**COMPONENTS:**

(1) Lanthanum chloride; LaCl₃; [10099-58-8]

(2) Hexachloro-1,3-butadiene; C₄Cl₆; [87-68-3]

**ORIGINAL MEASUREMENTS:**
Shevtsova, Z.N.; Korshunov, B.G.; Safonov, V.V.; Kogan, L.M.; Gudkova, V.I.

**VARIABLES:**

Temperature

**PREPARED BY:**
T. Mioduski and M. Salomon

**EXPERIMENTAL VALUES:**

Composition, densities, viscosities and refractive indices of saturated solutions.

<table>
<thead>
<tr>
<th>t/°C</th>
<th>mass %</th>
<th>mol kg⁻¹</th>
<th>d/g cm⁻³</th>
<th>η/π</th>
<th>nD²⁰</th>
<th>nature of the solid phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>0.040</td>
<td>0.00163</td>
<td>1.681</td>
<td>0.0382</td>
<td>1.5564</td>
<td>LaCl₃·4H₂O</td>
</tr>
<tr>
<td>50</td>
<td>0.042</td>
<td>0.00171</td>
<td>1.642</td>
<td>0.0305</td>
<td>1.5554</td>
<td>LaCl₃·4H₂O</td>
</tr>
<tr>
<td>75</td>
<td>0.057</td>
<td>0.00233</td>
<td>1.614</td>
<td>0.0244</td>
<td>1.5547</td>
<td>LaCl₃·2H₂O</td>
</tr>
</tbody>
</table>

Molalities calculated by the compilers.

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Isothermal method used. Depending on temp, equil was established after 12 d at 25°C, 10 d at 50°C, and 7 d at 75°C.

Chloride was detd by the Volhard method, and lanthanum detd gravimetrically by precipitating as the oxalate and igniting to the oxide. Lanthanum was also detd by titration with Trilon B with Xylene Orange indicator.

The composition of the solid phase was established by chemical analysis, and confirmed by X-ray analysis.

Samples of the solid phases were also studied thermographically after removal of excess solvent by washing with absolute ethyl ether which is claimed not to change the composition of hydrate.

Authors state that at 110°C the equil solid phase is the monohydrate, but no solubility data are given. At 120°C partial hydrolysis takes place with formation of LaOCl.

**SOURCE AND PURITY OF MATERIALS:**

LaCl₃·7H₂O prep'd by dissolving La₂O₃ in HCl, evaporating and cooling, and then recrystallized and dried in a desiccator. La₂O₃, 99.9% pure, contained oxide impurities of other rare earth metals, Fe (0.01%), Ca (0.01-0.05%), and Cu (0.01%). Analysis of the heptahydrate gave the following (in mass % units): La 37.42; Cl 28.67; H₂O 33.91.

Purified solvent (method not specified) had the following properties: d₄ = 1.6807 g/ml, and nD = 1.5543.

**ESTIMATED ERROR:**

Soly: nothing specified.

Temp: accuracy ± 0.1 K (authors).

**REFERENCES:**
COMPONENTS:
(1) Lanthanum chloride; $\text{LaCl}_3$; [10099-58-8]
(2) Methanol; $\text{CH}_3\text{OH}$; [67-56-1]
(3) Benzene; $\text{C}_6\text{H}_6$; [71-43-2]

VARIABLES:
Concentration of $\text{CH}_3\text{OH}$
$T/K = 295$

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>Initial Conc</th>
<th>$\text{LaCl}_3$ solubility$^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{Methanol mol dm}^{-3}$</td>
<td>$\text{mol dm}^{-3}$</td>
</tr>
<tr>
<td>1.0</td>
<td>0.00225</td>
</tr>
<tr>
<td>1.5</td>
<td>0.00580</td>
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<td>2.0</td>
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<tr>
<td>3.0</td>
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<td>3.5</td>
<td>0.03155</td>
</tr>
<tr>
<td>4.0</td>
<td>0.04169</td>
</tr>
</tbody>
</table>

$^a$Solid phase is $\text{LaCl}_3\cdot\text{CH}_3\text{OH}$.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Isothermal method used as described in (1). Solvent mixtures of known alcohol concentration were saturated with anhydrous $\text{LaCl}_3$ at $22 \pm 1^\circ\text{C}$. Equilibrium was confirmed from constancy of the rare earth metal concentration upon repeated analyses. Liquid phases were analysed for rare earth metal concentration (method not specified). At least 3 separate experiments were carried out for each system studied. In addition, the solid phases were analysed for several arbitrary experimental points (method not specified).

SOURCE AND PURITY OF MATERIALS:
Source and purity of $\text{LaCl}_3$ not specified. Anhydrous $\text{LaCl}_3$ prepared by method described in (2). C.p. grade organic solvents were purified by "known" methods (3).

ESTIMATED ERROR:
Soly: nothing specified.
Temp: precision $\pm 1$ K.

REFERENCES:
COMPONENTS:
(1) Lanthanum chloride; LaCl₃; [10099-58-8]
(2) Alcohols; ROH
(3) Benzene; C₆H₆; [71-43-2]

ORIGINAL MEASUREMENTS:
Golub, A.M.; Yankovich, V. N.

VARIABLES:
Concentration of ROH
T/K = 295

PREPARED BY:
M. Salomon and T. Mioduski

EXPERIMENTAL VALUES:
Numerical data were given only for the LaCl₃ - CH₃OH - C₆H₆ system (see the compilation for this system). The remaining data were presented graphically and in the form of the equation:

\[ K = \frac{[\text{LaCl}_3 \cdot n\text{ROH}]}{[\text{ROH}]^n} \]  \[ (1) \]

In this equation \([\text{LaCl}_3 \cdot n\text{ROH}]\) is the solubility in units of mol dm\(^{-3}\), \([\text{ROH}]\) is the total alcohol concentration in units of mol dm\(^{-3}\), and \(n\) is the solvate number in solution (see ref. 1). According to this equation, \(n\) is calculated from the slope of a plot of the logarithm of the solubility, \(\log [\text{LaCl}_3 \cdot n\text{ROH}]\), against \(\log [\text{ROH}]\). Thus the solubility of LaCl₃ can be calculated as a function of ROH concentration using the reported values of \(n\) and \(K\) (see table below). The alcohol concentrations were varied from 1-5 mol dm\(^{-3}\).

