


A11100 995019

NBS
PUBLICATIONS

NAT'L INST. OF STAND & TECH

A11106 222634

NBSIR 81-2356

A Compilation of Thermodynamic and Transport Properties of Aqueous Potassium Hydroxide

June 1981

Issued January 1982

Prepared for:

Department of Energy

DOE Order No. EW 78-X-03-0509-A001.

QC

100

.U56

81-2356

1981

c. 2

FEB 3 1982

not acc R4

QC100

.U56

110.21-0350

1982

U.S.

NBSIR 81-2356

**A COMPILATION OF THERMODYNAMIC
AND TRANSPORT PROPERTIES OF
AQUEOUS POTASSIUM HYDROXIDE**

Rebecca E. Joseph and Bert R. Stables

June 1981

Issued January 1982

Prepared for:
Department of Energy
DOE Order No. EW 78-X-03-0509-A001.



U.S. DEPARTMENT OF COMMERCE, Malcolm Baldrige, *Secretary*
NATIONAL BUREAU OF STANDARDS, Ernest Ambler, *Director*

NATIONAL BUREAU OF STANDARDS

NBS Interim Report 81-XXX

June 1981

A Compilation of Thermodynamic and
Transport Properties of
Aqueous Potassium Hydroxide

by

Rebecca E. Joseph and Bert R. Staples

Prepared for:

Department of Energy

DOE Order No. EW 78-X-03-0509-A001

LBL Subcontract No. 4504510



A COMPILATION OF THERMODYNAMIC AND
TRANSPORT PROPERTIES OF
AQUEOUS POTASSIUM HYDROXIDE

Rebecca E. Joseph

and

Bert R. Staples

Electrolyte Data Center
Chemical Thermodynamics Division
National Measurement Laboratory
National Bureau of Standards
Washington, DC 20234

ABSTRACT

A detailed compilation of sources of data for the thermodynamic and transport properties of aqueous potassium hydroxide is presented. Data for all ranges of temperature, concentration and pressure are included.

Key words: Activity coefficients; aqueous; compilation; conductivity; enthalpy; electrolytes; Gibbs energy; osmotic coefficients; potassium hydroxide; solutions; thermodynamic properties; transport properties.

The purpose of this publication is to identify published sources which contain various types of experimental data for aqueous potassium hydroxide solutions. The principal thermodynamic properties considered herein are calorimetric heat capacity measurements, enthalpy of dilution measurements, enthalpy of solution measurements, vapor pressure measurements, isopiestic measurements, freezing point measurements and electromotive force measurements. There are also some review articles concerning the evaluation of osmotic and activity coefficients, and relative partial molal enthalpies and apparent molal heat capacities of KOH.

The need for reliable thermodynamic data for both the scientific and the industrial communities has increased greatly in recent years. Recently the National Battery Advisory Committee (1) recommended that sulfuric acid and potassium hydroxide data contained in the data base at the National Bureau of Standards be included in the data base at the Lawrence Livermore Laboratory since these data are of interest to the battery industry. This data would be identified by NBS and would be evaluated for its quality. A bibliography on the properties of aqueous sulfuric acid has been prepared(2). The present report deals with KOH electrolytes since KOH is a major constituent in a number of battery systems.

This bibliography has been compiled in support of the project funded by the Division of Energy Storage Systems of the Department of Energy under order number EW 78-X-03-0509-A001. This publication is also a part of the continuing program for the compilation and critical evaluation of thermodynamic properties of electrolytes.

The bibliography was based upon a search of the following:

(1) files of the Chemical Thermodynamic and Electrolyte Data Centers at the National Bureau of Standards; (2) the computerized index to Chemical Abstracts from January of 1969 through January of 1981; (3) appropriate citations given in the papers mentioned above; and (4) two publications of the Electrolyte Data Center: "A Bibliography of Sources Leading to Activity or Osmotic Coefficients for Polyvalent Electrolytes in Aqueous Solution" (3) and "A Bibliography of Sources of Experimental Data Leading to Thermal Properties of Binary Aqueous Electrolyte Solutions" (4).

Titles of each article are provided to indicate the type of data in the article.

The bibliography is listed in alphabetical order by the first author in the Appendix.

