₄ in molten NaCl - KCl (50 - 50 mol%) mixture at different temperatures are reported to be:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>C₁/mass%</th>
<th>10³ x₁&quot;/mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td>2.84</td>
<td>9.95</td>
</tr>
<tr>
<td>750</td>
<td>2.68</td>
<td>9.39</td>
</tr>
<tr>
<td>800</td>
<td>2.39</td>
<td>8.37</td>
</tr>
<tr>
<td>850</td>
<td>2.30</td>
<td>8.06</td>
</tr>
<tr>
<td>900</td>
<td>2.18</td>
<td>7.64</td>
</tr>
</tbody>
</table>

* Calculated by the compiler.
Pressure of TiCl₄ was the vapor pressure of liquid TiCl₄ at 160°C.

Smoothed Data:
Temperature dependence of C₁ is expressed by the equation:

\[ \log(C₁/\text{mass%}) = -0.243 + 678.8/(T/K) \] (compiler)

std. dev. = 0.8% (compiler)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Isothermal method. Vapors of titanium tetrachloride were passed through the molten NaCl - KCl mixture, kept at a constant temperature, for about 10 - 15 min. The melt became saturated with the tetrachloride within 2 - 3 min. The saturated melt was solidified and titanium was determined volumetrically.

SOURCE AND PURITY OF MATERIALS:
Titanium tetrachloride was of 99.99% purity. Sodium and potassium chlorides were of "chemically pure" grade.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
COMPONENTS:
(1) Titanium tetrachloride; TiCl₄; [7550-45-0]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Potassium chloride; KCl; [7447-40-7]

VARIABLES:
T/K = 963 & 993
P/kPa = 87.993

EXPERIMENTAL VALUES:

It has been reported that titanium tetrachloride vapors react with the fused NaCl - KCl (50 - 50 mol%) mixture. After an exposure of 30 hrs. to the vapors of titanium tetrachloride, the following concentrations are found in the melt solution:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>Solubility*/mass%</th>
<th>10² x₁p/mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>690</td>
<td>14</td>
<td>4.91</td>
</tr>
<tr>
<td>720</td>
<td>5</td>
<td>1.75</td>
</tr>
</tbody>
</table>

* Equilibrium concentration was not reached even after 30 hrs; after sufficient time saturation concentration would be attained eventually, resulting in the formation of K₂TiCl₆ corresponding to the amount of KCl present in the melt.

b Calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Thermobalance technique.
The diagram and details of the apparatus and procedure employed for solubility measurements are described in the original paper. Briefly, the increase in weight of the melt in contact with vapors of titanium tetrachloride was directly observed with a quartz spring balance. Temperature of the melt was controlled within ± 0.5°C.

SOURCE AND PURITY OF MATERIALS:
Commercially pure titanium tetrachloride was purified by distillation in the presence of copper shavings under a stream of argon. The first part of the distillate was rejected.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:
COMPONENTS:

(1) Vanadyl trichloride; VOCl₃; [7727-18-6]
(2) Sodium chloride; NaCl; [7647-14-5]

VARIABLES:

T/K = 1093 - 1173

EXPERIMENTAL VALUES:

Solubilities of VOCl₃ in molten NaCl at different temperatures are reported to be:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>C₁/mass%</th>
<th>10³ x₁⁺/mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>820</td>
<td>1.9</td>
<td>6.41</td>
</tr>
<tr>
<td>850</td>
<td>3.23</td>
<td>10.90</td>
</tr>
<tr>
<td>860</td>
<td>3.44</td>
<td>11.61</td>
</tr>
<tr>
<td>880</td>
<td>4.35</td>
<td>14.68</td>
</tr>
<tr>
<td>900</td>
<td>5.45</td>
<td>18.40</td>
</tr>
</tbody>
</table>

Pressure of VOCl₃ was the vapor pressure of liquid VOCl₃ at 160°C.

* Calculated by the compiler.

Smoothed Data:

Temperature dependence of C₁ is expressed by the relation:

log(C₁/mass%) = 6.879 - 7191/(T/K) (compiler)

std. dev. = 2.4% (compiler)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isothermal method.

Vapors of vanadyl trichloride were passed through the molten NaCl, kept at a constant temperature, for about 10 - 15 min. The melt was saturated with the trichloride within 2 - 3 min. The saturated melt was solidified and analyzed for vanadium by the usual method of titration with aqueous acidified iron sulfate.

SOURCE AND PURITY OF MATERIALS:

Vanadyl trichloride was obtained by repeated rectification of TiCl₄ - VOCl₃ mixture; the concentration of titanium tetrachloride in the vanadyl trichloride was less than 0.01%. Sodium chloride was "chemically pure" grade.

ESTIMATED ERROR:

Not specified.

REFERENCES:
COMPONENTS:
(1) Vanadyl trichloride; $\text{VOCl}_3$
    [7727-18-6]
(2) Potassium chloride; KCl
    [7447-40-7]

ORIGINAL MEASUREMENTS:
Kurmaev, R. Kh.; Amirova, S. A.
1968, 13, 1166 - 68. (*).

VARIABLES:
$T/K = 1073 - 1173$

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>$t/°C$</th>
<th>$C_1$/mass%</th>
<th>$10^3 x_1$/mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>800</td>
<td>4.5</td>
<td>19.36</td>
</tr>
<tr>
<td>830</td>
<td>9.5</td>
<td>40.87</td>
</tr>
<tr>
<td>840</td>
<td>11.4</td>
<td>49.05</td>
</tr>
<tr>
<td>850</td>
<td>13.5</td>
<td>58.08</td>
</tr>
<tr>
<td>860</td>
<td>15.6</td>
<td>67.12</td>
</tr>
<tr>
<td>880</td>
<td>19.5</td>
<td>83.90</td>
</tr>
<tr>
<td>900</td>
<td>25.3</td>
<td>108.85</td>
</tr>
</tbody>
</table>

* Calculated by the compiler.
Pressure of $\text{VOCl}_3$ was the vapor pressure of liquid $\text{VOCl}_3$ at 160°C.

Smoothed Data:
Temperature dependence of $C_1$ is given by the equation:

$$\log(C_1/\text{mass%}) = 9.254 - 9162.9/(T/K)$$
(compiler)

std. dev. = 4.4% (compiler)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Isothermal method.
Vapors of vanadyl trichloride were passed through the molten KCl, kept at a constant temperature, for about 10 - 15 min. The melt became saturated with the trichloride within 2 - 3 min. The saturated melt was solidified and analyzed for vanadium by the usual method of titration with aqueous acidified iron sulfate.

SOURCE AND PURITY OF MATERIALS:
Vanadyl trichloride was obtained by repeated rectification of $\text{TiCl}_4 - \text{VOCl}_3$ mixture; the concentration of titanium tetrachloride in the vanadyl trichloride was less than 0.01%.
Potassium chloride was of "chemically pure" grade.

ESTIMATED ERROR:
Nothing specified.

REFERENCES:

COMPONENTS:

(1) Vanadyl trichloride; VOCl₃; [7727-18-6]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Potassium chloride; KCl; [7447-40-7]

VARIABLES:

T/K = 973 - 1173

EXPERIMENTAL VALUES:

Solubilities of VOCl₃ in molten NaCl - KCl (50 - 50 mol%) mixture at different temperatures are reported to be:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>C₁/mass%</th>
<th>10³ x₁*/mol fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td>5.23</td>
<td>20.07</td>
</tr>
<tr>
<td>750</td>
<td>6.38</td>
<td>24.48</td>
</tr>
<tr>
<td>800</td>
<td>6.40</td>
<td>24.56</td>
</tr>
<tr>
<td>850</td>
<td>8.75</td>
<td>33.58</td>
</tr>
<tr>
<td>900</td>
<td>10.80</td>
<td>41.44</td>
</tr>
</tbody>
</table>

* Calculated by the compiler.

Pressure of VOCl₃ was the vapor pressure of liquid VOCl₃ at 160°C.

Smoothed Data:

Temperature dependence of C₁ is expressed by the relation:

\[ \log(C₁/mass\%) = 2.483 - 1733/(T/K) \]  (compiler)

std. dev. = 4.1%  (compiler)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isothermal method.
Vapors of vanadyl trichloride were passed through the molten NaCl - KCl mixture, kept at a constant temperature, for about 10 - 15 min. The melt became saturated with the trichloride within 2 - 3 min. The saturated melt was solidified and analyzed for vanadium by the usual method of titration with aqueous acidified iron sulfate.

SOURCE AND PURITY OF MATERIALS:

Vanadyl trichloride was obtained by repeated rectification of TiCl₄ - VOCl₃ mixture; the concentration of titanium tetrachloride in vanadyl trichloride was less than 0.01%.

Sodium chloride and potassium chloride were of "chemically pure" grade.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:
COMPONENTS:

(1) Methane; CH₄; [74-82-8]
(2) Sodium nitrate; NaN₃; [7631-99-4]
(3) Potassium nitrate; KNO₃; [7757-79-1]

ORIGINAL MEASUREMENTS:

Paniccia, F.; Zambonin, P. G.

VARIABLES:

T/K = 508 - 603
P/kPa = 10²

PREPARED BY:

N. P. Bansal

EXPERIMENTAL VALUES:

The solvent was an equimolar molten mixture of sodium and potassium nitrates. The solubilities of methane in the melt at different temperatures are:

<table>
<thead>
<tr>
<th>T/K</th>
<th>10⁸ Kₜ/mol cm⁻³ bar⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>508</td>
<td>0.82</td>
</tr>
<tr>
<td>533</td>
<td>0.97</td>
</tr>
<tr>
<td>573</td>
<td>1.3</td>
</tr>
<tr>
<td>603</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Smoothed Data:

The temperature dependence of Henry's law constant, Kₜ, is given by the relation:

\[
\log(Kₜ/mol cm⁻³ atm⁻¹) = -6.38 - 865/(T/K) \quad \text{(compiler)}
\]

\[
\text{std. dev.} = 0.8\% \quad \text{(compiler)}
\]

The enthalpy, ΔH, and the standard entropy, ΔS°, of solution are:

\[
\Delta H/kJ \text{ mol}⁻¹ = 17 \quad \Delta S°/J \text{ K}⁻¹ \text{ mol}⁻¹ = -33 \quad \text{(at 533K)}
\]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Nanometric technique.

The details of the apparatus and procedure employed for solubility measurements are described elsewhere (1). Briefly, the melt was vacuum degassed for a few hours. The vacuum was disconnected and methane gas introduced at about one bar pressure. The melt was vigorously stirred and pressure changes were noted with a manometer as a function of time until the equilibrium was reached. The amount of gas dissolved was calculated from the final pressure variation after a suitable calibration.

SOURCE AND PURITY OF MATERIALS:

Methane (High Purity Grade) was purified by keeping in contact with Ascarite (A. H. Thomas Co., Philadelphia) for several hours to remove carbon dioxide and other acidic impurities and molecular sieve 5A (Carlo Erba, Milano) at -80°C to remove water.

Reagent grade NaN₃ and KNO₃ were used to prepare the melt which was filtered in the molten state.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

1. Desimoni, E.; Paniccia, F.; Zambonin, P. G.
<table>
<thead>
<tr>
<th>COMPONENTS:</th>
<th>ORIGINAL MEASUREMENTS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Chloroform; CHCl₃; [67-66-3]</td>
<td>Allulli, S.</td>
</tr>
<tr>
<td>(3) Potassium nitrate; KNO₃; [7757-79-1]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VARIABLES:</th>
<th>PREPARED BY:</th>
</tr>
</thead>
<tbody>
<tr>
<td>one temperature: T/K = 433</td>
<td>N. P. Bansal</td>
</tr>
</tbody>
</table>

**EXPERIMENTAL VALUES:**

The solubility of chloroform in the molten eutectic LiNO₃ - KNO₃ at 160°C was found to be too small (<10⁻⁷ mol/(mol of melt)⁻¹ mm⁻¹) to be detected with the experimental method used.

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Manometric technique.

**SOURCE AND PURITY OF MATERIALS:**

Chloroform (ERBA RP) was distilled under vacuum.

LiNO₃ (ERBA RP) was dehydrated at 70°C to avoid hydrolysis. KNO₃ (ERBA RP) was finely powdered and dried under vacuum at 110°C for 24 hr.

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**
### COMPONENTS:

(1) Acetone; \((\text{CH}_3\text{)}_2\text{CO}\); [67-64-1]

(2) Lithium nitrate; LiNO₃; [7790-69-4]

(3) Potassium nitrate; KNO₃; [7757-79-1]

### VARIABLES:

one temperature: \(T/K = 433\)

### ORIGINAL MEASUREMENTS:

Allulli, S.


### EXPERIMENTAL VALUES:

The solubility of acetone in the molten LiNO₃ - KNO₃ eutectic at 160°C was found to be too small \(<10^{-7} \text{ mol(mol of melt)}^{-1} \text{ mm}^{-1}\) to be measured with the experimental method employed.

### AUXILIARY INFORMATION

**METHOD/APPARATUS/PROCEDURE:**

Manometric technique.

**SOURCE AND PURITY OF MATERIALS:**

Acetone (ERBA RP ACS) was distilled under vacuum.

LiNO₃ (ERBA RP) was dehydrated at 70°C to avoid hydrolysis. KNO₃ (ERBA RP) was finely powdered and vacuum dried at 110°C for 24 hr.

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**
COMPONENTS:
1 Boron trifluoride;BF₃;[7637-07-2]
2 Lithium fluoride;LiF;[7789-24-4]
3 Beryllium fluoride;BeF₂; [7789-49-7]
4 Zirconium fluoride;ZrF₄;[7783-64-4]
5 Thorium fluoride;ThF₄;[13709-59-6]
6 Uranium fluoride;UF₄;[10049-14-6]

VARIABLES:
T/K = 773 - 973
P/kPa = 121.59 - 192.52

EXPERIMENTAL VALUES:

The values of Henry's law constant, Kₜ, for the solubility of BF₃ in the melt LiF - BeF₂ - ZrF₄ - ThF₄ - UF₄ (65-28-5-1-1 mol%) at different temperatures are:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10²soly/mol liter⁻³atm⁻¹</th>
<th>10⁵Kₜ/mol cm⁻³atm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>26.7 ± 0.5</td>
<td>26.7 ± 0.5</td>
</tr>
<tr>
<td>550</td>
<td>13.2 ± 0.1</td>
<td>13.2 ± 0.1</td>
</tr>
<tr>
<td>600</td>
<td>8.26± 0.25</td>
<td>8.26± 0.25</td>
</tr>
<tr>
<td>700</td>
<td>3.46± 0.17</td>
<td>3.46± 0.17</td>
</tr>
</tbody>
</table>

* Calculated by the compiler.

Smoothed data:

Temperature dependence of Kₜ can be expressed by the relation

log(Kₜ/mol cm⁻³atm⁻¹) = -7.857 + 3296.6/(T/K) (compiler)

Std. dev. = 2.5% (compiler)

The enthalpy of the solution, ΔH, and the standard entropy of the solution, ΔS°, are:

ΔH/kJ mol⁻¹ = -63.18
ΔS°/J K⁻¹ mol⁻¹ = -56.5
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Lithium oxide; Li₂O; [12057-24-8]
(3) Silica; SiO₂; [7631-86-9]

VARIABLES:
T/K: 1340 - 1740
H₂O P/kPa = 101.3 (760 mmHg)
mol% Li₂O = 23.4 - 39

EXPERIMENTAL VALUES:
The authors reported the solubility of H₂O in various Li₂O-SiO₂ melts in the temperature range 1340 - 1740 K. The solubility as a function of temperature is shown in fig. 1 and of Li₂O content is shown in fig. 2.

Fig. 1 Solubility of H₂O in Li₂O-SiO₂ melts as a function of temperature; mol% of Li₂O: (1) 39, (2) 33, (3) 29, (4) 25, (5) 23.4

METHOD/APPARATUS/PROCEDURE:
The stream of H₂O at near one atm. was bubbled up through the melt in a Pt lined mullite tube. The determination of the solubility of H₂O was made by the gas purging method with dried O₂ as described in ref. 1.

SOURCE AND PURITY OF MATERIALS:
The samples were made by melting high purity sand and analytical reagent grade lithium carbonate.

ESTIMATED ERROR:
δ(ppm)/(ppm): within ± 0.10 (authors)

REFERENCES:
1. Russell, L. E.
COMPONENTS:
(1) Water; H\(_2\)O; [7732-18-5]
(2) Lithium oxide; Li\(_2\)O; [12057-24-8]
(3) Silica; SiO\(_2\); [7631-86-9]

VARIABLES:
T/K = 1473 - 1773
H\(_2\)O P/kPa = 101.3 (760 mmHg)
mol% Li\(_2\)O = 23.4 - 39

EXPERIMENTAL VALUES:

Fig. 2 Solubility of H\(_2\)O in Li\(_2\)O-SiO\(_2\) melts as a function of mol% Li\(_2\)O

AUXILIARY INFORMATION

ORIGINAL MEASUREMENTS:
Kurkjian, C. R.; Russell, L. E.

PREPARED BY:
M. Shinmei

REFERENCES;
The authors reported the solubility of H$_2$O in various Li$_2$O-SiO$_2$ melts as a function of mol% Li$_2$O at P$_{H_2O}$ = 146 mmHg in graphical form only, which is shown in fig. 1. The effect of temperature on the solubility is also given in fig. 2.

**Fig. 1 Solubility of H$_2$O in Li$_2$O-SiO$_2$ melts as a function of Li$_2$O concentration**

**EXPERIMENTAL VALUES:**

**METHOD/APPARATUS/PROCEDURE:**

The samples in Pt crucibles were equilibrated with the stream of N$_2$ + H$_2$O near one atm., and were quenched.

The solubility of H$_2$O was determined by the method of analysis described in ref. 1.

**SOURCE AND PURITY OF MATERIALS:**

The silicates were prepared by mixing together the purest available constituents.
SiO$_2$: Brazilian rock quartz.
Li$_2$O: Made from carbonate.

**ESTIMATED ERROR:**

Not described in the paper, but is estimated to be similar to that in ref. 1

$6$(ppm)/(ppm) = ± 0.05 (M.S.)

**REFERENCES:**

1. Walsh, J. H.; Chipman, J.; King, T. B.; Grant, N. J.
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Lithium oxide; Li₂O; [12057-24-8]
(3) Silica; SiO₂; [7631-86-9]

ORIGINAL MEASUREMENTS:
Uys, J. M.; King, T. B.

VARIABLES:  T/K = 1678 - 1925
            H₂O P/kPa = 19.5 (146 mmHg)
            mol% Li₂O = 19 - 46

PREPARED BY:
M. Shinmei

EXPERIMENTAL VALUES:

Fig. 2 Solubility of H₂O in Li₂O-SiO₂ melts as a function of temperature.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:

(1) Water; H$_2$O; [7732-18-5]
(2) Sodium oxide; Na$_2$O; [1313-59-3]
(3) Silica; SiO$_2$; [7631-86-9]

ORIGINAL MEASUREMENTS:

Kurkjian, C. R.; Russell, L. E.

VARIABLES: T/K: 1300 - 1730
mol% Na$_2$O = 16.6 - 50
H$_2$O p/kPa = 7.3 (55 mmHg) - 101.3 (760 mmHg)

PREPARED BY:
M. Shinmei

EXPERIMENTAL VALUES:

The authors reported the solubility of H$_2$O in various Na$_2$O-SiO$_2$ melts in the temperature range 1300 - 1730 K and at P$_{H_2O}$ = 7.3 - 101.3 kPa in graphical form: the solubility as a function of $^2$H$_2$O partial pressure for Na$_2$O.2.4SiO$_2$ at 1100°C is shown in fig. 1 and the variations of the solubility with temperature and with Na$_2$O content are shown in figs. 2, 3.