<table>
<thead>
<tr>
<th>Alcohol</th>
<th>(n)</th>
<th>(-\log K)</th>
<th>Nature of the solid phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methanol; CH₃OH; [67-56-1]</td>
<td>2</td>
<td>2.58</td>
<td>LaCl₃·CH₃OH</td>
</tr>
<tr>
<td>Ethanol; C₂H₅OH; [64-17-5]</td>
<td>1</td>
<td>2.05</td>
<td>LaCl₃·3C₂H₅OH</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2.57</td>
<td></td>
</tr>
<tr>
<td>1-Propanol; C₃H₇OH; [71-23-8]</td>
<td>1</td>
<td>2.10</td>
<td>LaCl₃·3C₃H₇OH</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>3.29</td>
<td></td>
</tr>
</tbody>
</table>

For those systems where two values of \(n\) and \(K\) are reported, the overall solubility of LaCl₃ is obtained by using the values for \(n\cdot K\) in eq. [1] which give the greater solubility.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Isothermal method used as described in (1). Solvent mixtures of known alcohol concentration were saturated with anhydrous LaCl₃ at 22 ± 1°C. Equilibrium was confirmed from constancy of the rare earth metal concentration upon repeated analyses.

Liquid phases were analysed for rare earth metal concentration (method not specified). At least 3 separate experiments were carried out for each system studied. In addition, the solid phases were analysed for several arbitrary points of each series of experiments (method not specified).

SOURCE AND PURITY OF MATERIALS:
Source and purity of LaCl₃ not specified. Anhydrous LaCl₃ prepared by method described in (2).
C.p. grade organic solvents were purified by "known" methods (3).

ESTIMATED ERROR:
Soly: nothing specified.
Temp: precision ± 1 K

REFERENCES:
1. Golub, A.M.; Golovorushkin, V.I.
2. Spedding, F.H.; Deen, A. H.
   Electrochemistry of Metals in Nonaqueous Solutions.
   Khimiya Press, Moscow, 1974, p 440.
Lanthanum Chloride

COMPONENTS:

(1) Lanthanum chloride; LaCl₃; [10099-58-8]

(2) Methanol; CH₃OH; [67-56-1]

ORIGINAL MEASUREMENTS:


VARIABLES:

T/K = 273.2, 298.2, 323.2

PREPARED BY:

T. Mioduski and M. Salomon

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>a</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
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<td>2.23</td>
</tr>
<tr>
<td>25</td>
<td>2.45</td>
<td>2.44</td>
</tr>
<tr>
<td>50</td>
<td>---</td>
<td>2.98</td>
</tr>
</tbody>
</table>

a Initial solid was LaCl₃·4CH₃OH. Equilibrated solid phase analysed and found to contain 4.0 moles methanol per mole of salt.

b Initial solid was anhydrous LaCl₃. Equilibrated solid phase not analysed.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isothermal method as in (1,2). Mixtures were equilibrated for at least 4 days. Prolonged operations were performed in a dry box. Lanthanum determined by titration with (NH₄)₂H(EDTA) using a small amount of urotropine buffer and Xylenol Orange indicator. Chloride was determined by potentiometric titration with AgNO₃ solution. Composition of the adduct LaCl₃·4CH₃OH confirmed by ¹H NMR and x-ray diffraction.

The reported solubilities are mean values of 2-4 determinations.

SOURCE AND PURITY OF MATERIALS:

La₂O₃ of at least 99.9% purity dissolved in HCl to produce the heptahydrate. The adduct LaCl₃·4CH₃OH prepared by dissolving the heptahydrate in a small excess of o-methylformate followed by distillation and crystallization from methanol. The anhydrous salt prepared by dehydration as described in (3). Methanol was purified and dried by the Vogel method.

ESTIMATED ERROR:

Soly: precision ± 0.5% as in (1) (compilers).
Temp: precision probably at least ± 0.05 K as in (1) (compilers).

REFERENCES:


2. Platt, R. Chemia 1952, 6, 62.
COMPONENTS:
(1) Lanthanum chloride; LaCl₃; [10099-58-8]
(2) Ethanol; C₂H₆O; [64-17-5]

VARIABLES:
Temperature

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>g La₂O₃ in 10 cc satd sol</th>
<th>density/g cm⁻³</th>
<th>solubility of LaCl₃ a,b mol dm⁻³</th>
<th>solubility of LaCl₃ a,b mol kg⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>mean</td>
<td>av exp.</td>
<td>av exp.</td>
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<td></td>
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</tr>
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<td></td>
<td></td>
</tr>
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</tr>
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<td></td>
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<td>1.1689</td>
</tr>
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</tr>
<tr>
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<td>1.1835</td>
</tr>
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<td>1.1509</td>
</tr>
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<td>1.1718</td>
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<td>40</td>
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<td></td>
</tr>
<tr>
<td>40°C</td>
<td>3.6374</td>
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<td></td>
</tr>
<tr>
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<td>4.1469</td>
<td>4.1472</td>
<td>1.4100</td>
<td>1.4102</td>
</tr>
<tr>
<td>50</td>
<td>4.1474</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a, b Calculated by compilers. b. From average values of mass La₂O₃ and satd sol densities.

Auxiliary Information:

METHOD/APPARATUS/PROCEDURE:
Salt and ethanol placed in 250 cc stoppered bottles and mechanically agitated in a thermostat for at least 24 h. Bottles were sealed by placing rubber tubing over the stopper and neck of each bottle. Sins allowed to settle until anhyd salt obtained. The salt was analysed for H₂O by gravimetric analysis (oxalate-oxide method), but results not given; presumably little or no water found. Ethanol obtained from the stock room (i.e. source and purity unknown) was dried with anhyd Na₂SO₄.

SOURCE AND PURITY OF MATERIALS:
LaCl₃ prep from spectro-pure La₂O₃ by addn of aq HCl, and evapn to the point of crystn. Crystals dried in atm of dry HCl for 24 h at room temp followed by slow heating in dry HCl until anhyd salt obtained. The salt was stored in a vac desiccator over P₂O₅. The salt was analysed for H₂O by gravimetric analysis (oxalate-oxide method), but results not given; presumably little or no water found. Ethanol obtained from the stock room (i.e. source and purity unknown) was dried with anhyd Na₂SO₄.

ESTIMATED ERROR:
Soly: precision no better than ± 5% (compilers)
Temp: precision ± 1 K.

