BX05 - Beneficiation Aspects of Low-grade Unutilized Materials (Partially Lateritised Khondalite and Laterite) Associated with Bauxite Mine

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Abstract

Lateritic bauxites are the products of intense subaerial rock weathering. The resources of bauxite in the Country are in the order of 3850 million tones and occupy 5th position in World. The major deposits are in East coast, Central India, West coast and Gujarat however, the occurrences of Laterite are widespread in various regions. Bauxite deposits consist of four horizons namely Duricrust (Laterite), Bauxite, Partially Lateritised Khondalite – PLK/ Saprolite (weathered) and parent rock which is responsible for formation of bauxite ore. JNARDDC has evaluated bauxite and laterite deposits of India from geo-technological point of view. The bauxite mines/ deposits are associated with various low-grade materials and it remains unutilized at mine site due to their inferior composition. For utilization of these low-grade materials, quality of the same has to be improved.

Keeping in view the improvement in quality of low-grade materials, beneficiation studies have been carried out at JNARDDC. The PLK contains high silica, iron oxide, low alumina and resembles the characteristics of alumino-silicate materials. In general, laterite is originated from various rocks and comprises iron oxide, silica and alumina bearing minerals. The beneficiation studies have been done on PLK and laterite (ferruginous, aluminous, siliceous) indicated that the ore can be upgraded with relevance to reduction in iron oxide, silica and enrichment in alumina content. At present, India is importing alumina containing raw materials required for non-metallurgical applications (refractory, chemical, etc.). The beneficiation studies have shown great promise to be developed as a substitute for the applications requiring high-grade ores. This will have a significant effect on the life of bauxite mines as well as dwindling natural resources.

Keywords: Bauxite mine, PLK, laterite, Eastern Ghats, Western Ghats, beneficiation.

1. Introduction

India is endowed with abundant resources of bauxite and the deposits/occurrences are in various parts of the Country (East coast/Eastern Ghats, Central India, West coast/Western Ghats and Gujarat). Various factors such as composition of parent rock, origin, geomorphology, process of bauxite formation, etc. are responsible for the characteristics of bauxite and laterite ore. The bauxite deposits associated with PLK and laterite (Overburden) are in East Coast region however, deposits situated in Central India, Gujarat and West Coast are associated with laterite and saprolite resources. During the bauxite mining, various low-grade materials such as saprolite, low grade bauxite, laterite, PLK are generated. However, these are discarded off due to their inferior composition. These materials have characteristics of low alumina, high silica and iron content.

Due to this inferior quality, these materials could not be used for alumina production or other industrial applications. Hence, they remain unutilized at mine site. The National Mineral Policy (NMP-2019) has emphasized utilization of small group of deposits along with mineral wealth. The occurrences and isolated deposits of bauxite and laterite are scattered all over the Country and available for economic extraction of mineral values. Keeping in view the improvement in quality of low-grade materials, beneficiation studies has been done at JNARDDC. The studies carried out on PLK, ferruginous, aluminous, siliceous laterite indicated that it can be upgraded with relevance to reduction in iron oxide, silica and enrichment in alumina content. India is having limited resources of high-grade, high alumina bauxite ore and in the current scenario, country is importing raw material required for non-metallurgical applications (refractory, chemical, etc.) to overcome the material shortage. The positive impact on cost anomaly as well as life of mine may appreciably increase by processing inferior material associated with bauxite horizon. The optimum use of in-house resources of available raw material associated with bauxite mines requires proper data and information in order to establish their suitability for industrial uses. This paper describes various beneficiation techniques attempted for upgrading quality of various materials which are not in use, because of its inferior quality with respect to the applications.

2. Sampling and Characterization

For the present study, the representative samples of PLK and laterite were collected from bauxite deposits located in Eastern Ghats (Panchpatmali, Odisha) and Western Ghats. The Eastern Ghats bauxite deposits contain 12-meter (average) thickness of bauxite with 4-meter laterite (overburden). The bauxite zone is underlying by weathered rock i.e. partially lateritised khondalite (PLK) with thickness of about 6 meter and varies. In Western Ghats and coast (Maharashtra) deposits, the thickness of bauxite is 2.5 meter (avg.). It is pisolitic in nature and contains moderate to high alumina as well as low silica [1]. The laterite (overburden) occurs above the bauxite zone and it is hard, massive in nature with red, pink and grey in colour.

The samples were crushed to -25 mm size by jaw crusher. For the characterization studies, -200 mesh size samples have been prepared by universal mill/ bond mill and thoroughly mixed using homogenizer. The representative sample was drawn by coning and quartering procedure.

The chemical and mineralogical analysis of samples has been done by wet chemical method and XRD with XDB software, respectively. PLK is characterized by high silica (25-35 %), high iron oxide (14-18 %) and quite low alumina (32-36 %) content. Laterite contains high iron oxide (25-45 %), high silica (6-15 %), low alumina (25-35 %) and titania (2-4 %). In some deposits (Kolhapur), laterite contains very low silica (2%). Mineralogical analysis by XRD shows that laterite is comprised of hematite, goethite, kaolinite and gibbsite minerals. The petrology studies indicate that laterite is pisolitic and iron minerals exhibit colloform texture. The gibbsites are cryptocrystalline and pseudomorph after plagioclase feldspars. The morphology studies indicated that laterite contains undeveloped crystals of gibbsite and in some laterites, it is hexagonal in shape [2]. Our studies reveal that in most of the laterite deposits, the gibbsite is not well developed due to partial bauxitisation [3, 4]. In PLK, kaolinite is a major dominant mineral and about 70 % alumina and silica present in the form of kaolinite. The microscopy studies indicated laterite is dominant in hematite, goethite, and gibbsitic minerals and PLK shows kaolinitic texture [5, 6]. It is observed that habit of minerals, crystal shape, etc. are not prominent in low grade ores as compared to bauxite.

3. Beneficiation Studies on Laterite and PLK

The Country's abundant low-grade resources (PLK, low grade bauxite and laterite) are characterized by high iron oxide, silica and low alumina content, which restrict their use in metallurgical as well as non-metallurgical applications. Thus, any beneficiation process which

this technique is that it can be done at mine site, without much environmental impact, with insignificant energy use. The hydro cyclone and WHIMS are good techniques for removal of impurities however, the process requires water. The chemical leaching process is very effective for reduction of iron oxide content. The only disadvantage is that HCl is corrosive in nature. By using minimum acid concentration followed by physical beneficiation, this problem can be solved to a greater extent.

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6. References

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