REFERENCES

- (1) Memo dated March 19, 1979, D.N. Bennion, Chairman Data and Communication Subcommittee of the National Battery Advisory Committee to the Department of Energy.
- (2) Staples, B.R. and Wobbeking, Theresa F. "A Compilation of Thermodynamic and Transport Properties of Aqueous Sulfuric Acid"; Nat. Bur. Stand. (U.S.) NBS Interim Report 81, U.S. Government Printing Office, Washington, D.C., (1981).
- (3) Goldberg, R.N., Staples, B.R., Nutall, R.L., and Arbuckle, R., "A Bibliography of Sources of Experimental Data Leading to Activity or Osmotic Coefficients for Polyvalent Electrolytes in Aqueous Solutions," Nat. Bur. Stand. (U.S.) Spec. Pub. 485, U.S. Government Printing Office, Washington, D.C., (1977).
- (4) Smith-Magowan, D. and Goldberg, R.N., "A Bibliography of Experimental Data Leading to Thermal Properties of Binary Aqueous Electrolyte Solutions," Nat. Bur. Stand. (U.S.) Spec. Pub. 537, U.S. Government Printing Office, Washington, D.C., (1979).

APPENDIX

Actins, A., Slaidins, G., and Basotskii, V.S., Latv. Gos. Univ. im. Stucki, Risa, USSR

Use of rotating disk electrode with a ring for studying the mechanism of reduction of gamma.-manganese (IV) oxide in a 9 N aq. potassium hydroxide solution.

Ahrland, S. and Kullberg, L., Acta Chem. Scand., 25, 3471-3483 (1971)
Metal Formation II.

Akerlof, G. and Bender, P., J. Am. Chem. Soc., 70, 2366 (1948)
Thermodynamics of aqueous solutions of KOH.

Amirhanian, V., Inst. Phys. Chem., Istanbul Univ., Istanbul, Turk.
Istanbul Univ. Fen Fak. Mecm., Seri C, 63,33(1-4),1-6
Electrical conductivity of strong aqueous solutions of caustic potash.

Angerstein-Kozłowska, H., Conway, B.E., J. Electroanal. Chem. Interfacial Electrochem., 79, 95(1), 1-29
Evaluation of rate constants and reversibility parameters for surface reactions by the potential-sweep method.

Baker, C.T. and Trachtenberg, I.J., J. Electrochem. Soc., 67, 114(10), 1045-6
Conductivity of potassium hydroxide and potassium hydroxide-zinc oxide electrolytes from 36.degree. to -66. degree.

Batrakov, V.V., Nikiforova, Yu, A. and Iofa, Z.A., Elektrokimiya., 70, 6(7), 1017-20
Influence of mechanical and thermal treatment on the adsorption properties of iron in alkaline solutions.

Berthelot, M., Ann. Chim. Phys., [5] 4, 513 (1875f)
Dissolution des acides et des alcalis.

- Berthelot, M., Ann. Chim. Phys., [5] 4, 445 (1875d)
Dissolution des acides et des alcalis.
- Biermann, W.J., Can. J. Chem., 38, 57 (1960)
The relative enthalpies of concentrated potassium hydroxide solutions.
- Boite, H., Z. Physik. Chem., 80, 338-360 (1912)
- Bro, P. and Kang, H.Y., J. Electrochem Soc., 118 1430-1434 (1971)
The low temperature activity of water in concentrated KOH solution.
- Brodskaya, B. Kh., Eiskop, R., Paju, A., Eesti NSV Tead. Akad. Toim.,
Keem., Geol., 68, 17(3), 251-7
Development of pulsed discharges in liquids of good electrical
conductivity.
- Budeka, Yu. F., Grishaeva, G.A., Gurevich, I.G., Vetsi Akad. Navuk
Belarus, SSR, Ser. Fiz.-Tekh. Navuk, 67, (4), 110-12
Viscosity and density of alcoholic solutions of alkalies.
- Burkal'tseva, L.A., Rotenberg, Z.A., and Pshenichnikov, A.G., Inst.
Elektrokhim., Moscow, USSR. Elektrokhimiya, 78, 14(11), 1658-62
Characteristics of the photoemission of electrons at the nickel
electrode aqueous electrolyte solution interface.
- Chow, M., J. Amer. Chem. Soc., 42, 476 (1920)
The free energy of KOH in aqueous sol. and the activities of its ions.
- Ciavetta, L. and Palombar, R., Gazz. Chim. Ital., 102 1098-1108 (1973)
An isothermal jacket calorimeter for enthalpy studies on complex formation.
- Darken, L.S. and Meir, H.F., J. Amer. Chem. Soc., 64, 621-3 (1942)
Conductance of aqueous solutions of the hydroxides of lithium,
sodium, and potassium at 25⁰.
- Davis, R.E., Horvath, G.L. and Tobais, C.W., Electrochim. Acta, 67,
12(3), 287-97
Solubility and diffusion coefficients of oxygen in potassium hydroxide
solutions.
- Dergazarian, T.E. et al, Bull. of Chem. Thermodynamics, No. 3, (1960),
pp.33-34
- De-Wane, H.J. and Hamer, W.J., Nat. Bur. of Stand., Washington D.C.
20234, NASA Contract. Rep., 68, (NASA-CR-97593), 27 pp. Sci. Tech.
Aerosp. Rep., 1969, 7(1), 28
Electrochemical data. IX. Electrolytic conductivity of aqueous solutions
of the alkali metal hydroxides.
- Dirkse, T.P., U.S. Govt. Res. Develop. Rep. 1967, 67(11), 64
Silver oxide electrode processes.

