COMPONENTS:	EVALUATOR:
1. Arsine; AsH_3; [7784-42-1] 2. Organic liquids	P. G. T. Fogg, School of Chemistry, Polytechnic of North London, Holloway, London, N7 8DB, UNITED KINGDOM. August 1983

CRITICAL EVALUATION:

The data published by Devyatykh *et al.* (1) and those published by Corriez and Berton (2) have been discussed in detail by Gerrard (3). The data of Devyatykh *et al.* (1) were determined using a gas chromatographic technique. The solubility refers to that at a very low pressure of arsine and it is unlikely that extrapolation to one atmosphere pressure is valid. In addition, possible adsorption at the stationary phase-carrier gas interface could have occurred and the results should be viewed with caution. It is unwise to use the data given by Devyatykh to predict gas solubilities at 1 atmosphere pressure. The data may, perhaps, be used to estimate relative solubilities in the solvents which were studied but such estimates may not be very percise.

Solubilities measured by Corriez and Berton are consistent with the properties of the solvents which were studied and may be accepted as provisional values.

References

1. Devyatykh, G. G.; Ezheleva, A. E.; Zorin, A. D.; Zueva, M. V. *Zh. Neorgan. Khim.* 1963, *8*, 1307 (*Russ. J. Inorg. Chem.* 1963, *8*, 678).

2. Corriez, P.; Berton, A. *Bull. Soc. Chim. France* 1950, 43.

3. Gerrard, W. *Gas Solubilities – Widespread Applications*, Pergamon Press, Oxford, 1980.

COMPONENTS:

1. Arsine; AsH_3; [7784-42-1]
2. Hydrogen cyanide and aliphatic nitriles.

ORIGINAL MEASUREMENTS:

Corriez, P.; Berton, A.
Bull. Soc. Chim. France
1950, 43-45.

VARIABLES:

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

Solvent	T/K	Bunsen coefficient α	Mole fraction* x_{AsH_3} (1 atm)
Hydrocyanic acid; HCN; [74-90-8]	287.2	0.7	0.0012
Acetonitrile; C_2H_3N; [75-05-8]	287.2	5.3	0.0122
Propanenitrile (propionitrile); C_3H_5N; [107-12-0]	287.2	7.9	0.0242
Butanenitrile (butyronitrile); C_4H_7N; [109-74-0]	287.2	8.0	0.0302

* Calculated by compiler using the density of arsine given in ref. (1) and the densities of solvents given in refs. (2) and (3).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The initial volume of gas was measured over mercury in a gas burette at the barometric pressure. This volume was adjusted to 0 °C and 1 atm by the relation PV = RT. Gas was passed into an absorption pipette containing a known volume of liquid S. The final volume of gas was measured at the barometric pressure, p_{total}. The final pressure of arsine, p_{AsH_3}, was taken to be p_{total} minus vapor pressure of pure solvent. The final volume of gas was adjusted from p_{AsH_3} to 1 atm and 0 °C. The Bunsen absorption coefficient, α, was the difference between the initial and final adjusted volumes divided by the volume of solvent.

SOURCE AND PURITY OF MATERIALS:

No information given.

REFERENCES:

1. Mellor, J.W., *Comprehensive Treatise on Inorganic & Theoretical Chemistry*, Vol. IX, Longmans, London. 1929.
2. Timmermans, J., *Physico-Chemical Constants of Pure Organic Compounds* Vol. 1, Elsevier , Amsterdam. 1950.
3. Timmermans, J., *Physico-Chemical Constants of Pure Organic Compounds* Vol. 2, 1965.

COMPONENTS:

1. Arsine; AsH_3; [7784-42-1]
2. Various liquids

ORIGINAL MEASUREMENTS:

Devyatykh, G.G.; Ezheleva, A.E.; Zorin, A.D.; Zueva, M.V.

Russ. J. Inorg. Chem. 1963, *8*, 678-682.

