

COMPONENTS: (1) Cobalt; Co; [7440-48-4] (2) Mercury; Hg; [7439-97-6]	EVALUATOR: C. Guminski; Z. Galus Department of Chemistry University of Warsaw Warsaw, Poland July, 1985
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CRITICAL EVALUATION:

The solubility of cobalt near room temperature is very low, and there are no reliable experimental determinations in this range; only the highest limit of the solubility based on the sensitivity of the analytical method has been reported. For example, Irvin and Russell (1) reported that the solubility is below 3×10^{-4} at % at 293 K, while Strachan and Harris (2) reported the solubility to be below 9×10^{-3} at % at room temperature, and deWet and Haul (3) reported that the solubility is below 3×10^{-6} at % at 303 K. Jangg and Palman (4) determined the solubility at 773 and 823 K and they extrapolated the two experimental points to 293 K to obtain a solubility of 2.4×10^{-7} at % at the latter temperature. However, this extrapolation is most likely erroneous because the temperature dependence of the solubility at high temperatures, reported by Weeks and coworkers (5-7), shows a steeper slope than the two measured points of Jangg and Palman. More recently, Speranskaya and Panina (8) reported that the solubility of cobalt at 363 K should be much lower than 10^{-5} at %, while Babkin and Omarova (9) reported that cobalt is insoluble in mercury at room temperature.

Kozin's (10) predicted solubility of 1.8×10^{-4} at % at 298 K is too high. Tammann and coworkers (11, 12) reported solubilities of 0.56 and 0.21 at % at 290 K and room temperature, respectively, while Nagaoka (13) reported a solubility of 1.7 at % at room temperature; the values reported by these authors are clearly too high and are rejected. The high values by the latter authors could be the result of the tendency for cobalt to form supersaturated amalgams.

At high temperatures, Weeks and coworkers (5-7, 14, 15) determined solubilities of 6.5×10^{-5} to 1.1×10^{-3} at % in the temperature range of 798 to 1023 K; Weeks and Fink (7) reported a value of 3.7×10^{-4} at % for the solubility of Co at 923 K.

No intermetallic compounds have been found in this system; the amalgam is in equilibrium with solid cobalt (3, 16).

Parkman (17-19) determined the cobalt content in mercury after Co alloys were equilibrated with mercury at different temperatures; it was reported that the solubility of cobalt from the alloys was of similar magnitude as with pure cobalt.

Tentative values of Co solubility in Hg:

<u>T/K</u>	<u>Soly/at %</u>	<u>Reference</u>
773	7×10^{-5a}	[4,5]
873	2×10^{-4}	[5]
973	7×10^{-4}	[5]

^a mean value from cited references.

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CRITICAL EVALUATION: (continued) 14. Weeks, J.R.; Fink, S. <i>U.S. At. Ener. Comm. Rep.</i> , BNL-799, 1963, p. 85. 15. Weeks, J.R.; Fink, S. <i>U.S. At. Ener. Comm. Rep.</i> , BNL-823, 1963, p. 80. 16. Lihl, F. <i>Z. Metallk.</i> 1953, 44, 160. 17. Parkman, M.F. <i>Ext. Abst., Electrothermics and Metallurgy Div.</i> , Vol. 2, No. 2, The Electrochemical Soc., 1964, pp. 16-21. 18. Parkman, M.F. <i>U.S. At. Ener. Comm. Rep.</i> , TID-7626, 1962, Pt. I, p. 35. 19. Parkman, M.F.; Whaley, D.K. <i>Aerojet-General Nucleonics, Rep. AN-957</i> , 1963; as cited in 6.	