![Graph](image)

**Fig. 1 Solubility of H$_2$O in Na$_2$O.2.2SiO$_2$ as a function of P$_{H_2O}^{1/2}$ at 1100°C: A - result by O$_2$, V - result by N$_2$, solid line - result in ref. 1**

AUXILIARY INFORMATION:

METHOD/APPARATUS/PROCEDURE:

The stream of O$_2$ + H$_2$O at nearly one atm. was bubbled up through the melt in a mullite tube. The determination of the solubility of H$_2$O was carried out by the gas purging method with dried O$_2$ as described in ref. 1.

SOURCE AND PURITY OF MATERIALS:

The samples were made by melting high purity sand and analytical reagent grade sodium carbonate.

ESTIMATED ERROR:

$\delta$(ppm)/(ppm): within ± 0.10 (authors)

REFERENCES:

1. Russell, L. E.
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Sodium oxide; Na₂O;
   [1313-59-3]
(3) Silica; SiO₂; [7631-86-9]

VARIABLES: T/K = 1300 - 1730
            H₂O P/kPa = 7.3 - 101.3
            mol% Na₂O = 16.6 - 50

ORIGINAL MEASUREMENTS:
Kurkjian, C. R.; Russell, L. E.

EXPERIMENTAL VALUES:
continued

Fig. 2 Solubility of H₂O in Na₂O-SiO₂ melts as a function of temperature; mol% Na₂O: (1) 50, (2) 30,
   (3) 25, (4) 20, (5) 16.6

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:

(1) Water; H₂O; [7732-18-5]
(2) Sodium oxide; Na₂O; [1313-59-3]
(3) Silica; SiO₂; [7631-86-9]

VARIABLES:

T/K = 1430 - 1740
H₂O P/kPa = 101.3
mol% Na₂O = 16.6 - 50

EXPERIMENTAL VALUES:

continued

Fig. 3 Solubility of H₂O in Na₂O-SiO₂ melts as a function of mol% Na₂O.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: 

SOURCE AND PURITY OF MATERIALS: 

ESTIMATED ERROR: 

REFERENCES: 

ORIGINAL MEASUREMENTS:

Kurkjian, C. R.; Russell, L. E.

PREPARED BY:

M. Shinmei
COMPONENTS:

(1) Water; \( \text{H}_2\text{O} \); [7732-18-5]
(2) Sodium oxide; \( \text{Na}_2\text{O} \);
[1313-59-3]
(3) Silica; \( \text{SiO}_2 \); [7631-86-9]

ORIGINAL MEASUREMENTS:

Tomlinson, J. W.


VARIABLES:

\( T/K = 1173, 1273, 1373 \)
\( \text{H}_2\text{O} \) \( P/\text{kPa} = 6.5 - 101.3 \)
mass ratio \( m_2/m_3 = 31/69 \)

PREPARED BY:

M. Shinmei

EXPERIMENTAL VALUES:

The author reported the solubility of \( \text{H}_2\text{O} \) in sodium silicate, approximately \( \text{Na}_2\text{O}.2\text{SiO}_2 \), at 900, 1000 and 1100°C and at \( P_{\text{H}_2\text{O}} = 101.3, 24.1, 11.9 \)
and 6.5 kPa in graphical form only.
The \( \text{H}_2\text{O} \) solubility at 1100°C with various \( \text{H}_2\text{O} \) pressures is shown in fig. 1 and the effect of temperature on the logarithm of the solubility of \( \text{H}_2\text{O} \)
corrected at \( P_{\text{H}_2\text{O}} = 101.3 \) kPa is in fig. 2

![Graph 1](image1.png)

![Graph 2](image2.png)

fig. 1

fig. 2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

One gram of sample rod in a Pt boat was equilibrated with the stream of \( \text{N}_2 + \text{H}_2\text{O} \) at nearly one atm. and was quenched. Analysis of the melts for \( \text{H}_2\text{O} \) was carried out by reheating, trapping in a liquid air trap and determining the pressure change on freezing in solid \( \text{CO}_2 \) and evaporating into a known volume.

SOURCE AND PURITY OF MATERIALS:

Sodium silicate was prepared by fusing Analar sodium carbonate with silica obtained from selected pieces of mineral quartz. After sintering at 500°C to remove \( \text{CO}_2 \), the sample was fused in vacuum, and rods 0.5 mm diameter were drawn from the melt in air.

ESTIMATED ERROR:

\( \delta(\text{ppm})/(\text{ppm}) < 0.15 \) (author)

REFERENCES:
COMPONENTS:

(1) Water; H₂O; [7732-18-5]
(2) Sodium oxide; Na₂O; [1313-59-3]
(3) Silica; SiO₂; [7631-86-9]

VARIABLES:

\[
\begin{align*}
T/K &= 1396 & 1640 \\
\text{mol ratio } n_2/n_3 &= 2.4 \\
H₂O P/kPa &= 25.3 \ (190 \text{ mmHg})
\end{align*}
\]

EXPERIMENTAL VALUES:

The authors measured the solubility of H₂O in 30% Na₂O - 70% SiO₂ (mass) glass melts with 190 mmHg of H₂O vapor pressure at 1123°C and 1367°C and reported the calculated solubility for 760 mmHg of H₂O by using the equation:

\[
C_{H₂O} = kP_{H₂O}^{1/2}
\]

where \( C_{H₂O} \) is the solubility of H₂O and \( k \) is constant for constant temperature and for constant composition of the melt.

<table>
<thead>
<tr>
<th>Temperature °C</th>
<th>ppm (mass/mass) of H₂O at ( P_{H₂O} = 25.33 \text{ kPa} )</th>
<th>ppm (mass/mass) of H₂O at ( P_{H₂O} = 101.3 \text{ kPa} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1123</td>
<td>443</td>
<td>885</td>
</tr>
<tr>
<td>1367</td>
<td>423</td>
<td>846</td>
</tr>
</tbody>
</table>

* Actual experimental value (estimated by M. S.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A slag in a Pt crucible was equilibrated with the stream of nearly one atm. of N₂ + H₂O, and was quenched by lowering the crucible into either Hg or H₂O. The solubility of H₂O was determined by applying the vacuum fusion technique to the sample wrapped with Al foil at about 1600°C.

SOURCE AND PURITY OF MATERIALS:

The slags were prepared by mixing the chemically pure components.

ESTIMATED ERROR:

\[
\frac{\delta \text{ (ppm)}}{\text{ (ppm)}} > 0.048 \quad \text{(authors)}
\]

REFERENCES:

Walsh, J. H.; Chipman, J.; King, T. B.; Grant, N. J.
J. Metals 1956, 8, 1568 - 1576.
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Potassium oxide; K₂O; [12136-45-7]
(3) Silica; SiO₂; [7631-86-9]

VARIABLES:
- T/K: 1230 - 1820
- H₂O P/kPa = 101.3 (760 mmHg)
- mol% K₂O = 17.5 - 45

EXPERIMENTAL VALUES:
The authors reported the solubility of H₂O in various K₂O-SiO₂ melts in the temperature range about 1230 - 1820 K. The solubility as a function of temperature is in fig. 1 and of K₂O is in fig. 2.

METHOD/APPARATUS/PROCEDURE:
The stream of H₂O at near one atm. was bubbled up through the melt in a mullite tube. The determination of the solubility of H₂O was made by the gas purging method with dried O₂ as described in ref. 1.

SOURCE AND PURITY OF MATERIALS:
The samples were made by melting high purity sand and analytical reagent grade potassium carbonate.

ESTIMATED ERROR:
δ(ppm)/(ppm): within ±0.10 (authors)

REFERENCES:
1. Russell, L. E.
COMPONENTS:

(1) Water; H₂O; [7732-18-5]
(2) Potassium oxide; K₂O; [12136-45-7]
(3) Silica; SiO₂; [7631-86-9]

VARIABLES: T/K = 1373 - 1673
H₂O p/kPa = 101.3 (760 mmHg)
mol% K₂O = 17.5 - 45

EXPERIMENTAL VALUES:

continued

Fig. 2 Solubility of H₂O in K₂O-SiO₂ melts as a function of K₂O content.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS: ORIGINAL MEASUREMENTS:

(1) Water; H₂O; [7732-18-5]
(2) Cesium oxide; Cs₂O; [20281-00-9]
(3) Silica; SiO₂; [7631-86-9]

Russell, L. E.

VARIABLES: T/K: 1150 - 1400
H₂O P/kPa = 101.3(760 mmHg)
mol ratio n₂/n₃ = 0.5

PREPARED BY:
M. Shinmei

EXPERIMENTAL VALUES:

The author reported the solubility of H₂O in Cs₂O.2SiO₂ melts as a function of reciprocal temperature in the temperature range about 1150 - 1400 K, and in graphical form only.

![Graph showing solubility of H₂O in Cs₂O.2SiO₂ melts as a function of reciprocal temperature.](image)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The stream of O₂ + H₂O at near one atm. was bubbled up through the melt in a mullite tube. The determination of the solubility of H₂O was made by the gas purging method with dried O₂ (Although no details about the partial pressure of H₂O bubbled were given the solubility data shown are corresponding to that at P₄=1 atm.)

SOURCE AND PURITY OF MATERIALS:

The samples were made by melting high purity sand and analytical reagent grade cesium carbonate.

ESTIMATED ERROR:

δ(ppm)/(ppm): it may be more than ±0.10 because of high volatility of Cs₂O.

REFERENCES:
COMPONENTS:

(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Silica; SiO₂; [7631-86-9]

VARIABLES:

\[ T/K = 1823 \]
\[ H₂O P/kPa = 101.3 \text{ (1 atm.)} \]
\[ \text{Mol} \% \text{ CaO} = 34.5 - 58.7 \]

EXPERIMENTAL VALUES:

The authors reported the solubility of H in various CaO-SiO₂ melts at 1500°C under steam atmosphere.

<table>
<thead>
<tr>
<th>CaO</th>
<th>SiO₂</th>
<th>CaO</th>
<th>SiO₂</th>
<th>H²⁻</th>
<th>H₂O⁻⁻</th>
</tr>
</thead>
<tbody>
<tr>
<td>33</td>
<td>67</td>
<td>34.5</td>
<td>65.5</td>
<td>74.3</td>
<td>664</td>
</tr>
<tr>
<td>50</td>
<td>50</td>
<td>51.7</td>
<td>48.3</td>
<td>82.9</td>
<td>741</td>
</tr>
<tr>
<td>57</td>
<td>43</td>
<td>58.7</td>
<td>41.3</td>
<td>85.1</td>
<td>760</td>
</tr>
</tbody>
</table>

- Average value (authors)
- Calculated by the compiler

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A slag in a Pt crucible was equilibrated with a stream of nearly one atmosphere of N₂ + H₂O or H₂O, and was quenched by lowering the crucible into either Hg or H₂O.

The solubility of H₂O was analyzed as a H content by the vacuum fusion technique for the sample wrapped with Al foil at about 1600°C.

SOURCE AND PURITY OF MATERIALS:

The slags were prepared by mixing the chemically pure constituents.

ESTIMATED ERROR:

\[ \delta(\text{ppm})/(\text{ppm}) = \pm 0.048 \] (authors)
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Silica; SiO₂; [7631-86-9]

VARIABLES: Mol% CaO: 43 - 61
H₂O P/kPa = 38.5 (289 mmHg)
T/K = 1773, 1823, 1873

EXPERIMENTAL VALUES:

The authors reported the solubility of H₂O in various CaO-SiO₂ melts at 1500°C, 1550°C and 1600°C under the pressure of H₂O at 289 mm Hg, and in graphical form only. The effect of temperature on the solubility is shown in fig. 1 and of composition of the melt at 1600°C is shown in fig. 2.

![Graph showing the effect of temperature on hydrogen content in melts]  

fig. 1, Effect of temperature on hydrogen content in 63 mass% SiO₂ - 37 mass% CaO melts; P₁₆O = 38.5 kPa.

continued

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The sample in a Pt crucible was equilibrated with the H₂O + Ar stream of nearly one atm., and was quenched. The H₂O in the sample was reduced to H₂ by Al at 1550 - 1600°C and was measured volumetrically by using a micro-Orsat gas analyzer.

SOURCE AND PURITY OF MATERIALS:

CaO: Made by thermal decomposition of reagent grade carbonate (over 99.5%)
SiO₂: Ground quartz (over 99.9%)

ESTIMATED ERROR:

analysis of H₂O:
δ(ppm)/(ppm) = ± 0.08 (author's)
COMPONENTS:

(1) Water; $\text{H}_2\text{O}$; [7732-18-5]
(2) Calcium oxide; $\text{CaO}$; [1305-78-8]
(3) Silica; $\text{SiO}_2$; [7631-86-9]

ORIGINAL MEASUREMENTS:

Fukushima, T.; Iguchi, Y.; Ban-ya, S.; Fuwa, T.

VARIABLES:

EXPERIMENTAL VALUES:

continued

fig. 2, Effect of $\text{SiO}_2$ concentration on hydrogen content of $\text{CaO-}$
$\text{SiO}_2$ melts; $P_{\text{H}_2\text{O}} = 38.5$ kPa and 1600°C

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS: ORIGINAL MEASUREMENTS:

(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Silica; SiO₂; [7631-86-9]

Iguchi, Y.; Ban-ya, S.; Fuwa, T.

VARIABLES: T/K = 1773 - 1873
H₂O P/kPa = 38.5 (289 mmHg)
mol ratio n₂/n₃ = 0.63 & 1.26

PREPARED BY: M. Shinmei

EXPERIMENTAL VALUES:

The authors reported the solubility of water in CaO-SiO₂ melts as a function of temperature, and in graphical form only.

![Graph showing solubility of water in CaO-SiO₂ melts at P₃O₅ = 38.5 KPa; mol ratio of CaO/SiO₂ are, --0.63, --0--1.26.]

METHOD/APPARATUS/PROCEDURE:

The sample in a Pt crucible was equilibrated with the H₂O + Ar stream at nearly one atm., and was quenched in a water cooled Cu mold.

H₂O in a quenched sample was reduced to H₂ by Al at 1550 - 1600°C, which was measured volumetrically by using a micro-Orsat gas analyzer.

SOURCE AND PURITY OF MATERIALS:

CaO: made by thermal decomposition of reagent grade calcium carbonate
SiO₂: high purity quartz (over 99.9%)

ESTIMATED ERROR:

analysis of Hydrogen: δ(ppm)/(ppm) = ± 0.06 (authors)

REFERENCES:

1. Fukushima, T.; Iguchi, Y.; Ban-ya, S.; Fuwa, T.
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Silica; SiO₂; [7631-86-9]

VARIABLES: T/K = 1873
H₂O P/kPa = 38.5 (289 mmHg)
mol ratio n₂/n₃ = 0.63 - 1.26

EXPERIMENTAL VALUES:
The authors reported the solubility of H₂O in various CaO-SiO₂ melts at 1600°C in graphical form. The authors provided the original data for this file.

<table>
<thead>
<tr>
<th>mol ratio CaO/SiO₂</th>
<th>ppm (mass/mass) H₂O</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.63</td>
<td>405</td>
</tr>
<tr>
<td>0.80</td>
<td>390</td>
</tr>
<tr>
<td>1.00</td>
<td>372</td>
</tr>
<tr>
<td>1.18</td>
<td>419</td>
</tr>
<tr>
<td>1.26</td>
<td>427</td>
</tr>
</tbody>
</table>

METHOD/APPARATUS/PROCEDURE:
The sample in a Pt crucible was equilibrated with the stream of Ar + H₂O of nearly one atm., and was quenched in a H₂O cooled Cu mold. H₂O in the sample was reduced to H₂ with Al at 1550 - 1600°C, and was measured volumetrically by using a micro-Orsat gas analyzer.

SOURCE AND PURITY OF MATERIALS:
CaO: Made by thermal decomposition of reagent grade carbonate (over 99.5%)
SiO₂: Ground quartz (over 99.9%)

ESTIMATED ERROR:
Analysis of H₂O: δ(ppm)/(ppm) = ± 0.08 (authors)

REFERENCES:
1. Fukushima, T.; Iguchi, Y.; Ban-ya, S.; Fuwa, T.
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Silica; SiO₂; [7631-86-9]

VARIABLES:
T/K = 1873
H₂O P/kPa = 101.3 (760 mmHg)
mol% SiO₂ = 45 - 60

EXPERIMENTAL VALUES:
The authors reported the solubility of H₂O in CaO-SiO₂ melts at 1873 K and at P₇₆0 = 101.3 kPa in mass% of H (Actual measurements were carried out at P₇₆0 = 31.2 kPa).

<table>
<thead>
<tr>
<th>Composition of melt</th>
<th>Solubility of H₂O</th>
</tr>
</thead>
<tbody>
<tr>
<td>mol % CaO</td>
<td>mol % SiO₂</td>
</tr>
<tr>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>45</td>
<td>55</td>
</tr>
<tr>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>55</td>
<td>45</td>
</tr>
</tbody>
</table>

* Calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
The samples in Pt crucibles were equilibrated with the stream of Ar + H₂O at near one atm. and were quenched.
The solubility of H₂O was determined by the method described in ref. 1.

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:

analysis of H₂:
δ(ppm)/(ppm) = ± 0.05 (authors)

REFERENCES:
1. Obst, K.-H.; Malissa, H.
Arch. Eisenhüttenwes. 1959, 30, 601 - 603.
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Strontium oxide; SrO; [1314-11-0]
(3) Silica; SiO₂; [7631-86-9]

ORIGINAL MEASUREMENTS:
Russell, L. E.

VARIABLES: T/K: 1670 - 1870
H₂O P/ kPa= 101.3 (760 mmHg)
mol ratio n₂/n₃ = 0.5

EXPERIMENTAL VALUES:
The authors reported the solubility of H₂O in SrO.2SiO₂ melts as a function of reciprocal temperature in the temperature range 1660 - 1870 K, and in graphical form only.

EXPERIMENTAL VALUES:

METHOD/APPARATUS/PROCEDURE:
The stream of O₂ + H₂O at a pressure near one atm. was bubbled up through the melt in a mullite tube. The determination of the solubility was carried out by the gas purging method with dried O₂. (Although no details on the partial pressure of H₂O bubbled were given, the solubility data shown are corresponding to that at P₄H₂O = 1 atm.)

SOURCE AND PURITY OF MATERIALS:
The samples were made by melting high purity sand and analytical reagent grade strontium carbonate.

ESTIMATED ERROR:
6(ppm)/(ppm): within : 0.10 (author)

REFERENCES:
COMPONENTS:

(1) Water; H₂O; [7732-18-5]
(2) Barium oxide; BaO;
    [1304-28-5]
(3) Silica; SiO₂; [7631-86-9]

VARIABLES:

T/K: 1630 - 1780
H₂O P/kPa = 101.3 (760 mmHg)
Mol ratio n₂/n₃ = 0.5

EXPERIMENTAL VALUES:

The author reported the solubility of H₂O in BaO.2SiO₂ melts as a function of reciprocal temperature in the temperature range 1360 - 1780 K, and in graphical form only.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The stream of O₂ + H₂O at a total pressure near 1 atm. was bubbled up through the melt in a mullite tube. The determination of the solubility was carried out by the gas purging method with dried O₂ (Although no details about the partial pressure of H₂O were given the solubility data shown are corresponding to that at P₇₅₀ = 1 atm.)

