A Process for Development of Calcined Bauxite from Ferruginous Bauxite

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Abstract

In India, the resources of high-grade bauxite suitable for non-metallurgical applications (refractive, abrasive, chemical) are very limited. In general, calcined bauxite is manufactured from high alumina, low iron bauxite. The specification required is very stringent concerning chemico-mineralogical composition. The bauxite should contain low iron oxide (Fe_2O_3 < 5 %) and high alumina (Al_2O_3 > 55 %). Due to this, India is importing specific quality bauxite to fulfill the requirement of the industry. For the present study, the ferruginous lateritic bauxite sample was collected from the Eastern ghat deposit and characterized. The bauxite contains high iron oxide (Fe_2O_3 15–25 %) and moderate alumina (Al_2O_3 44–49 %). Mineralogically it is gibbsitic in nature with hematite and alumino-goethite being dominant iron oxide minerals. JNARDDC has conducted experiments to convert ferruginous bauxite into high alumina bauxite. The beneficiation tests have been done for the elimination of iron oxide by physical and chemical methods. After the removal of iron oxide from raw bauxite, pellets/ granules of beneficiated low iron bauxite have been prepared. The calcination tests have been done on parameters such as temperature, residence time, and heating-cooling rate. The calcined granules (calcined bauxite) have been characterized and properties determined. It contains 82 % Al_2O_3 and 1.9 % Fe_2O_3 with corundum, and mullite as major minerals. The bulk density of developed calcined bauxite is 2.7-3 g/cm^3. The results indicate that calcined bauxite can be developed from ferruginous bauxite. In this paper, an attempt is being made to highlight the status of high-grade bauxite resources in India and the process for the conversion of calcined bauxite from ferruginous bauxite.

Keywords: Ferruginous bauxite, Beneficiation, Calcination, Product, Calcined bauxite.

1. Introduction

India is endowed with 3 896 million tonnes of resources of Lateritic Bauxite deposits and placed 6th in terms of bauxite production. The geological and geomorphological features of lateritic bauxite deposits of India are unusual from region to region. The high-level deposits are located at an elevation of 900-1300 m above the mean sea level (e.g. Eastern ghat & coast, Chhattisgarh, Jharkhand, Western ghat, etc.) and on the other hand low level deposits with an altitude of 50-350 m above msl (Gujarat, coastal Maharashtra, West coast, etc.) [2, 7, 10, 14]. The characteristics of these deposits vary in context with geology, morphology, physical, chemical mineralogy and minor elements. JNARDDC have been evaluated lateritic bauxite deposits of India. The details of geological, morphological, chemical and mineralogical characteristics are given in Table-1 [5, 6, 7, 13, 15, 16]. In general, calcined bauxite is manufactured from high alumina low iron bauxite. In current scenario, the reserves of high-quality bauxite are limited and getting exhausted. The Eastern ghat (Odisha) bauxite is good quality (gibbsitic) with very less impurity as compared to other Indian bauxites. However, a major impurity is the presence of the high amount of iron oxide. An attempt is being made to convert the ferruginous bauxite into high alumina bauxite. The

successful conversion of ferruginous bauxite into calcined bauxite, resulting in reducing the import of bauxite.

Table 1. Characteristics of lateritic bauxite deposits (India).

Region/ State	Parent rock Nature of deposit	Chemical & Mineralogical Feature	Remarks
Central India Chhattisgarh and Madhya Pradesh	Deccan Trap, Upper Rewa Sandstone, Vindhyan Sandstone; Mostly high level, occurs as discontinuous lenses or tabular bodies within laterite occurrences	Moderate to high alumina and high titania Mixed gibbsitic boehmitic and boehmitic type with 0.5-3% diaspore	Hard in nature (BWI 14–19 kWh/t) Laterites occurs above the bauxite zone and or sandwiched in horizon Non-metallurgical grade bauxite deposits are small & unexplored
Maharashtra	Mainly Deccan Trap Basalt High level and low level (coastal) mostly pockets, lenses and blanket type	Medium to high Al_2O_3, low silica, TiO_2 (2–6 %) and devoid of CaO Gibbsitic (coastal) & mixed gibbsitic boehmitic type (high level)	Hard in nature (BWI 14–18 kWh/t) Laterites underlain by bauxite zone High grade bauxite deposits (non-metallurgical grade) are in pockets
Jharkhand	Deccan trap, Granite gneiss; High level-blanket type	Moderate to high alumina and high TiO_2 (Mixed gibbsitic boehmitic type	Hard in nature (BWI 16–18 kWh/t) High grade bauxite deposits (non-metallurgical grade) are small
Eastern ghat & coast Odisha A. P.	Khondalite and Charnockite; high level lateritic type, which occur on plateau tops as blanket covers	Moderate Al_2O_3 (42–46 %), high Fe_2O_3 (20–30 %), low silica (1–3 %) & titanium Fully Gibbsitic, minor amount of boehmite	Soft in nature (BWI 9–12 kwh/t) Laterites occurs above bauxite zone Mostly metallurgical grade; high grade bauxites are in pockets Endowed with 70% of the total resources (India)
Gujarat	Deccan Trap basalt, argillaceous and calcareous sandstone and Limestone. Low level mainly pockety and boundary	Kachchh - High Al_2O_3, low SiO_2 and CaO Sabarkantha & Kheda Low-moderate Al_2O_3, high TiO_2 & moderate CaO Gibbsitic, with some amount of boehmite & diaspore	Hard in nature (BWI 14–19 kWh/t) Reserves of high grade (plant grade-PG) bauxite are exhausting. The resources of low to medium grade bauxite is abundant.
Western Ghats & Coast Kerala	Charnockite, Sandstone of Varkala and Quilon formation; Low level (Coastal) Pockets in laterite	Medium Al_2O_3, at places high SiO_2, low TiO_2 and traces of CaO Gibbsitic, part of silica as quartz	Moderate (BWI 13–16 kWh/t) High grade bauxite is in pockets
Karnataka	Deccan trap basalt, Dharwarian meta sediments, Granite gneiss; irregular lenses in the laterites	Medium Al_2O_3, SiO_2 low TiO_2 and traces of CaO Gibbsitic at places mixed gibbsitic-boehmitic	Moderate to hard (BWI 13–17 kWh/t) High grade bauxite exposed at some places
Tamil Nadu	Charnockite High level deposits	Moderate alumina & high silica Gibbsite major mineral	Moderate (BWI 10-14 kWh/t)

4. Conclusions

- In India, the high-grade bauxite deposits are small and scattered. The group of small deposits comprising of favorable Chemico -mineralogical, physical characteristics may be viable for utilization. The technological evaluation of the deposits are necessary to identify resources of high alumina low iron bauxite.
- Bauxite for non-metallurgical industries (calcination, refractory) meets very rigid physicochemical requirements and specifications particularly for constituents like alumina (Al_2O_3 %) and iron oxide (Fe_2O_3 %) compared to ore used for the metallurgical industry. The price of imported calcined bauxite varies depending on the quality and parameters. As far as Indian bauxite is concern, it may be more economical to find an indigenous source/option for complex mining and by using low -medium grade bauxite by adopting suitable beneficiation techniques. It is suggested to properly segregate both grades of bauxites while mining.
- The laboratory test results show that it is possible to produce high alumina low iron bauxite by integrated beneficiation processes. The studies indicate after beneficiation, the processed ferruginous ore could be used in the production of calcined bauxite.

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