COMPONENTS: (1) Cobalt; Co; [7440-48-4] (2) Mercury; Hg; [7439-97-6]	ORIGINAL MEASUREMENTS: Jangg, G.; Palman, H. <i>Z. Metallk.</i> <u>1963</u> , 54, 364-9.																								
VARIABLES: Temperature: 20-550°C	PREPARED BY: C. Guminski; Z. Galus																								
EXPERIMENTAL VALUES: The solubility of cobalt in mercury: <table data-bbox="441 521 1029 817" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th><u>t/°C</u></th> <th><u>Soly/mass %</u></th> <th><u>Soly/at %</u></th> </tr> </thead> <tbody> <tr> <td>550</td> <td>2.4×10^{-5}</td> <td>8.2×10^{-5}</td> </tr> <tr> <td>500</td> <td>2.0×10^{-5}</td> <td>6.8×10^{-5}</td> </tr> <tr> <td>400^a</td> <td>1.2×10^{-5}</td> <td>4.1×10^{-5}</td> </tr> <tr> <td>300^a</td> <td>6×10^{-6}</td> <td>2.0×10^{-5}</td> </tr> <tr> <td>200^a</td> <td>2.2×10^{-6}</td> <td>7.5×10^{-6}</td> </tr> <tr> <td>100^a</td> <td>5×10^{-7}</td> <td>1.7×10^{-6}</td> </tr> <tr> <td>20^a</td> <td>7×10^{-8}</td> <td>2.4×10^{-7}</td> </tr> </tbody> </table> <p data-bbox="287 848 1141 930">^aOnly the 500 and 550°C solubilities were experimentally determined. The values at the lower temperatures were estimated by extrapolation from the two experimental points.</p>		<u>t/°C</u>	<u>Soly/mass %</u>	<u>Soly/at %</u>	550	2.4×10^{-5}	8.2×10^{-5}	500	2.0×10^{-5}	6.8×10^{-5}	400 ^a	1.2×10^{-5}	4.1×10^{-5}	300 ^a	6×10^{-6}	2.0×10^{-5}	200 ^a	2.2×10^{-6}	7.5×10^{-6}	100 ^a	5×10^{-7}	1.7×10^{-6}	20 ^a	7×10^{-8}	2.4×10^{-7}
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AUXILIARY INFORMATION																									
METHOD/APPARATUS/PROCEDURE: The heterogeneous amalgams were introduced into a specially constructed apparatus of refractory chromium steel. This type of apparatus could be used because the solubility of iron in mercury is very low and the chromous oxide film on the surface inhibits the wetting of the steel by mercury. After 12 hr of equilibration at the temperature of the experiment the amalgam was filtered through the sintered iron frit under a pressure of purified nitrogen; 3- to 4-fold filtration was usually necessary. The metal content in the filtered amalgam was determined analytically by an unspecified procedure.	SOURCE AND PURITY OF MATERIALS: Nothing specified.																								
ESTIMATED ERROR: Soly: accuracy \pm 5%. Temp: precision \pm 2 K.																									
REFERENCES:																									

COMPONENTS: (1) Cobalt; Co; [7440-48-4] (2) Mercury; Hg; [7439-97-6]	ORIGINAL MEASUREMENTS: Weeks, J.R. <i>Corrosion</i> 1967, 23, 98-106.																																	
VARIABLES: Temperature: 525-750°C	PREPARED BY: C. Guminski; Z. Galus																																	
EXPERIMENTAL VALUES: The solubility of cobalt in mercury was presented graphically as a function of temperature. The data points were read off the curve by the compilers. <table border="1" data-bbox="376 511 1021 919" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>$t/^\circ\text{C}$</th> <th>Soly/mass % $\times 10^5$</th> <th>Soly/at % $\times 10^4$^a</th> </tr> </thead> <tbody> <tr><td>750</td><td>32</td><td>11</td></tr> <tr><td>725</td><td>18</td><td>6.1</td></tr> <tr><td>700</td><td>21</td><td>7.1</td></tr> <tr><td>675</td><td>7.0</td><td>2.4</td></tr> <tr><td>650</td><td>12</td><td>4.1</td></tr> <tr><td>625</td><td>4.1</td><td>1.4</td></tr> <tr><td>600</td><td>4.0</td><td>1.4</td></tr> <tr><td>575</td><td>8.0</td><td>2.7</td></tr> <tr><td>550</td><td>5.4</td><td>1.8</td></tr> <tr><td>525</td><td>1.9</td><td>0.65</td></tr> </tbody> </table> <p style="text-align: center;">^aby compilers.</p> <p>The data for this paper were also reported in refs. (1) and (2).</p>		$t/^\circ\text{C}$	Soly/mass % $\times 10^5$	Soly/at % $\times 10^4$ ^a	750	32	11	725	18	6.1	700	21	7.1	675	7.0	2.4	650	12	4.1	625	4.1	1.4	600	4.0	1.4	575	8.0	2.7	550	5.4	1.8	525	1.9	0.65
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METHOD/APPARATUS/PROCEDURE: Cobalt was immersed in Hg which was contained in the upper part of a two-chambered quartz tube; a coarse quartz filter separated the two chambers. After loading, the tube was sealed under vacuum, then placed in a steel bomb which contained Hg to equalize the pressures inside and outside the quartz tube at high temperatures. The bomb was then placed in a centrifuge which was contained in a furnace, and the sample was equilibrated for 72 hr at the desired temperature. After this time the sample was centrifuged at temperature to force the amalgam through the filter. After cooling, the tube was opened and the Hg content in the amalgam was determined by the evaporation method. Cobalt was dissolved in HF-HNO ₃ and determined spectrographically.	SOURCE AND PURITY OF MATERIALS: Mercury was triple-distilled, reagent grade. Cobalt purity and source not specified. ESTIMATED ERROR: Soly: nothing specified. Temp: precision \pm 2 K. REFERENCES: 1. Weeks, J.R.; Minardi, A.; Fink, S. <i>U.S. At. Ener. Comm. Rep.</i> , BNL-841, 1963, p. 76. 2. Weeks, J.R.; Fink, S. <i>U.S. At. Ener. Comm. Rep.</i> , BNL-900, 1964, p. 136.																																	