SOURCE AND PURITY OF MATERIALS:

The samples were made by melting high purity sand and analytical reagent grade barium carbonate.

ESTIMATED ERROR:

6(ppm)/(ppm): within ± 0.01 (author)

REFERENCES:

ORIGINAL MEASUREMENTS:

Russell, L. E.

PREPARED BY:

M. Shinmei
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Iron oxide; FeO; [1345-25-1]
(3) Silica; SiO₂; [7631-86-9]

ORIGINAL MEASUREMENTS:
Uys, J. M.; King, T. B.

VARIABLES:

T/K = 1673
H₂O P/kPa = 19.5 (146 mmHg)
mol% FeO: 59 - 100

PREPARED BY:
M. Shinmei

EXPERIMENTAL VALUES:
The authors reported the solubility of H₂O in "FeO"-SiO₂ melts as a function of FeO concentration at 1400°C and at P₇₄O = 146 mmHg in graphical form only.

METHOD/APPARATUS/PROCEDURE:
Silicates in Armco iron crucibles were equilibrated with the stream of N₂ + H₂ + H₂O at nearly one atm., and were quenched. The solubility of H₂O was determined by the method of analysis described in ref. 1. Vacuum fusion technique was applied to the sample wrapped in Al foil and evolved H₂ was analyzed by a thermal conductivity cell.

SOURCE AND PURITY OF MATERIALS:
The silicates were prepared by mixing together the purest available constituents.
SiO₂: Brazilian rock quartz.
FeO: Armco iron crucibles were used under H₂O - H₂ mixtures to contain FeO in the silicate melts.

ESTIMATED ERROR:
Although not described in the original paper it is estimated to be similar to that in ref. 1:
8(ppm)/(ppm) = ± 0.05 (M. S.)

REFERENCES:
1. Walsh, J. H.; Chipman, J.; King, T. B.; Grant, N. J.
**COMPONENTS:**

1. Water; H$_2$O; [7732-18-5]
2. Iron oxide; FeO; [1345-25-1]
3. Silica; SiO$_2$; [7631-86-9]

**ORIGINAL MEASUREMENTS:**
Wahlster, M.; Reichel, H.-H.

**VARIABLES:**

- T/K = 1873
- H$_2$O p/ kPa = 101.3 (760 mmHg)
- mol% FeO = 55 - 100

**PREPARED BY:**
M. Shinmei

**EXPERIMENTAL VALUES:**

The authors reported the solubility of H$_2$O in various FeO-SiO$_2$ melts at 1873 K and at P$_{H_2O}$ = 101.3 kPa (actual measurements were carried out at P$_{H_2O}$ = 31.2 kPa).

<table>
<thead>
<tr>
<th>Composition of Melt</th>
<th>Solubility of H$_2$O</th>
</tr>
</thead>
<tbody>
<tr>
<td>mol% FeO</td>
<td>mol% SiO$_2$</td>
</tr>
<tr>
<td>55</td>
<td>45</td>
</tr>
<tr>
<td>68</td>
<td>32</td>
</tr>
<tr>
<td>73</td>
<td>27</td>
</tr>
<tr>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>90</td>
<td>10</td>
</tr>
<tr>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

* Calculated by the compiler.

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

The samples in Pt crucibles were equilibrated with the stream of Ar + H$_2$O at nearly one atm. and were quenched.

The solubility of H$_2$O was determined by the method described in ref. 1.

**SOURCE AND PURITY OF MATERIALS:**
Not described.

**ESTIMATED ERROR:**

analysis of hydrogen 5(ppm)/(ppm) = ± 0.05 (authors)

**REFERENCES:**

1. Obst, K.-H.; Malissa, H.
Arch. Eisenhüttenwes. 1959, 30, 601 - 603.
COMPONENTS:
(1) Water; H$_2$O; [7732-18-5]
(2) Manganese oxide; MnO; [1344-70-3]
(3) Silica; SiO$_2$; [7631-86-9]

ORIGINAL MEASUREMENTS:
Walsh, J. H.; Chipman, J.;
King, T. B.; Grant, N. J.
J. Metals 1956, 8, 1568 - 1576.

VARIABLES:
T/K = 1623 & 1723
H$_2$O P/kPa: 30 - 101.3
mol ratio n$_2$/n$_3$ = 1.38

PREPARED BY:
M. Shinmei

EXPERIMENTAL VALUES:
The authors reported the solubility of H in 62% MnO - 38% SiO$_2$ (mass%) melts as a function of P$_{H_2O}^{1/2}$ at 1350 and 1450°C, and only in graphical form.

METHOD/APPARATUS/PROCEDURE:
A slag in a Pt crucible was equilibrated with the stream of nearly one atm. of N$_2$ + H$_2$O and was quenched by lowering the crucible into either Hg or H$_2$O.
The solubility of H$_2$O was analyzed as H content by applying the vacuum fusion technique to the sample wrapped with Al foil at about 1600°C.

AUXILIARY INFORMATION

SOURCE AND PURITY OF MATERIALS:
The slags were prepared by mixing the chemically pure components.
The slags were dark brown in color, presumably due to the presence of Mn$^{3+}$ ions. However, the effect of Mn$^{3+}$ on the solubility of H$_2$O was considered to be small.

ESTIMATED ERROR:
δ(ppm)/(ppm) = ± 0.048 (authors)

REFERENCES:
COMPONENTS:
(1) Water; H_2O; [7732-18-5]
(2) Cobalt oxide; CoO;
    [1307-96-6]
(3) Silica; SiO_2; [7631-86-9]

ORIGINAL MEASUREMENTS:
Uys, J. M.; King, T. B.

VARIABLES:
T/K = 1773
H_2O P/ kPa = 19.5 (146 mmHg)
mol% CoO: 50 - 73

EXPERIMENTAL VALUES:
The authors reported the solubility of H_2O in CoO-SiO_2 melts as a function of mol% of CoO at 1500°C and P_H_2O = 146 mmHg in graphical form only.

METHOD/APPARATUS/PROCEDURE:
The samples in Pt crucibles were equilibrated with the stream of N_2 + H_2O at near one atm., and were quenched.
The solubility of H_2O was determined by the method of analysis described in ref. 1.

SOURCE AND PURITY OF MATERIALS:
The silicates were prepared by mixing together the purest available constituents.
SiO_2: Brazilian rock quartz
CoO: Thermal decomposition of carbonate.

ESTIMATED ERROR:
Although not described in the original paper, it is estimated to be similar to that in ref. 1 5(ppm)/(ppm) = ± 0.05 (M.S.)

REFERENCES:
1. Walsh, J. H.; Chipman, J.; King, T. B.; Grant, N. J.
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Silica; SiO₂; [7631-86-9]
(3) Zinc oxide; ZnO; [1314-13-2]

VARIABLES: mol% ZnO = 44 - 72.5
H₂O P/kPa = 19.5 (146 mmHg)
T/K = 1796, 1835, 1871, 1925

EXPERIMENTAL VALUES:

The authors reported the solubility of H₂O in various SiO₂-ZnO melts as a function of mol% of ZnO at P₁ = 146 mmHg (fig. 1) and the temperature effect on the solubility (fig. 2), in graphical form only.

METHOD/APPARATUS/PROCEDURE:

The samples in Pt crucibles were equilibrated with the stream of N₂ + H₂O at nearly one atm., and were quenched. The solubility of H₂O was determined by the method of analysis described in ref. 1.

SOURCE AND PURITY OF MATERIALS:

The silicates were prepared by mixing together the purest available constituents.
SiO₂: Brazilian rock quartz
ZnO: Reagent grade chemicals

ESTIMATED ERROR:
Not described in the paper, but is estimated to be similar to that in ref. 1; δ(ppm)/(ppm) = ± 0.05 (M. S)

REFERENCES:
1. Walsh, J. H.; Chipman, J.; King, T. B.; Grant, N. J.
COMPONENTS:

(1) Water; H₂O [7732-18-5]
(2) Calcium oxide; CaO [1305-78-8]
(3) Lithium oxide; Li₂O [12057-24-8]
(4) Silica; SiO₂ [7631-86-9]

VARIABLES: T/K: 1573, 1673
H₂O P/kPa: 2.1 (16 mmHg)
- 19.5 (146 mm Hg)
Mol % (Li₂O + CaO): 26 - 70

EXPERIMENTAL VALUES:

The authors reported the solubility of H₂O in various CaO - Li₂O - SiO₂ melts as the function of mol% (CaO + Li₂O) at 1300°C and 1400°C (fig. 1, 2) and of square root of H₂O pressures at 1300°C (fig. 3), in graphical form only.

Fig. 1 - Solubility of water in Li₂O-CaO-SiO₂ melts as function of mole pot base. Pct Li₂O approximately constant. P_H₂O = 146 mm Hg.

METHOD/APPARATUS/PROCEDURE:

The samples in Pt crucibles were equilibrated with the stream of N₂ + H₂O at near one atm., and were quenched.

The solubility of H₂O was determined by the method of analysis described in ref. 1.

AUXILIARY INFORMATION

SOURCE AND PURITY OF MATERIALS:

The silicates were prepared by mixing together the purest available constituents.

SiO₂: Brazilian rock quartz
CaO, Li₂O: Made by thermal decomposition of carbonates.

ESTIMATED ERROR:

Not described, but it is estimated to be similar to that in ref. 1.
δ(ppm)/(ppm) = 0.05 (M. S.)

REFERENCES:

1. Walsh, J. H.; Chipman, J.; King, T. B.; Grant, N. J.
COMPONENTS:
(1) Water; H₂O [7732-18-5]
Silicate melt components:
(2) Calcium oxide; CaO [1305-78-8]
(3) Lithium oxide; Li₂O [12057-24-8]
(4) Silica; SiO₂ [7631-86-9]

ORIGINAL MEASUREMENTS:
Uys, J. M.; King, T. B.

VARIABLES:
T/K : 1673
H₂O P/kPa : 19.5(146 mmHg)
Mol % (Li₂O + CaO) : 45 - 65

EXPERIMENTAL VALUES:
continued.

Fig. 2 - Solubility of water in Li₂O-CaO-SiO₂ melts as function of mole pct base. Pct CaO constant. P₇H₂O = 146 mm Hg. Temperature-1400°C.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:

(1) Water; \( \text{H}_2\text{O} \) [7732-18-5]
Silicate melt components:
(2) Calcium oxide; \( \text{CaO} \) [1305-78-8]
(3) Lithium oxide; \( \text{Li}_2\text{O} \) [12057-24-8]
(4) Silica; \( \text{SiO}_2 \) [7631-86-9]

VARIABLES:

\[
\begin{align*}
T/K & : 1573 \\
\text{H}_2\text{O} \ P/kPa & : 2.1 - 19.5 \\
\text{Mol} \ % \ \text{SiO}_2 & : 28.9 - 46.9
\end{align*}
\]

EXPERIMENTAL VALUES:
continued.

![Graph](image)

Fig. 3 - Solubility of water in \( \text{Li}_2\text{O}-\text{CaO}-\text{SiO}_2 \) melts as a function of \( p_{\text{H}_2\text{O}} \). Temperature-1300°C.

ORIGINAL MEASUREMENTS:

Uys, J. M.; King, T. B.

PREPARED BY:

M. Shinmei

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Lithium oxide; Li₂O; [12057-24-8]
(4) Silica; SiO₂; [7631-86-9]

VARIABLES:  
T/K = 1823
H₂O p/kPa = 38.5 (289 mmHg)
mol% Li₂O = 17.2 – 42.5
mol ratio = n₂/n₄ = 0.26 – 1.84

EXPERIMENTAL VALUES:
The authors reported the solubility of H₂O in various CaO - Li₂O - SiO₂ melts at 1450°C in graphical form. The original data were provided by the authors.

<table>
<thead>
<tr>
<th>mol% CaO</th>
<th>mol% Li₂O</th>
<th>mol% SiO₂</th>
<th>mole ratio</th>
<th>ppm(mass/mass)</th>
</tr>
</thead>
<tbody>
<tr>
<td>27.0</td>
<td>17.2</td>
<td>55.8</td>
<td>0.49</td>
<td>402</td>
</tr>
<tr>
<td>31.1</td>
<td>17.4</td>
<td>51.5</td>
<td>0.60</td>
<td>371</td>
</tr>
<tr>
<td>33.3</td>
<td>22.3</td>
<td>44.5</td>
<td>0.75</td>
<td>443</td>
</tr>
<tr>
<td>41.9</td>
<td>18.9</td>
<td>39.2</td>
<td>1.07</td>
<td>644</td>
</tr>
<tr>
<td>11.7</td>
<td>27.2</td>
<td>61.1</td>
<td>0.63</td>
<td>516</td>
</tr>
<tr>
<td>14.1</td>
<td>30.1</td>
<td>55.8</td>
<td>0.25</td>
<td>479</td>
</tr>
<tr>
<td>22.3</td>
<td>27.4</td>
<td>50.2</td>
<td>0.45</td>
<td>461</td>
</tr>
<tr>
<td>29.0</td>
<td>28.1</td>
<td>42.9</td>
<td>0.68</td>
<td>555</td>
</tr>
<tr>
<td>37.3</td>
<td>27.2</td>
<td>35.5</td>
<td>1.05</td>
<td>1125</td>
</tr>
<tr>
<td>10.4</td>
<td>35.8</td>
<td>53.9</td>
<td>0.80</td>
<td>528</td>
</tr>
<tr>
<td>13.5</td>
<td>34.8</td>
<td>51.7</td>
<td>0.26</td>
<td>512</td>
</tr>
<tr>
<td>20.3</td>
<td>36.7</td>
<td>43.0</td>
<td>1.26</td>
<td>558</td>
</tr>
<tr>
<td>24.7</td>
<td>35.4</td>
<td>40.0</td>
<td>1.43</td>
<td>705</td>
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<tr>
<td>29.4</td>
<td>34.3</td>
<td>36.3</td>
<td>0.81</td>
<td>1125</td>
</tr>
<tr>
<td>9.5</td>
<td>42.1</td>
<td>48.4</td>
<td>0.91</td>
<td>720</td>
</tr>
<tr>
<td>12.0</td>
<td>42.5</td>
<td>45.5</td>
<td>1.03</td>
<td>618</td>
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<td>18.4</td>
<td>41.2</td>
<td>40.3</td>
<td>1.30</td>
<td>860</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
The sample in a Pt crucible was equilibrated with the Ar + H₂O stream at nearly one atm., and was quenched.
H₂O in a sample was measured as H₂ volumetrically by a micro-Orsat gas analyzer after reducing with Al at 1550 - 1600°C.

SOURCE AND PURITY OF MATERIALS:
CaO, Li₂O: Reagent grade chemicals
SiO₂: Transparent high purity silica was washed and cleaned (over 99.9%)

ESTIMATED ERROR:
analysis of H₂: 6(ppm)/(ppm) = ± 0.06 (authors)

REFERENCES:
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Lithium oxide; Li₂O; [12057-24-8]
(4) Silica; SiO₂; [7631-86-9]

VARIABLES:
T/K = 1823
H₂O P/kPa = 38.5 (289 mmHg)
mol% Li₂O = 17.2 - 42.5
mol ratio n₂/n₄ = 0.26 - 1.84

EXPERIMENTAL VALUES: continued

<table>
<thead>
<tr>
<th>mol%</th>
<th>mole ratio</th>
<th>ppm (mass/mass)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaO</td>
<td>Li₂O</td>
<td>SiO₂</td>
</tr>
<tr>
<td>19.1</td>
<td>39.6</td>
<td>41.3</td>
</tr>
<tr>
<td>21.0</td>
<td>41.5</td>
<td>37.5</td>
</tr>
<tr>
<td>22.0</td>
<td>41.5</td>
<td>36.5</td>
</tr>
<tr>
<td>26.2</td>
<td>41.1</td>
<td>32.6</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Lithium oxide; Li₂O; [12057-24-8]
(4) Silica; SiO₂; [7631-86-9]

VARIABLES:
T/K = 1823
H₂O p/ kPa = 38.5 (289 mmHg)
mol% Li₂O = 17.2 - 42.5
mol ratio n₃/n₄ = 0.26 - 1.84

EXPERIMENTAL VALUES:

Fig. 1 Solubility of water in CaO - Li₂O - SiO₂ melts as a function of CaO/SiO₂.

<table>
<thead>
<tr>
<th>mass %</th>
<th>mol%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Li₂O</td>
<td>Li₂O</td>
</tr>
<tr>
<td>10</td>
<td>17.5</td>
</tr>
<tr>
<td>15</td>
<td>27.5</td>
</tr>
<tr>
<td>20</td>
<td>35</td>
</tr>
<tr>
<td>25</td>
<td>41.5</td>
</tr>
</tbody>
</table>

P_H₂O = 188 mmHg
Temp. = 1450°C

REFERENCES:

PREPARED BY:
M. Shinmei
COMPONENTS:
(1) Water; H_2O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Sodium oxide; Na_2O; [1313-59-3]
(4) Silica; SiO_2; [7631-86-9]

ORIGINAL MEASUREMENTS:
Fukushima, T.; Iguchi, Y.; Ban-ya, S.; Fuwa, T.

VARIABLES: T/K = 1573
H_2O P/kPa=12.3-58.0(92.5-435 mmHg)
mass% Na_2O = 15.0
mass ratio CaO/SiO_2 = 0.417

EXPERIMENTAL VALUES:
The authors measured the solubility of H in 60% SiO_2 - 25% CaO - 15%
Na_2O (mass) at 1300°C under water vapor pressure 92.5 mmHg - 435 mmHg and
confirmed the linear relationship between the solubility and P_{H_2O}^{1/2}.
The compiler converted the original solubility, expressed in ppm of H_2O,
to ppm(mass/mass) of H.

<table>
<thead>
<tr>
<th>P_{H_2O} (mmHg)</th>
<th>[H] (ppm(mass/mass))</th>
<th>P_{H_2O} (mmHg)</th>
<th>[H] (ppm(mass/mass))</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.33 92.5 26 232</td>
<td>38.53 289 47.5 424</td>
<td>19.87 149 30.5 273</td>
<td>47.33 355 51 456</td>
</tr>
<tr>
<td>19.87 149 32 286</td>
<td>47.33 355 46.5 416</td>
<td>31.20 234 37.5 335</td>
<td>47.33 355 51 456</td>
</tr>
<tr>
<td>31.20 234 42 375</td>
<td>58.00 435 51 456</td>
<td>31.20 234 42 375</td>
<td>58.00 435 56 500</td>
</tr>
<tr>
<td>38.53 289 46.0 411</td>
<td>58.00 435 61 545</td>
<td>38.53 289 46.0 411</td>
<td>58.00 435 63.5 567</td>
</tr>
</tbody>
</table>

The compiler fitted the data for [H_2O, ppm] by least squares to [H_2O, ppm
(mass/mass)] = 66.9 P_{H_2O}^{1/2} (\delta = 26.5), where P_{H_2O} is expressed in kPa
and \delta is the standard dev. of the precision of the least square fit.

METHOD/APPARATUS/PROCEDURE:
The sample in a Pt crucible was equilibrated with the H_2O +
Ar stream of nearly one atm., and
was quenched in a water cooled
Cu mold.
H_2O in the sample was reduced
to H_2 by Al at 1550 - 1600°C,
and H_2 was measured volumetrically
by using a micro-Orsat gas
analyzer.