- Dirkse, T.P. and Kroon, D.J., J. Appl. Electrochem., 71, 1(4), 293-6
Effect of ionic strength on the passivation of zinc electrodes in potassium hydroxide solutions.
- Ferguson, A. and Vogel, I., Phil. Mag., 171 4, 300-5 (1927),
Conductance of hydrogen and hydroxyl ions at infinite dilution.
- Fischer, P. and Heitbaum, J., J. Electroanal. Chem. Interfacial Electrochem., 80, 112(2), 231-8
Mechanistic aspects of cathodic oxygen reduction.
- Forcrand, de R., Comptes Rendus, 149 1344(1904).
- Forcrand, de R., Comptes Rendus, 133 158(1901).
- Forcrand, de R., Comptes Rendus, 149 1341(1909).
- Gautron, J., Lemasson, P., Rabaso, F. and Triboulet, R.,
Lab. Phys. Matr. Solide, Univ. Tours, Tours, 32700, Fr. J. Electrochem. Soc., 79, 126(11), 1868-75
Electrochemical behavior of an aq. electrolyte/iodine-doped zinc selenide junction in the dark and under illumination.
- Gawlik, H.Z., Ver. Deut. Ing., 79, 1089 (1935)
Zwillingskalorimeter für kleine Wärmemengen.
- Ginzburg, D.M., Kochkalda, V.E. and Guba, N.I., Russ. J. Phys. Chem. (Eng Trans.), 47, 1214 (1973). Zh. Fiz. Khim. 47, 2145 (1973)
Enthalpies and heat capacities in the potassium hydroxide-water system.
- Gorodetskii, Yu.S., and Cheslov, Yu. F., Issled. Khim. Koord. Soedin. Fiz. Khim. Metod. Anal., 69, 155-7
Polarization of iron electrodes in alkaline solutions using a pulsating current.
- Gorvovrecka, J. and Hlasko, M., Roczniki Chem., 12, 403-15 (415 French) (1932)
The electrolytic conductivity of hydroxides of alkali metals in water and the molality of the OH⁻ ion.
- Grenthe, I., Ots, H. and Ginstrup, O., Acta Chem. Scand., 24, 1067-1080 (1970)
A calorimetric determination of the enthalpy of ionization of water and the enthalpy of protonation of THAM at 5, 20, 25, 35 and 50°C.
- Gucker, F.T. Jr., and Schminke, K.H., J. Am. Chem. Soc., 54, 1358 (1932)
A study of the heat capacity and related thermodynamic properties of aqueous solutions of lithium chloride, hydrochloric acid and potassium hydroxide at 25°C.
- Gunn, S.R., U.S. AEC UCRL Report, 7992(1964)
Note concerning an electrical heater error in the rocking-bomb solution calorimeters.

Gusarov, A.V. and Goroklov, L.V., Zh. Fiz. Khim., 42 860(1968)
Mass spectrometric study of the evaporation of potassium hydroxide.

Hamann, Sefton D. and Linton, M., Div. Appl. Chem., CSIRO., R.O.,
Melbourne, Aust. Trans. Faraday Soc., 69, 65(8), 2186-96
Electrical conductivities of aqueous sol. of KCl, KOH, and HCl,
and the ionization of water at high stock.

Harned, H.S. and Cook, M.A., J. Am. Chem. Soc., 59, 495 (1937a)
The thermodynamics of aqueous potassium hydroxide.

Heitbaum, J. and Gonzales-Velasco, J., J. Electroanal. Chem.
Interfacial Electrochem., 75, 63(1), 23-30
Measurement of the diffusion coefficient of the formate anion in
strong alkaline electrolytes using a rotating palladium disk
electrode.

Hertz, H.G., Ber. Bunsenges. Phys. Chem., 80, 84(7), 622-9
A new estimate of the hydrogen ion concentration in pure water.
Part 2. Numerical results and a new interpretation of the limiting
equivalent conductance of hydrogen chloride.

Hildenbrand, D.L., Hatton, W.E. and Stull, D.R., Bull. of Chem.
Thermodynamics No. 2, 1959, pp. 44-45

Hlasko, M. and Salitorvna, A., Roczniki Chem., 15, 153-62 (1935)
Electrolytic conductivity of alkali hydroxides in very dilute solutions.