REFERENCES:
**COMPONENTS:**

(1) Lanthanum chloride; LaCl₃; [10099-58-8]
(2) Ethanol; C₂H₆O; [64-17-5]

**ORIGINAL MEASUREMENTS:**


**VARIABLES:**

T/K = 273.2, 298.2, 323.2

**PREPARED BY:**

T. Mioduski and M. Salomon

**EXPERIMENTAL VALUES:**

<table>
<thead>
<tr>
<th>t/°C</th>
<th>a</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>---</td>
<td>1.14</td>
</tr>
<tr>
<td>25</td>
<td>1.26</td>
<td>1.34</td>
</tr>
<tr>
<td>50</td>
<td>---</td>
<td>1.97</td>
</tr>
</tbody>
</table>

a. Initial solid was LaCl₃·3C₂H₆O. Equilibrated solid phase analysed and found to contain 3.6 moles ethanol per mole of LaCl₃.

b. Initial solid was anhydrous LaCl₃. The equilibrated solid phase was not analysed.

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Isothermal method as in (1,2). Mixtures were equilibrated for at least 4 days. Prolonged operations were performed in a dry box. Lanthanum determined by titration with (NH₄)₃H(EDTA) using a small amount of urotropine buffer and Xylenol Orange indicator. Chloride was determined by potentiometric titration with AgNO₃ solution. Composition of the adduct LaCl₃·3C₂H₆O confirmed by ¹H NMR and x-ray diffraction.

The reported solubilities are mean values of 2-4 determinations.

**SOURCE AND PURITY OF MATERIALS:**

La₂O₃ of at least 99.9% purity dissolved in HCl to produce the heptahydrate. The adduct LaCl₃·3C₂H₆O prepared by dissolving the hydrate in a small excess of o-ethylformate followed by distillation and crystallization from ethanol. The anhydrous salt was prepared by dehydration as described in (3).

Ethanol (Fluka) was used as received. Purity and absence of water was confirmed by NMR method.

**ESTIMATED ERROR:**

Soly: precision ± 0.5% as in (1) (compilers).

Temp: precision probably at least ± 0.05 K as in (1) (compilers).

**REFERENCES:**

2. Platt, R. Chimia 1952, 6, 62.

Reference (3) was incorrectly cited in the source paper as: J. Inorg. Nucl. Chem. 1958, 7, 224. (this is the reference to a paper by J. H. Freeman and M. L. Smith which describes the preparation of anhydrous salts by treatment with thionyl chloride). Reference (3) was corrected by the compilers.
## Components

1. Lanthanum chloride; LaCl$_3$; [10099-58-8]
2. Ethanol; C$_2$H$_6$O; [64-17-5]
3. Water; H$_2$O; [7732-18-5]

## Original Measurements

Sakharova, N.N.; Sakharova, Yu.G.; Ezhova, T.A.; Izmailova, A.A.

## Variables

- Temperature

## Experimental Values

<table>
<thead>
<tr>
<th>Temperature ($^\circ$C)</th>
<th>Sample 1 (g/100 g)</th>
<th>Sample 2 (g/100 g)</th>
<th>Sample 3 (g/100 g)</th>
<th>Sample 4 (g/100 g)</th>
<th>Mean Solubility (g/100 g)</th>
<th>Molality (mol kg$^{-1}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
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<td>40.23</td>
<td>39.82</td>
<td>40.23</td>
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<td>71.36</td>
<td>71.23</td>
<td>2.016</td>
</tr>
</tbody>
</table>

*a* It is not clearly stated whether the mixture is 96.8 mass % ethanol or 96.8 volume % ethanol.

*b* Solubilities reported as grams of hexahydrate in 100 g of solvent.

*c* Molalities calculated by the compilers.

## Auxiliary Information

**Method/Apparatus/Procedure:**

- Isothermal method used. Equilibrium was reached after 3-4 h. Identical results obtained by approaching equilibrium from above and below. Two of the data points in the table obtained after 3 hours of equilibration, and the remaining two data points obtained after 4 h of equilibration.

- The metal content in each aliquot taken for analysis was determined by complexometric titration with Trilon B.

- Analyses of the solids withdrawn at 20$^\circ$C, 40$^\circ$C and 60$^\circ$C showed the solid phase to be the hexahydrate: i.e. ethanol was not found in any of the solid phases.

- The hexahydrate melted at 93.9 - 94.5$^\circ$C.

**Source and Purity of Materials:**

- LaCl$_3$.6H$_2$O prepd by dissolving c.p. grade oxide in dil (1:3) HCl followed by evapn and crystn. The crystals were dried in a desiccator over CaCl$_2$, P$_2$O$_5$ and NaOH. The crystals analysed for the metal by titrn with Trilon B, and for Cl by the Volhard method. Found (%) for La: 39.20, 39.39 (calcd 39.33). Found (%) for Cl: 30.10, 30.08 (calcd 30.16). 96.8% ethanol prepd by prolonged boiling of c.p. grade 93.5% ethanol with anhyd CuSO$_4$ followed by distn. Ethanol concn detd re­fractometrically and pycnometrically.

**Estimated Error:**

- Solubility: results apparently precise to within ± 0.8% (compilers).
- Temp: nothing specified.

**References:**
## COMPONENTS:

1. Lanthanum chloride; LaCl$_3$; [10099-58-8]
2. 1,2-Ethanediol (ethylene glycol); C$_2$H$_6$O$_2$; [107-21-1]

## ORIGINAL MEASUREMENTS:

Racster, L.V.
Masters Thesis.
University of Illinois. Urbana, IL 1932.

## VARIABLES:

Temperature

## EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>g La$_2$O$_3$ in 10 cc of satd sln</th>
<th>density/g cm$^{-3}$</th>
<th>solubility of LaCl$_3$</th>
<th>mol dm$^{-3}$</th>
<th>mol kg$^{-1}$</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>50</td>
<td>3.0810</td>
<td>1.4410</td>
<td>1.6929</td>
<td>1.792</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>2.9565</td>
<td>1.4413</td>
<td>1.6929</td>
<td>1.792</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>2.5923</td>
<td>1.6010</td>
<td>1.6929</td>
<td>1.792</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>2.6240</td>
<td>1.6010</td>
<td>1.6929</td>
<td>1.792</td>
<td></td>
</tr>
</tbody>
</table>

a. Calculated by compilers.
b. Calculated by compilers from average mass La$_2$O$_3$ and average density of satd sln.

The solid phase was not analysed.