SOURCE AND PURITY OF MATERIALS:
CaO: Made by thermal decomposition
of reagent grade carbonate of
over 99.5% at 900°C
Na_2O: Reagent grade chemical (over
99.5%)
SiO_2: Ground quartz (over 99.5%)

ESTIMATED ERROR:
\delta(ppm)/(ppm) = \pm 0.10 (authors)

REFERENCES:
1. Fuwa, T.; Ban-ya, S.;
Fukushima, T.
Report of the 19th Committee of
the Japan Society for Promotion
of Science, No. 7834, May 1965.
COMPONENTS:
1. Water; H$_2$O; [7732-18-5]
2. Calcium oxide; CaO; [1305-78-8]
3. Sodium oxide; Na$_2$O; [1313-59-3]
4. Silica; SiO$_2$; [7631-86-9]

ORIGINAL MEASUREMENTS:
Iguchi, Y.; Ban-ya, S.; Fuwa, T.

VARIABLES:
- T/K = 1723
- H$_2$O P/ kPa = 25.1 (188 mmHg)
- mol% Na$_2$O = 10.2 - 25.4
- mol ratio $n_2/n_4 = 0.27 - 1.10$

EXPERIMENTAL VALUES:

The authors reported the solubility of H$_2$O in various CaO - Na$_2$O - SiO$_2$ melts at 1450°C under the vapor pressure of H$_2$O at 188 mmHg.

<table>
<thead>
<tr>
<th>mol%</th>
<th>mole ratio</th>
<th>ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaO</td>
<td>Na$_2$O</td>
<td>SiO$_2$</td>
</tr>
<tr>
<td>21.7</td>
<td>11.2</td>
<td>67.1</td>
</tr>
<tr>
<td>28.3</td>
<td>10.4</td>
<td>61.8</td>
</tr>
<tr>
<td>31.4</td>
<td>13.3</td>
<td>55.9</td>
</tr>
<tr>
<td>33.7</td>
<td>10.7</td>
<td>55.6</td>
</tr>
<tr>
<td>37.4</td>
<td>11.3</td>
<td>51.3</td>
</tr>
<tr>
<td>39.8</td>
<td>10.7</td>
<td>49.5</td>
</tr>
<tr>
<td>46.8</td>
<td>10.2</td>
<td>43.0</td>
</tr>
<tr>
<td>22.7</td>
<td>16.2</td>
<td>61.1</td>
</tr>
<tr>
<td>26.9</td>
<td>16.4</td>
<td>56.7</td>
</tr>
<tr>
<td>35.8</td>
<td>14.3</td>
<td>49.9</td>
</tr>
<tr>
<td>44.2</td>
<td>15.6</td>
<td>40.2</td>
</tr>
<tr>
<td>16.8</td>
<td>21.6</td>
<td>61.6</td>
</tr>
<tr>
<td>17.4</td>
<td>19.4</td>
<td>63.3</td>
</tr>
<tr>
<td>21.8</td>
<td>19.1</td>
<td>59.1</td>
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<td>53.5</td>
</tr>
<tr>
<td>30.3</td>
<td>20.3</td>
<td>49.3</td>
</tr>
<tr>
<td>32.0</td>
<td>18.3</td>
<td>49.7</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
The sample in a Pt crucible was equilibrated with the H$_2$O + Ar stream at nearly one atm., and was quenched in a water cooled Cu mold.

H$_2$O in a quenched sample was reduced to H$_2$ by Al at 1550 - 1600°C, which was measured volumetrically by using a micro-Orsat gas analyzer.

SOURCE AND PURITY OF MATERIALS:
CaO: Thermal decomposition of reagent grade carbonate (over 99.5%) at 900°C
Na$_2$O: Reagent grade chemical (over 99.5%)
SiO$_2$: Ground quartz (99.9%)

ESTIMATED ERROR:
Analysis of H$_2$O: 5(ppm)/(ppm) < ± 0.06 (authors)

REFERENCES:
1. Fukushima, T.; Iguchi, Y.; Ban-ya, S.; Fuwa, T.
2. Iguchi, Y.; Ban-ya, S.; Fuwa, T.
   Ibid. 1969, 9, 189 - 195.
### COMPONENTS:
1. Water; H$_2$O; [7732-18-5]
2. Calcium oxide; CaO; [1305-78-8]
3. Sodium oxide; Na$_2$O; [1313-59-3]
4. Silica; SiO$_2$; [7631-86-9]

### VARIABLES:
- T/K = 1723
- H$_2$O P/kPa = 25.1 (188 mmHg)
- mol% Na$_2$O = 10.2 - 25.4
- mol ratio n$_2$/n$_3$ = 0.27 - 1.10

### ORIGINAL MEASUREMENTS:
Iguchi, Y.; Ban-ya, S.; Fuwa, T.

### PREPARED BY:
M. Shinmei

### EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>mol%</th>
<th>mole ratio</th>
<th>ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaO</td>
<td>Na$_2$O</td>
<td>SiO$_2$</td>
</tr>
<tr>
<td>37.2</td>
<td>20.7</td>
<td>42.2</td>
</tr>
<tr>
<td>16.2</td>
<td>25.2</td>
<td>58.6</td>
</tr>
<tr>
<td>21.1</td>
<td>24.3</td>
<td>54.6</td>
</tr>
<tr>
<td>23.9</td>
<td>25.4</td>
<td>50.7</td>
</tr>
<tr>
<td>27.8</td>
<td>24.6</td>
<td>47.6</td>
</tr>
<tr>
<td>32.1</td>
<td>24.0</td>
<td>43.9</td>
</tr>
</tbody>
</table>

### AUXILIARY INFORMATION

### METHOD/APPARATUS/PROCEDURE:

### SOURCE AND PURITY OF MATERIALS:

### ESTIMATED ERROR:

### REFERENCES:
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Sodium oxide; Na₂O; [1313-59-3]
(4) Silica; SiO₂; [7631-86-9]

ORIGINAL MEASUREMENTS:
Iguchi, Y.; Ban-ya, S.; Fuwa, T.

VARIABLES:
T/K = 1723
H₂O P/kPa = 25.1 (188 mmHg)
mol% Na₂O = 10.2 – 25.4
mol ratio n₂/n₃ = 0.27 – 1.10

PREPARED BY:
M. Shinmei

EXPERIMENTAL VALUES:
continued
Fig. 1, Solubility of water in CaO - Na₂O - SiO₂ melts as a function of mol ratio CaO/SiO₂ at 1450°C and P₇H₂O = 25.1 kPa.

<table>
<thead>
<tr>
<th>Na₂O Mass%</th>
<th>Mol%</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>20</td>
<td>21</td>
</tr>
<tr>
<td>25</td>
<td>25</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Potassium oxide; K₂O; [12136-45-7]
(4) Silica; SiO₂; [7631-86-9]

VARIABLES: T/K = 1723
H₂O P/kPa = 38.5 (289 mmHg)
mol% K₂O = 6.1 - 17.8
mol ratio n₂/n₄ = 0.44 - 1.11

EXPERIMENTAL VALUES:

The authors reported the solubility of H₂O in various CaO - K₂O - SiO₂ melts at 1450°C and at 289 mmHg of H₂O in graphical form. The original data were provided by the authors.

<table>
<thead>
<tr>
<th>mole %</th>
<th>mole ratio</th>
<th>ppm(mass/mass)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaO</td>
<td>K₂O</td>
<td>SiO₂</td>
</tr>
<tr>
<td>CaO/SiO₂</td>
<td>H₂O</td>
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</tr>
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<td>41.2</td>
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</tr>
<tr>
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<td>32.1</td>
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<td>32.8</td>
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<td>49.5</td>
</tr>
<tr>
<td>41.4</td>
<td>9.7</td>
<td>48.9</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The sample in a Pt crucible was equilibrated with the H₂O + Ar stream at near one atm., and was quenched in a water cooled Cu mold. H₂O in a quenched sample was reduced to H₂ by Al at 1500 - 1600°C, and was measured volumetrically by using a micro-Orsat gas analyzer.

SOURCE AND PURITY OF MATERIALS:

CaO: Made by thermal decomposition of reagent grade carbonate (over 99.5%) at 900°C
K₂O: Reagent grade chemical (over 99.5%)
SiO₂: Ground quartz (over 99.9%)

ESTIMATED ERROR:

Analysis of H₂O: δ(ppm)/(ppm) = ± 0.06 (authors)

REFERENCES:
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Potassium oxide; K₂O; [12136-45-7]
(4) Silica; SiO₂; [7631-86-9]

VARIABLES:
T/K = 1723 (1450°C)
H₂O P/kPa = 38.5 (289 mmHg)
mol% K₂O = 6.1 - 17.8
mol ratio n₂/n₄ = 0.44 - 1.11

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>CaO</th>
<th>K₂O</th>
<th>SiO₂</th>
<th>mole %</th>
<th>mole ratio</th>
<th>ppm(mass/mass)</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
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<td>44.4</td>
<td>1.05</td>
<td>515</td>
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</tr>
<tr>
<td>26.9</td>
<td>14.6</td>
<td>58.5</td>
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<td>502</td>
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<td>13.7</td>
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<td>32.4</td>
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<tr>
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<td>39.1</td>
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<td>0.82</td>
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<td></td>
</tr>
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<td>39.8</td>
<td>13.0</td>
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<td>0.85</td>
<td>509</td>
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<tr>
<td>41.2</td>
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<tr>
<td>42.8</td>
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</tr>
<tr>
<td>25.7</td>
<td>17.5</td>
<td>55.9</td>
<td>0.46</td>
<td>603</td>
<td></td>
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<tr>
<td>26.4</td>
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<td>56.9</td>
<td>0.46</td>
<td>615</td>
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AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:

ORIGINAL MEASUREMENTS:

Iguchi, Y.; Ban-ya, S.; Fuwa, T.
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Potassium oxide; K₂O; [121-36-45-7]
(4) Silica; SiO₂; [7631-86-9]

VARIABLES:
T/K = 1723
H₂O P/kPa = 38.5 (289 mmHg)
mol% K₂O = 6.1 - 17.8
mol ratio n₂/n₄ = 0.44 - 1.11

ORIGINAL MEASUREMENTS:
Iguchi, Y. Ban-ya, S.; Fuwa, T.
Report of the 19th Committee of the
Japan Society for Promotion of

PREPARED BY:
M. Shinmei

EXPERIMENTAL VALUES: continued

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fig. 1, Solubility of water in CaO - K₂O - SiO₂ melts as a function of mol ratio CaO/SiO₂ at 1450°C and P₃H₂O = 38.5 kPa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:

1. Water; H₂O; [7732-18-5]
2. Calcium oxide; CaO; [1305-78-8]
3. Magnesium oxide; MgO; [1309-48-4]
4. Silica; SiO₂; [7631-86-9]

ORIGINAL MEASUREMENTS:

Iguchi, Y.; Fuwa, T.

VARIABLES:

T/K = 1673 - 1873
H₂O P/kPa = 38.5 (289 mmHg)
mol% MgO = 7.0 - 36
mol ratio n₂/n₄ = 0.16 - 1.2

EXPERIMENTAL VALUES:

The authors reported the solubility of H₂O in various CaO - MgO - SiO₂ melts at 1400, 1450, 1500, 1550 and 1600°C under the vapor pressure of H₂O at 289 mmHg. The solubility data at 1550°C is shown in Table 1 and in Figs. 1 - 2. The effect of temperature on the solubility of H₂O from 1400 to 1600°C is shown in Table 2 and Fig. 3. Some misprints in the original report were corrected by the compiler by correspondence with the authors.

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AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The sample in a Pt crucible was equilibrated with the H₂O + Ar stream at near one atm., and was quenched in a water cooled Cu mold.
H₂O in the quenched sample was reduced to H₂ by Al at 1550 - 1600°C, and H₂ was measured volumetrically by using a micro-Orsat gas analyzer. (refs. 1, 2)

SOURCE AND PURITY OF MATERIALS:

CaO and MgO: Reagent grade chemicals
SiO₂: Transparent high purity silica was washed and cleaned (over 99.9%).

ESTIMATED ERROR:

analysis of H₂:
6(ppm)/(ppm) = < ± 0.06 (authors)

REFERENCES:

1. Fukushima, T.; Iguchi, Y.; Ban-ya, S.; Fuwa, T.
2. Iguchi, Y.; Ban-ya, S.; Fuwa, T.
   Ibid. 1969, 9, 189 - 195.
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Magnesium oxide; MgO; [1309-48-4]
(4) Silica; SiO₂; [7631-86-9]

ORIGINAL MEASUREMENTS:
Iguchi, Y.; Fuwa, T.

VARIABLES: T/K = 1673 - 1873
H₂O P/kPa = 38.5 (289 mmHg)
mol% MgO = 7.0 - 36
mol ratio n₂/n₄ = 0.16 - 1.2

EXPERIMENTAL VALUES: continued

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AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Magnesium oxide; MgO; [1309-48-4]
(4) Silica; SiO₂; [7631-86-9]

VARIABLES:
T/K = 1673 - 1873
H₂O P/kPa = 38.5 (289 mmHg)
mol% MgO = 7.0 - 36
mol ratio n₂/n₄ = 0.16 - 1.2

EXPERIMENTAL VALUES: continued

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continued

REFERENCES:
Iguchi, Y.; Fuwa, T.
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Magnesium oxide; MgO; [1309-48-4]
(4) Silica; SiO₂; [7631-86-9]

VARIABLES: T/K = 1823
H₂O p/ kPa = 38.5 (289 mmHg)
mol% MgO = 7.0 - 36
mol ratio n₂/n₄ = 0.16 - 1.2

EXPERIMENTAL VALUES:

Fig. 1 Solubility of water in CaO - MgO - SiO₂ melts at 1550°C and P₅₋₀ = 38.5 kPa as a function of mole ratio CaO/SiO₂;

- 7 mol% MgO
- 15 mol% MgO
- 20 mol% MgO
- 28 mol% MgO
- 32 mol% MgO

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Magnesium oxide; MgO; [1309-48-4]
(4) Silica; SiO₂; [7631-86-9]

ORIGINAL MEASUREMENTS:
Iguchi, Y.; Fuwa, T.

VARIABLES:
T/K = 1823
H₂O p/kPa = 38.5 (289 mmHg)
mol% MgO = 7.0 - 36
mol ratio n₂/n₄ = 0.16 - 1.2

EXPERIMENTAL VALUES:
continued

Fig. 2 Iso-solubility lines of water in CaO - MgO - SiO₂ melts at 1550°C.

EXPERIMENTAL VALUES:
continued

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
**COMPONENTS:**

1. Water; H$_2$O; [7732-18-5]
2. Calcium oxide; CaO; [1305-78-8]
3. Magnesium oxide; MgO; [1309-48-4]
4. Silica; SiO$_2$; [7631-86-9]

**ORIGINAL MEASUREMENTS:**

Iguchi, Y.; Fuwa, T.


**VARIABLES:**

- $T/K = 1673 - 1873$
- $H_2O P/kPa = 38.5$ (289 mmHg)
- mol% MgO = 7.0 - 36
- mol ratio $n_2/n_4 = 0.16 - 1.2$

**PREPARED BY:**

M. Shinmei

**EXPERIMENTAL VALUES:**

Fig. 3 Effect of temperature on the solubility of water in CaO - MgO - SiO$_2$ melts at $P_{H_2O} = 38.5$ kPa; mol ratio of: (CaO + MgO)/(SiO$_2$) are:

- (1) 1.3
- (2) 1.0
- (3) 0.7

**Auxiliary Information**

**METHOD/APPARATUS/PROCEDURE:**

**SOURCE AND PURITY OF MATERIALS:**

**ESTIMATED ERROR:**

**REFERENCES:**
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Magnesium oxide; MgO; [1309-48-4]
(4) Silica; SiO₂; [7631-86-9]

ORIGINAL MEASUREMENTS:
Ban-ya, S.; Iguchi, Y.; Yamamoto, S.
Tetsu to Hagane 1986, 72, 2210 - 2217.

VARIABLES:
T/K = 1723
H₂O P/kPa = various
n₂/n₃/n₄ = various

EXPERIMENTAL VALUES:
The authors reported the iso-water vapor capacities defined by:
\[ \log K' = \log(\text{mass \% H}_2\text{O}/P^{1/2}H_2O) \]
as shown in Fig. 1, where \( P_{H_2O} \) is expressed in mm Hg.

![Graph showing iso-water vapor capacity lines in CaO - MgO - SiO₂ melts at 1450°C](Fig. 1 Iso-water vapor capacity lines in CaO - MgO - SiO₂ melts at 1450°C)

METHOD/APPARATUS/PROCEDURE:
Synthesized slag was equilibrated with water vapor by blowing nearly one atm. Ar + H₂O gas mixture over the melt. Water contents were determined by the method developed by the authors (1).

SOURCE AND PURITY OF MATERIALS:
CaO: made by fining reagent grade CaCO₃
MgO: reagent grade powder
SiO₂: crushed quartz

ESTIMATED ERROR:
No description in the paper but is estimated to be of the same order as in ref. 1.

REFERENCES:
1. Ban-ya, S.; Iguchi, Y.; Nagata, S.
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Barium oxide; BaO;
[1304-28-5]
(3) Calcium oxide; CaO;
[1305-78-8]
(4) Silica; SiO₂; [7631-86-9]

ORIGINAL MEASUREMENTS:
Iguchi, T.; Ban-ya, S.; Fuwa, T.

VARIABLES:
T/K = 1823
H₂O p/kPa = 38.5 (289 mmHg)
Mol% BaO = 1.9 - 11.8
mol ratio n₃/n₄ = 0.35 - 1.10

EXPERIMENTAL VALUES:
The authors reported the solubility of H₂O in various BaO - CaO - SiO₂ melts at 1550°C under the H₂O vapor pressure at 289 mmHg. The original data were provided by the authors.

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AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
The sample in a Pt crucible was equilibrated with H₂O + Ar stream at nearly one atm., and was quenched in a water cooled Cu mold. H₂O in the quenched sample was reduced to H₂ by Al at 1550 - 1600°C, and was measured volumetrically by using a micro-Orsat gas analyzer.

SOURCE AND PURITY OF MATERIALS:
BaO: Reagent grade chemical (over 99.9%)
CaO: Decomposition of reagent grade carbonate (over 99.5%) at 900°C
SiO₂: Ground quartz (over 99.9%)

ESTIMATED ERROR:
Analysis of Hydrogen,
$6$(ppm)/(ppm) = ± 0.04 (authors)

REFERENCES:
1. Fukushima, T.; Iguchi, Y.; Ban-ya, S.; Fuwa, T.
2. Iguchi, Y.; Ban-ya, S.; Fuwa, T.
   Ibid. 1969, 9, 189 - 195.
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Barium oxide; BaO; [1304-28-5]
(3) Calcium oxide; CaO; [1305-78-8]
(4) Silica; SiO₂; [7631-86-9]

VARIABLES:
T/K = 1823
H₂O P/kPa = 38.5 (289 mmHg)
mol% BaO = 1.9 - 11.8
mol ratio n₃/n₄ = 0.35 - 1.10

ORIGINAL MEASUREMENTS:
Iguchi, Y.; Ban-ya, S.; Fuwa, T.

