Leaching of Manganese ore from Northeastern Vietnam by Reduction with SO2 gas in an H2SO4-rich Solution

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The sulphur dioxide process was first patented by Van Arsdale and Mair in 1918 (Vedensky, 1946), but in recent time it caught the attention of manufacturers of electrolytic manganese dioxide (EMD). Compared to a conventional process, where Mn ore is heated to about 1,000 °C to convert MnO_2 to MnO dissolved in hot sulphuric acid, extraction of Mn from the raw ore using SO_2 gas as a reducing agent in an H_2SO_4 overcomes all the disadvantages, such as, high energy consumption, environmental pollution and loss of Mn (Everett, 1976).

The Mn ore of the Toc Tat Mn mine in northeastern Vietnam contains mainly Mn oxide minerals, such as, pyrolusite (MnO_2), manganite (MnOOH), hollandite ($BaMn_8O_{16}$), bixbyite (Mn_2O_3), and jacobsite (Mn_3O_4), and therefore is suitable for the sulphur dioxide process (Sully, 1955). The net reaction of the extraction can be described as follows:

$MnO_2(s) + SO_2(g) = Mn^{2+}(aq) + SO_4{}^{2-}(aq)$

Systematic experiments were carried out to establish the optimal conditions for extracting Mn from the Toc Tat ore. The best results were obtained when (1) the particle size of ore is 0.2 mm; (2) the ratio between raw ore and solution is 200 g/L; (3) the pH of the leach solution ranges from 0.7 to 1; (4) leaching time lasts 30 - 35 min; (5) the mass ratio between the amount of SO_2 gas supplied and the MnO_2 content in the raw ore added to the leaching tank ranges from 1.5 to 2.0; (6) stirrer speed is 400 r/min; and (7) the leaching process starts at room temperature. At these conditions, only 5 wt% of the Mn originally present in the raw ore remain in the residual, i.e. 95 wt% of Mn can be recovered. Moreover, less than 10 wt% of the Fe present in the raw ore was dissolved.

This method thus allows us to recover most of the Mn and, at the same time, dissolves only a small amount of Fe, one of the main unwanted components for EMD production. We are currently investigating procedures to remove the Fe and other impurities from the solution prior to electrolysis.

References

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