BENEFICIATION OF BAUXITE

Bauxite is chief ore mineral for the production of aluminium metal and alumina. It is also used to some extent as fine abrasive tool after calcination. Presently bauxite is also finding uses in the steel industry in place of fluorspar to remove the slags from the furnaces.

Calcite, iron oxides and silica are the common gangue minerals associated with bauxites. Iron in the form of iron oxides will be present as a coating on the oolite grains of the bauxite mineral whereas calcite and silica present in the ore matrix itself. Detailed account of the investigations carried over at the NML on the bauxites from Gujarat and Madhya Pradesh States are given. Table 3.6 gives the beneficiation results of bauxite samples.

A. BAUXITE FROM GUJARAT

M/s. Carborandum Universal Ltd., had sponsored a bauxite sample from Jamnagar area, Saurastra, Gujarat. The bauxite was of rich grade but contained high $CaCO_3$ content which was objectionable for use in the abrasive industry.

The sample in its "as received" state contained lumps upto 75 mm in size and fines., showing various shades of buff, pink and grey colours. Complete chemical analysis of the sample was as follows :

Constituent	*Assay%*
Al_2O_3	59.29
SiO_2	3.00
TiO_2	2.43
Fe_2O_3	2.83
CaO	1.63
Co_2	2.15
Alkalies	0.15
So_4	0.45
LOI	29.78

Microscopic examination of the sample revealed that the aluminous matrix was chiefly composed of gibbsite, bohemite, and bauxite and was associated with minor amounts of kaolinite, montmorillonite and illite. Small quantities of calcareous and siliceous matter were also observed, which were liberated at 65 mesh size.

As the removable carbonates were less and liberated at finer size, froth flotation was adopted to reduce the CaO content from 1.6% level to less than 0.6% level by floating off the carbonates. By this test a bauxite product analysing 61.55% Al_2O_3 and 0.2% CaO was produced with 56.75% Al_2O_3 distribution in it.

Leaching for 15 mts with 5 Ml/litre of Hcl solution with 10 mesh ground ore produced a product analysing 62.18% Al_2O_3, trace of CaO with 98% Al_2O_3 distribution ; when the ore was ground to 65% mesh size, the leaching time was reduced to 5 mts.

Calcination (20 mts) followed by slaking did not help in reducing the CaO content below 1.07% level.

B. BAUXITE FROM MADHYA PRADESH

The bauxite sample reddish brown in colour received from Katni fire bricks and Potteries works was drawn from a roadside mine Jabbalpur dist. The sample was of ferruginous nature and Fe_2O_3 content was to be reduced to less than 2.0% level. Complete chemical analysis of the sample was as follows :

Constituent	*Assay%*
Al_2O_3	53.3
Fe_2O_3	5.2
TiO_2	8.0
SiO_2	6.3
LOI	26.83

The oolites of the bauxite were cemented together with hydroxides of iron, the removal of which would be rather difficult. Small amounts of anatase, brookite, ilmenite etc. present in the ore contribute to titanium content of the ore.

28 mesh ore sized in hydroclassifier followed by tabling produced concentrate analysing 3.5% Fe_2O_3 and 7.1% TiO_2 and 57.6% Al_2O_3 in it with 31% Al_2O_3 recovery only.

Reduction roast followed by magnetic separation at 10 mesh size produced a non-magnetic product analysing 3.88% Fe_2O_3, 9.6% TiO_2 and 72.4% Al_2O_3 with 67.1% Al_2O_3 recovery.

Reduction roast followed by magnetic separation tests with deslimed and sized ore produced a non-magnetic product analysing 3.1% Fe_2O_3, 10.2% TiO_2 and 72.3% Al_2O_3 with 54.2% recovery.

Calcined sample

Tests with a calcined bauxite sample from the same area received analysing 75.6% Al_2O_3 6.0% Fe_2O_3, 10.0% TiO_2 and 7.98% SiO_2 were taken up with a view to reduce the Fe_2O_3 content below 2.8%. Reduction roast and magnetic separation with the sized ore (−3 mesh) produced non-magnetic bauxite conc. analysing 4.38% Fe_2O_3, 10.6% TiO_2 and 77.6% Al_2O_3 with a recovery of 84.1% Al_2O_3.

Because of the very fine association of the iron oxides with bauxite, it was not possible to reduce the Fe_2O_3 content of the sample to the desired level.

Ferruginous Bauxite from Amarkantak area, Shahdole Dist.

The sample was sent by M/s. Hindusthan Aluminium Corporation and consisted of lumps of 250 mm to fines. The sample was brownish in colour and soft in nature. Complete chemical analysis of the sample is given below:

Constituent	*Assay%*
Al_2O_3	39.0
Fe_2O_3	28.1
TiO_2	7.1
SiO_2	3.0
LOI	18.5

Microscopic examination of the sample indicated that hematite, goethite, rutile, laterite and quartz formed the iron and silica contributing gangue. Bauxite and gangue were liberated at 100 mesh size.

Tabling tests at 28 mesh size after sizing produced a combined bauxite concentrate analysing 42.78% Al_2O_3, and 23.52% Fe_2O_3 in it with 62.9% Al_2O_3 distribution.

Reduction roast followed by magnetic separation at 100 mesh size produced a non-magnetic conc. analysing 9.25% Fe_2O_3 and 68.14% Al_2O_3 with 55.3% Al_2O_3 distribution.

Flotation tests with three cleanings using 200 mesh ground material with oleic acid as collector for bauxite and starch, sodium silicate, sodium metaphosphate, and Dextrine to depress the various gangue minerals produced a final bauxite concentrate analysing 9.8% Fe_2O_3, 57.0% Al_2O_3 with 66.4% Al_2O_3 distribution. The grade of bauxite may be used in the production of alumina powder.

The tabulated results of the above samples investigated are given as follows: (Table 37).

References

1 Beneficiation of ferruginous bauxite from Amarkantak Madhya Pradesh—NML IR. No. 425/67—K. N. Rakshit, P. V. Raman & P.I.A. Narayanan.

2 Reduction of iron oxide content in a Bauxite sample from Roadside Mine. Jabbalpur, Dist. Madhya Pradesh—NML IR. No. 197/60—S. K. Banerjee, G. V. Subrahmanya & P. I. A. Narayanan.

3 Reduction of lime content of a bauxite sample from Saurashtra—NML IR. No. 697/72—D. M. Chakravarty P. V. Raman & G. P. Mathur.

TABLE 3.6—BENEFICIATION RESULTS OF BAUXITE

State and Locality	Assay % ROM Al_2O_3	Beneficiation Method	Assay % conc. Al_2O_3	% Recov. Al_2O_3	Remarks
Gujarat					
1) Jamnagar area	59.29	Leaching with acid	62.18	98.0	Calcareous bauxite
Madhya Pradesh					
2) Jabbalpur	53.3 5.2% Fe_2O_3	Reduction roast followed by Magnetic separation	3.88 Fe_2O_3 72.4 Al_2O_3	—	Fe_2O_3 could not be reduced to less than 2%
3) Amarkantak	39.0 Al_2O_3 28.1 Fe_2O_3	,,	9.25 Fe_2O_2 68.14 Al_2O_3	— 68.4	,,