Hlasko, M. and Salitorona, A., Roczniki Chem., 14, 1038-51 (1934)
Direct determination of the limiting conductivity of strong electrolytes
and the conductivity of very dilute weak electrolytes.

Horne, R.A., Bannon, W.J., Sullivan, E. and Frysinge, G.R., J. Elec-
trochem. Soc., 110(12), 1282-3(1963)
Effect of pressure on the conductivity of battery electrolytes.

Jarrousseau, J.C. and Valensi, G., Thermodyn. Chim. Electrochem.
Fac. Sci., Poitiers, Fr. J. Chim. Phys. Physicochim. Biol., 69, (Oct.)
(num. Spec.), 33-42
Transport processes in concentrated aqueous potassium hydroxides solutions.

Jeffery, G.H. and Vogel, A.I., Phil. Mag., 15, 395-408 (1933)
Electrical conductivity of aqueous solutions of sodium and potassium
hydroxides and the limiting mobility of the hydroxide ion at 25C.

Jeffery, G.H. and Vogel, A.I., Phil. Mag., 16, 64-5 (1933)
Electrical conductivities of aqueous solutions of sodium and potassium
hydroxides at 25C and the validity of the "water correction".

Jeffery, G.H. and Vogel, A.I., Phil. Mag., 17, 582-4 (1934)
Revised figures for the electrical conductivity of aqueous solutions of sodium and potassium hydroxides and the limiting mobility of the hydroxyl ion at 25C.

Joannes, M.A., Ann. Chem. Physic., 12 358(1887)
Sur les alliages du potassium et du sodium.

Joseph, O., J. Univ. Bombay, Sect. A, 20, Pt.3 (Science No. 30), 39-42(1951)
Electrical conductivities of solution containing aluminum hydroxide and sodium and potassium hydroxide.

Juliao, J.F., Decker, F., Brenzikofer, R. and Abramovich, M., Inst. Fis., UNICAMP, Campinas, Brazil, J. Electrochem. Soc., 80, 127(9) 2067-2071
Anomalous behavior in I-V character curves of n-titanium dioxide and n-strontium titanate electrodes in aqueous solution.

Kangro, W.O. and Groneveld, A., Z. Phys. Chem. (Frankfurt am Main), 32, 110 (1962)
Konzentrierte wabrige losungen, I.

Kertesz, D., de Korosy, F. and Zeiserson, E., Desalination, 67, 2(2), 161-9
Advances in the electrochemistry of permselective membrane.

Ketchen, E.E. and Wallace, W.E., J. Amer. Chem. Soc., 76 4736(1954)
Heats of reaction of sodium and potassium hydroxides and the standard heats of formation of aqueous sodium and potassium hydroxides at 25C.

Kirppatnick, W.S., Sutherland, B.P. and Wight, C.H., Trans. Electrochem. Soc., 63, 9 (1932)33
Electrolytes for hydrogen-oxygen cells.

Klochko, M.A. and Godneva, M.M., Zh. Neorg. khim., 4, 2127-35 (1959)
Electric conductivity and viscosity of aqueous solutions of sodium and potassium hydroxides.

Klochko, M.A. and Godneva, M.M., Zh. Neorg. Khim., 4, 2136-42 (1959)
Electric conductivity and viscosity in the region of the transition from a fusion of sodium and potassium hydroxides to their aqueous solutions.

Klochko, M.A. and Godneva, M.M., J. Inorganic Chem., IV, 21 27 (1959)
Conductivity of KOH solutions.

Korotkov, P.M. and Sokolov, N.K., J. Gen. Chem. USSR., 3, 670-8 (1933)
Conductivities of NaOH and KOH solutions at elevated temperatures.