VARIABLES:

Temperature, pressure

PREPARED BY:

P.G.T. Fogg

EXPERIMENTAL VALUES:

Solvent	Pressure range /mmHg	Distribution constant $vol_{AsH_3}/vol_{solvent}$	Heat of solution /kcal mol^{-1}
2-Ethoxyethanol, $C_4H_{10}O_2$; [110-80-5]	0.2 - 23.4	16.5	-0.98
1,1′-oxybis [2-chloroethane], $C_4H_8Cl_2O$; [111-44-4]	0.05- 13.4	22.4	-2.5
Nitrobenzene, $C_6H_5NO_2$; [98-95-3]	0.01- 17.0	11.72	-1.80
Liquid paraffin	0.2 - 26.5	22.7	-3.5
Silicone PFMS-4F	0.02- 17.5	31.4	-3.2

Temperature = 293.2 K 760 mmHg = 1 atm = 1.013×10^5 Pa.

Distribution constants were measured between 278.2 K and 323.2 K over a range of partial pressures of arsine and a total pressure of about 760 mmHg. At a fixed temperature the distribution constants did not depart from the mean values by more than ±3%. These mean values were reported at one temperature only but heats of solution, said to have been calculated from the variation of distribution constants with temperature, were given. If it is assumed that distribution constants vary with temperature according to equations of the form :

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A chromatographic method was used. Temperatures were controlled to ± 0.5K. The support phase consisted of Nichrome spirals. The carrier gas was either nitrogen or hydrogen. The volume, V_l, of the liquid phase was calculated from the weight of the column before and after filling with liquid and allowing to drain. The free volume, V_g, was equated with the retention volume for hydrogen gas. The distribution constant, *K*, was calculated from the James and Martin equation:

$$V_R = V_g + KV_l$$

where V_R is the retention volume for arsine.

SOURCE AND PURITY OF MATERIALS:

1. Prepared by reaction between Zn_3As_2 and aqueous acid; purified by vacuum distillation; no impurities detected by chromatography.

   H_2 & N_2 : passed through activated carbon and through molecular sieve.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Arsine; AsH ; [7784-42-1]
2. Various liquids

ORIGINAL MEASUREMENTS:

Devyatykh, G.G.; Ezheleva, A.E.; Zorin, A.D.; Zueva, M.V.

Russ, J. Inorg. Chem. 1963, *8*, 678-682.

EXPERIMENTAL VALUES:

$$\ln K = (-\Delta H/RT) + A$$

where K is the distribution constant for a temperature T,ΔH is the heat of solution of arsine in the solvent and A is a constant for the solvent, then distribution constants at any temperature in the range 278.2 K to 323.2 K may be estimated from a value at 293.2 K and the corresponding value of the heat of solution. The equation for K may be written in the form.

$$K = \exp\,[A + (B/T)]$$

The following values of A and B have been calculated by the compiler:

Solvent	A	B/K
2-Ethoxyethanol	1.120	493
1,1´-oxybis [2-chloroethane]	-1.184	1259
Nitrobenzene	-0.630	906
Liquid paraffin	-2.888	1762
Silicone PFMS-4F	-2.049	1611

In the opinion of the compiler these distribution constants cannot be equated with Ostwald coefficients unless the assumption is made that equilibrium was established between gas and liquid phases under the conditions of the experiment.

In addition,possible adsorption of arsine at the stationary phase-carrier gas interface may have lowered the accuracy of the results.

COMPONENTS:

1. Arsine, AsH_3; [7784-42-1]
2. Various liquids

ORIGINAL MEASUREMENTS:

Devyatykh, G.G.; Ezheleva, A.E.; Zorin, A.D.; Zueva, M.V.

Russ. J. Inorg. Chem. 1963, *8*, 678-682.

