

The Liquid Miscibility Gap and the Distribution of Silver Between Speiss and Metallic Lead in the Pb-Fe-As, Pb-Cu-As and Pb-Fe-Cu-As System at 1200

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Thermodynamic Evaluations of Extractive Metallurgical Processes

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Among the various, possible applications of thermodynamics to extractive metallurgical processes, the availability of chemical potential diagrams and calculation methods combining stoichiometric relations with equilibrium constants are emphasized. In hydrometallurgical processes, the value of potential-pH diagrams has been well recognized and the application of similar techniques to rather complex systems containing ligands such as the cyanidation process is very interesting. In the roasting of sulfide ores, various information is derived from sulfur-oxygen potential ($\log P_{S_2} - \log P_{O_2}$) diagrams. Especially convenient for sulfation roasting are the SO_2-O_2 potential diagrams. Various smelting processes including the direct production of metal from sulfide ore are discussed with the use of chemical potential diagrams. Based upon the prediction derived from sulfur-oxygen potential diagram, the recovery of elemental sulfur from oxidation of FeS is evaluated by stoichiometric calculations. Volatilization behaviour of elements such as zinc, cadmium, and mercury are also explained by similar diagrams and the possibility of the direct distillation of zinc sulfide is predicted by stoichiometric calculations. Analogous calculations are used to clarify the reasons why the segregation process is amenable to copper oxide ore but not to nickel ore.

The Liquid Miscibility Gap and the Distribution of Silver Between Speiss and Metallic Lead in the Pb-Fe-As, Pb-Cu-As and Pb-Fe-Cu-As System at 1200°C

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The liquid miscibility gap and the distribution of silver between speiss and metallic lead for the Pb-Fe-Cu-As quaternary system have been determined at 1200°C. The miscibility gap in the Pb-Fe-As system covered a wide composition range. Molten lead containing a small

amount of arsenic equilibrated with the speiss which consisted of iron arsenide with a small quantity of dissolved lead. The miscibility gap in the Pb-Cu-As system was also determined. In this system, the solubility of lead in speiss had a minimum with increasing arsenic content. In the quaternary system, the region of immiscibility was found to be distributed between the above, two, ternary systems on a pseudoternary phase diagram and was dependent on the Cu/Fe + Cu ratio in speiss. The arsenic content in molten lead increased sharply beyond a definite quantity of arsenic in speiss. The behaviour of the distribution ratio of silver, K_{Ag} , defined as wt.% Ag in speiss/wt.% Ag in metallic lead was summarized as follows:

(1) In the Pb-Fe-As system, the values for K_{Ag} were low when the arsenic content in speiss was below 40%; but above this range, the values increased sharply.

(2) In the Pb-Cu-As system, K_{Ag} was around 1.2 for all speiss compositions investigated.

(3) In the Pb-Fe-Cu-As system, the value of K_{Ag} was distributed between those obtained for the two ternary systems. The distribution ratios of silver derived from practical data agreed well with present work.

From these results, a pyrometallurgical process in which lead and precious metals are recovered as bullion and in which arsenic is fixed and discarded as iron arsenide speiss can be proposed.

Behaviour of Minor Elements in the Roasting of Zinc Concentrate

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Behaviour of minor elements in the dust collecting system connected with fluidized bed roaster for zinc concentrate was investigated by use of the bench scale experimental apparatus. Some volatile elements such as lead, cadmium and arsenic tend to concentrate in the fine calcine obtained in hot electrostatic precipitator especially in the case of the roasting with insufficient air supply. Special interests were paid for behaviour of mercury. In the roasting tests for plain zinc concentrate both elemental and compound forms of mercury were found in the gas stream. To promote the compound formations, some additives for concentrate, such as selenium and halogens were effective, especially selenium of a few times equivalent to form HgSe represented complete conversion of mercury from elemental to compound.

To clarify the behaviour and removal mechanism of mercury, various