COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Molten and Solid Salt Systems	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA 1986, June

CRITICAL EVALUATION:

The Solubility of Mercury in Some Molten and Solid Salt Systems.

There are several papers reporting the solubility of metallic mercury in molten salts. Most, if not all, of these systems involves a chemical reaction. Also included in this section is a paper on emulsification of mercury by freshly precipitated oxides and a paper on the retrograde solubility of mercury in solid mercury telluride. There are no confirming data for any of the systems. All of the data are classed tentative. The individual systems are discussed below.

Mercury + Sodium chloride; [7647-14-5] + Aluminum chloride; [7446-70-0]

Plotnikov and Fortunatov (ref. 1) report the solubility of mercury in a melt of 0.680 mole fraction sodium chloride. The mercury solubility increases from 0.065 weight percent at 491 K to 1.521 weight percent at 623 K. The authors state that the solubility of mercury obeys Henry's law and there is no chemical reaction between mercury and the molten salt components. In view of the reactions in other mercury + molten salt systems the last statement is of doubtful validity.

Mercury + Iron; [7439-89-6] + Iron (II) sulfide; [1317-37-9]

Vogel (ref. 2) studied 24 elements as additives to the Fe + FeS system. The paper contains a small scale figure of the Hg-Fe-S system at an undefined high temperature. He implies the reaction Hg + FeS = Fe + HgS takes place and the equilibrium lies well to the left. There are no quantitative data for the system. No data sheet was prepared.

Mercury + Mercury (II) chloride; [7487-94-7]

Yosim and Mayer (ref. 3) report the solubility of mercury in mercury (II) chloride by a freezing point depression method. The mercury solubility increases from 0 to 0.0485 mole fraction as the temperature decreases from 552.65 K (the mp of pure $HgCl_2$) to 545.61 K. The authors present evidence that the reaction

$$Hg + HgCl_2 = Hg_2Cl_2$$

takes place, and that the dissolved species in not mono-atomic Hg, but the disproportionation product Hg_2Cl_2.

Mercury + Lithium chloride; [7447-41-8] + Potassium chloride; [7447-40-7]

Delmaskii *et al.* (ref. 4) report a mercury solubility of 0.113 mass percent at 673 K in the eutectic salt mixture of 0.583 mole fraction LiCl. The dissolution of mercury is accompanied by the reaction

$$2\ Hg + 2\ LiCl = Hg_2Cl_2 + 2\ Li$$

Mercury + Lead (IV) oxide; [1309-60-0]
Mercury + Mercury (II) oxide; [21908-53-2]

Pichugina (ref. 5) reports that active PbO_2 and HgO precipitates are good emulsifiers for metallic mercury. No data sheet was prepared.

Mercury + Mercury telluride; [12068-90-5]

Levitskaya *et al.* (ref. 6) studied solid HgTe between 477 and 873 K

in the presence of excess Hg and Te. The systems has a retrograde solidus curve. At the mercury boundry, mercury is soluble in HgTe between 553 and 673 K. The maximum solubility of mercury in HgTe is 1.7×10^{-5} percent at 626.7 K.

REFERENCES:

1. Plotnikov, V. A.; Fortunatov, N. S. *Mem. Inst. Chem., Ukr. Acad. Sci.* 1936, *3*, 123.

2. Vogel, R. *Chalmers teka Hogskolas Handl.* 1943, No. 18, 24 pp.

3. Yosim, S. J.; Mayer, S. W. *J. Phys. Chem.* 1960, *64*, 909; *USAEC Report* 1960, NAA-SR-5094.

4. Delimarskii, Yu. K.; Tumanova, N. Kh.; Prikhod'ko, M. U. *Zh. Neorg. Khim.* 1971, *16*, 559; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1971, *16*, 298.

5. Pichugina, A. *Acta Univ. Voronegienis* 1935, *8(2)*, 18 - 20; *Chem. Abstr.* 1938, *32*, 5680.

6. Levitskaya, T. D.; Vanyukov, A. V.; Krestovikov, A. N.; Bykharov, I. M. *Izv. Akad. Nauk SSSR, Neorg. Mater.* 1970, *6(5)*, 849; *Inorg. Mater. (Engl. Transl.)* 1970, *6*, 747.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6]; (2) Sodium chloride; NaCl; [7647-14-5] (3) Aluminum chloride; $AlCl_3$; [7446-70-0]	Plotnikov, V. A.; Fortunatov, N. S. *Mem. Inst. Chem., Ukr. Acad. Sci.* 1936, *3*, 123 - 8.
VARIABLES: T/K = 491.15 - 623.15 solvent, NaCl, x_2 = 0.680	PREPARED BY: H. L. Clever M. Iwamoto

EXPERIMENTAL VALUES:

Temperature t/°C	Temperature T/K[a]	Mercury Weight Percent
218	491.15	0.066
		0.066
		0.064
		0.065 avg.
223	496.15	0.074
		0.078
		0.076
		0.076 avg.
268	541.15	0.880 [sic.]
302	575.15	0.559
		0.560
		0.561
		0.560 avg.
307	580.15	0.560
350	623.15	1.521

[a]Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The solubility of mercury was determined in a NaCl + $AlCl_3$ melt which was 48.3 wt % NaCl, and 51.7 wt % $AlCl_3$. This corresponds to a mole fraction of 0.680 NaCl. The authors state the solubility of mercury obeys Henry's law and there is no chemical reaction between the Hg and solvent.	ESTIMATED ERROR: REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Lithium chloride; LiCl; [7447-41-8] (3) Potassium chloride; KCl; [7447-40-7]	Delimarskii, Yu. K.; Tumanova, N. Kh.; Prikhod'ko, M. U. *Zh. Neorg. Khim.* 1971, *16*, 559 - 60. *Russ. J. Inorg. Chem.* (Eng. Trans.) 1971, *16*, 298 - 9.
VARIABLES: T/K = 673.15	PREPARED BY: H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Potassium chloride Mole fraction	Mercury as Hg_2Cl_2	Mercury as Hg Mole fraction
t/°C	T/K	x_3	mass %	$10^4 x_1$
400	673.15	0.417	0.113	2.8

