**Project Title:** Optimization of digestion efficiency in Bayer process by ascertaining the ideal size fraction of bauxite feed (**S-32)**

**File no: Met4-14/8/2019**

**Name of the PI, Institution, contact details:**

**Dr. (Mrs.) Suchita B. Rai**

Jawaharlal Nehru Aluminium Research Development and Design Centre

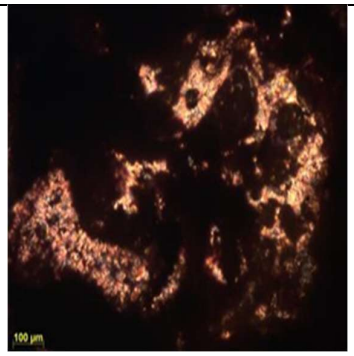
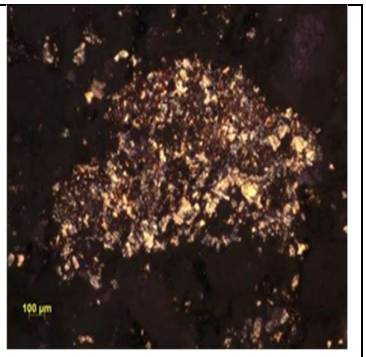
suchitarai@jnarddc.gov.in : 9423680346: **JNARDDC, Nagpur**

**Objective:**

- Determination of the optimum size of bauxite for digestion by grinding and characterization of various size fractions.
- Technological testing and evaluation of various size fractions of bauxite to optimize digestion efficiency.

**Abstract:**

In the Bayer process, for production of alumina, the bauxite ore is ground to a size fraction to achieve the maximum extraction of alumina from the bauxite and to attain the desired supersaturation level to accomplish high liquor productivity. The most important aspect is to consider the suitability of ore for alumina production. Apart from chemical analysis of bauxite, the mineralogy becomes an important consideration; the latter influences the technology for processing. In addition to this, with the fast depletion of good quality bauxite resources, it has become necessary to use suitable beneficiation process, mainly to bring down silica, iron and titanium oxide content in Indian bauxite. The physico-chemical and mineralogical properties of bauxite vary from deposit to deposit. It is often possible to crush, grind and sieve the bauxite from a deposit in various fractions and to ascertain suitable feed size for alumina production. The liberation of minerals due to size reduction is an important stage of mineral processing as it predicts up to some extent the fineness to which the ore may be ground. Taken this into consideration, the project was taken up to determine the optimum size of bauxite for digestion by grinding and characterization of various size fractions. Another aim of the project was to conduct technological testing and evaluation of various size fractions of bauxite to optimize the digestion efficiency.

| | | |
|---|---|---|
|  |  |  |
| Photomicrograph showing reaction rim texture formed by gibbsite minerals of east coast bauxite | Photomicrograph showing morphology of gibbsite and indicate alteration of parent rock minerals of east coast bauxite | Photomicrograph showing morphology of gibbsite minerals of central India bauxite |

**Findings:**

- The project findings reveal that if we reject the finer size fraction there will be reduction in consumption of both specific bauxite and caustic soda consumption leading to improvement in digestion efficiency. The optimum particle size of the feed bauxite to digestion has been recommended in the report. The final recommendation will be used for primary Aluminium producers utilizing east coast and central India bauxite.

**Highlights of the findings achieved in the project**: -

- The project investigates the chemical, mineralogical, rare earth, trace elements, petrology characteristics of the bauxites used from predominantly two regions in India, namely East Coast and Central India.
- The results show that there is a clear enrichment of $SiO_2$, $Fe_2O_3$ in the finer fractions both for East Coast bauxite and Central India bauxite. Thus, the removal of some of these size fractions can improve the overall grade of these bauxites. However, these reductions are not appreciable to make bauxite suitable for refractory and abrasive industries.
- The mineralogical analysis shows that alumo-goethite, kaolinite is, in general, high in finer fractions and correspondingly gibbsite is low.
- In the digestion study of the ROM bauxites and 13 fractions of each bauxite, exploratory work for calculating the digestion efficiency was carried out. Specific

bauxite consumption and caustic consumption increased from coarser to a finer fraction in both the bauxites. Recoverable alumina % was also calculated.

- Digestion efficiency on TA basis of ROM east coast bauxite digested at 145°C and 45 min time duration and ROM central India bauxite at 240°C and 40 min time duration is 86.01 % and 69.56 % respectively due to different mineralogy of bauxites.
- Digestion efficiency on TA basis for east coast bauxite is found to be 87.34% and 70.09 % in the central India bauxite for coarsest fraction i.e. +2.8 mm size. Hence this can be treated as a suitable size for optimizing the digestion efficiency among all the fractions.
- Digestion efficiency decreased with a decrease in size fractions, but a significant drop is observed below 1 mm size fraction in the east coast bauxite and below 0.150 mm size fraction in the central India bauxite. This is due to the reduction of $Al_2O_3$ and increase in $SiO_2$ content in these fractions.
- Increase in $SiO_2$ content increases the formation of sodium alumino-silcates in the red mud which is a loss of both alumina and caustic soda. This leads to a reduction in digestion efficiencies in low size fractions.
- Specific bauxite consumption (t/t of alumina) and caustic consumption was found to be more in central India bauxite as compared to east coast bauxite.
- Data related to trace and rare earth elements in both the bauxites, various bauxite fractions and red mud would act as a reference for all the studies and future investigations.
- Based on the above results it is advantageous to discard finer fraction before wet ball milling to reduce the silica in the process bauxite.

Paper titled, 'Variation of Chemical analysis of East Coast Bauxite based on Granulometry of Bauxite and its implication in cost saving in an Alumina Refinery' under consideration for presentation in IBAAS 2022