## AUXILIARY INFORMATION

### METHOD/APPARATUS/PROCEDURE:

LaCl$_3$ and solvent placed in 250 cc glass stoppered bottle and mechanically agitated for 24 h. Rubber tubing placed over stopper and neck of bottle and end of tubing sealed with a rubber stopper to prevent water from entering the bottle. Slns allowed to settle for 12–18 h, but slight turbidity persisted, particularly at the lowest and highest temps. At 60°C sln turbidity was significant and appeared different leading author to speculate possible reaction between solute and solvent. Results at 50°C and 60°C said to be approximate. Duplicate 10 cc aliquots pipetted from the bottle for each temp. Each aliquot diluted with 25 cc H$_2$O and the rare earth pptd as the oxalate with oxalic acid. The oxalate was filtered, ignited and weighed as the oxide. Densities at satd slns detd pycnometrically using pycnometer calibrated at each temp. Densities at 10°C and 15°C may be high due to the condensation of atm water on the surface of the pycnometer.

### SOURCE AND PURITY OF MATERIALS:

LaCl$_3$ prepd by addn of HCl to spectro-pure La$_2$O$_3$, and evapn of solvent until crystn. Crystals dehydrated by method of Kremers (2). Salt analysed for presence of H$_2$O gravimetrically by conversion to oxalate and ignition to the oxide. No water of crystn was found. Ethylene glycol (source and purity not specified) was distilled and initial 5% of distillate discarded. The distilled solvent was stored in a flask sealed with paraffin.

### ESTIMATED ERROR:

Soly: Precision no better than ± 3%, and accuracy is probably poor (compilers).

Temp: Not specified.

### REFERENCES:


COMPONENTS:

(1) Lanthanum chloride; LaCl₃; [10099-58-8]

(2) 1-Propanol; C₃H₆O; [71-23-8]

ORIGINAL MEASUREMENTS:

West, D.H.
Masters Thesis.
University of Illinois. Urbana, IL. 1932.

VARIABLES:

Temperature

PREPARED BY:

M. Salomon and T. Mioduski

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>g La₂O₃ in 10 cc of saturated sln</th>
<th>solubility of LaCl₃ a,b</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>sample 1: 1.8057 sample 2: 1.8263</td>
<td>average: 1.8160 c: 1.1148</td>
</tr>
<tr>
<td></td>
<td></td>
<td>mol dm⁻³</td>
</tr>
<tr>
<td>20</td>
<td>sample 1: 2.0097 sample 2: 2.0251</td>
<td>2.0174: 1.2384</td>
</tr>
<tr>
<td>30</td>
<td>sample 1: 2.3641 sample 2: 2.3763</td>
<td>2.3702: 1.4550</td>
</tr>
<tr>
<td>40</td>
<td>sample 1: 2.8013 sample 2: 2.7879</td>
<td>2.7946: 1.7115</td>
</tr>
</tbody>
</table>

a. Calculated by compilers.

b. Calculated by compilers from average mass La₂O₃.

c. Author gives 1.8146 g for this average.

The solid phase was not analysed.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isothermal method. About 100 cc of alcohol and excess salt placed in 250 cc glass stoppered bottle, and rubber tubing placed over the stopper and neck of the bottle and a rubber bung fitted into the open end of the tubing to prevent leakage of water into the bottle. The bottle was immersed in a thermostat and mechanically agitated for at least 12 h. The saturated solutions were then permitted to settle for a minimum of 12 h, and duplicate 10 cc aliquots removed with a pipet. Water was added to the aliquots and the sln heated and oxalic acid added to precipitate the rare earth oxalate. The precipitate was filtered, washed with distilled water, and ignited and weighed as the oxide.

SOURCE AND PURITY OF MATERIALS:

LaCl₃ prepd by addn of HCl to spectro-pure La₂O₃, and evaporating the sln to a paste which crystallized upon cooling. The hydrate was dried in a stream of dry HCl by slowly increasing the temp. The anhyd salt was stored in cork-stoppered bottles in a desiccator over P₂O₅. Analysis by conversion to the oxalate and ignition to the oxide showed the salt to be anhydr. Commercial alcohol placed over CaO for 1 week and then distilled: the first and last 15-20 cc were discarded. CuSO₄ test for H₂O was negative.

ESTIMATED ERROR:

Soly: precision probably within ± 3 % (compilers).

Temp: precision ± 0.2 K (author).

REFERENCES:

COMPONENTS:

(1) Lanthanum chloride; LaCl₃; [10099-58-8]
(2) 2-Propanol; C₃H₈O; [67-63-0]

ORIGINAL MEASUREMENTS:

West, D.H.
Masters Thesis.
University of Illinois. Urbana, IL 1932.

VARIABLES:

Temperature

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>t/°C</th>
<th>g La₂O₃ in 10 cc of saturated sln</th>
<th>solubility of LaCl₃ a,b</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>sample 1</td>
<td>sample 2</td>
</tr>
<tr>
<td>10</td>
<td>0.0283</td>
<td>0.0269</td>
</tr>
<tr>
<td>20</td>
<td>0.0335</td>
<td>0.0319</td>
</tr>
<tr>
<td>30</td>
<td>0.0656</td>
<td>0.0642</td>
</tr>
<tr>
<td>40</td>
<td>0.0884</td>
<td>0.0906</td>
</tr>
</tbody>
</table>

a. Calculated by compilers.
b. Calculated by compilers from average mass La₂O₃.

The solid phase was not analysed.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isothermal method. About 100 cc of alcohol and excess salt placed in 250 cc glass stoppered bottle, and rubber tubing placed over the stopper and neck of the bottle and a rubber bung fitted into the open end of the tubing to prevent leakage of water into the bottle. The bottle was immersed in a thermostat and mechanically agitated for at least 12 h. The saturated solutions were then permitted to settle for a minimum of 12 h, and duplicate 10 cc aliquots removed with a pipet. Water was added to the aliquots and the sln heated and oxalic acid added to precipitate the rare earth oxalate. The precipitate was filtered, washed with distilled water, and ignited and weighed as the oxide.

SOURCE AND PURITY OF MATERIALS:

LaCl₃ prep'd by addn of HCl to spectro-pure La₂O₃, and evaporating the sln to a paste which crystallized upon cooling. The hydrate was dried in a stream of dry HCl by slowly increasing the temp. The anhyd salt was stored in cork-stoppered bottles in a desiccator over P₂O₅. Analysis by conversion to the oxalate and ignition to the oxide showed the salt to be anhydr. Commercial alcohol placed over CaO for 1 week and then distilled: the first and last 15-20 cc were discarded. CuSO₄ test for H₂O was negative.

ESTIMATED ERROR:

Soly: precision probably within ± 3% (compilers).
Temp: precision ± 0.2 K (author).