- Korovin, N.V., Fillippov, E.L. and Tanicheva, E.I., *Elektokhimiya*, 74 10(10) 1590-4
Ion exchange membranes in electrochemical systems with alkaline electrolyte. I. Conductivity of ion exchange membranes in potassium hydroxide solutions.
- Krutilova, L.E., Maksimova, I.N., Razuvaev, V.E. and Shcherba, M.U., *Ukr. Khim. Zh. (Russ. Ed.)*, 76, 42(9), 925-8
Electric conductivity of solutions of alkali metal hydroxides at low and intermediate temperatures.
- Krutilova, L.E., Maksimova, I.N. and Shcherba, M.U. *USSR Zh. Prikl. Khim. (Leningrad)*, 77, 50(6), 1430
Application of a comparative analysis method to ternary alkaline systems.
- Kuczkowski, R.L., Lide, D.R. and Krusher, L.C., *J. Chem. Physics*, 44 (8) 3132(1966)
Microwave spectra of alkali hydroxides: evidence of linearity of CsOH and KOH.
- LeRoy, R.L., Janjua, M.B.I., Renauld, R. and Levenberger, Zu., *J. Electrochem. Soc.*, 79, 126(10), 1674-82
Analysis of time-variation effects in water electrolyzers.
- Lown, D.A., and Thirsk, Harold R., *Phys. Chem., Univ. Newcastle-upon-Tyne, Newcastle-upon-Tyne, Engl. Trans. Faraday Soc.*, 71, 67(1), 132-48
Proton transfer conductance in aqueous solution. 1. Conductance of concentrated aqueous alkali metal hydroxide solution at elevated temperatures and pressures.
- Lukashov, Yu. M., Komissarov, K.B., Golubev, B.P., Smirnov, S.V. and Svistunov, E.P. *Teploenergetika (Moscow)*, 75 (12), 78-81
Electrolytic properties of mono-monovalent electrolytes at high parameters of state.
- Lukashov, Yu. M., and Ripol-Saragosi, F.B., Rostov, *Inzh.-Stroit. Inst. Rostov, USSR Deposited Doc.*, 76, (VINITI 1833-76), 19 pp.
Electric conductivity of salts, acids, and bases at high parameters of state.
- Lux, H. and Brandl, F., *Zanorg. ALLGEM Chem.*, 326 25-30(1963)
Die dampfdruckkurve der gesättigten lösungen in den systemen NaOH-H₂O and KOH-H₂O.
- Magie, W.F., *Phys. Rev.*, 25, 171 (1907)
Specific heat of solutions.

Maksimova, I.N. and Sergeev, S.V., USSR. Zh. Prikl. Khim. (Leningrad), 74 47(7), 1666-8

Equations for determining the density, viscosity, and electric conductivity of potassium hydroxide solutions from -60 to +60°C.

Malachesky, P.A., Jasinski, R.J. and Burrows, B., J. Electrochem. Soc., 67, 114(11), 1104-7

Impurity effects in the pre-electrolysis of caustic electrolytes.

Malandin O.G. and Chernykh, Yu. N., Elektrokimiya, 67, 3(9), 1049-55, Behavior of a nickel oxide electrode in anodic polarization and self-discharge.

Mansfield, F. and Gilman, S., J. Electrochem. Soc., 70, 117(10), 1328-33 Effect of several electrode and electrolyte additives on the corrosion and polarization behavior of the alkaline zinc electrode.

Manvelyan, M.G., Krmoyan, T.V., Eganyan, A.G. and Kocharyan, A.M., Izvest. Akad. Nauk Armyan. SSR., Ser. Fiz.-Mat. Estestven i Tekh. Nauk B, No 4, 73-8 (1955)

The conductivity of concentrated solutions of NOH and KOH, their carbonates and mixtures of NaOH and KOH at 25C.

Marshall, A., Hampson, N.A., Saunders, M.P. and Drury, J.S., J. Electroanal. Chem. Interfacial Electrochem., 78, 307-311 (1977)

The electrode behavior of zinc in ternary alkaline electrolytes stabilized by silicate.

Marshall, P.R. and Katz, J.J., Inorg. and Nuclear Chem., 36, 1589-1594 (1974)

Activity coefficients of 1-1 electrolytes in heavy water ($^2\text{H}_2\text{O}$)*.

Mashovets, V.P., Krungal's, B.S., Dibrov, I.A., and Metveeva, R.P., Zh. Prikl. Khim. (Leningrad) 38, 2342 (1965), J. Appl. Chem. USSR (Eng Trans.) 38, 2294 (1965)

Vapour pressure of KOH solutions up to 400° and the activity of water in LiOH, NaOH, and KOH solutions over a wide range of concentrations.

Matarev, V.N., Bychkovskii, S.K., Yuppets, F.R. and Klevtsov, S.A. Elektrokimiya, 80, 16(9), 1385-9

Flow of liquid in a porous layer during occurrence of an electrochemical reaction.

May, C.E., Sci. Tech. Aerosp. Rep. 1978, 16(10), Abstr. No. N78-19648-19648 Determination of the zincate diffusion coefficient and its application to alkaline battery problems.

Mehta, S.M., Kabadi, M.B., and Sheth, V.T., Current Science, 15, 129 (1946) The electrical conductivity of concentrated solutions of sodium and potassium hydroxides.

Mehta, S.M. and Kabadi, M.B., J. Univ. Bombay, Sec A, 18, 39-44 (1949) The electrical conductivity of solutions containing $\text{Zn}(\text{OH})_2$ and KOH.

Messer, C.E., Fasolino, C.E. and Thalmayer, C.E., J. Am. Soc., 777
4524(1955)

The heats of formation of lithium, sodium and potassium hydroxides.