PREPARED BY:
M. Shinmei

EXPERIMENTAL VALUES:

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AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Barium oxide; BaO; [1304-28-5]
(3) Calcium oxide; CaO; [1305-78-8]
(4) Silica; SiO₂; [7631-86-9]

VARIABLES: T/K = 1823
H₂O P/kPa = 38.5 (289 mmHg)
mol% BaO = 1.9 - 11.8
mol ratio n₃/n₄ = 0.35 - 1.10

EXPERIMENTAL VALUES:

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<th>BaO mass%</th>
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</tr>
</thead>
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<td>15</td>
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<td>4)</td>
<td>20</td>
</tr>
<tr>
<td>5)</td>
<td>25</td>
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Fig. 1 Solubility of water in BaO - CaO - SiO₂ melts at 1550°C and P₄H₂O = 38.5 kPa.
COMPONENTS:

(1) Water; H\(_2\)O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Silica; SiO\(_2\); [7631-86-9]
(4) Strontium oxide; SrO; [1314-11-0]

VARIABLES: \( T / K = 1823 \)
\( \text{H}_2\text{O} \ P/\text{kPa} = 38.5 \ (289 \text{ mmHg}) \)
\( \text{mol}\% \text{SrO} = 2.8 - 15.8 \)
\( \text{mol ratio} \ n_2/n_3 = 0.34 - 1.1 \)

EXPERIMENTAL VALUES:

The authors reported the solubility of H\(_2\)O in various CaO - SiO\(_2\) - SrO melts at 1550°C and at 289 mmHg of H\(_2\)O partial pressure in graphical form. The original data were provided by the authors.

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<td>2.9</td>
</tr>
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<td>9.1</td>
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<tr>
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AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The sample in a Pt crucible was equilibrated with the \( \text{Ar} + \text{H}_2\text{O} \) stream at nearly one atm., and was quenched.

H\(_2\)O in a sample was measured as H\(_2\) volumetrically by a micro-Orsat gas analyzer after reducing with Al at 1550 - 1600°C.

SOURCE AND PURITY OF MATERIALS:

CaO, SrO: Reagent grade chemicals
SiO\(_2\): Transparent high purity SiO\(_2\) was washed and cleaned (over 99.9%)

ESTIMATED ERROR:

Analysis of H\(_2\) : 
\( \delta(\text{ppm})/\text{ppm} = 0.06 \) (authors)

REFERENCES:


PREPARED BY:

M. Shinmei
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Silica; SiO₂; [7631-86-9]
(4) Strontium oxide; SrO; [1314-11-0]

VARIABLES: T/K = 1823
H₂O P/kPa = 38.5 (289 mmHg)
mol% SrO = 2.8 - 15.8
mol ratio n₂/n₃ = 0.34 - 1.1

ORIGINAL MEASUREMENTS:
Iguchi, Y.; Ban-ya, S.; Fuwa, T.
App. on Ferrous Met. held at Univ. Sheffield, 19 - 21 July 1971, The

PREPARED BY:
M. Shinmei

EXPERIMENTAL VALUES: continued

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<th>mol%</th>
<th>mole ratio</th>
<th>ppm(mass/mass)</th>
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<td>42.1</td>
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AUXILIARY INFORMATION

SOURCE AND PURITY OF MATERIALS:

REFERENCES:
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Silica; SiO₂; [7631-86-9]
(4) Strontium oxide; SrO; [1314-11-9]

VARIABLES: T/K = 1823
H₂O P/kPa = 38.5 (289 mmHg)
mol% SrO = 2.8 - 15.8
mol ratio n₂/n₃ = 0.34 - 1.1

EXPERIMENTAL VALUES:

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<th>SrO mass%</th>
<th>mol%</th>
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</thead>
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<td>10</td>
<td>5.9</td>
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<tr>
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<td>9.1</td>
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<tr>
<td>20</td>
<td>12.4</td>
</tr>
<tr>
<td>25</td>
<td>15.8</td>
</tr>
</tbody>
</table>

fig. 1, Solubility of water in CaO - SiO₂ - SrO melts as a function of CaO/SiO₂.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:

ORIGINAL MEASUREMENTS:

PREPARED BY:
M. Shinmei
**COMPONENTS:**
(1) Water; \(H_2O\); [7732-18-5]
(2) Boron oxide; \(B_2O_3\); [1303-86-2]
(3) Calcium oxide; \(CaO\); [1305-78-8]
(4) Silica; \(SiO_2\); [7631-86-9]

**VARIABLES:**
- \(T/K = 1823\)
- \(H_2O\) \(P/kPa = 38.5\) (289 mmHg)
- mol% \(B_2O_3 = 2.5 - 11.2\)
- mol ratio \(n_2/n_4 = 0.63\)

**EXPERIMENTAL VALUES:**
The authors reported the solubility of \(H_2O\) in ppm of \(H\) in various \(B_2O_3 - CaO - SiO_2\) melts at 1500°C and at \(P_{H_2O} = 289\) mmHg in graphical form. The original data are shown in ref. 1.

<table>
<thead>
<tr>
<th>Mass%</th>
<th>Mol%</th>
<th>mol ratio</th>
<th>ppm (mass/mass)</th>
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<td>(SiO_2)</td>
<td>(B_2O_3)</td>
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<td>59.7</td>
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</table>

* Calculated by the compiler.

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**
The sample in a Pt crucible was equilibrated with the \(H_2O + Ar\) stream of nearly one atm., and was quenched in a water cooled Cu mold.

\(H_2O\) in a quenched sample was reduced to \(H_2\) by \(Al\) at 1500 - 1600°C, and was measured volumetrically by using a micro-Orsat gas analyzer.

**SOURCE AND PURITY OF MATERIALS:**
- \(B_2O_3\): Reagent grade chemical (over 90%, impurity except for \(H_2O\) was less than 0.1%)
- \(CaO\): Made by thermal decomposition of reagent grade carbonate (over 99.5%) at 900°C
- \(SiO_2\): Ground quartz (over 99.9%)

**ESTIMATED ERROR:**
\(\delta{(ppm)/(ppm)} = \pm 0.08\) (authors)

**REFERENCES:**
1. Fuwa, T.; Ban-ya, S.; Fukushima, T.
COMPONENTS:
(1) Water; H\textsubscript{2}O; [7732-18-5]
(2) Aluminum oxide; Al\textsubscript{2}O\textsubscript{3}; [1344-28-1]
(3) Calcium oxide; CaO; [1305-78-8]
(4) Silica; SiO\textsubscript{2}; [7631-86-9]

ORIGINAL MEASUREMENTS:
Iguchi, Y.; Ban-ya, S.; Fuwa, T.

VARIABLES:
\( T/K = 1823 \)
\( H_2O \ P/kPa = 38.4 \ (288 \ \text{mmHg}) \)
\( Al_2O_3/\text{mass}\% = 3.0 - 51.7 \)
\( \text{mass ratio } n_3/n_4 = 0.51 - 8.96 \)

PREPARED BY:
M. Shinmei

EXPERIMENTAL VALUES:
The authors reported the solubility of H\textsubscript{2}O in various Al\textsubscript{2}O\textsubscript{3} - CaO - SiO\textsubscript{2} melts at 1550°C in graphical form. The original data were provided by the authors.

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</table>

continued

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
The samples in Pt crucibles were equilibrated with H\textsubscript{2}O + Ar stream at near one atm. and were quenched.
The water in quenched samples was reduced to H\textsubscript{2}O by Al at 1450 - 1600°C and was determined volumetrically as H\textsubscript{2}. (ref. 1)

SOURCE AND PURITY OF MATERIALS:
Al\textsubscript{2}O\textsubscript{3}: reagent grade chemical (over 99.9%).
CaO: made by thermal decomposition of reagent grade calcium carbonate
SiO\textsubscript{2}: high purity quartz (over 99.9%)

ESTIMATED ERROR:
Analysis of H\textsubscript{2}: \( \delta (\text{ppm})/(\text{ppm}) = \pm 0.06 \) (authors)

REFERENCES:
1. Fukushima, T.; Iguchi, Y.; Ban-ya, S.; Fuwa, T.
COMPONENTS:
1. Water; H₂O; [7732-18-5]
2. Aluminum oxide; Al₂O₃; [1344-28-1]
3. Calcium oxide; CaO; [1305-78-8]
4. Silica; SiO₂; [7631-86-9]

ORIGINAL MEASUREMENTS:
Iguchi, Y.; Ban-ya, S.; Fuwa, T.

ORIGINAL MEASUREMENTS:
Iguchi, Y.; Ban-ya, S.; Fuwa, T.

VARIABLES:
- T/K = 1823
- H₂O P/kPa = 38.4 (288 mmHg)
- Al₂O₃/mass% = 3.0 - 51.7
- mass ratio n₃/n₄ = 0.51 - 8.96

PREPARED BY:
M. Shinmei

EXPERIMENTAL VALUES: continued.

<table>
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<tr>
<th></th>
<th>Al₂O₃</th>
<th>CaO</th>
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<th>mole ratio</th>
<th>ppm(mass/mass)</th>
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</tr>
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</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Aluminum oxide; Al₂O₃; [1344-28-1]
(3) Calcium oxide; CaO; [1305-78-8]
(4) Silica; SiO₂; [7631-86-9]

VARIABLES:
T/K = 1823
H₂O P/kPa = 38.4 (288 mmHg)
Al₂O₃/mass% = 3.0 51.7
mass ratio n₃/n₄ = 0.51 - 8.96

ORIGINAL MEASUREMENTS:
Iguchi, Y.; Ban-ya, S.; Fuwa, T.

PREPARED BY:
M. Shinmei

EXPERIMENTAL VALUES: continued

fig. 1 Solubility of H₂O (ppm) in Al₂O₃ - CaO - SiO₂ melts at 1550°C and at P₇₅ = 289 mmHg. Dashed lines represent iso-solubility curves.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Alumina; Al₂O₃; [1344-28-1]
(3) Calcium oxide; CaO; [1305-78-8]
(4) Silica; SiO₂; [7631-86-9]

VARIABLES:
T/K = 1673 K
H₂O P/kPa = various
n₂/n₃/n₄ = various

EXPERIMENTAL VALUES:

The authors reported the iso-water vapor capacities defined by:

$$\log K' = \log\left(\frac{\text{mass} \% \text{H}_2\text{O}}{P_{\text{H}_2\text{O}}^a}\right)$$

as shown in Fig. 1 for the Al₂O₃ - CaO - SiO₂ melts at 1400°C, where

$$P_{\text{H}_2\text{O}}$$

is expressed in mm Hg.

Fig. 1. Iso-contours of water-vapor capacity, log K'.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Synthesized slag melt was equilibrated with water vapor by blowing one atm. of Ar + H₂O gas mixture over the melt.

Water contents were determined by the method developed by the authors (1) (vacuum fusion with Al metal).

SOURCE AND PURITY OF MATERIALS:

Al₂O₃: reagent grade alumina powder
CaO: made by fining reagent grade CaCO₃
SiO₂: crushed quartz

ESTIMATED ERROR:

δ(ppm)/(ppm) = within 0.05 (Authors)

REFERENCES:

1. Fukushima, T.; Iguchi, Y.; Ban-ya, S.; Fuwa, T.
COMPONENTS:
(1) Water; $H_2O$; [7732-18-5]
(2) Alumina; $Al_2O_3$; [1344-28-1]
(3) Calcium oxide; $CaO$; [1305-78-8]
(4) Silica; $SiO_2$; [7631-86-9]

VARIABLES: $T/K = 1643, 1723, 1823$
mass$% \ Al_2O_3/ CaO/ SiO_2 = 20/40/40$
$H_2O$ P/kPa: 1.0 - 101.3 (7.7 - 760 mmHg)

EXPERIMENTAL VALUES:
The authors reported the solubility of $H_2O$ in ppm of H as a function of $P_{H_2O}^{1/2}$ in 20% $Al_2O_3$ - 40% CaO - 40% $SiO_2$ (mass) melts at 1370, 1450, 1550°C, and in graphical form only.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
A slag in a Pt crucible was equilibrated with the stream at nearly one atm. of $N_2 + H_2O$ and was quenched by lowering the crucible into either Hg or $H_2O$.
The solubility of $H_2O$ was analyzed as $H$ content by applying the vacuum fusion technique to the sample wrapped with $Al$ foil, heating at about 1600°C.

SOURCE AND PURITY OF MATERIALS:
The slags were prepared by mixing the chemically pure constituents.

ESTIMATED ERROR:
$\delta$(ppm)/(ppm) = ± 0.048 (authors)

REFERENCES:
COMPONENTS:  
(1) Water; H₂O; [7732-18-5]  
(2) Calcium oxide; CaO;  
[1305-78-8]  
(3) Phosphorous oxide; P₂O₅;  
[1314-56-3]  
(4) Silica; SiO₂; [7631-86-9]  

ORIGIONAL MEASUREMENTS:  
Fukushima, T.; Iguchi, Y.;  
Ban-ya, S.; Fuwa, T.  

VARIABLES:  
T/K = 1773  
H₂O P/kPa = 38.5 (289 mmHg)  
mol% P₂O₅ = 0-1.4 (0-3.5 mass%)  
mol ratio n₂/n₄ = 0.63  

EXPERIMENTAL VALUES:  
The authors reported the solubility of water as hydrogen content in CaO - P₂O₅ - SiO₂ melts of constant mass ratio of CaO/SiO₂ (= 0.59) at 1500°C as a function of P₂O₅ concentration at P₄O₁₀ = 38.5 kPa (289 mmHg) and in graphical form only. The numerical data were provided by the authors.  

<table>
<thead>
<tr>
<th>mass%</th>
<th>mol%</th>
<th>mass ratio</th>
<th>ppm(mass/mass)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>P₂O₅</td>
<td>SiO₂</td>
<td>CaO</td>
</tr>
<tr>
<td>37.1</td>
<td>0</td>
<td>62.9</td>
<td>38.7</td>
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<tr>
<td>36.4</td>
<td>2.0</td>
<td>61.6</td>
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</tr>
<tr>
<td>35.8</td>
<td>3.5</td>
<td>60.7</td>
<td>38.2</td>
</tr>
</tbody>
</table>

- Calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:  
The sample in a Pt crucible was equilibrated with the H₂O + Ar stream of nearly one atm., and was quenched in a water cooled Cu mold. H₂O in a quenched sample was reduced by Al at 1500 - 1600°C, and was measured volumetrically using a micro-Orsat gas analyzer.

SOURCE AND PURITY OF MATERIALS:  
CaO: Made by thermal decomposition of reagent grade carbonate (over 99.5%) at 900°C  
P₂O₅: Reagent grade chemical (over 99.8%)  
SiO₂: Ground quartz (over 99.9%)

ESTIMATED ERROR:  
Analysis of H₂:  
6(ppm)/(ppm) = ± 0.08 (authors)

REFERENCES:  
1. Fuwa, T.; Ban-ya, S.; Fukushima, T.  
COMPONENTS:
(1) Water; H\textsubscript{2}O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Phosphorous oxide; P\textsubscript{2}O\textsubscript{5}; [1314-56-3]
(4) Silica; SiO\textsubscript{2}; [7631-86-9]

VARIABLES:
\begin{align*}
T/K &= 1823 \\
H_2O P/kPa &= 38.5 \text{ (289 mmHg)} \\
mol\% P_2O_5 &= 0-5.5 \text{ (0-11 mass\%)} \\
mol ratio n_2/n_4 &= 1.3
\end{align*}

EXPERIMENTAL VALUES:
The authors reported the solubility of water in CaO – P\textsubscript{2}O\textsubscript{5} – SiO\textsubscript{2} melts of constant mole ratio of CaO/SiO\textsubscript{2} (= 1.3) at 1550°C as a function of P\textsubscript{2}O\textsubscript{5} concentration at P_{H_2O} = 38.5 kPa (289 mmHg), and in graphical form only.

The numerical data were provided by the authors.

<table>
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<th>mol%</th>
<th>mole ratio</th>
<th>ppm*</th>
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</thead>
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<td>SiO\textsubscript{2}</td>
</tr>
<tr>
<td>---------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>56.5</td>
<td>0</td>
<td>43.5</td>
</tr>
<tr>
<td>55.1</td>
<td>2.5</td>
<td>42.4</td>
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<tr>
<td>54.3</td>
<td>4.0</td>
<td>41.7</td>
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<tr>
<td>53.4</td>
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</tr>
<tr>
<td>53.4</td>
<td>5.5</td>
<td>41.1</td>
</tr>
</tbody>
</table>

* mass/mass

EXPERIMENTAL VALUES (continued):

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
The sample in a Pt crucible was equilibrated with the H\textsubscript{2}O + Ar stream of nearly one atm., and was quenched in a water cooled Cu mold. H\textsubscript{2}O in a quenched sample was reduced to H\textsubscript{2} by Al at 1500 – 1600°C, and was measured volumetrically by using a micro-Orsat gas analyzer.

SOURCE AND PURITY OF MATERIALS:
CaO: Made by thermal decomposition of reagent grade carbonate (over 99.5%) at 900°C
P\textsubscript{2}O\textsubscript{5}: Reagent grade chemical (over 99.8%)
SiO\textsubscript{2}: Ground quartz (over 99.9%)

ESTIMATED ERROR:
Analysis of H\textsubscript{2}: 
δ(ppm)/(ppm) = 0.08 (authors)

REFERENCES:
1. Fukushima, T.; Iguchi, Y.; Ban-ya, S.; Fuwa, T.
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO;
[1305-78-8]
(3) Silica; SiO₂; [7631-86-9]
(4) Titanium oxide; TiO₂;
[13463-67-7]

VARIABLES:
T/K = 1823
H₂O P/ kPa= 38.5 (289 mmHg)
mass% TiO₂ = 5.0 - 47.5
mol ratio n₂/n₃ = 0.59 - 1.31

EXPERIMENTAL VALUES:
The authors reported the solubility of H₂O in various CaO - SiO₂ - TiO₂ melts at 1550°C under the vapor pressure of H₂O at 289 mmHg in graphical form only. The original data were provided by the authors.

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<tr>
<th>mass%</th>
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<tr>
<td>34.8</td>
<td>36.0</td>
<td>28.7</td>
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AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
The sample in a Pt crucible was equilibrated with the H₂O + Ar stream of nearly one atm., and was quenched in a canal made of thick Cu plate. H₂O in the sample was reduced to H₂ by Al at 1550 - 1600°C, and H₂ was measured volumetrically by using a micro-Orsat gas analyzer.

SOURCE AND PURITY OF MATERIALS:
CaO & TiO₂: Reagent grade chemicals
SiO₂: Transparent high purity silica was washed and cleaned (over 99.9%).

ESTIMATED ERROR:
Analysis of H₂:
δ(ppm)/(ppm) < : 0.08 (authors)

REFERENCES:
1. Fukushima, T.; Iguchi, Y.; Ban-ya, S.; Fuwa, T.
COMPONENTS:
(1) Water; H$_2$O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Silica; SiO$_2$; [7631-86-9]
(4) Titanium oxide; TiO$_2$; [13463-67-7]

VARIABLES:
$T/K = 1823$
$H_2O P/kPa = 38.5$ (289 mmHg)
mass% $TiO_2 = 5.0 - 47.5$
mol ratio $n_2/n_3 = 0.59 - 1.31$

EXPERIMENTAL VALUES:

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<th>ppm(mass/mass)</th>
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<td>TiO$_2$</td>
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<tr>
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<td>46.1</td>
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<td>20.0</td>
</tr>
<tr>
<td>44.9</td>
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<td>14.6</td>
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<tr>
<td>52.2</td>
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<td>5.0</td>
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</table>

continued

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:  

SOURCE AND PURITY OF MATERIALS:  

ESTIMATED ERROR:  

REFERENCES:  

ORIGINAL MEASUREMENTS:
Iguchi, Y.; Ban-ya, S.; Fuwa, T.  