VARIABLES:

Temperature

PREPARED BY:

P.G.T. Fogg

EXPERIMENTAL VALUES:

Solvent	Distribution constant $vol_{AsH_3}/vol_{solvent}$	Heat of solution /kcal mol^{-1}
2-Furancarboxaldehyde; $C_5H_4O_2$; [98-01-1]	15.68	-3.6
1,2-Benzenedicarboxylic acid, didecyl ester; $C_{28}H_{46}O_4$; [84-77-5]	31.8	-3.0
Triethoxysilane, $C_6H_{16}O_3Si$; [998-30-1]	19.7	-5.8
Silicic acid, tetraethyl ester, $C_8H_{20}O_4Si$; [78-10-4]	17.0	-4.3
Silicone 702-DF	38.0	-4.7
Silicone VKZh-94B	26.2	-5.6

Temperature = 293.2 K

Distribution constants were measured between 278.2 K and 323.2 K. The partial pressures of arsine at which these measurements were made were not stated but would have been very small. The total pressure of arsine and carrier gas was about 760 mmHg in each case. Distribution constants were reported at one temperature only but heats of solution, said to have been calculated from the variation of distribution constants with

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A chromatographic method was used. Temperatures were controlled to ± 0.5 K. The support phase consisted of Nichrome spirals. The carrier gas was either nitrogen or hydrogen. The volume, V_l, of the liquid phase was calculated from the weight of the column before and after filling with liquid and allowing to drain. The free volume, V_g, was equated with the retention volume for hydrogen gas. The distribution constant, K , was calculated from the James and Martin equation :

$$V_R = V_g + KV_l$$

where V_R is the retention volume for arsine.

SOURCE AND PURITY OF MATERIALS:

1. Prepared by reaction between Zn_3As_2 and aqueous acid; purified by vacuum distillation. no impurities detected by chromatography.

H_2 & N_2 : passed through activated carbon and through molecular sieve.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Arsine, AsH_3; [7784-42-1]
2. Various liquids

ORIGINAL MEASUREMENTS:

Devyatykh, G.G.; Ezheleva, A.E.; Zorin, A.D.; Zueva, M.V.

Russ. J. Inorg. Chem. 1963, *8*, 678-682.

EXPERIMENTAL VALUES:

temperature, were given.

If it is assumed that distribution constants vary with temperature according to equations of the form :

$$\ln K = (-\Delta H/RT) + A$$

where K is the distribution constant for a temperature T, ΔH is the heat of solution of arsine in the solvent and A is a constant for the solvent, then distribution constants at any temperature in the range 278.2 K to 323.2 K may be estimated from a value at 293.2 K and the corresponding value of the heat of solution. The equation for K may be written in the form:

$$K = \exp [A + (B/T)]$$

The following values of A and B have been calculated by the compiler:

Solvent	A	B/K
2-Furancarboxaldehyde	-3.430	1813
1,2-Benzenedicarboxylic acid, didecyl ester	-1.693	1511
Triethoxysilane	-6.980	2920
Silicic acid, tetraethyl ester	-4.551	2165
Silicone 702-DF	-4.434	2367
Silicone VKZh-94B	-6.351	2820

In the opinion of the compiler these distribution constants cannot be equated with Ostwald coefficients unless the assumption is made that equilibrium was established between gas and liquid phases under the conditions of the experiment.

In addition, possible adsorption of the arsine at the stationary phase-carrier gas interface may have lowered the accuracy of the results.

COMPONENTS:

1. Arsine; AsH_3; [7784-42-1]
2. Various liquids.

ORIGINAL MEASUREMENTS:

Corriez, P.; Berton, A.
Bull. Soc. Chim. France,
1950, 43-45.