REFERENCES:

**COMPONENTS:**

1. Lanthanum chloride; \(\text{LaCl}_3\); [10099-58-8]
2. 2-Propanol; \(\text{C}_3\text{H}_6\text{O}\); [67-63-0]

**ORIGINAL MEASUREMENTS:**


**VARIABLES:**

\(T/K = 298.2\)

**PREPARED BY:**

T. Mioduski and M. Salomon

**EXPERIMENTAL VALUES:**

Two results were reported for 25°C.

1. Starting with \(\text{LaCl}_3.3\text{C}_3\text{H}_8\text{O}\), the solubility was reported to be 0.004 mol kg\(^{-1}\). The equilibrated solid phase was analysed and found to contain 4.5 - 5.1 moles of iso-propanol per mole of \(\text{LaCl}_3\).

2. Starting with the anhydrous salt, the solubility was reported to be 0.016 mol kg\(^{-1}\). The equilibrated solid phase was not analysed.

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Isothermal method as in (1,2). Mixtures were equilibrated for at least 4 days. Prolonged operations were performed in a dry box. Lanthanum determined by titration with \((\text{NH}_4)_2\text{H(EDTA)}\) using a small amount of urotrpine buffer and Xylenol Orange indicator. Chloride was determined by potentiometric titration with AgNO\(_3\) solution. Composition of the adduct \(\text{LaCl}_3.3\text{C}_3\text{H}_8\text{O}\) confirmed by \(^1\text{H}\) NMR and x-ray diffraction.

The reported solubilities are mean values of 2-4 determinations.

**SOURCE AND PURITY OF MATERIALS:**

\(\text{La}_2\text{O}_3\) of at least 99.9% purity dissolved in HCl to produce the heptahydrate. The adduct \(\text{LaCl}_3.3\text{C}_3\text{H}_8\text{O}\) prepared by dissolving the hydrate in a small excess of \(\sigma\)-methylformate followed by distillation and trans-solvation of the methanol complex with 2-propanol. The anhydrous salt was prepared by dehydration as described in (3).

Iso-propanol (Fluka) was used as received. Purity and absence of water confirmed by NMR.

**ESTIMATED ERROR:**

Soly: precision ± 0.5% as in (1) (compilers).

Temp: precision probably at least ± 0.05 K as in (1) (compilers).

**REFERENCES:**

**COMPONENTS:**

1. Lanthanum chloride; LaCl$_3$; [10099-58-8]
2. 1,2,3-propanetriol (glycerol); C$_3$H$_8$O$_3$; [56-81-5]

**ORIGINAL MEASUREMENTS:**

- Dawson, L. R.
- Masters Thesis.
- University of Illinois. Urbana, IL. 1932.

**VARIABLES:**

- Temperature

**EXPERIMENTAL VALUES:**

<table>
<thead>
<tr>
<th>t/°C</th>
<th>g La$_2$O$_3$ in 25 cc satd soln</th>
<th>density/g cm$^{-3}$</th>
<th>solubility of LaCl$_3$ $^a,b$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>experimental</td>
<td>average</td>
<td>exptl</td>
</tr>
<tr>
<td>10</td>
<td>0.2423</td>
<td>0.2495</td>
<td>1.2732</td>
</tr>
<tr>
<td>20</td>
<td>2.6962</td>
<td>2.6918</td>
<td>1.3592</td>
</tr>
<tr>
<td>25</td>
<td>2.0927</td>
<td>2.0891</td>
<td>1.3330</td>
</tr>
<tr>
<td>30</td>
<td>1.3266</td>
<td>1.3277</td>
<td>1.3114</td>
</tr>
<tr>
<td>40</td>
<td>2.3038</td>
<td>2.3049</td>
<td>1.3639</td>
</tr>
<tr>
<td>50</td>
<td>2.4841</td>
<td>2.4812</td>
<td>1.3514</td>
</tr>
<tr>
<td>60</td>
<td>2.5302</td>
<td>2.5213</td>
<td>------</td>
</tr>
</tbody>
</table>

- a. Calculated by compilers.
- b. Based on average mass of La$_2$O$_3$.
- c. Recalculated by compilers.
- d. Value tabulated in Thesis is 1.334, but this is obviously a typographical error.

The solid phase was not analysed.

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

- About 175 cc glycerol placed in 250 cc glass stoppered bottles and "liberal amounts" of salt added. Mixtures mechanically agitated in thermostat for 24 h, and even after 15 h of standing turbidity was present. All analyses carried out on turbid slns. For analyses, duplicate 25 cc aliquots (from each bottle) were taken and the rare earth pptd as the oxalate. The ppt was filtered, ignited, and weighed as the oxide. Author states the presence of turbidity has small effect on the overall accuracy of the soly detns. Densities of satd slns determined by withdrawing samples from the bottles, placing them into a pycnometer, and weighing "as quickly as possible."

**COMMENTS AND/OR ADDITIONAL DATA:**

- Since there is a sharp rise in soly from 10°C to 20°C followed by a sharp decrease to 30°C at which point the soly begins to rise again, it is evident that the solid phase in equil with the satd slns is changing. Unsuccessful attempts were made to isolate and identify the solid phases.

**SOURCE AND PURITY OF MATERIALS:**

- LaCl$_3$ prep'd by adding HCl to spectro-pure La$_2$O$_3$, and evaporating the solvent to the point of crystallization. Dehydration was carried out in a stream of dry HCl first at room temp 24 h, then at 100°C for ~12 h, 110°C for ~6 h, and 200°C for ~3 h. HCl prep'd from NaCl + H$_2$SO$_4$, and passed through H$_2$SO$_4$ drying towers. Glycerol (presumably c.p. or A.R. grade; compilers) distilled at reduced pressure and the "first portion" rejected (no other details given).

**ESTIMATED ERROR:**

- Soly: based upon precision in analyses and temp control, overall precision in soly around ± 3%. Error in accuracy due to turbidity is unknown.
- Temp: precision ± 0.5 K except for the 10°C run where precision was ± 1.5 K.

**REFERENCES:**

COMPONENTS:

(1) Lanthanum chloride; LaCl₃; [10099-58-8]

(2) 2-Methoxyethanol (methyl cellosolve); C₇H₈O₂; [109-86-4]

ORIGINAL MEASUREMENTS:

McCarty, C.N.

Masters Thesis.