PREPARED BY:  
M. Shinmei
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Silica; SiO₂; [7631-86-9]
(4) Titanium oxide; TiO₂; [13463-67-7]

VARIABLES:
T/K = 1823
H₂O P/kPa = 38.5 (289 mmHg)
mass% TiO₂ = 5.0 - 47.5
mol ratio n₂/n₃ = 0.59 - 1.31

EXPERIMENTAL VALUES:

<table>
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<tr>
<th>CaO</th>
<th>SiO₂</th>
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<th>ppm (mass/mass)</th>
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</tr>
<tr>
<td>12.2</td>
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<td>5.0</td>
<td>1.31</td>
<td>370</td>
</tr>
</tbody>
</table>

Fig. 1, Solubility of water in CaO - SiO₂ - TiO₂ melts (ppm) at P₇H₂O = 38.5 kPa and 1550°C.

AUXILIARY INFORMATION

ORIGINAL MEASUREMENTS:
Iguchi, Y.; Ban-ya, S.; Fuwa, T.

PREPARED BY:
M. Shinmei

REFERENCES:
COMPONENTS:
(1) Water; \( \text{H}_2\text{O}; [7732-18-5] \)
(2) Calcium oxide; \( \text{CaO}; [1305-78-8] \)
(3) Titanium oxide; \( \text{TiO}_2; [13463-67-7] \)
(4) Silica; \( \text{SiO}_2; [7631-86-9] \)

VARIABLES:
- \( T/\text{K} = 1723 \)
- \( \text{H}_2\text{O} \ P/\text{kPa} = \text{various} \)
- \( n_2/n_3/n_4 = \text{various} \)

EXPERIMENTAL VALUES:

The authors reported the iso-water vapor capacities defined by:

\[
\log K' = \log(\text{mass } \% \text{H}_2\text{O}/P_{\text{H}_2\text{O}})
\]

as shown in the figure, where \( P_{\text{H}_2\text{O}} \) is expressed in mm Hg.

![Fig. 1 Iso-water vapor capacity lines in CaO - SiO2 - TiO2 melts at 1450°C.](image)

Original Measurements:
Ban-ya, S.; Iguchi, Y.; Yamamoto, S.
Tetsu to Hagane 1986, 72, 2210 - 2217.

Prepared By:
M. Shinmei

Auxiliary Information

Method/Apparatus/Procedure:

Synthesized slag was equilibrated with water vapor by blowing nearly one atm. of Ar + \( \text{H}_2\text{O} \) gas mixture over the melt. Water contents were determined by the method developed by the authors (1).

Source and Purity of Materials:

CaO: made by fining reagent grade \( \text{CaCO}_3 \).
TiO2: reagent grade \( \text{TiO}_2 \) powder.
SiO2: crushed quartz.

Estimated Error:

Not described, but is estimated to be of the same order as in ref. 1.

References:
1. Ban-ya, S.; Iguchi, Y.; Nagata, S.
**COMPONENTS:**

1. Water; H$_2$O; [7732-18-5]
2. Calcium oxide; CaO; [1305-78-8]
3. Manganese oxide; MnO; [1344-43-0]
4. Silica; SiO$_2$; [7631-86-9]

**ORIGINAL MEASUREMENTS:**

Abe, Y.

Tetsu to Hagane 1961, 47, 693 - 698.

**VARIABLES:**

T/K = 1673
H$_2$O P/kPa = 2.7 (20 mmHg)
_mass% CaO/MgO/SiO$_2$ = 35/30/35

**EXPERIMENTAL VALUES:**

The author reported the solubility of H$_2$O in 35% CaO - 30% MnO - 35% SiO$_2$ melt at 1400°C and at P$_{H_2O}$ = 20 mmHg as (H) = 27.5 (ppm, mass/mass). However, two points should be raised regarding this study: (i) Whether only one hour passing of a N$_2$ + H$_2$O stream over the sample was enough to assure the equilibrium state. ii) Using of an Al$_2$O$_3$ boat as the sample container might change the above composition by dissolution of Al$_2$O$_3$.

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

The sample in an Al$_2$O$_3$ boat was heated for one hour at 1400°C under a stream of N$_2$ + H$_2$O at near one atm.

**SOURCE AND PURITY OF MATERIALS:**

Not given.

**ESTIMATED ERROR:**

Not given.

**REFERENCES:**
COMPONENTS: ORIGINAL MEASUREMENTS:
(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Iron oxide; FeO; [1345-25-1]
(4) Silica; SiO₂; [7631-86-9]
Imai, M.; Ooi, H.; Emi, T.
Tetsu to Hagane 1962, 48, 111 - 117.

VARIABLES:
- mol% FeO = 22.8 - 34.0
- mol ratio n₂/n₈ = 0.4 - 3.14
- T/K = 1623 - 1823

PREPARED BY:
M. Shinmei

EXPERIMENTAL VALUES:
The authors reported the solubility of H₂O in various CaO - FeO - SiO₂ melts at 1623, 1723 and 1823 K and at P₇₅ = 2.8 and 10.1 kPa. Fig. 1 shows the relation between H content and square root of H₂O pressures. Effect of temperature and of basicity on the H content of the melts are shown in Table 1 and in Fig. 2, respectively.

Fig. 1 Solubility of water in CaO - FeO - SiO₂ melts as a function of square root of water vapor pressure at 1550°C.

Method/Apparatus/Procedure:
The samples in Pt crucibles were equilibrated with the stream of Ar + H₂O nearly one atm., and were quenched in either Hg or H₂O. H₂O in the samples was determined by the method of analysis described in ref. 1

Source and Purity of Materials:
All materials used were reagent grade chemicals.

Estimated Error:
Not described explicitly.

Auxiliary Information:

References:
1. Imai, M.; Nakayama, T.; Ooi, H.; Emi, T.
Tetsu to Hagane 1959, 45, 1080 - 1082.
COMPONENTS: ORIGINAL MEASUREMENTS:
(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Iron oxide; FeO; [1345-25-1]
(4) Silica; SiO₂; [7631-86-9]
Imai, M.; Ooi, H.; Emi, T.
Tetsu to Hagane 1962, 48, 111 - 117.

VARIABLES:
H₂O P/kPa = 2.8 (21.1 mmHg), 10.1 (76 mmHg)
PREPARED BY:
M. Shinmei

EXPERIMENTAL VALUES:
continued

Table 1
Effect of Temperature on Hydrogen Content of CaO - FeO - SiO₂ Melts

<table>
<thead>
<tr>
<th>Composition of melts/mol%</th>
<th>Hydrogen content/ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaO FeO SiO₂</td>
<td>1350°C</td>
</tr>
<tr>
<td>----------------</td>
<td>------</td>
</tr>
<tr>
<td>29.1 24.5 46.4</td>
<td>11.7</td>
</tr>
<tr>
<td>38.7 24.3 37.0</td>
<td>15.7</td>
</tr>
<tr>
<td>26.6 32.8 40.6</td>
<td>16.1</td>
</tr>
<tr>
<td>33.4 33.6 33.0</td>
<td>15.1</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:
(1) Water; H₂O [7732-18-5]
(2) Calcium oxide; CaO [1305-78-8]
(3) Iron oxide; FeO [1345-25-1]
(4) Silica; SiO₂ [7631-86-9]

ORIGINAL MEASUREMENTS:
Imai, M.; Ooi, H.; Emi, T.
Tetsu to Hagane, 1962, 48, 111 - 117

VARIABLES:

EXPERIMENTAL VALUES:
continued.

PREPARED BY:
M. Shinmei

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:

Fig. 1 Effect of basicity on the hydrogen content of CaO - FeO - SiO₂ melts at 1550°C. • P₇₆ = 76 mmHg, ○ P₂₁ = 21.1 mmHg.
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Iron oxide; FeO; [1345-25-1]
(4) Silica; SiO₂; [7631-86-9]

VARIABLES: mol% FeO = 3.1 - 39.2
mol% CaO = 18.8 - 57.6
H₂O P/kPa = 2.8 - 90.9
T/K = 1823 & 1873

EXPERIMENTAL VALUES:

The authors studied the solubility of H₂O in various CaO - FeO - SiO₂ melts coexisting with liquid iron at 1550 and 1600°C. Considering the dissolution reaction of H₂O takes place:

H₂O(g) + O(melt) = 2OH(melt)  

they obtained:

\[ \log K = \frac{C_{OH}^2}{P_{H_2O}} \times a_o \]  \( \text{(1)} \)

\[ \log K = -2160/T + 8.144 \]  \( \text{(2)} \)

where \( C_{OH} \) is the concentration of OH in the melt expressed in ppm (mass/mass), \( P_{H_2O} \) is the pressure of H₂O expressed in atm, and \( a_o \) is the activity of oxygen which was assumed to equal the activity of FeO.

The compiler obtained the following as solubility of H₂O:

\[ \log C_{H_2O}(ppm, \text{mass/mass}) = -1080/T + 2.789 + (1/2) \log P_{H_2O}(KPa) \]  

\[ (1/2) \log a_o \]

\[ \log C_H(ppm, \text{mass/mass}) = -1080/T + 1.838 + (1/2) \log P_{H_2O}(KPa) \]  

\[ (1/2) \log a_o \]

The original data are shown in Tables 2 and 3.  \( \text{(authors)} \)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The samples in SiO₂ crucibles were equilibrated with the stream of Ar + H₂O at near one atm., and were quenched.

The analysis of H in the sample was made by the method described in ref. 1.

SOURCE AND PURITY OF MATERIALS:

All materials used were reagent grade chemicals.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Imai, M.; Nakayama, T.; Ooi, H.; Emi, T.
   Tetsu to Hagane 1959, 45, 1080 - 1082.
COMPONENTS:
(1) Water; H$_2$O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Iron oxide; FeO; [1345-25-1]
(4) Silica; SiO$_2$; [7631-86-9]

ORIGINAL MEASUREMENTS:
Wahlster, M.; Reichel, H.-H.

VARIABLES: mol% $n_3 = 20 \& 35$
mol ratio $n_2/n_4 = 20/20 \& 30/35$
H$_2$O P/kPa = 101.3 (760 mmHg)
T/K = 1683 - 1873

PREPARED BY:
M. Shinmei

EXPERIMENTAL VALUES:

The authors reported the solubility of H$_2$O in CaO - FeO - SiO$_2$ melts as a function of temperature at P$_{H_2O}$ = 101.3 kPa.

For 20 mol% CaO - 30 mol% FeO - 35 mol% SiO$_2$ melt:

$\log H(ppm) = -625/T + 2.04$

$\log H_2O^*(ppm) = -625/T - 1.01$

and for 20 mol% CaO - 60 mol% FeO - 20 mol% SiO$_2$ melt:

$\log H(ppm) = -1940/T + 2.89$

$\log H_2O^*(ppm) = -1940/T - 0.159$

* Calculated by the compiler.

AUXILIARY INFORMATION:

METHOD/APPARATUS/PROCEDURE:
The samples in Pt crucibles were equilibrated with the stream of Ar + H$_2$O at nearly one atm., and were quenched.
The solubility of H$_2$O was determined by the method described in ref. 1.

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:

Analysis of hydrogen
$\delta(ppm)/(ppm) = \pm 0.05$

REFERENCES:
1. Obst, K.-H.; Malissa, H.
Arch. Eisenhuttenwes. 1959, 30, 601 - 603.
COMPONENTS:

1. Water; H\textsubscript{2}O; [7732-18-5]
2. Calcium oxide; CaO; [1305-78-8]
3. Iron oxide; FeO; [1345-25-1]
4. Silica; SiO\textsubscript{2}; [7631-86-9]

VARIABLES:

- T/K = 1873 (1600°C)
- H\textsubscript{2}O P/kPa = 101.3 (760 mmHg)
- mol\% FeO = 0 - 100
- mol\% SiO\textsubscript{2} = 0 - 50

EXPERIMENTAL VALUES:

The authors reported the solubility of H\textsubscript{2}O in various CaO - FeO - SiO\textsubscript{2} melts at 1873 K and at P\textsubscript{H\textsubscript{2}O} = 101.3 kPa (actual measurements were carried out at P\textsubscript{H\textsubscript{2}O} = 31.2 kPa). The numerical values in the figure are ppm (mass\% /mass) of hydrogen.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The samples in Pt crucibles were equilibrated with the stream of Ar + H\textsubscript{2}O at near one atm. and were quenched.

The solubility of H\textsubscript{2}O was determined by the method described in ref. 1.

SOURCE AND PURITY OF MATERIALS:

Not described.

ESTIMATED ERROR:

- analysis of hydrogen
  \( \delta(\text{ppm})/(\text{ppm}) = 0.05 \) (authors)

REFERENCES:

1. Obst, K.-H.; Malissa, H.
   Arch. Eisenhuttenwes. 1959, 30, 601 - 603.
**COMPONENTS:**

(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Iron oxide; FeO; [1345-25-1]
(4) Silica; SiO₂; [7631-86-9]

**ORIGINAL MEASUREMENTS:**

Iguchi, Y.; Ban-ya, S.; Fuwa, T.

**VARIABLES:**

| T/K = 1823 |
|---|---|---|---|---|---|
| H₂O P/kPa = 38.5 (289 mmHg) |
| mass% FeO = 3.9 - 19.8 |
| mol ratio n₂/n₄ = 0.62 - 1.28 |

**EXPERIMENTAL VALUES:**

The authors reported the solubility of H₂O in various CaO - FeO - SiO₂ melts at 1550°C under the vapor pressure of H₂O at 289 mmHg in graphical form, and the original data were provided by the authors.

<table>
<thead>
<tr>
<th>mass %</th>
<th>mole ratio</th>
<th>ppm(mass/mass)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaO</td>
<td>FeO</td>
<td>SiO₂</td>
</tr>
<tr>
<td>30.1</td>
<td>19.7</td>
<td>49.1</td>
</tr>
<tr>
<td>30.7</td>
<td>14.5</td>
<td>53.2</td>
</tr>
<tr>
<td>32.8</td>
<td>10.4</td>
<td>56.2</td>
</tr>
<tr>
<td>34.7</td>
<td>5.3</td>
<td>58.3</td>
</tr>
<tr>
<td>35.7</td>
<td>14.8</td>
<td>48.1</td>
</tr>
<tr>
<td>38.1</td>
<td>9.6</td>
<td>51.3</td>
</tr>
<tr>
<td>38.2</td>
<td>19.8</td>
<td>40.9</td>
</tr>
<tr>
<td>39.6</td>
<td>5.5</td>
<td>54.2</td>
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<tr>
<td>40.7</td>
<td>14.7</td>
<td>43.6</td>
</tr>
<tr>
<td>41.1</td>
<td>19.0</td>
<td>39.0</td>
</tr>
<tr>
<td>42.7</td>
<td>9.2</td>
<td>46.0</td>
</tr>
<tr>
<td>42.9</td>
<td>19.3</td>
<td>36.6</td>
</tr>
<tr>
<td>43.5</td>
<td>14.0</td>
<td>41.6</td>
</tr>
<tr>
<td>44.3</td>
<td>4.8</td>
<td>48.7</td>
</tr>
<tr>
<td>46.1</td>
<td>9.2</td>
<td>43.9</td>
</tr>
<tr>
<td>46.6</td>
<td>13.1</td>
<td>39.2</td>
</tr>
<tr>
<td>48.6</td>
<td>4.6</td>
<td>46.1</td>
</tr>
<tr>
<td>49.2</td>
<td>8.4</td>
<td>41.1</td>
</tr>
<tr>
<td>51.4</td>
<td>3.9</td>
<td>43.9</td>
</tr>
</tbody>
</table>

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

The sample in a Pt crucible was equilibrated with the H₂O + Ar stream of nearly one atm., where the oxygen potential was maintained to keep 1.5 x 10⁻⁶ atm. at 1550°C, and was quenched in a canal made of thick Cu plate. H₂O in the sample was measured as H₂ volumetrically by a micro-Orsat gas analyzer after reducing with Al at 1550 - 1600°C.

**SOURCE AND PURITY OF MATERIALS:**

All oxides used were reagent grade chemicals except silica, which was transparent high purity silica ground to the size of 100 mesh and washed and cleaned (over 99.9% SiO₂), FeO was prepared by heating ferrous oxalate at 500°C for 5 hrs. in the Ar stream.

**ESTIMATED ERROR:**

analysis of H₂:

δ(ppm)/(ppm) = less than ± 0.04 (authors)

**REFERENCES:**

1. Fukushima, T.; Iguchi, Y.; Ban-ya, S.; Fuwa, T.
COMPONENTS:
(1) Water; H$_2$O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Iron oxide; FeO; [1345-25-1]
(4) Silica; SiO$_2$; [7631-86-9]

VARIABLES: T/K = 1823
H$_2$O P/kPa = 38.5 (289 mmHg)
mass% FeO = 3.9 - 19.8
mol ratio n$_2$/n$_4$ = 0.62 - 1.28

EXPERIMENTAL VALUES: continued

Fig. 1 Iso-solubility lines of water (ppm) in CaO - FeO - SiO$_2$ melts at 1550°C and P$_{H_2O}$ = 38.5 kPa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Germanium oxide; GeO₂; [1310-53-8]
(4) Silica; SiO₂; [7631-53-8]

ORIGINAL MEASUREMENTS:
Fukushima, T.; Iguchi, Y.; Ban-ya, S.; Fuwa, T.

VARIABLES:
T/K = 1773
H₂O P/kPa = 38.5 (289 mmHg)
mol% GeO₂ = 3 - 9
mol ratio n₂/n₄ = 0.63

EXPERIMENTAL VALUES:
The authors reported the solubility of H₂O in various CaO - GeO₂ - SiO₂ melts at 1500°C and at 289 mmHg of H₂O in graphical form (the numerical data are given in ref. 1).

<table>
<thead>
<tr>
<th>Mass%</th>
<th>Mol %</th>
<th>Mole Ratio</th>
<th>ppm (mass/mass)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaO</td>
<td>GeO₂</td>
<td>SiO₂</td>
<td>CaO GeO₂ SiO₂</td>
</tr>
<tr>
<td>35.3</td>
<td>5</td>
<td>59.7</td>
<td>37.7 2.9</td>
</tr>
<tr>
<td>33.4</td>
<td>10</td>
<td>56.6</td>
<td>36.5 5.8</td>
</tr>
<tr>
<td>31.5</td>
<td>15</td>
<td>53.5</td>
<td>35.2 9.0</td>
</tr>
<tr>
<td>31.5</td>
<td>15</td>
<td>53.5</td>
<td>35.2 9.0</td>
</tr>
</tbody>
</table>

" Calculated by the compiler

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
The sample in a Pt crucible was equilibrated with the H₂O + Ar stream at nearly one atm., and was quenched in a water cooled Cu mold.
H₂O in a quenched sample was reduced to H₂ by Al at 1500 - 1600°C, and was measured volumetrically by using a micro-Orsat gas analyzer. (ref. 1)

SOURCE AND PURITY OF MATERIALS:
CaO: Made by thermal decomposition of reagent grade carbonate (over 99.5%) at 900°C.
GeO₂: Reagent for semi-conductor materials (over 99.999999%)
SiO₂: Ground quartz (over 99.9%)

ESTIMATED ERROR:
δ(ppm)/(ppm) = ± 0.08 (authors)

REFERENCES:
1. Fuwa, T.; Ban-ya, S.; Fukushima, T.
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Potassium oxide; K₂O; [12136-45-7]
(3) Sodium oxide; Na₂O; [1313-59-3]
(4) Lead oxide; PbO; [1317-36-8]
(5) Silica; SiO₂; [7631-86-9]

VARIABLES: T/K: 1490 - 1520
H₂O P/ kPa= 101.3
mol ratio K₂O/Na₂O/PbO/SiO₂ = 8/5/30/57

EXPERIMENTAL VALUES:

The author reported the solubility of H₂O in commercial lead glass melt at P_H₂O = 101.3 kPa in the temperature range 1490 - 1520 K.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
The stream of H₂O at near one atm. was bubbled up through the melt in a mullite tube. The determination of the solubility of H₂O was made by the gas purging method with dry O₂.