Nesterov, B.P., Alashkin, V.M., Tverdokhlebov, E.S., Beletskii, M.S. and
Zastavskaya, S.A., USSR. Tr. Mosk. Energ. Inst., 78, 365, 16-21

Study of electrochemical current sources with an alkali electrolyte.
Electric conductivity of a carbonated potassium hydroxide solution.

Okuyama, M., Oyama Kogyo Koto Senmon Gakko Kenkyu Kiyo, 80, 12, 118-26

Effect of repeated cathodic polarization on metallic hydrogen
electrodes.

Oshe, A.I., Kulyavik, Ya. Ya, Popova, T.I. and Kabanov, B.N. Elektro-
khimiya 66, 2(12), 1485-7

Use of the rotating-disk electrode with a ring in the investigation
of the passivation mechanism of metals.

Palfalvi-Rozsahegyi, M., Buvari, A., Bacza, S. and Szabo, Z.G.,
Acta Chim. Acad. Sci. Hung., 79, 102(4), 401-12

Conductivity of rather concentrated electrolyte solutions at constant
cation (anion) concentration - the applicability of conductometry in
coordination chemistry.

Past, V. and Hasa, M., Elektrokhimiya, 69, 5(3), 319-23

Cathodic liberation of hydrogen on antimony in an alkaline medium.

Peller, J., Listy Cukrovan 49,346-52 (1931).

The influence of sucrose on the conductivity of electrolytes.

Philipp, W.H. and Hsu, L., Sci. Tech. Aerosp. Rep. 1979, 17(12),
Abstr. No. N79-21128

Three methods for in situ crosslinking of poly(vinyl alcohol) films for
application as ion-conducting membranes in potassium hydroxide
electrolyte.

Pratt, F.R., J. Franklin Inst. 185, 663 (1918)

Heats of dilution and their variation with temperature.

Pshenichnikov, A.G., Kryukov, Yu.I. and Burshtein, R.Kh., Elektrokhimiya,
71, 7(10), 1532-5

Oxidation of hydrogen on a hydrophobic platinum electrode in a potassium
hydroxide solution.

Puchkov, L.V., Baranova, T.A., and Lapidus, M.E., J. Appl Chem., USSR (Eng trans.) 43, 463 (1970). Zh. Prikl. Khim (Leningrad) 43, 455 (1970) Specific heats of aqueous KOH solutions at temperatures up to 400K.

Randall, M. and Scallione, C.C., J. Am. Chem. Soc., 49, 1486-92 (1927) The conductance of dilute aqueous solutions of the alkali hydroxides at 25.

Ratiani, N.P., Kakhdze, A.E., Michri, A.A. and Pshenichnikov, A.G., Elektrokimiya, 75, 11(9), 1387-9 Ethylene hydrogenation at a nickel electrode. I. Determination of the surface coverage of a nickel electrode by hydrogen.

Razuvaev, V.E., Krutilova, L.E. and Maksimova, I.N., Elektrokimiya, 76, 12(8), 1343

Study of the electric conductivity of the cesium hydroxide-potassium hydroxide-water ternary system at -60 to +95 degree C.

Razuvaev, V.E., Nikol'skii, V.A., Maksimova, I.N., Leskii, I.N., Krutilova, L.E. and Andreeva, G.P., Sb. Rabot po Khim. Istochnikam Toka. Vses. N.-i. Proekt.-konstrukt. i Tekhnol. Akkumulyator. In-t, 76, (11), 189-91. Ref. Zh. Khim. 1977, Abstr. No. 8L232

Study of electrical conductivity of a cesium hydroxide-potassium hydroxide water ternary system at low temperatures.

Razuvaev, V.E., Maksimova, I.N. and Krutilova, L.E. USSR Elektrokimiya, 76, 12(11), 1772

Study of the electric conductivity of the rubidium hydroxide-potassium hydroxide-water ternary system at -60 to +95. degree.

Renegade, E., Comptes Rendus, 146 129(1908).

Renegade, E., Comptes Rendus, 14 546(1908).

Reshetnikov, N.D., Zh. Neorg. Khim, 6 #3 682-686(1961).

Richards, T.W. and Rowe, A.W., Proc. Am. Acad. Arts Sci., 49, 173 (1913a) An improved method for determining the specific heats of liquids with data concerning dilute hydrochloric, hydrobromic, hydroiodic, nitric and perchloric acids, and lithium, sodium and potassium hydroxides.

Richards, T.W. and Hall, L.P., J. Am. Chem. Soc. 51, 707 (1929a) Specific heats of sodium and potassium hydroxide solutions.