<p>COMPONENTS:</p> <p>(1) Rhodium; Rh; [7440-16-6] (2) Mercury; Hg; [7439-97-6]</p>	<p>EVALUATOR:</p> <p>C. Guminski; Z. Galus Department of Chemistry University of Warsaw Warsaw, Poland July, 1985</p>
<p>CRITICAL EVALUATION:</p> <p>The solubility of rhodium in mercury is very low at 298 K; Kozin predicted this solubility as 1.1×10^{-11} (1) and 1.0×10^{-8} at % (2). Jangg and Dörtbudak (3) reported an experimental solubility of 1.2×10^{-4} at % at 773 K. Kozin's second estimate at 298 K appears to be of the correct order of magnitude by comparison with the high temperature determination of Jangg and Dörtbudak. Strachan and Harris (4) reported a solubility of 0.31 at % at room temperature, but this value is much too high to be acceptable.</p> <p>The saturated rhodium amalgams are in equilibrium with the compounds, RhHg_2, $\text{RhHg}_{4.63}$ and RhHg_5; the respective decomposition temperatures of the compounds are 593, 689 and 833 K (5).</p> <p><u>References</u></p> <ol style="list-style-type: none">1. Kozin, L.F. <i>Tr. Inst. Khim. Nauk Akad. Nauk Kaz. SSR</i> <u>1962</u>, 9, 101.2. Kozin, L.F. <i>Fiziko-Khimicheskie Osnovy Amalgamoi Metallurgii</i>, Nauka, Alma-Ata, <u>1964</u>.3. Jangg, G.; Dörtbudak, T. <i>Z. Metallk.</i> <u>1973</u>, 64, 715.4. Strachan, J.F.; Harris, N.L. <i>J. Inst. Metals</i> <u>1956-57</u>, 85, 17.5. Jangg, G.; Kirchmayr, H.R.; Mathis, H.B. <i>Z. Metallk.</i> <u>1967</u>, 58, 724.	

COMPONENTS: (1) Rhodium; Rh; [7440-16-6] (2) Mercury; Hg; [7439-97-6]	ORIGINAL MEASUREMENTS: Jangg, G.; Dörtbudak, T. <i>Z. Metallk.</i> <u>1973</u> , 64, 715-9.
VARIABLES: One temperature: 773 K	PREPARED BY: C. Guminski; Z. Galus
EXPERIMENTAL VALUES: The solubility of rhodium in mercury at 773 K was found to be 6×10^{-5} mass %. The corresponding atomic % solubility calculated by the compilers is 1.2×10^{-4} at %.	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: The amalgam was equilibrated in a quartz tube which was contained in a pressurized bomb. One end of the tube consisted of a fused quartz filter through which the amalgam was filtered at the equilibration temperature. Subsequently, tin was added to the amalgam and the mercury was removed by evaporation. The rhodium, which was alloyed into the tin, was then analyzed spectroscopically; the tin served as an internal standard.	SOURCE AND PURITY OF MATERIALS: Rhodium: powder material supplied by Degussa. Hg purity not specified. ESTIMATED ERROR: Soly: nothing specified. Temp: nothing specified. REFERENCES:

<p>COMPONENTS:</p> <p>(1) Iridium; Ir; [7439-88-5] (2) Mercury; Hg; [7439-97-6]</p>	<p>EVALUATOR:</p> <p>C. Guminski; Z. Galus Department of Chemistry University of Warsaw Warsaw, Poland</p> <p>July, 1985</p>
<p>CRITICAL EVALUATION:</p> <p>Strachan and Harris (1) equilibrated iridium and mercury, but they could not detect any solubility of iridium in mercury at room temperature; their analytical detection limit for iridium was 10^{-3} at %. Jangg and Dörtbudak (2) equilibrated the two metals at 773 K and could not detect any dissolution of iridium at this higher temperature; the detection limit by the latter authors was 10^{-5} at %. Exposure of iridium to mercury at 823 K showed no corrosion of the iridium (3). The extremely low solubility of iridium in mercury is suggested by the estimates of 6.6×10^{-18} (5) and 2.9×10^{-12} at % (4) at 298 K by Kozin; the second value appears to be more reliable to the evaluators.</p> <p>Pure iridium should be in equilibrium with its saturated amalgam (2).</p> <p><u>References</u></p> <ol style="list-style-type: none">1. Strachan, J.F.; Harris, N.L. <i>J. Inst. Metals</i> <u>1956-57</u>, <i>85</i>, 17.2. Jangg, G.; Dörtbudak, T. <i>Z. Metallk.</i> <u>1973</u>, <i>64</i>, 715.3. Rhys, D.W.; Price, E.G. <i>Metal. Ind.</i> <u>1964</u>, <i>105</i>, 243.4. Kozin, L.F. <i>Fiziko-Khimicheskie Osnovy Amalgamoi Metallurgii</i>, Nauka, Alma-Ata, <u>1964</u>.5. Kozin, L.F. <i>Tr. Inst. Khim. Nauk Akad. Nauk Kaz. SSR</i> <u>1962</u>, <i>9</i>, 101.	