SOURCE AND PURITY OF MATERIALS:
Commercial lead glass.

ESTIMATED ERROR:
δ(ppm)/(ppm): within ± 0.10 (author)

REFERENCES:
COMPONENTS:
(1) Water; H₂O; [7732-18-5]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Iron oxide; FeO; [1345-25-1]
(4) Magnesium oxide; MgO; [1309-48-4]
(5) Silica; SiO₂; [7631-86-9]

ORIGINAL MEASUREMENTS:
Iguchi, Y.; Ban-ya, S.; Fuwa, T.

VARIABLES:

T/K = 1823
H₂O P/kPa = 38.5 (289 mmHg)
mol ratio n₂/n₅ = 1.1
mol% FeO=0-11.8, mol% MgO=17.0-21.3

PREPARED BY:
M. Shinmei

EXPERIMENTAL VALUES:

The authors reported the solubility of H₂O in various CaO - FeO -MgO - SiO₂ melts at 1550°C and at P_H₂O = 38.5 kPa in graphical form only. The original data were provided by the authors.

<table>
<thead>
<tr>
<th>mol%</th>
<th>mole ratio</th>
<th>ppm(mass/mass)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaO</td>
<td>FeO</td>
<td>MgO</td>
</tr>
<tr>
<td>39.8</td>
<td>0</td>
<td>21.3</td>
</tr>
<tr>
<td>40.5</td>
<td>3.8</td>
<td>18.5</td>
</tr>
<tr>
<td>38.9</td>
<td>7.6</td>
<td>17.8</td>
</tr>
<tr>
<td>37.1</td>
<td>11.8</td>
<td>17.0</td>
</tr>
</tbody>
</table>

METHOD/APPARATUS/PROCEDURE:
The samples in Pt crucibles were equilibrated with the stream of Ar + H₂O at near one atm., and were quenched. Details of experimental procedure and analysis of H₂O in the sample are described in refs. 1 and 2.

SOURCE AND PURITY OF MATERIALS:
All materials were reagent grade chemicals.

ESTIMATED ERROR:
Analysis of H₂O:
δ(ppm)/(ppm) = ± 0.06 (authors)

REFERENCES:
1. Fukushima, T.; Iguchi, Y.; Ban-ya, S.; Fuwa, T.
2. Iguchi, Y.; Ban-ya, S.; Fuwa, T.
Ibid. 1969, 9, 189 - 195.
COMPONENTS:
(1) Nitrogen; N₂; [7727-37-9]
(2) Calcium oxide; CaO; [1305-78-8]
(3) Sodium oxide; Na₂O; [1313-59-3]
(4) Silica; SiO₂; [7631-86-9]

VARIABLES:
T/K = 1673
N₂ P/kPa = 101.3
n₂/n₃/n₄ = 10/16/74

ORIGINAL MEASUREMENTS:
Mulfinger, H.-O.

PREPARED BY:
M. Shinmei

EXPERIMENTAL VALUES:
The author reported the solubility of N₂ (physically melted) in CaO - Na₂O - SiO₂ melts at 1400°C.

<table>
<thead>
<tr>
<th>Melt Composition (mol%)</th>
<th>Solubility of N₂ (ml(STP)/ml glass)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaO</td>
<td>Na₂O</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
The melted glass was saturated by bubbling N₂ at nearly one atm. at 1400°C for 16 hr. The concentration of N₂ was determined by hot extraction and gas chromatographic analysis described in the reference.

SOURCE AND PURITY OF MATERIALS:
Not described.

ESTIMATED ERROR:
The deviation in 4 measurements was about ± 2%. The author estimated the absolute error was about 15%.

REFERENCES:
Mulfinger, H.-O.; Scholzie, H.
COMPONENTS:

(1) Nitrogen; N\textsubscript{2}; [7727-37-9]
(2) Alumina; Al\textsubscript{2}O\textsubscript{3}; [1344-28-1]
(3) Calcium oxide; CaO; [1305-78-8]
(4) Silica; SiO\textsubscript{2}; [7631-86-9]

VARIABLES:

\begin{align*}
T/K & = 1773 \\
N\textsubscript{2} P/kPa & = 93.2; \quad CO P/kPa = 8.1 \\
n_{\text{\textsubscript{2}N}}/n_{\text{\textsubscript{CO}}} & = 10-50/23-50/30-57
\end{align*}

EXPERIMENTAL VALUES:

The authors reported the solubility of N\textsubscript{2} in various compositions of the Al\textsubscript{2}O\textsubscript{3} - CaO - SiO\textsubscript{2} melt contained in a carbon crucible at 1773 K under the stream of N\textsubscript{2} + CO (92 vol.\% N\textsubscript{2} and 8 vol.\% CO).

<table>
<thead>
<tr>
<th>Mass %</th>
<th>Al\textsubscript{2}O\textsubscript{3}</th>
<th>CaO</th>
<th>SiO\textsubscript{2}</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.0</td>
<td>50.0</td>
<td>40.0</td>
<td>0.435</td>
<td></td>
</tr>
<tr>
<td>20.0</td>
<td>23.0</td>
<td>57.0</td>
<td>0.237</td>
<td></td>
</tr>
<tr>
<td>20.0</td>
<td>30.0</td>
<td>50.0</td>
<td>0.153</td>
<td></td>
</tr>
<tr>
<td>20.0</td>
<td>50.0</td>
<td>30.0</td>
<td>0.210</td>
<td></td>
</tr>
<tr>
<td>25.0</td>
<td>40.0</td>
<td>35.0</td>
<td>0.442</td>
<td></td>
</tr>
<tr>
<td>50.0</td>
<td>50.0</td>
<td>--</td>
<td>1.460</td>
<td></td>
</tr>
</tbody>
</table>

Heat of N\textsubscript{2} dissolution = 263.6 ± 8.4 kJ/g atom N

(*) Data taken from the abstract

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The samples in a graphite crucible were melted at 1773 K and N\textsubscript{2} + CO mixture was blown through a capillary tube immersed in the melt. The equilibrium was established within 2 hrs.

SOURCE AND PURITY OF MATERIALS:

REFERENCES:
COMPONENTS:

(1) Nitrogen; N₂; [7727-37-9]
(2) Alumina; Al₂O₃; [1344-28-1]
(3) Calcium oxide; CaO; [1305-78-8]
(4) Silica; SiO₂; [7631-86-9]

VARIABLES:

\[ \frac{g}{K} = 1673; 1723; 1773; 1823 \]
\[ N_P / kPa = 93.2; CO_P / kPa = 8.1 \]
\[ \frac{m_2}{m_3} / m_4 = 0-50 / 10-50 / 0-72 \]

ORIGINAL MEASUREMENTS:

Shimoo, T.; Kimura, H.; Kawai, M.

EXPERIMENTAL VALUES:

The authors reported the solubility of N in the 20Al₂O₃ - 40CaO - 40SiO₂ (mass%) melt with graphite saturation at the temperatures 1673, 1723 and 1773 K under the stream of N₂ + CO mixture. The apparent solubility for the melt was expressed by a least square treatment as:

\[ \log C_N (\text{mass}) = \frac{23400}{T} - 12.7 \]

under \( P_{N₂} = 93.2 \text{ kPa} \); \( P_{CO} = 8.1 \text{ kPa} \).

The authors also reported the solubility of N in various compositions of the Al₂O₃ - CaO - SiO₂ melts whose compositions are shown in Fig. 1 and in Table 1, with graphite saturation at 1773 K. The form of N dissolved in the melts was supposed to be ions such as \( CN^- \), \( N^3- \), \( CN_2^- \).

Fig. 1. Slag compositions investigated on solubilities of nitrogen in molten CaO - SiO₂ - Al₂O₃ slag at 1773 K. Bold lines show liquid composition limit at this temperature.

(Continued)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The sample in a graphite crucible was equilibrated with the N₂ + CO stream of nearly one atm. The sampling for chemical analysis was made by quenching the melt with a stainless steel rod. Nitrogen was analyzed by the combustion method described in the previous report (1).

SOURCE AND PURITY OF MATERIALS:

Al₂O₃: Chemicals, more than 99.8 mass% purity
CaO: Reagent grade CaCO₃ was fired
SiO₂: Pulverized quartz

ESTIMATED ERROR:

\( \delta (\text{mass}) / (\text{mass}) = \pm 0.03 - 0.12 \)

Authors (2)

REFERENCES:

2. Shimoo, T.; Kimura, H.; Kawai, M.
Nippon Kinzoku Gakkaishi 1971, 35, 417 - 422.
COMPONENTS: ORIGINAL MEASUREMENTS:

(1) Nitrogen; N₂; [7727-37-9]
(2) Alumina; Al₂O₃; [1344-28-1]
(3) Calcium oxide; CaO; [1305-78-8]
(4) Silica; SiO₂; [7631-86-9]

Shimoo, T.; Kimura, H.; Kawai, M.

VARIABLES:

T/K = 1673, 1723, 1773, 1823
P/N₂ = 93.2 kPa, P/CO = 8.1 kPa
m₂/m₃/m₄ = 0 - 50/ 10 - 50/ 1 - 72

EXPERIMENTAL VALUES:

Table 1 Solubility of N in Al₂O₃ - CaO - SiO₂ Melts at 1773 K
(P/N₂ = 93.2 kPa, P/CO = 8.1 kPa)

<table>
<thead>
<tr>
<th>Al₂O₃</th>
<th>CaO</th>
<th>SiO₂</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>40</td>
<td>60</td>
<td>0.24</td>
</tr>
<tr>
<td>1</td>
<td>37</td>
<td>60</td>
<td>0.18</td>
</tr>
<tr>
<td>2</td>
<td>47</td>
<td>47</td>
<td>0.45</td>
</tr>
<tr>
<td>3</td>
<td>53</td>
<td>40</td>
<td>0.55</td>
</tr>
<tr>
<td>4</td>
<td>32</td>
<td>60</td>
<td>0.16</td>
</tr>
<tr>
<td>5</td>
<td>18</td>
<td>72</td>
<td>0.04</td>
</tr>
<tr>
<td>6</td>
<td>27</td>
<td>63</td>
<td>0.16</td>
</tr>
<tr>
<td>7</td>
<td>36</td>
<td>54</td>
<td>0.49</td>
</tr>
<tr>
<td>8</td>
<td>45</td>
<td>45</td>
<td>0.56</td>
</tr>
<tr>
<td>9</td>
<td>50</td>
<td>40</td>
<td>0.53</td>
</tr>
<tr>
<td>10</td>
<td>28</td>
<td>60</td>
<td>0.15</td>
</tr>
<tr>
<td>11</td>
<td>40</td>
<td>48</td>
<td>0.52</td>
</tr>
<tr>
<td>12</td>
<td>30</td>
<td>56</td>
<td>0.15</td>
</tr>
<tr>
<td>13</td>
<td>15</td>
<td>70</td>
<td>0.05</td>
</tr>
<tr>
<td>14</td>
<td>25</td>
<td>60</td>
<td>0.14</td>
</tr>
<tr>
<td>15</td>
<td>50</td>
<td>35</td>
<td>0.52</td>
</tr>
<tr>
<td>16</td>
<td>20</td>
<td>64</td>
<td>0.17</td>
</tr>
<tr>
<td>17</td>
<td>40</td>
<td>42</td>
<td>0.24</td>
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<tr>
<td>18</td>
<td>20</td>
<td>70</td>
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<td>55</td>
<td>0.14</td>
</tr>
<tr>
<td>20</td>
<td>32</td>
<td>48</td>
<td>0.15</td>
</tr>
<tr>
<td>21</td>
<td>40</td>
<td>40</td>
<td>0.26</td>
</tr>
<tr>
<td>22</td>
<td>30</td>
<td>49</td>
<td>0.15</td>
</tr>
<tr>
<td>23</td>
<td>16</td>
<td>60</td>
<td>0.05</td>
</tr>
<tr>
<td>24</td>
<td>20</td>
<td>56</td>
<td>0.10</td>
</tr>
<tr>
<td>25</td>
<td>25</td>
<td>50</td>
<td>0.14</td>
</tr>
<tr>
<td>26</td>
<td>10</td>
<td>63</td>
<td>0.07</td>
</tr>
<tr>
<td>27</td>
<td>28</td>
<td>42</td>
<td>0.25</td>
</tr>
<tr>
<td>28</td>
<td>30</td>
<td>40</td>
<td>0.25</td>
</tr>
<tr>
<td>29</td>
<td>35</td>
<td>35</td>
<td>0.29</td>
</tr>
<tr>
<td>30</td>
<td>35</td>
<td>30</td>
<td>0.12</td>
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cont'd...

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:

(1) Nitrogen; \( \text{N}_2 \); [7727-37-9]
(2) Alumina; \( \text{Al}_2\text{O}_3 \); [1344-28-1]
(3) Calcium oxide; \( \text{CaO} \); [1305-78-8]
(4) Silica; \( \text{SiO}_2 \); [7631-86-9]

VARIABLES:

EXPERIMENTAL VALUES:

continued

<table>
<thead>
<tr>
<th>( \text{Al}_2\text{O}_3 )</th>
<th>CaO</th>
<th>( \text{SiO}_2 )</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>30</td>
<td>30</td>
<td>0.21</td>
</tr>
<tr>
<td>40</td>
<td>40</td>
<td>20</td>
<td>0.07</td>
</tr>
<tr>
<td>45</td>
<td>45</td>
<td>10</td>
<td>0.45</td>
</tr>
<tr>
<td>50</td>
<td>50</td>
<td>0</td>
<td>0.50</td>
</tr>
</tbody>
</table>

ORIGINAL MEASUREMENTS:

Shimoo, T.; Kimura, H.; Kawai, M.

PREPARED BY:
M. Shinmei.

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:

(1) Nitrogen; N\textsubscript{2}; [7727-37-9]
(2) Alumina; Al\textsubscript{2}O\textsubscript{3}; [1344-28-1]
(3) Calcium oxide; CaO; [1305-78-8]
(4) Silica; SiO\textsubscript{2}; [7631-86-9]

ORIGINAL MEASUREMENTS:

Davies, M. W.; Meherali, S. G.
Metal. Trans. 1971, 2, 2729 - 2733.

VARIABLES:

T/K = 1773; 1823; 1873
N\textsubscript{2} P/kPa = 20.3 - 70.9

EXPERIMENTAL VALUES:

The authors studied the equilibrium solubility of N in aluminosilicate melts with compositions close to those of blast furnace slag with respect to major constituents.

Table Solubility of Nitrogen in Al\textsubscript{2}O\textsubscript{3} - CaO - SiO\textsubscript{2} Melts with Carbon Saturation Under Various Gas Mixtures of N\textsubscript{2} + CO + Ar

<table>
<thead>
<tr>
<th>Melt Comp. (mol%)</th>
<th>Atmosphere %</th>
<th>N\textsubscript{2}</th>
<th>CO</th>
<th>Ar</th>
<th>N Solubility</th>
</tr>
</thead>
<tbody>
<tr>
<td>T/K (K)</td>
<td>N\textsubscript{2}</td>
<td>CO</td>
<td>Ar</td>
<td>atom%</td>
<td>mass%</td>
</tr>
<tr>
<td>1773</td>
<td>Al\textsubscript{2}O\textsubscript{3} = 20 60 20</td>
<td>0.511±0.03</td>
<td>0.116±0.007</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12.1</td>
<td>20 40 40</td>
<td>0.819±0.03</td>
<td>0.195±0.01</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>47.1</td>
<td>50 40 10</td>
<td>1.329±0.10</td>
<td>0.303±0.02</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>SiO\textsubscript{2} = 37.9</td>
<td>50 40 10</td>
<td>2.96 ±0.09</td>
<td>0.673±0.02</td>
<td>8</td>
</tr>
<tr>
<td>1823</td>
<td>20 60 20</td>
<td>1.19±0.06</td>
<td>0.264±0.012</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20 40 40</td>
<td>1.90±0.13</td>
<td>0.428±0.03</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>40 60 0</td>
<td>1.67±0.07</td>
<td>0.379±0.016</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

N\textsubscript{2} + CO + Ar gas mixtures at nearly one atm. were passed over the samples contained in a carbon crucible at 5 ml/sec. After equilibrium was attained the samples were quenched by lowering into a bath of dried oil. The quenched samples were broken into pieces and analyzed for N by a similar method as in ref.1 (the N extraction method of melting with oxidizing flux in a vacuum).

SOURCE AND PURITY OF MATERIALS:

High-purity SiO\textsubscript{2}; "Analar" grade Al\textsubscript{2}O\textsubscript{3}; CaCO\textsubscript{3}; CaO: made by thermal decomposition of CaCO\textsubscript{3} for 16 hrs. at 1373 K.
Graphite Crucible: high quality electrode graphite
Ar: 99.995%
N\textsubscript{2}: 99.99%
CO: 97%, remainder N\textsubscript{2}

ESTIMATED ERROR:

δ(mass)/(mass) = within ± 0.015 (Authors)

REFERENCES:

1. Chuchmarev, S. K.; Kamyshov, V. M.
Zavodsk. Lab. 1964, 30, 1034.
COMPONENTS:

1) Nitrogen; N₂; [7727-37-9]
2) Alumina; Al₂O₃; [1344-28-1]
3) Calcium oxide; CaO; [1305-78-8]
4) Silica; SiO₂; [7631-86-9]

VARIABLES:

CO P/kPa = 20.3 - 60.8
n₂/n₃/n₄ = 12.1 - 12.4/47.05 - 55.1/30.95 - 37.9

EXPERIMENTAL VALUES: continued

<table>
<thead>
<tr>
<th>T/K</th>
<th>Melt Comp. (mol%)</th>
<th>Atmosphere %</th>
<th>N Solubility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N₂</td>
<td>CO</td>
<td>Ar</td>
</tr>
<tr>
<td>1823</td>
<td>70</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>55</td>
<td>40</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>40</td>
<td>10</td>
</tr>
<tr>
<td>Al₂O₃ = 12.0</td>
<td>20</td>
<td>60</td>
<td>0</td>
</tr>
<tr>
<td>CaO = 55.1</td>
<td>1873</td>
<td>31.0</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>40</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>55</td>
<td>25</td>
<td>20</td>
</tr>
</tbody>
</table>

a Definition is given by (No. of g-mol of N-atom N)/(No. of g-atom N + No. of g-mol of oxide)

ORIGINAL MEASUREMENTS:
Davies, M. W.; Meherali, S. G.
Metal. Trans. 1971, 2, 2729 - 2733.