- Richards, T.W. and Rowe, A.W., J. Am. Chem. Soc., 43, 770 (1921)
The heats of dilution and the specific heats of dilute solutions of nitric acid and of hydroxides and chlorides and nitrates of lithium, sodium, potassium and cesium.
- Richards, T.W. and Rowe, A.W., J. Amer. Chem. Soc., 44 684(1922)
The heats of neutralization of potassium, sodium and lithium hydroxides with HCl, HBr, HI, and HNO₃ various dilutions.
- Rossini, F.D., J. Res. Nat. Bur. Stand. 6, 791 (1931a)
Heat content values for aqueous solutions of the chlorides, nitrates, and hydroxides of hydrogen, lithium, sodium and potassium at 18C.
- Rossini, F.D., J. Res. Nat. Bur. Stand. 6, 791 (1931a)
Apparent and partial molal heat capacities in aqueous solutions of 19 uni-univalent strong electrolytes.
- Sabatier, P. Comptes Rendus, 89 234-236 (1879)
Etude thermochemique des sulfures alcalis dissous.
- Sabatier, A., Ann. Chim. Phys., 22, Ser. 5 5(1881)
Les sulfures.
- Sand, M.L. Report, 75, (LBL-3589,), 222pp. ERDA Res. Abstr. 1976, 1(2), Abstr. NO. 1390
Light interference in electrolyte films on metals.
- Scathard, G., J. Amer. Chem. Soc., 47 648 (1925)
A review of the activity coefficients of potassium, hydroxide, sodium, and lithium chloride and potassium hydroxide.
- Schoonmaker, R.C. and Porter, R.F., J. Chem. Phys., 3 830 (1959)
Mass spectrometric study of alkali hydroxide vapor.
- Shabanova, N.S., Sogolmonyants, Zh. S. and Dmitreva, S.I. Kolloid. Zh., 72, 34(6), 972-6
Effect of surfactants on the electrical conductivity of a microporous Kapron membrane in a strong alkaline medium.
- Shepelin, V.A., Zalkind, Ts.I. and Veselovskii, V.I. Elektrokimiya, 68, 4(2), 138-43
Kinetics of the combined ionization of hydrogen mixtures on the platinum electrode.
- Shepelin, V.A., Elektrokimiya, 67, 3(8), 1004-7
Formation of an electrolyte film on a partially immersed platinum electrode.

- Shibata, F.L.E., Oda, S. and Furukaw, S., J. Sci. Hiroshima Umu, A1 85(1932)
Vaporization of solution of KOH saturated at 25C.
- Shibata F.L.E. and Murata, F., Nippon Kogaku Zasshi, 52 645-50(1931).
- Singh, P.P., Wooley, E.M., McCurdy, K.G. and Hepler, L.G., Can. J. Chem. 54, 3315(1976)
Heat capacities of aqueous electrolytes: eight 1:1 electrolytes and the change in C_p for ionization of water 298K.
- Sinha, M. and Bennion, D.N., J. Electrochem. Soc., 78, 125(4), 556-61
Transport parameters for potassium hydroxide-water solution in a cation exchange membrane.
- Siverty, V., Rectimer, R.E. and Tartar, H.V., J. Am. Chem. Soc., 62, 1379-82 (1940)
The ionization constant of monoethanolammonium hydroxide from electrical conductance measurements at 25C.
- Slaidins, G., Cakste, J. and Bagotskii, V.S. Latv. PSR Zinat. Akad. Vestis, Kim. Ser., 76, (2), 172-7
Potentiostatic and potentiodynamic investigations of the performance of suspension electrodes.
- Slaidins, G., Alksnis, U., Kibare, S. and Lukovtsev, P.D. Ref. Zh. Khim., 1971, Abstr. No. 11B1220
Capacitance of an iron electrode in potassium hydroxide solutions.
- Sokol'skii, D.V., Zhubanov, K.Z., Krupenya, N.G. and Shalabaev, M.Sh. Elektrokimiya, 75, 11(3), 477-9
Electrical conductivity of Group VIII metal catalysts at high pressures.
- Susimoto, K. and Belanger, G., Piron, D.L., J. Electrochem. Soc., 79, 126(4) 535-41
Changes in the niobium electrode surface induced by strong cathodic polarization.
- Than, M.K., Gubbins, K.E. and Walker, R.D. Jr., J. Chem Eng. Data 12, (4) 525-6 (1967)
Densities of potassium hydroxide solutions.
- Thomsen, J., Thermochemische Untersuchungen Band III, J.A. Barth Verlag, Leipzig, (1883b)
Experimentelle untersuchungen uber die warmetonung bei der verdunnung wassriger losungen.
- Thomsen, J., Thermochemische Untersuchungen Band I, J.A. Barth Verlag, Leipzig, (1883a)
Ueber die spezifische warme wassriger losungen.