VARIABLES:

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

Solvent	T/K	Bunson coefficient α	Mole fraction* x_{AsH_3} (1 atm)
Huile de vaseline (liquid paraffin)	290.2	8	-
2-Propanone (acetone); C_3H_6O; [67-64-1]	298.2	9.3	0.030
Tetrahydronaphthalene (tetralin). $C_{10}H_{22}$; [119-64-2]	298.2	10	0.062
2-Aminoethanol (monoethanolamine); C_2H_7NO; [141-43-5]	285.2	1.75	0.0047
2,2',2"-Nitrilotris-ethanol (triethanolamine); $C_6H_{15}NO_3$; [102-71-6]	285.2	0.8	0.0047

1 atm = 1.015×10^5 Pascal

* Calculated by the compiler using the density of arsine given in ref. (1) and the densities of solvents given in ref. (2)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The initial volume of gas was measured over mercury in a gas burette at the barometric pressure. This volume was adjusted to 0°C and 1 atm by the relation PV = RT. Gas was passed into an absorption pipette containing a known volume of solvent. The final volume of gas was measured at the barometric pressure, p_{total}. The final pressure of arsine, p_{AsH_3} was taken to be p_{total} minus the vapor pressure of the pure solvent. The final volume of gas was adjusted from p_{AsH_3} to 1 atm and 0°C. The Bunsen absorption coefficient, α, was the difference between the initial and final adjusted volumes divided by the volume of solvent.

SOURCE AND PURITY OF MATERIALS:

2. Acetone was 'pure' grade. Tetralin, monoethanolamine, and triethanolamine were 'technical' grades.

ESTIMATED ERROR:

REFERENCES:

1. Mellor, J.W. *Comprehensive Treatise on Inorganic & Theoretical Chemistry*, Vol. IX, Longmans, London, 1929.
2. Timmermans, J., *Physico-Chemical Constants of Pure Organic Compounds* Vol. 2, Elsevier, Amsterdam, 1965.

COMPONENTS:

1. Arsine; AsH_3; [7784-42-1]
2. Chlorinated alkanes.

ORIGINAL MEASUREMENTS:

Corriez, P.; Berton, A. *Bull. Soc. Chim. France* 1950, 43-45

VARIABLES:

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

Solvent	T/K	Bunsen coefficient α	Mole fraction* x_{AsH_3} (1 atm)
Dichloromethane; CH_2Cl_2; [75-09-2]	298.2	10.7	0.0300
Trichloromethane, (Chloroform); $CHCl_3$; [67-66-3]	298.2	10.9	0.0379
Tetrachloromethane, (carbon tetrachloride); CCl_4; [56-23-5]	298.2	11.7	0.0485
1,2-Dichloroethane; $C_2H_4Cl_2$; [107-06-2]	298.2	8.8	0.0304
1,1,2,2-Tetrachloroethane; $C_2H_2Cl_4$; [79-34-5]	298.2	9.7	0.0440
1,2-Dichloroethene; $C_2H_2Cl_2$; [540-59-0]	298.2	12.3	0.0404
Trichloroethene; C_2HCl_3; [79-01-6]	298.2	12.5	0.0482
Tetrachloroethene; C_2Cl_4; [127-18-4]	298.2	11.2	0.0490

* Calculated by compiler using the density of arsine given in ref. (1) and the densities of solvents given in refs. (2), (3) and (4).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The initial volume of gas was measured over mercury in a gas burette at the barometric pressure. This volume was adjusted to 0 °C and 1 atm by the relation PV = RT. Gas was passed into an absorption pipette containing a known volume of liquid S. The final volume of gas was measured at the barometric pressure, p_{total}. The final pressure of arsine, p_{AsH_3}, was taken to be p_{total} minus vapor pressure of pure solvent. The final volume of gas was adjusted from p_{AsH_3} to 1 atm and 0 °C. The Bunsen absorption coefficient, α, was the difference between the initial and final adjusted volumes divided by the volume of solvent.

SOURCE AND PURITY OF MATERIALS:

No information given.

REFERENCES:

1. Mellor, J.W., *Comprehensive Treatise on Inorganic & Theoretical Chemistry*, Vol. IX, Longmans, London. 1929.
2. R.R. Dreisbach, *Physical Properties of Chemical Compounds*, A.C.S., Washington. 1959, 1961.
3. *Handbook of Chemistry & Physics* (61st edition), C.R.C. Press, Cleveland, Ohio. 1980.
4. *Lange's Handbook of Chemistry* (12th edition), McGraw-Hill, New York. 1979.