The system is liquid mercury in equilibrium with the LiCl + KCl eutectic mixture at 673.15 K. The dissolution of the mercury in the LiCl + KCl is accompanied by the reaction:

$$2Hg + 2LiCl = Hg_2Cl_2 + 2Li.$$

The mass % Hg_2Cl_2 was read from a small graph in the paper. The value with respect to mercury was given in the paper. From the 2.8 x 10^{-4} mole fraction value, we calculated a Hg_2Cl_2 mass % of 0.118, which is five percent larger than the graph value. The authors did not state the LiCl + KCl eutectic composition. The eutectic mixture is 0.417 mole fraction KCl and 0.583 mole fraction LiCl (ref. 1 - 3).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The mercury and the LiCl + KCl salt eutectic were added to a special cell. The system was heated at 2 deg min^{-1} to a temperature of (400 ± 5)°C. The system was maintained at the temperature for 3 hours, with periodic agitation. The solubility experiment was carried out in a atmosphere of argon and also under vacuum conditions.

The saturated solution was analyzed by polarography with solid platinum wires as electrodes. The mercury ion was reduced in a single wave with n = 1. A calibration wave was prepared using known amounts of Hg_2Cl_2.

SOURCE AND PURITY OF MATERIALS:

No information on the source or purity of the compounds.

ESTIMATED ERROR:

δT/K = ±5
$\delta x_1/x_1$ = ±0.05 (compiler)

REFERENCES:

1. Keitel, H.
Kali 1923, *17*, 248, 261.
2. Richards, T. W.; Meldrum, W. B.
J. Am. Chem. Soc. 1917, *39*, 1816 - 28.
3. Elchardus, E.; Laffitte, P.
Bull. Soc. Chim. France 1932 *51*, 1572 - 9.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6]; (2) Mercury(II) chloride; $HgCl_2$; [7487-94-7]	Yosim, S. J.; Mayer, S. W. *J. Phys. Chem.* 1960, *64*, 909 - 11. USAEC Report 1960, NAA-SR-5094, 9 pp.
VARIABLES: T/K = 545.61 - 551.60	PREPARED BY: H. L. Clever

EXPERIMENTAL VALUES:

Temperature $t/°C$[a]	Temperature T/K[a]	Freezing Point Depression $\Delta T_f/K$	Mole Fraction $10^2 x_1$
272.4_6	545.6_1	7.04	4.85
273.1_6	546.3_1	6.34	4.27
274.4_6	547.6_1	5.04	3.16
276.1_9	549.3_4	3.31	2.15
277.7_7	550.9_2	1.73	1.09
278.4_5	551.6_0	1.05	0.69
279.5[b]	552.6_5	0	0

[a]Calculated by compiler.
[b]Melting point of pure $HgCl_2$.

The authors present evidence that the dissolved species is not monoatomic Hg, but the disproportionation product Hg_2Cl_2.

$$Hg + HgCl_2 \rightarrow Hg_2Cl_2.$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Freezing point depression method. The salt and mercury were sealed in a 18 mm Pyrex or Vycor tube which had a thin-walled thermocouple well sealed in the bottem of the tube. Temperatures were measured with a calibrated chromel-alumel thermocouple. The samples were heated in a furnace automatically controlled by a regulator-pyrometer operating through a variable transformer.	(1) Mercury. Source not given; triple distilled. (2) Mercury(II) chloride. Source not given. Reagent grade; dried under a vacuum at 110°C for 24 hours.
The paper contains data on the Hg + $HgCl_2$ system over the entire composition range and temperatures up to 825 K.	ESTIMATED ERROR: $\delta x_1 = \pm 0.0005$ (compiler)
The AEC Report is identical to the published paper.	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Mercury telluride; HgTe [12068-90-5]	Levitskaya, T. D.; Vanyukov, A. V.; Krestovnikov, A. N.;Bykharov, I. M. *Izv. Akad. Nauk SSSR, Neorg. Mater.* 1970, *6(5)*, 849 - 54; *Inorg. Mater. (Engl. Transl.)* 1970, *6(5)*, 747 - 51.
VARIABLES:	PREPARED BY:
T/K = 553 - 653	H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Type of	Mercury Boundry	
t/°C	T/K	Excess	c/atom cm^{-3}	Excess Component, atom %
204	477	p	~8 x 10^{15}	~1.4 x 10^{-5} (Te)
300	573	n	3 x 10^{15}	5.1 x 10^{-6} (Hg)
353.5	626.7	n	9.9 x 10^{15}	1.68 x 10^{-5} (Hg)
400	673	p	(0.8 - 1.9) x 10^{16}	(1.4 - 3) x 10^{-5} (Te)
451	724	p	~3 x 10^{16}	~5 x 10^{-5} (Te)
505	778	p	2.3 x 10^{18}	3.9 x 10^{-3} (Te)
600	873	p	-	-

The system has a retrograde solidus curve. Mercury is soluble in the mercury telluride only between 553 and 653 K. The maximum solubility of Hg in HgTe is 1.7 x 10^{-5} atom percent.

Data for the tellurium boundy are also in the paper. At that boundry the maximum solubility of tellurium is 1.9 x 10^{-2} atom %.

The melting point maximum is displaced from the stoichiometric composition toward tellurium.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
	ESTIMATED ERROR:
	REFERENCES: