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PREPARATION OF ALUMINA FROM BAUXITE

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Preparation of alumina from Khushab bauxite has been examined by calcination process. The indigenous bauxite was evaluated for its mineralogical and chemical composition and its subsequent utilization as aluminium ore. Alumina of metallurgical grade was prepared on calcination with sodium carbonate. Various parameters for maximum recovery of alumina was observed with thermal treatment at different time intervals, temperature, and suitable ratio of reactions. Effect of particle size on the maximum extraction of alumina from bauxite have also been studied. The reaction is considered suitable for large scale production of alumina from bauxite.

Key words. Alumina, Bauxite, Sodium carbonate.

INTRODUCTION

Bauxite is noncrystalline, earthy white to reddish mineral containing mainly alumina [1].

Bauxite deposits were reported at Khushab and Attock areas in Pakistan. These deposits were found to be scattered over an area of 150 miles of district Khushab, Mianwali and Attock. There are 12 numbers of out crops of bauxite ore of varying magnitude in this area.

Bauxite occurs in a variety of structures, textures and colors. The color depend on the content of iron oxide and ranges from white to dark red or brown. Bauxite deposits consist largely of gibbsite $Al(OH)_3$ and boehmite. The chief impurities are clay minerals and iron oxides. The world production of bauxite has steadily increased [2].

Large number of process have been devised for production of alumina but some have succumbed in the competition against cheaper and more economical process [3].

At present bauxite ores form practically only commercial source of alumina [4]. Alumina is used for the production of metallic aluminium, ceramic insulators, pigments, etc. and in chemicals [5,6].

The rate material best suited to the economic production of alumina is bauxite [7]. A number of scientist have since then investigated on the extraction of alumina from clay and bauxite by sulphuric acid treatment. Result of such investigations are mostly covered by patents [8-10].

EXPERIMENTAL

Procedure for extraction of alumina from bauxite. Samples of Khushab bauxite containing 49.5 % Al_2O_3 was ground and mixed with fixed and/or different quantities of sodium carbonate and heated in a furnace to red hot. The sintered mass was greenish in color and friable. It was rapidly quenched with water and vigorously stirred and heated. The resultant mass of sodium aluminate was dissolved in water, while all the iron, much silica and some alumina remains behind

The hot solution of sodium aluminate was rapidly filtered to make it free from any insoluble residue. Carbon dioxide was passed through the liquid. Alumina was precipitated in a granular form and easily filterable condition.

$$3H_2O + 2Al(ONa)_3 + 3CO_2 \rightarrow 2Al(OH)_3 + Na_2CO_3$$ [11].

$$Al_2O_3 + Na_2CO_3 \rightarrow 2NaAlO_2 + CO_2$$

The precipitated alumina was filtered off and washed with water. The filterate from precipitated alumina contains sodium carbonate. The washing and filterate are combined and evaporated for recycling.

The effect of temperature on maximum recovery of alumina was noted by raising the temperature from 600° to 950° with an interval of 50°. It was found that at a temperature of 850°, the maximum yield have been shown in Fig. 1.

The effect of sodium carbonate on maximum recovery of alumina was studied by varying proportions of sodium

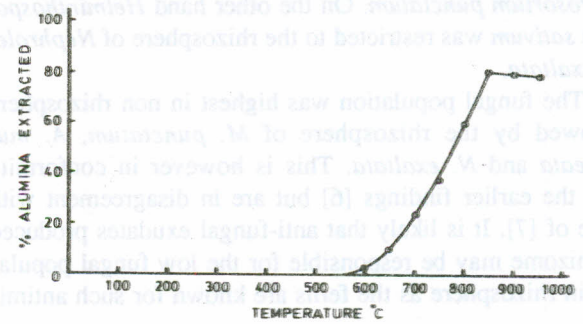

Fig. 1. Effect of temperature on extraction of alumina from bauxite.

carbonate (Na_2CO_3) and ore. It was found 1 . 2 ratio at a temp. 850°. The maximum yield shown in Fig. 2.