PREPARED BY:
M. Shinmei

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
The authors reported the solubility of N in Al₂O₃ - CaO - SiO₂ slags under a variety of highly reducing conditions. In Table 1 are the results with graphite and those with various reducing agents are in Table 2. N content at one atm. N₂ with graphite is given in Fig. 1 as a function of temperature (graphical form only).

### Table 1. N Content of Various Al₂O₃ - CaO - SiO₂ Slags Under One Atm. N₂ at 1823 K

<table>
<thead>
<tr>
<th>Composition (mass %)</th>
<th>N Content (mass %)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaO</td>
<td>SiO₂</td>
</tr>
<tr>
<td>55</td>
<td>45</td>
</tr>
<tr>
<td>51</td>
<td>44</td>
</tr>
<tr>
<td>45</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* As determined by different analytical methods on different size particles (expressed in "mesh").

### Method/Apparatus/Procedure:

N solubility in Al₂O₃ - CaO - SiO₂ slags in graphite was determined using an apparatus and technique similar to those of Davies et al. (1). The samples were held in the appropriate atmosphere for the required time and then quenched by lowering into oil. N content of the slags was determined both by hot extraction similar to that used by Chuchmarev et al. (2) and by the Kjeldahl method with two different solvents of H₂SO₄ and HF and HCl + HF + H₂O.

### Source and Purity of Materials:

Not described.

### Estimated Error:

Not evaluated.

### References:

### COMPONENTS:

1. Nitrogen; N₂; [7727-37-9]
2. Alumina; Al₂O₃; [1344-28-1]
3. Calcium oxide; CaO; [1305-78-8]
4. Silica; SiO₂; [7631-86-9]

### ORIGINAL MEASUREMENTS:

Dancy, E. A.; Janssen, D.

### VARIABLES:

**PREPARED BY:**

M. Shinmei

### EXPERIMENTAL VALUES: continued

<table>
<thead>
<tr>
<th>Composition (mass %)</th>
<th>N Content (mass %)*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CaO</td>
</tr>
<tr>
<td></td>
<td>-50</td>
</tr>
<tr>
<td>50 40 10</td>
<td>.90</td>
</tr>
<tr>
<td>42.75 42.25 10</td>
<td>.28</td>
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<tr>
<td>50 30 20</td>
<td>2.56</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td>47.5 32.5 20</td>
<td>1.82</td>
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<tr>
<td>40 40 20</td>
<td>.41</td>
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<tr>
<td>40 30 30</td>
<td>1.01</td>
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<td>35 35 30</td>
<td>.26</td>
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<td>35 35 30</td>
<td>.41</td>
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<tr>
<td></td>
<td></td>
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<td>50 10 40</td>
<td>2.71</td>
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<td>50 10 40</td>
<td>2.21</td>
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<td>40 10 50</td>
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<tr>
<td>49 2 49</td>
<td>1.90</td>
</tr>
<tr>
<td>50 50 40</td>
<td>1.13</td>
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### AUXILIARY INFORMATION

#### METHOD/APPARATUS/PROCEDURE:

#### SOURCE AND PURITY OF MATERIALS:

#### ESTIMATED ERROR:

#### REFERENCES:
COMPONENTS:
1. Nitrogen; N₂; [7727-37-9]
2. Alumina; Al₂O₃; [1344-28-1]
3. Calcium oxide; CaO; [1305-78-8]
4. Silica; SiO₂; [7631-86-9]

ORIGINAL MEASUREMENTS:
Dancy, E. A.; Janssen, D.

VARIABLES:
T/K = 1723 - 1823
N₂ P/kPa = 101.3

PREPARED BY:
M. Shinmei

EXPERIMENTAL VALUES: continued

Table 2. Nitrogen Content of Three Slags After Treatment with Nitrogen in the Presence of Various Reducing Agents in the Absence of Graphite

<table>
<thead>
<tr>
<th>Slag 5 g Charge</th>
<th>Reducing Agent (g)</th>
<th>Cruc Matl</th>
<th>Temp (°C)</th>
<th>Time (hrs)</th>
<th>Atmos.</th>
<th>N Content (mass %)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Hot Kjekdahl Ext</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Si, 0.06</td>
<td>Fe</td>
<td>1450</td>
<td>4</td>
<td>N₂</td>
<td>0.33</td>
<td>0.30</td>
</tr>
<tr>
<td>Si, 0.05</td>
<td>Fe</td>
<td>1500</td>
<td>2</td>
<td>N₂</td>
<td>0.48</td>
<td>0.36</td>
</tr>
<tr>
<td>Si/Fe, 0.25/2.5</td>
<td>MgO</td>
<td>1500</td>
<td>2</td>
<td>N₂</td>
<td>0.26</td>
<td>0.25</td>
</tr>
<tr>
<td>Si, 0.25</td>
<td>MgO</td>
<td>1450</td>
<td>2</td>
<td>N₂</td>
<td>1.75</td>
<td>1.41</td>
</tr>
<tr>
<td>Si, 0.25</td>
<td>MgO</td>
<td>1500</td>
<td>2</td>
<td>N₂</td>
<td>1.64</td>
<td>1.40</td>
</tr>
<tr>
<td>Al₂O₃ = 40</td>
<td>Si, 0.50</td>
<td>MgO</td>
<td>1500</td>
<td>2</td>
<td>N₂</td>
<td>2.90</td>
</tr>
<tr>
<td>Al, 0.05</td>
<td>Fe</td>
<td>1450</td>
<td>3</td>
<td>N₂</td>
<td>0.04</td>
<td>0.01</td>
</tr>
<tr>
<td>CaO = 50</td>
<td>Al/Fe, 0.25/2.5</td>
<td>MgO</td>
<td>1500</td>
<td>2</td>
<td>N₂</td>
<td>0.10</td>
</tr>
<tr>
<td>SiO₂ = 10</td>
<td>Al/Fe, 0.25/2.5</td>
<td>MgO</td>
<td>1550</td>
<td>2</td>
<td>N₂</td>
<td>0.17</td>
</tr>
<tr>
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<td>Al, 0.25</td>
<td>MgO</td>
<td>1450</td>
<td>2</td>
<td>N₂</td>
<td>1.22</td>
</tr>
<tr>
<td></td>
<td>Al, 0.50</td>
<td>MgO</td>
<td>1450</td>
<td>2</td>
<td>N₂</td>
<td>1.15</td>
</tr>
<tr>
<td></td>
<td>Si₃N₄, 0.50</td>
<td>MgO</td>
<td>1450</td>
<td>2</td>
<td>N₂</td>
<td>3.92</td>
</tr>
<tr>
<td></td>
<td>CaC₂, 0.25</td>
<td>MgO</td>
<td>1550</td>
<td>2</td>
<td>N₂</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>CaC₂, 0.50</td>
<td>MgO</td>
<td>1500</td>
<td>2</td>
<td>N₂</td>
<td>0.47</td>
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AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS: ORIGINAL MEASUREMENTS:

(1) Nitrogen; N\textsubscript{2}; [7727-37-9]
(2) Alumina; Al\textsubscript{2}O\textsubscript{3}; [1344-28-1]
(3) Calcium oxide; CaO; [1305-78-8]
(4) Silica; SiO\textsubscript{2}; [7631-86-9]

VARIABLES: PREPARED BY:

M. Shinmei

EXPERIMENTAL VALUES: continued

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
<th>Source</th>
<th>Temperature</th>
<th>Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaC\textsubscript{2}, 0.50</td>
<td>MgO</td>
<td>1500</td>
<td>5</td>
<td>N\textsubscript{2} 0.23 0.25</td>
</tr>
<tr>
<td>CaC\textsubscript{2}, 0.50</td>
<td>MgO</td>
<td>1550</td>
<td>2</td>
<td>N\textsubscript{2} 0.17 0.10</td>
</tr>
<tr>
<td>Si, 0.05</td>
<td>Fe</td>
<td>1450</td>
<td>2</td>
<td>N\textsubscript{2} 0.37 0.39</td>
</tr>
<tr>
<td>Si/Fe, 0.125/2.5</td>
<td>Al\textsubscript{2}O\textsubscript{3}</td>
<td>1500</td>
<td>2</td>
<td>N\textsubscript{2} 0.06 0.04</td>
</tr>
<tr>
<td>Si/Fe, 0.125/2.5</td>
<td>Al\textsubscript{2}O\textsubscript{3}</td>
<td>1550</td>
<td>2</td>
<td>N\textsubscript{2} 0.16 0.04</td>
</tr>
<tr>
<td>Si, 0.05</td>
<td>Al\textsubscript{2}O\textsubscript{3}</td>
<td>1450</td>
<td>2</td>
<td>N\textsubscript{2} 0.09 0.06</td>
</tr>
<tr>
<td>Si, 0.25</td>
<td>Al\textsubscript{2}O\textsubscript{3}</td>
<td>1450</td>
<td>2</td>
<td>N\textsubscript{2} 0.20 0.14</td>
</tr>
<tr>
<td>Si, 0.25</td>
<td>Al\textsubscript{2}O\textsubscript{3}</td>
<td>1450</td>
<td>5</td>
<td>N\textsubscript{2} 0.21 0.16</td>
</tr>
<tr>
<td>Al\textsubscript{2}O\textsubscript{3} = 40</td>
<td>Si, 0.25</td>
<td>Al\textsubscript{2}O\textsubscript{3}</td>
<td>1500</td>
<td>2</td>
</tr>
<tr>
<td>Al, 0.25</td>
<td>Al\textsubscript{2}O\textsubscript{3}</td>
<td>1450</td>
<td>2</td>
<td>N\textsubscript{2} 0.04 0.04</td>
</tr>
<tr>
<td>CaO = 30</td>
<td>Si\textsubscript{3}N\textsubscript{4}, 0.25</td>
<td>Al\textsubscript{2}O\textsubscript{3}</td>
<td>1450</td>
<td>2</td>
</tr>
<tr>
<td>Si\textsubscript{3}N\textsubscript{4}, 0.25</td>
<td>Al\textsubscript{2}O\textsubscript{3}</td>
<td>1500</td>
<td>2</td>
<td>N\textsubscript{2} 1.54 1.41</td>
</tr>
<tr>
<td>Si\textsubscript{3}N\textsubscript{4}, 0.50</td>
<td>Al\textsubscript{2}O\textsubscript{3}</td>
<td>1450</td>
<td>2</td>
<td>N\textsubscript{2} 2.75 2.07</td>
</tr>
<tr>
<td>Si\textsubscript{3}N\textsubscript{4}, 0.50</td>
<td>Al\textsubscript{2}O\textsubscript{3}</td>
<td>1450</td>
<td>2</td>
<td>N\textsubscript{2} 3.57 2.53</td>
</tr>
<tr>
<td>Si\textsubscript{3}N\textsubscript{4}, 1.00</td>
<td>Al\textsubscript{2}O\textsubscript{3}</td>
<td>1450</td>
<td>2</td>
<td>N\textsubscript{2} 3.21 2.32</td>
</tr>
<tr>
<td>Si\textsubscript{3}N\textsubscript{4}, 1.00</td>
<td>Al\textsubscript{2}O\textsubscript{3}</td>
<td>1450</td>
<td>2</td>
<td>N\textsubscript{2} 3.91 2.88</td>
</tr>
<tr>
<td>CaC\textsubscript{2}, 0.25</td>
<td>Al\textsubscript{2}O\textsubscript{3}</td>
<td>1550</td>
<td>2</td>
<td>N\textsubscript{2} 0.13 0.14</td>
</tr>
<tr>
<td>CaC\textsubscript{2}, 0.50</td>
<td>Al\textsubscript{2}O\textsubscript{3}</td>
<td>1550</td>
<td>2</td>
<td>N\textsubscript{2} 0.39 0.24</td>
</tr>
<tr>
<td>Al\textsubscript{2}O\textsubscript{3} = 20</td>
<td>Si, 0.25</td>
<td>MgO</td>
<td>1450</td>
<td>2</td>
</tr>
<tr>
<td>Al, 0.25</td>
<td>Al\textsubscript{2}O\textsubscript{3}</td>
<td>1450</td>
<td>2</td>
<td>N\textsubscript{2} 0.04 0.10</td>
</tr>
<tr>
<td>CaO = 40</td>
<td>Si\textsubscript{3}N\textsubscript{4}, 0.50</td>
<td>MgO</td>
<td>1450</td>
<td>2</td>
</tr>
<tr>
<td>CaC\textsubscript{2}, 0.25</td>
<td>MgO</td>
<td>1550</td>
<td>2</td>
<td>N\textsubscript{2} 0.02 0.02</td>
</tr>
<tr>
<td>Si\textsubscript{3}N\textsubscript{4}, 0.50</td>
<td>MgO</td>
<td>1550</td>
<td>2</td>
<td>N\textsubscript{2} 0.54 0.42</td>
</tr>
<tr>
<td>CaC\textsubscript{2}, 0.50</td>
<td>MgO</td>
<td>1550</td>
<td>2</td>
<td>N\textsubscript{2} 0.67 0.53</td>
</tr>
</tbody>
</table>

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:
(1) Nitrogen; N₂; [7727-37-9]
(2) Alumina; Al₂O₃; [1344-28-1]
(3) Calcium oxide; CaO; [1305-79-8]
(4) Silica; SiO₂; [7631-86-9]

ORIGINAL MEASUREMENTS:
Dancy, E. A.; Janssen, D.

VARIABLES:
T/K = 1723 - 1823
N₂ P/kPa = 101.3
m₂/m₃/m₄ = 20 - 40/30 - 50/10 - 40

EXPERIMENTAL VALUES:

Figure 2. Nitrogen content of three slags as a function of temperature. Graphite crucibles.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:
(1) Nitrogen; N₂; [7727-37-9]
(2) Alumina; Al₂O₃; [1344-28-1]
(3) Calcium oxide; CaO; [1305-78-8]
(4) Silica; SiO₂; [7631-86-9]

ORIGINAL MEASUREMENTS:
Chuchmarev, S. K.; Esin, O. A.; Kamyshev, V. M.
Chem. Abstr.; 1965, 62, 14233g (**)

VARIABLES:
T/K = 1673&1773 N₂ P/kPa=32.4-93.2
CO P/kPa = 11.1 - 68.9
m₂/m₃/m₄ = 12.1/47.6/40.3

EXPERIMENTAL VALUES:

The authors reported the solubility of N in the 12.1 Al₂O₃ - 47.6 CaO -
40.3 SiO₂ (mass %) melt saturated with graphite at 1673 K and 1773 K
under the various N₂ + CO gas mixtures, and they interpreted that the
form of N in the melt was CN⁻ by the following reactions:

\[ 3C + O²^- + N₂ = 2CN⁻ + CO, \text{ at } 1673 \text{ K} \]
\[ 3C + O²^- + C₂²^- + 2N₂ = 4CN⁻ + CO, \text{ at } 1773 \text{ K} \]

<table>
<thead>
<tr>
<th>N₂ P/kPa</th>
<th>CO P/kPa</th>
<th>N at 1673 K (mass %)</th>
<th>N at 1773 K (mass %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>93.2</td>
<td>8.1</td>
<td>0.139</td>
<td>0.325</td>
</tr>
<tr>
<td>82.1</td>
<td>11.1</td>
<td>0.088</td>
<td>0.178</td>
</tr>
<tr>
<td>65.8</td>
<td>35.5</td>
<td>0.063</td>
<td>---</td>
</tr>
<tr>
<td>32.4</td>
<td>68.9</td>
<td>0.031</td>
<td>0.114</td>
</tr>
</tbody>
</table>

* Original report gave the solubility as "ml/100 g". The
  compiler converted to "mass %".

** Data taken from the abstract

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
The sample was saturated with
N and C by bubbling N₂ and CO
gases under nearly one atm. at
1673 K and 1773 K.

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:
(1) Nitrogen; N₂; [7727-37-9]
(2) Alumina; Al₂O₃; [1344-28-1]
(3) Calcium oxide; CaO; [1305-78-8]
(4) Magnesium oxide; MgO; [1309-48-4]
(5) Silica; SiO₂; [7631-86-9]

ORIGINAL MEASUREMENTS:
Davies, M. W.; Meherali, S. G.
Metal. Trans. 1971, 2, 2729 - 2733.

VARIABLES: T/K = 1823
P/kPa = 50.7; CO P/kPa = 40.5
n₂/n₃/n₄/n₅ = 12.1-12.5/32.6-47.0
7.3-14.8/24.7-37.9

EXPERIMENTAL VALUES:
The authors reported the equilibrium solubility of N in the slag melts with compositions close to those of blast furnace slag with respect to major constituents at 1823 K.

Table Solubility of Nitrogen in Al₂O₃ - CaO - MgO - SiO₂ Melts with Carbon Saturation in an Atmosphere of 50% N₂, 40% CO, 10% Ar at 1823 K

<table>
<thead>
<tr>
<th>melt composition (mole%)</th>
<th>N Solubility</th>
<th>Number of Experiments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al₂O₃</td>
<td>CaO</td>
<td>MgO</td>
</tr>
<tr>
<td>12.1</td>
<td>39.8</td>
<td>7.3</td>
</tr>
<tr>
<td>12.15</td>
<td>32.55</td>
<td>14.55</td>
</tr>
<tr>
<td>12.2</td>
<td>35.15</td>
<td>14.7</td>
</tr>
<tr>
<td>12.3</td>
<td>40.3</td>
<td>14.7</td>
</tr>
<tr>
<td>12.3</td>
<td>43.4</td>
<td>14.8</td>
</tr>
<tr>
<td>12.4</td>
<td>41.4</td>
<td>7.45</td>
</tr>
<tr>
<td>12.4</td>
<td>47.0</td>
<td>14.8</td>
</tr>
<tr>
<td>12.5</td>
<td>46.7</td>
<td>7.5</td>
</tr>
</tbody>
</table>

Definition is given by (No. of g-atom N)/(No. of g-atom N + No. of g-mol oxide).

AUXILIARY INFORMATION

METHOD APPARATUS PROCEDURE:
N₂ + CO + Ar gas mixtures at nearly one atm. were passed over the samples contained in a carbon crucible at a rate of 5 ml/sec. After equilibrium was attained the samples were broken into pieces and analyzed for N by a similar method to that in ref. 1 (extraction method with oxidizing flux in a vacuum).

SOURCE AND PURITY OF MATERIAL:
High-purity SiO₂
"Analar" grade Al₂O₃; MgO; CaCO₃
CaO: made by thermal decomposition of CaCO₃ at 1373 K for 16 hrs.
Graphite crucible: high-quality electrode graphite
Ar = 99.995%
N₂ = 99.99%
CO = 97%, remainder N₂

ESTIMATED ERROR:
δ(mass)/mass = within ± 0.015
(Authors)

REFERENCES:
1. Chuchmarev, S. K.;
Kamyshov, V. M.
Zavodsk. Lab. 1964, 30, 1034.
SYSTEM INDEX

Page numbers preceded by E refer to evaluation texts whereas those not preceded by E refer to compilation tables.

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  + hydrogen 65
  + water 390

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  + water 390

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  + chlorine 169-173

Aluminium fluoride (multicomponent)
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Aluminium oxide (ternary)
  + carbon dioxide 270-272

Aluminium oxide (multicomponent)
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  + carbon dioxide 241
  + hydrogen chloride 321

Barium chloride (ternary)
  + carbon dioxide 269

Barium chloride (multicomponent)
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  + carbon dioxide 269
  + water 468

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  + hydrogen fluoride 290

Boron oxide (multicomponent)
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