- Tomassi, W. and Wisniewski, L., *Biul. Wojsk. Akad. Tech.*, 73, 22(11), 121-6
Negative electrode of a metal-oxygen cell. II. Corrosion of two- and three-component electrodes.
- Troshin, V.P. and Zvyagina, E.V., *Fiz.-Tekh. Inst. im. Ioffe, Leningrad, USSR Dokl. Akad. Nauk SSSR*, 74, 218(6), 1397-9 (Phys Chem)
True protein transport numbers in aqueous solutions of alkali metal acids and hydroxides.
- Vedeneev, A.V. and Skuratov, S.M., *Zhin. Fiz. Khim.*, 25 837(1951)
- Verser, B. and Demange, P., *Ger. Offen.*, 781012, Patent No.: 2813408
Applic. No.: 77710208 Date: 770405
Electrolytic device.
- Vilche, J.R. and Arvia, A.J., *Passivity Met., Proc. Int. Symp.*, 4th, 78, 861-77 Publ: Electrochem. Soc.,
Kinetics and mechanism of the nickel electrode in acid and alkaline media.
- Vogel, W.M., Routsis, K.J., Kehner, V.J., Landsman, D.A. and Tschinkel, J.G., *J. Chem Eng. Data* 12 (4) 465-72 (1967)
Some physiochemical properties of the KOH-H₂O system. Range 55-85% and 120 to 250C.
- Vol'fkovich, Yu. M. and Sosenkin, V.E., *Dokl. Akad. Nauk SSSR*, 77, 236(3), 653-656 (Phys. Chem.)
Effect of electrochemical reactions on electrolyte diffusion coefficients.
- Voskresenskaya, A., *Secteur Anal. Phys. Chim. Inst. Chim-gen (USSR)* 10 259 (1938).
- Vsanovich, M.I. and Sushkevich, T.I., *J. Applied Chem.* 24, 590-2 (1951)
Electrical conductivity and viscosity in the system KOH-K₂CO₃-H₂O.
- Vsanovich, M.I. and Sushkevich, T.I., *Zhur. Prikl. Khim.*, 24, 590 (1951)
Conductivity and viscosity of aqueous KOH and K₂CO₃.
- Wilson, R.H., *Res. Dev. Cent., Gen. Electr. Co., Schenectady, NY*, 12301, U.S.A. *J. Electrochem. Soc.*, 80, 127(1), 228-34
Observation and analysis of surface states on titanium dioxide electrodes in aqueous electrolytes.
- Yushkevich, V. Yu., Bullan, V.A. and Maksimova, I.N., *Elektrokhimaya*, 3(12) 1491-3 (1967) *Soviet Electrochemistry* 3 (12) (1967) *Eng. Trans.*
Electrical conductivity of potassium hydroxide solution at high temperatures.

U.S. DEPT. OF COMM. BIBLIOGRAPHIC DATA SHEET <i>(See instructions)</i>	1. PUBLICATION OR REPORT NO. NBSIR 81-2356	2. Performing Organ. Report No.	3. Publication Date January 1982
4. TITLE AND SUBTITLE A Compilation of Thermodynamic and Transport Properties of Aqueous Potassium Hydroxide			
5. AUTHOR(S) Rebecca E. Joseph and Bert R. Staples			
6. PERFORMING ORGANIZATION <i>(If joint or other than NBS, see instructions)</i> NATIONAL BUREAU OF STANDARDS DEPARTMENT OF COMMERCE WASHINGTON, D.C. 20234		7. Contract/Grant No. EW 78-X-03-0509-A001	8. Type of Report & Period Covered Interim 81-XXX
9. SPONSORING ORGANIZATION NAME AND COMPLETE ADDRESS <i>(Street, City, State, ZIP)</i> Department of Energy Lawrence Berkeley Laboratory University of California Berkeley, California 94720			
10. SUPPLEMENTARY NOTES <input type="checkbox"/> Document describes a computer program; SF-185, FIPS Software Summary, is attached.			
11. ABSTRACT <i>(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)</i> A detailed compilation of sources of data for the thermodynamic and transport properties of aqueous potassium hydroxides are presented. All ranges of temperature, concentration, and pressure are included.			
12. KEY WORDS <i>(Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)</i> activity coefficients; aqueous; compilation; conductivity; enthalpy; electrolytes; Gibbs energy; osmotic coefficients; potassium hydroxide; solutions; thermodynamic properties; transport properties.			
13. AVAILABILITY <input checked="" type="checkbox"/> Unlimited <input type="checkbox"/> For Official Distribution. Do Not Release to NTIS <input type="checkbox"/> Order From Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. <input checked="" type="checkbox"/> Order From National Technical Information Service (NTIS), Springfield, VA. 22161		14. NO. OF PRINTED PAGES 17 15. Price \$6.00	