University of Illinois. Urbana, IL. 1933.¹

VARIABLES:

Temperature

PREPARED BY:

M. Salomon and T. Mioduski

EXPERIMENTAL VALUES:

Composition of Saturated Solutions

<table>
<thead>
<tr>
<th>t/°C</th>
<th>La₂O₃</th>
<th>LaCl₃</th>
<th>LaCl₃</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>g/25 cc</td>
<td>g/dm³</td>
<td>mol/dm³</td>
</tr>
<tr>
<td>0</td>
<td>0.5793</td>
<td>34.89</td>
<td>0.1422</td>
</tr>
<tr>
<td>10</td>
<td>0.9068</td>
<td>54.61</td>
<td>0.2227</td>
</tr>
<tr>
<td>20</td>
<td>1.1026</td>
<td>66.40</td>
<td>0.2707</td>
</tr>
<tr>
<td>30</td>
<td>1.2228</td>
<td>73.64</td>
<td>0.3002</td>
</tr>
<tr>
<td>40</td>
<td>1.3677</td>
<td>78.75</td>
<td>0.3211</td>
</tr>
<tr>
<td>50</td>
<td>1.5886</td>
<td>95.67</td>
<td>0.3901</td>
</tr>
</tbody>
</table>

a. Apparently these are average values of at least two analyses from a given bottle. The author did not indicate whether there were any differences in results using LaCl₃ from preparations 1 and 2.

b. Recalculated by the compilers using 1977 IUPAC recommended atomic masses (1).

The equilibrated solid phase was not analysed.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isothermal method. About 75–100 cc of solvent + excess salt were placed in bottles and agitated in a thermostat for at least 12 h. Ice + water was used for the 0°C measurements. The bottles were fitted with ground glass stoppers and sealed from the atmosphere by placing gum rubber tubing over the stoppers and necks of the bottles, and a rubber bung fitted into the upper end of the tubing. After equilibration, the solutions were allowed to settle for at least 12 h, and using a calibrated 25 cc pipet two samples were removed for analysis. The samples were evaporated to dryness and dissolved in aq HCl and pptd as the oxalate by addn of oxalic acid. The samples were filtered, washed with dist water and ignited to constant weight as the oxide. The oxide was found to be insoluble in the organic solvent.

ESTIMATED ERROR:

Soly: precision probably within 3 % (compilers).

Temp: precision ± 0.2 K (author).

SOURCE AND PURITY OF MATERIALS:

Commercial solvent was permitted to stand over CaO for at least 1 week and then distilled. A middle portion (fraction not specified) was retained and stored in a stoppered flask: b.p. 123°C. La salts prep in 1925 as double ammonium nitrates were of "spectroscopic purity" and converted to the oxide (no details) and the anhydr chloride prep by two methods. 1. The oxide was dissolved in aq HCl and the excess HCl evapd. The crystallized salt was dehydrated by heating in the presence of dry HCl first at 100°C for several h, then at 200°C. 2. The rare earth benzoate was pptd from the aq chloride or nitrate with sodium benzoate, and the benzoate dehydrated by heating to 110°C for at least 24 h. Extraction the chloride was carried out with HCl and then in dry air. The salt was stored in a desiccator over P₂O₅. Dry HCl was prep from NaCl + H₂SO₄ and by passing the resulting HCl through H₂SO₄ drying towers.

REFERENCES:

Lanthanum Chloride

COMPONENTS:
(1) Lanthanum chloride; LaCl₃; [10099-58-8]
(2) 2-Ethoxyethanol (ethyl cellosolve); C₄H₁₀O₂; [110-80-5]

ORIGINAL MEASUREMENTS:
McCarty, C.N.
M.S. Thesis, University of Illinois. Urbana, IL. 1933.¹

VARIABLES:
Temperature

PREPARED BY:
M. Salomon and T. Mioduski

EXPERIMENTAL VALUES:

| Composition of Saturated Solutions | La₂O³ | | LaCl₃ | | LaCl³ |
|-----------------------------------|-------|-------|-------|-------|
| t/°C | g/25 cc | g/dm³ | mol/dm³ |
| 0    | 0.2746  | 15.54  | 0.0674 |
| 10   | 0.4968  | 29.92  | 0.1220 |
| 20   | 0.7331  | 44.15  | 0.1800 |
| 30   | 0.9991  | 60.17  | 0.2453 |
| 40   | 1.1125  | 67.00  | 0.2732 |
| 50   | 1.3391  | 80.64  | 0.3288 |

a. Apparently these are average values of at least two analyses from a given bottle. The author did not indicate whether there were any differences in results using LaCl₃ from preparations 1 and 2.

b. Recalculated by the compilers using 1977 IUPAC recommended atomic masses (1).

The equilibrated solid phase was not analysed.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Isothermal method. About 75-100 cc of solvent + excess salt were placed in bottles and agitated in a thermostat for at least 12 h. Ice + water was used for the 0°C measurements. The bottles were fitted with ground glass stoppers and sealed from the atmosphere by placing gum rubber tubing over the stoppers and necks of the bottles, and a rubber bung fitted into the upper end of the tubing. After equilibration, the solutions were allowed to settle for at least 12 h, and using a calibrated 25 cc pipet, two samples were removed for analysis. The samples were evaporated to dryness and dissolved inaq HCl and pptd as the oxalate by addn of oxalic acid. The samples were filtered, washed with dist water and ignited to constant weight as the oxide. The oxide was found to be insoluble in the organic solvent.

SOURCE AND PURITY OF MATERIALS:
Commercial solvent was permitted to stand over CaO for at least 1 week and distilled. About 75-100 cc of solvent + excess salt were placed in bottles and agitated in a thermostat for at least 12 h. Ice + water was used for the 0°C measurements. The bottles were fitted with ground glass stoppers and sealed from the atmosphere by placing gum rubber tubing over the stoppers and necks of the bottles, and a rubber bung fitted into the upper end of the tubing. After equilibration, the solutions were allowed to settle for at least 12 h, and using a calibrated 25 cc pipet, two samples were removed for analysis. The samples were evaporated to dryness and dissolved inaq HCl and pptd as the oxalate by addn of oxalic acid. The samples were filtered, washed with dist water and ignited to constant weight as the oxide. The oxide was found to be insoluble in the organic solvent.

ESTIMATED ERROR:
Soly: precision probably within 3% ( compilers).
Temp: precision ± 0.2 K (author).

