CHAPTER 3

EFFECT OF PARTICLE SIZE AND PULP DENSITIES OF THE BAUXITE ORE ON BIOLEACHING OF SILICA AND IRON OXIDE BY *ASPERGILLUS NIGER* X_1.

The diversity of microbial anatomy and mechanism for growth result in variations in growth rate. Since the mutant strains of **Aspergillus niger** has to be used in an industrial scale to remove silica and iron from bauxite ore, studies of various optimal physical conditions are needed to understand the level of adoption and tolerance of silica by the microbe with respect to the mineral substrates. In the present chapter the effects of (i) size of the ore (particle size) (ii) pulp densities of ore in the release of silica and iron from bauxite ore by a mutant strain of **Aspergillus niger** X_1 are discussed.

Reports regarding the effect of the particle size of the insoluble metal substrates on microbiological leaching rate and final yield of extraction suggests that the material with smaller particle size was more susceptible to bacterial action than was the larger ones. Patrick and Holding **(154)** and Lewin **(155)** have also found the same relationship between the silica solubilization and the surface area of the substrate in case of diatom frustules.

Pulp density indirectly monitor the release of silica from the medium. Mishra et al. **(156)** reported that with the increase of pulp density in the medium, the pH of the medium during bacterial growth as well as silica release tended to increase, perhaps due to the dissolution of the carbonate material of the ore. Increase in pulp density may increase the cell weight of organism but beyond the optimal pulp density silica release does not increase. As a consequence of the laws

of conservation of mass, it is essential to balance the elemental requirements for growth and product formation.

3. EXPERIMENTAL AND RESULTS :

3.1 Micro-organism :

A mutant strain of **Aspergillus niger** developed by using ethylene imine (1:5000) and X-rays was used. The mutant **A.niger** X_1 was capable of releasing silica (49.8%) and iron (56.4%).

3.2 Medium and Cultural Conditions :

The mutant strain **A.niger** X_1 was maintained in malt extract agar medium. The medium used for the fermentation of bauxite for leaching of silica and iron, consisted of 0.2% $NaNO_3$ 0.1% KH_2PO_4, 0.05% $MgSO_4.7H_2O$, 0.05% KCl and yeast extract 0.01%. The pH was adjusted to 4. It was sterilized at 121°C for 15 minutes. 4 percent glucose was sterilized separately and added to the medium aseptically.

When the cultures were needed for the fermentation, they were transferred to slants of malt extract and incubated at 27°C for 7 days for sufficient sporulation. Spore crops were harvested by washing the slant with sterile distilled water and filtering the resulting spore suspension through several layers of sterile absorbent cotton. The spore density was adjusted to 1.2×10^7 per ml of the suspension. The spore suspension was used for the inoculation of the fermentation medium, surface culture fermentation was carried out using 250 ml conical flask, each containing 50 ml of medium. The flasks were then incubated at 27°C for 7 days.

The optimum cultural condition for the bioleaching of silica and iron from bauxite ore by **A.niger** X_1 were worked out by keeping all the factors constant except the one which was varied.

Silica and iron concentration was determined as discussed in the earlier chapter (Chapter 2 Page 47 of thesis).

3.3 Effect of particle size on leaching :

Decreasing particle size of a low grade ore below a critical value will result in relatively much larger surface area of the host rock materials than it would be for the substrate surface (R). In the situation further decrease in particle size below a critical value will be equivalent to a dilution of the substrate and consequently leaching effectiveness will be adversely affected.

Results are shown in Table 3.1.

Table 3.1 Effect of particle size on leaching of silica and iron oxide from bauxite by A.niger X_1

Particle size	Cellular growth Dry wt.(g/l)	Silica leaching(%)	Iron oxide leaching(%)
-85 to 120	4.8	33.0	35.0
-120 to 150	5.0	38.4	40.2
-150 to 170	5.4	44.5	47.5
-170 to 200	5.7	50.7	56.6
-200 to 240	6.0	46.0	50.4
-240 to above	6.6	41.7	44.5

In the present study, the maximum silica and iron leaching was found with the particle size of -170 to 200 mesh and greater than the size, there is a decrease in the leaching capacity of A.niger X_1 and there is also decrease in the leaching of silica and iron when the size is smaller than this.

3.4 Effects of pulp densities on leaching :

The different pulp densities used for this study were 0.15, 0.25, 0.3, 0.35 and 0.4 percent respectively. The results are shown in Table 3.2.

Table 3.2 Effect of pulp densities on leaching of silica and iron oxide from bauxite ore by A.niger X_1.

Pulp Density (%)	Cellular growth Dry wt. (g/l)	Silica* leaching(%)	Iron Oxide* Leaching(%)
0.15	4.4	40.0	42.5
0.25	5.2	46.5	48.0
0.30	5.7	50.7	56.6
0.35	6.1	47.5	52.0
0.40	6.5	41.0	48.2

* Mean of three experiments.

Table 3.2 indicates that the maximum silica and iron leaching are found with the pulp density of 0.3% of bauxite ore by A.niger X_1. Beyond this there is decrease of leaching capacity of A.niger X_1 but the maximum cell growth is obtained at 0.4 percent pulp density.