INTRODUCTION

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The reserves of high grade ores are on the wane throughout the world and India, in particular. This depletion of high grade ores occurs because of their continuous and indiscriminate exploitation for the production of metals and chemicals for immediate gain. Practically, no attempt has been made in India for planned and progressive use of low grade ores. Metals are extracted mostly through pyrometallurgical processes. The pollutants from these processes, like emission of sulphur dioxide from smelters, are creating severe environmental problems. Moreover, the cost of pyrometallurgical processes is also on the increase. The metallurgical industries are presently aware of this problem and some attempts are being made for the effective utilisation of low grade ores. Besides this, there are consistent efforts on the part of researchers to extract metals from industrial slags and rejects from mines and beneficiation plants. Hydrometallurgical processes, commonly known as wet processes, can recover metal values from the low grade ores more economically. In hydrometallurgical treatment of ores, the ore is first selectively leached with a suitable solvent and the desired metal gets dissolved in the leached solution. The metal ion concentration in the solution is then increased through solvent extraction or ion exchange. The metal is then recovered from the concentrated solution through electrowinning or precipitation.

The advantages of hydrometallurgical processes are many. The important advantages are : (i) metal can be obtained in a pure form from the leached solution by electrowinning, (ii) the siliceous gangue present in the ore is unaffected by most of the chemicals used in the process so that the cost of fluxes needed in the pyrometallurgical processes for slag formation is eliminated, (iii) the operations in the hydrometallurgical processes are carried out at room temperature and so, handling of the products becomes easier and (iv) it is possible to extract metal values from low grade deposits with profit.

Hydrometallurgical processes have their disadvantages as well, namely increased power requirement during electrowinning and problems associated with the handling of corrosive solvents. Nevertheless, the advantages outweigh the drawbacks of the process.

Leaching of ore is rather a complex phenomenon and a large number of operations are involved during the extraction of ore. A critical review of the literature in the area of leaching of low grade ores shows that some concerted effort is needed to explore the possibility of developing newer processes for their commercial exploitation. Similar viewpoints have been expressed at various seminars and symposia held recently throughout the country. (National Mineral Convention, New Delhi, 1981; Conservation of Mineral Resources, Bhubaneswar, India, 1980; Advances in Science and Technology of Mineral Beneficiation in India, Hyderabad, 1981.)

The present investigations pertain to the leaching of two low grade ores, namely chalcopyrite and rock phosphate. Low grade oxide and lean sulphide ores of copper are available in different reserves in India such as Malanjkhand (Madhya Pradesh). Leaching of chalcopyrite for recovery of metal values has never been commercially practised in India. Likewise, leaching of low grade rock phosphate for the manufacture of phosphoric acid has also not been attempted by any industrial unit in the country.

The conventional leaching plants employ mechanically agitated reactors for contacting the solid and the solvent. Since the impeller and other moving parts are in contact with the slurry, this may often lead to severe corrosion and erosion. As against this, ejector (found suitable for fluid-fluid contacting) and other types of contactors like the packed, fluidized and semifluidized bed contactors can be successfully employed for the leaching of ores. Such contactors are reported (Jain et al, 1981; Jain et al, 1982) to have much better performance from the standpoint of mass-transfer.

An ejector assembly consists of a nozzle through which a fluid is forced in the form of a jet. Due to Bernoulli effect, a secondary fluid is entrained into the suction chamber of the ejector and then both the fluids mix intimately in the mixing chamber. Because of the jet action, high turbulence is created resulting in enhanced mass transfer coefficient and large interfacial area.

In view of the advantages which can be derived from the use of jet contactors (ejector), studies have been undertaken for the leaching of chalcopyrite and rock phosphate ores using

sulphuric acid as the solvent in a properly designed jet contactor. Some investigations have also been made using rock phosphate-dilute sulphuric acid system in packed, fluidized and semifluidized beds. The experimental data obtained, demonstrate that these techniques have good potential for their application in the extraction of metals and chemicals from low grade ores.