The effect of time from 10–60 minutes at a temperature of reaction 850° was observed on maximum extraction of alumina. The time was noted 50 minutes for the maximum recovery of alumina as shown in Fig. 3.

The effect of particle size from 36–100 mesh was also studied. It was observed that –85 mesh at 850° for 50 minutes time, the yield was maximum as shown in Fig. 4. Box diagram of alumina extraction from bauxite as shown in Fig. 5.

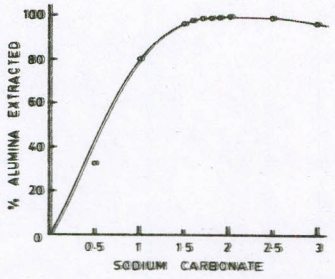

Fig. 2. Effect of increase in concentration of sodium carbonate.

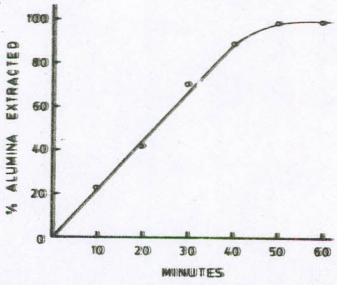

Fig. 3. Effect of time on extraction of alumina from bauxite.

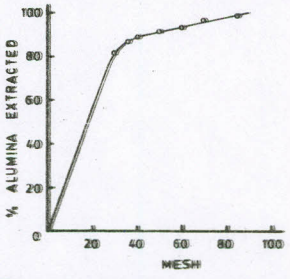

Fig. 4. Effect of partical size on recovery of alumina from bauxite.

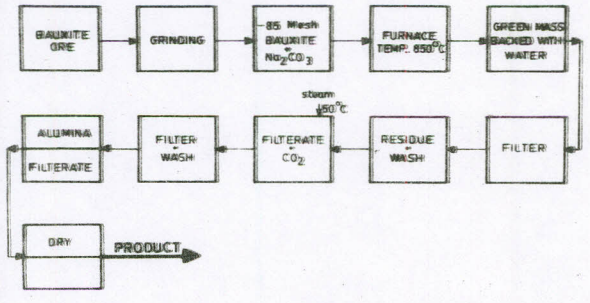

Fig. 5. Box diagram of alumina extraction from bauxite.

RESULTS AND DISCUSSION

The optimum conditions for the extraction of alumina from bauxite was determined by varying the temperature, time period of heating ratio of bauxite and sodium carbonate, and size of particle, by successfully manipulating the above four factors, 99.84 % alumina from bauxite was achieved.

It can been seen from Fig. 1 that the percentage of alumina at 600° is only 2.4 % but after this the rate of extraction is more gradual and reaches to 80.35 % conversion at 850° From Fig. 2 it is obvious that the optimum ratio between bauxite and sodium carbonate is 1 2. The optimum time period of heating for above reaction is 50 minutes. The particle size for the maximum recovery of alumina is 100 mesh.

In order to get the optimum conditions, a set of experiments were performed by varying the above four factors.

From the figures it is obvious that bauxite 100 mesh and sodium carbonate in the ratio 1 . 2 and heating for a period of 50 minutes, the maximum rate of conversion to 99.84 % is achieved. All the above studies would prove useful in scaling up the process.

Box diagram of alumina extraction from bauxite. The ROM ore is ground to -85. It is mixed with sodium carbonate and roasted at 850°. The product after thermal treatment is greanmass which is leached with water and then filtered, washed. Carbon dioxide is passed through the solution at 50°. White precipitates of alumina is formed which is then filtered, washed and dried.

CONCLUSION

Indigenous bauxite of district Khushab, Sargodha division was processed after calcination with commercial grade soda ash. Alumina of metallurgical grade was obtained at a temperature of 850° as compared to the reported temperature of 900 – 950°. It was also found out that the recovery was maximum i e. 99.84 % with sodium carbonate concentration less by 6.28 %. The iron contents is also lower than previously worked out processes. All these studies were undertaken with a mesh size of – 85 and the recovery was found to be maximum, as compared to 200-mesh reported earlier. The Khushab bauxite appears to be amonable to processing for extraction of metallurgical grade alumina.

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