REFERENCES:
## COMPONENTS:

(1) Lanthanum chloride; LaCl₃; [10099-58-8]

(2) Ethers

## VARIABLES:

Room temperature: T/K = 293–298

## EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>solvent</th>
<th>mass %</th>
<th>mol kg⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-methoxyheptane; C₈H₁₆O; [629-32-3]</td>
<td>0.6</td>
<td>0.025</td>
</tr>
<tr>
<td>1-methoxyoctane; C₉H₂₀O; [929-56-6]</td>
<td>0.1</td>
<td>0.004</td>
</tr>
</tbody>
</table>

\[ a \] Molalities calculated by the compilers.

\[ b \] Solid phase ratios La:ether found to be 1: > 2.

## AUXILIARY INFORMATION

**METHOD/APPARATUS/PROCEDURE:**

The solute-solvent mixtures were isothermally agitated at room temperature until equilibrium was attained. The anhydrous reagents were handled in a dry box containing P₄O₁₀.

La was determined by complexometric titration using Xylenol Orange indicator.

The reported solubilities are mean values based on four determinations.

**SOURCE AND PURITY OF MATERIALS:**

Nothing specified.

**ESTIMATED ERROR:**

Nothing specified.

**REFERENCES:**

Kirmse, E.M.; Dressler, H. 
COMPONENTS:

(1) Lanthanum chloride; LaCl$_3$; [10099-58-8]

(2) Ethers

VARIABLES:

Room temperature: T/K around 298

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>Solvent</th>
<th>LaCl$_3$ solubility$^a$</th>
<th>LaCl$_3$ solubility$^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-ethoxy-2-methoxyethane; C$_3$H$_7$O$_2$; [5137-45-1]</td>
<td>0.4</td>
<td>0.016</td>
</tr>
<tr>
<td>1,3-dioxolane; C$_3$H$_6$O$_2$; [646-06-0]</td>
<td>0.5</td>
<td>0.020</td>
</tr>
<tr>
<td>1,4-dioxane; C$_4$H$_8$O$_2$; [123-81-1]</td>
<td>0.02</td>
<td>0.0008</td>
</tr>
</tbody>
</table>

$^a$ Molalities calculated by the compilers.

$^b$ Nature of solid phases not specified.

ORIGINAL MEASUREMENTS:

Kirmse, E.M.; Zwietausch, K.J.; Tirschmann, J.; Oelsner, L.; Niedergesaess, U.
Z. Chem. 1968, 8, 472-3.

PREPARED BY:

Mark Salomon and Tomasz Mioduski

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
The solute-solvent mixtures were isothermally agitated at 25°C or at room temperature. Authors state that the difference found for the solubilities was within experimental error limits.

La determined by complexometric titration.

No other details given.

SOURCE AND PURITY OF MATERIALS:
The anhydrous salt was prepared by the method of Taylor and Carter (1).

No other information given.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

1. Taylor, M.D.; Carter, C.P.
COMPONENTS:
(1) Lanthanum chloride; LaC1₃; [10099-58-8]
(2) Methanol; CH₄O; [67-56-1]
(3) 1,4-Dioxane; C₄H₈O₂; [123-91-1]

ORIGINAL MEASUREMENTS:
Golub, A.M.; Yankovich, V. N.

VARIABLES:
Concentration of CH₄OH
T/K = 295

EXPERIMENTAL VALUES:

<table>
<thead>
<tr>
<th>Initial Conc Methanol</th>
<th>LaCl₃ solubilityᵃ</th>
</tr>
</thead>
<tbody>
<tr>
<td>mol dm⁻³</td>
<td>mol dm⁻³</td>
</tr>
<tr>
<td>1.5</td>
<td>0.01320</td>
</tr>
<tr>
<td>2.0</td>
<td>0.02972</td>
</tr>
<tr>
<td>2.5</td>
<td>0.05482</td>
</tr>
<tr>
<td>3.0</td>
<td>0.09300</td>
</tr>
<tr>
<td>3.5</td>
<td>0.13804</td>
</tr>
<tr>
<td>4.0</td>
<td>0.21380</td>
</tr>
</tbody>
</table>

ᵃSolid phase is LaCl₃·CH₄OH.

PREPARED BY:
T. Mioduski

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Isothermal method used as described in (1). Solvent mixtures of known alcohol concentration were saturated with anhydrous LaCl₃ at 22 ± 1°C. Equilibrium was confirmed from constancy of the rare earth metal concentration upon repeated analyses.

Liquid phases were analysed for rare earth metal concentration (method not specified). At least 3 separate experiments were carried out for each system studied. In addition, the solid phases were analysed for several arbitrary experimental points (method not specified).

SOURCE AND PURITY OF MATERIALS:
Source and purity of LaCl₃ not specified. Anhydrous LaCl₃ prepared by method described in (2).

C.p. grade organic solvents were purified by "known" methods (3).

ESTIMATED ERROR:
Soly: nothing specified.
Temp: precision ± 1 K.

REFERENCES:
COMPONENTS:
(1) Lanthanum chloride; LaCl₃; [10099-58-8]
(2) Alcohols; ROH
(3) 1,4-Dioxane; C₄H₈O₂; [123-91-1]

ORIGINAL MEASUREMENTS:
Golub, A. M.; Yankovich, V. N.
1977, 43, 16-20.

VARIABLES:
Concentration of ROH
T/K - 295

EXPERIMENTAL VALUES:
Numerical data were given only for the LaCl₃ - CH₃OH - C₄H₈O₂ system (see the compilation for this system). The remaining data were presented graphically and in the form of the equation

\[ K = \frac{[\text{LaCl}_3 \cdot n\text{ROH}]}{[\text{ROH}]^n} \]  

[1]

\(n\), the number of alcohol molecules in the solid phase, is calculated from the slope of a plot of the logarithm of the solubility, \(\log [\text{LaCl}_3 \cdot n\text{ROH}]\), against \(\log [\text{ROH}]\). Thus the solubility of LaCl₃ can be calculated as a function of ROH concentration using the reported values of \(n\) and \(K\) (see table below). The alcohol concentrations were varied from 1-5 mol dm⁻³.

<table>
<thead>
<tr>
<th>Alcohol</th>
<th>(n)</th>
<th>-(\log K)</th>
<th>Nature of the solid phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methanol; CH₃OH; [67-56-1]</td>
<td>3</td>
<td>2.36</td>
<td>LaCl₃·CH₃OH</td>
</tr>
<tr>
<td>Ethanol; C₂H₆O; [64-17-5]</td>
<td>3</td>
<td>3.10</td>
<td>LaCl₃·3C₂H₅OH</td>
</tr>
<tr>
<td>1-propanol; C₃H₈O; [71-23-8]</td>
<td>1,2</td>
<td>2.90, 3.45</td>
<td>LaCl₃·3C₃H₇OH</td>
</tr>
</tbody>
</table>

For the last system where two values of \(n\) and \(K\) are reported, the overall solubility of LaCl₃ is obtained by using the values for \(n\)-\(K\) in eq. [1] which give the greater solubility.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:
Isothermal method used as described in (1). Solvent mixtures of known alcohol concentration were saturated with anhydrous LaCl₃ at 22 ± 1°C. Equilibrium was confirmed from constancy of the rare earth metal concentration upon repeated analyses.

