

SOLUBILITY OF OXYGEN IN MOLTEN LEAD

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In spite of their metallurgical importance only a few publications regarding to the solubility of oxygen in molten lead have been mentioned in these ten years. In the present investigation, for the purpose of determining the solubility, molten lead was saturated with oxygen in air and its content was analysed by hydrogen reduction method; the amount of water produced by the reaction was determined by the measurement of the pressure of water vapour at the known volume. The study was made at the range of temperatures from 600°C to 900°C.

Experimental Procedure

30~50 g of lead, of commercial extra pure grade, was melted in an alumina crucible positioned in the resistance furnace of the vertical type, and then the molten lead was stirred up for 10 to 15 minutes by a well polished iron rod in air. Since the velocity of oxidation of molten lead is markedly high, the thin film of oxide was produced on the molten lead after a few minutes. After the molten lead was equilibrated with the oxide and settled for about 30 minutes at constant temperature, sampling was made by sacking up the metal with a long silica tube 3 mm in dia. inserted into the melt. The hot melt in the silica tube was dipped into water for quenching, and thus obtained rod was cleaned by planing away its surface layer with a razor, and then was used as a sample for the analysis of the oxygen dissolved in it. The sample for the analysis was heated at 800°C for 2 hrs in flowing hydrogen.

Hydrogen gas was generated in Kipp's apparatus by the reaction of pure synthetic hydrochloric acid on electrolyzed zinc and was purified by passing it through a series of purifiers containing the following substances respectively: potassium hydroxide, potassium permanganate, calcium chloride, and Pt-asbest, and also through phosphorous pentoxide.

Fig. 1 shows the analysis assembly. The method of analysis was as follows: About 15 gm of sample weighed in the silica boat was placed in the reaction tube made of quartz glass, and then the whole system was evacuated. When high vacuum was attained, the cocks 4, 5, 6 and 7 were closed, and the cock 1 was slowly opened to introduce hydrogen gas into the reduction chamber, and the trap G_2 was cooled by liquid oxygen in Dewar vessel. When the pressure of hydrogen in the reduction chamber reached to 1 atm, the cock 8 was opened and then the hydrogen was flowed to the direction showed by the arrow in Fig. 1. After the lead was deoxidized to perfection, the cocks 8 and 2 were closed, and then G_3 and G_1 were connected to the pump through the cocks 3, 4 and 5 for removing all the extraneous hydrogen. When high vacuum was attained, 6 was opened, 5 was closed, and Dewar vessel was taken away. The solidified H_2O vapourizes in G_1

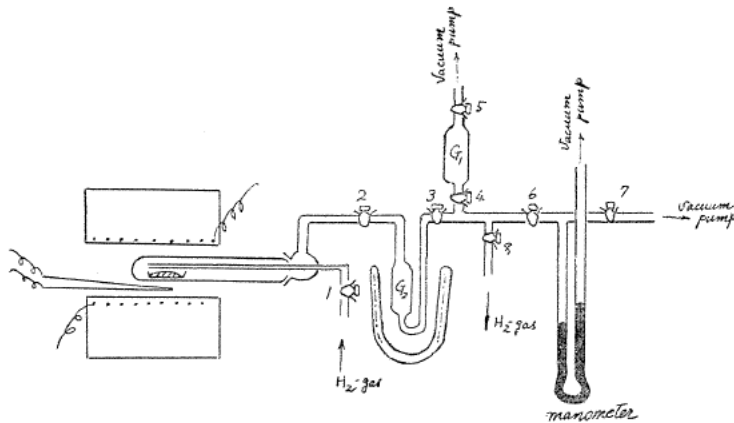


FIG. 1 Apparatus for analysis of oxygen in liquid lead.

and G_2 as G_2 returns to the original temperature. After recording the pressure of water vapour with the manometer, cock 4 was closed and 5 was opened and then G_1 was evacuated to 10^{-4} mm Hg. Next, 5 was closed and 4 was opened, the pressure was observed again. This procedure was repeated until the pressure of water vapour attains to the lowest value enable to observe. Thus obtained values by each run of the observations were added up to the total pressure, from which the amount of dissolved oxygen was calculated.

Results

The results of experiments were shown in Table 1 and Fig. 2. All the values of the other investigators in the figure were obtained also by the method of hydrogen reduction. It was found that the data by the present writers are markedly lower than those of Barteld and Hofmann at over 700°C , but at low temperatures, they keep a comparatively good agreement with them. However that may be, the amount of dissolved oxygen in molten lead is very little. The relation of $1/T$ with $\log [\text{O}]$ may be expressed as follows:

$$\log [\text{O}] = -1,418/T - 1.12$$

TABLE 1. Results of Experimental Measurement

Temperature ($^\circ\text{C}$)	(O%) $\times 10^4$
400	5
400	6
600	22
800	37
800	25
800	35
800	33
900	42
900	47
900	51

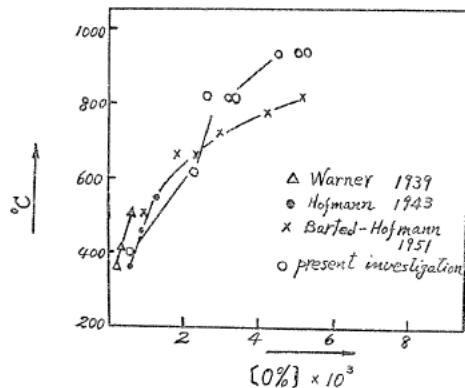


FIG. 2 Comparison of published data.

TABLE 2. Comparison of Calculated Values
with Those Observed

Temp (°C)	$1/T \times 10^4$	$(O\%) \times 10^4$	
		exp.	calc.
400	14.859	5.5	6.00
600	11.455	22.0	18.20
800	9.320	32.5	36.4
900	8.525	47.0	47.2

The values of solubility of oxygen calculated by this equation are shown in the 3th column of Table 2.

References

- 1) J. Fische, H. Beckel Z. Erzbergbau., **5** (1952), 14.
- 2) K. Barteld, W. Hofmann Z. Erzbergbau., **5** (1952), 102.