Liquid phases were analysed for rare earth metal concentration (method not specified). At least 3 separate experiments were carried out for each system studied. In addition, the solid phases were analysed for several arbitrary points of each series of experiments (method not specified).

SOURCE AND PURITY OF MATERIALS:
Source and purity of LaCl₃ not specified. Anhydrous LaCl₃ prepared by method described in (2).
C.p. grade organic solvents were purified by "known" methods (3).

ESTIMATED ERROR:
Soly: nothing specified.
Temp: precision ± 1 K

REFERENCES:
### COMPONENTS:

1. Lanthanum chloride; LaCl₃; [10099-58-8]
2. Hexamethylphosphorotriamide; C₆H₁₈N₃OP; [680-31-9]

### ORIGINAL MEASUREMENTS:

Mikheev, N.B.; Kamenskaya, A.N.; Konovalova, N.A.; Zhilina, T.A.

### EXPERIMENTAL VALUES:

Starting with anhydrous LaCl₃, the solubility at 25 ± 3°C was given as

\[ 0.106 \pm 0.002 \text{ mol dm}^{-3} \]

Starting with the solvate LaCl₃.3((CH₃)₂N)₃PO, the solubility at 25 ± 3°C was given as

\[ 0.107 \pm 0.002 \text{ mol dm}^{-3} \]

### AUXILIARY INFORMATION

**METHOD/APPARATUS/PROCEDURE:**

Isothermal method used. Salt and solvent were placed in a test-tube in a dry box, and the tube agitated at room temperature (25 ± 3°C) until equilibrium was reached. Aliquots were withdrawn periodically and analysed for the metal content. Rare earth concentration was determined by complexometric titration, and by the radiometric method using the isotope Tm-170 (t₁/₂ = 169 d). Authors state that results for both methods agreed. Although not clearly stated, it appears that equilibrium was reached in several weeks to several months.

Solid phase samples washed three times with benzene or ether and dried on a steam bath in an argon atmosphere. The solid phase was analysed and found to be LaCl₃.3C₆H₁₈N₃OP.

The solvate was analysed for metal content by complexometric titration, for chloride by the Volhard method, and the solvent was obtained by difference. IR spectra confirmed the absence of water. Structural studies of the solvate also carried out by x-ray analysis.

**SOURCE AND PURITY OF MATERIALS:**

Anhyd LaCl₂ prep'd similar to that in (1) by subliming NH₄Cl from a mixt of LaCl₃ and 6 moles of NH₄Cl in a stream of inert gas at 200-400°C (LaOCl content less than 3%). The solvent was purified as in (2).

LaCl₃.3C₆H₁₈N₃OP prep'd by dissolving the hydrate in C₆H₁₈N₃OP and heating to 140-145°C for 5 m. The solvate was ppt'd by addition of abs ether, washing 7 times with ether, and drying over P₂O₅ in a stream of dry nitrogen. Yield was about 90%.

**ESTIMATED ERROR:**

Soly: precision ± 0.002 mol dm⁻³ at a 95% level of confidence (authors).

Temp: precision ± 3 K.

**REFERENCES:**

**Lanthanum Chloride**

**COMPONENTS:**
1. Lanthanum chloride; LaCl₃; [10099-58-8]
2. Tetrachlorostannate; SnCl₄; [7646-78-8]
3. Phosphorus oxychloride; POCl₃; [10025-87-3]

**ORIGINAL MEASUREMENTS:**

**VARIABLES:**
T/K = 293
Concentration of SnCl₄

**EXPERIMENTAL VALUES:**
<table>
<thead>
<tr>
<th>SnCl₄:POCl₃ ratio (by volume)</th>
<th>SnCl₄ concentration mol dm⁻³</th>
<th>La₂O₃ solubilitya moles La dm⁻³</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.012</td>
</tr>
<tr>
<td>1:250</td>
<td>0.035</td>
<td>0.14</td>
</tr>
<tr>
<td>1:100</td>
<td>0.085</td>
<td>0.26</td>
</tr>
<tr>
<td>1:50</td>
<td>0.17</td>
<td>0.30</td>
</tr>
<tr>
<td>1:25</td>
<td>0.33</td>
<td>0.27</td>
</tr>
<tr>
<td>1:15</td>
<td>0.59</td>
<td>0.22</td>
</tr>
<tr>
<td>1:10</td>
<td>0.78</td>
<td>0.21</td>
</tr>
</tbody>
</table>

This is also the solubility of LaCl₃ in the SnCl₄-POCl₃ mixtures because the oxide is quantitatively converted to the chloride according to:

\[
\text{La}_2\text{O}_3 + 6\text{POCl}_3 = 2\text{LaCl}_3 + 3\text{P}_2\text{O}_5\text{Cl}_4
\]

Thus the equilibrated solutions should actually be considered to be a four component system containing SnCl₄, LaCl₃, P₂O₅Cl₄ and POCl₃ (the compiler assumes P₂O₅Cl₄ is soluble).

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**
Isothermal method used. POCl₃ + SnCl₄ solutions were prepared by volume in a dry box. The SnCl₄ content was verified by chemical analysis for Sn. This solution and La₂O₃ were placed in sealed ampoules, heated to 20-250°C to increase the rate of solution, and then rotated in an air thermostat at 20°C for 2-200 hours. Without preheating, equilibrium was established after 200 hours. Preheating to 120°C lowered the equilibration time to 20°C to 2 hours.

La was determined by the oxalate method. The reported solubilities are mean values based on 3-5 parallel determinations.

**SOURCE AND PURITY OF MATERIALS:**
La₂O₃ of "the first sort" was ignited at 950°C for 2 hours.
"Pure" grade SnCl₄ and POCl₃ were dehydrated with P₂O₅ and distilled under vacuum.

**ESTIMATED ERROR:**
Soly: authors state the "coefficient of variance" to be less than 7%.
Temp: precision presumably ± 0.2K (compiler).

**REFERENCES:**