Research on the Microstructure and Reaction Properties of Ferrous Mineral in Laos Bauxite

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Abstract

This article mainly studies the reaction properties of Laos' laterite bauxite. Research on the microstructure of hematite, goethite, ilmenite and distribution characteristics utilized existing analytical methods such as Scanning Electron Microscope (SEM), Energy dispersive X-ray spectroscopy (EDS), and X-ray diffraction analysis (XRD). More goethite can affect red mud settling velocity, high temperature digestion can improve the dissolution of the Laos bauxite significantly and moreover, the hematite ore cannot react to bauxite components and sodium-aluminate solution then transfer to the red mud.

Keywords: Microstructure; Ferrous mineral; Reaction properties.

1. Introduction

The primary use of bauxite ore is for the extraction of metallic aluminum in the aluminum industry, as refractory materials and abrasive materials, and as raw materials for high aluminum cement [1]. At present, the related research of various minerals in bauxite is mainly based on X-ray diffraction (XRD), DTA-TG thermal analysis [2], infrared spectroscopy (IR) [3] and other characterization methods. It is difficult however, to reflect the influence of the existing state and distribution characteristics of minerals on the digestion performance of bauxite. In this article, the microstructure and composition of bauxite were characterized by scanning electron microscope (SEM), energy disperse spectroscopy (EDS).

Laos's bauxite was chosen as a typical representative iron-rich bauxite and is of great significance for solving the problem of the current shortage of high-quality bauxite in China. A Laos laterite bauxite was studied, its main ore phases beinggibbsite, hematite, goethite, with secondary minerals of kaolinite, quartz, and ilmenite. In addition, there are scattered minerals such as phosphosiderite, chlorite, and zircon. Since different kinds of iron minerals directly affect the settling performance of red mud slurry [4], the technological test conditions of laterization bauxite were obtained through settling performance tests of digestion slurry and the selection of the type and dosage of flocculant.

2. Sample Preparation and Research Methods

The following process was followed to prepare samples for analysis:

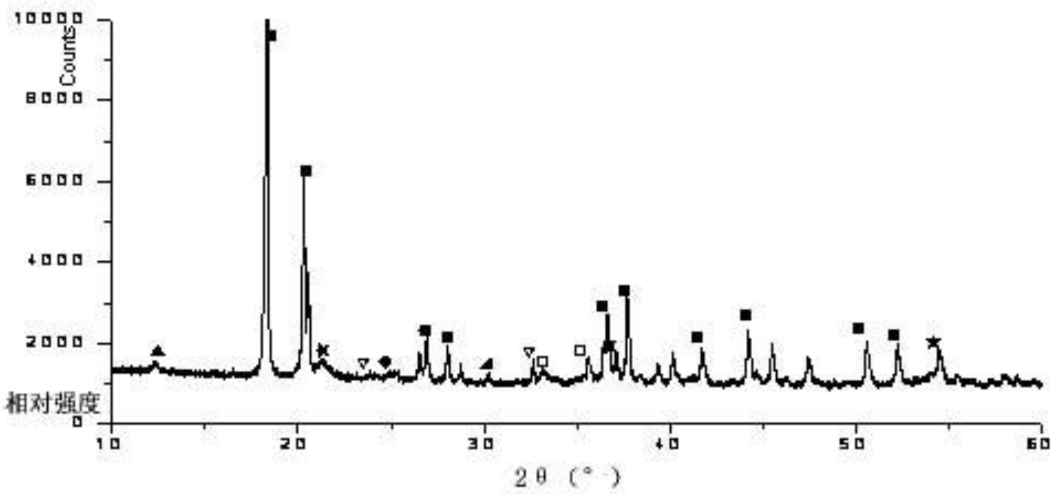
1. Red-brown and yellow-white block samples were selected from the raw ore and crushed to flakes to obtain a fresh section of the ore
2. The sample was smoothed back with sandpaper and placed in a beaker filled with absolute ethanol
3. Ultrasonic cleaning was undertaken for 8 minutes to remove debris attached to the surface
4. After the ethanol was volatilized, the sample was fixed and sprayed onto carbon to obtain a sample for SEM and EDS.

In order to compare the results, diffraction and polarization samples were also prepared for typical iron-bearing ores. The ore phase was measured on ORTHOLUXIIPOL-BK polarizing microscope from German Lerzt Company. Ore composition was performed on X'pert pro X-ray diffractometer from Netherlands PANalytical Company. Component analysis was conducted on JEOL JSM-6360LV scanning electron microscope and Oxford energy spectrum.

3. Results and Discussion

3.1 Analysis of Ore Phase

The phase of the reddish-brown raw ore was analyzed by XRD. As shown in Figure1, the sample is mainly composed of gibbsite and alumogoethite, and contains hematite, ilmenite, magnetite, kaolinite, quartz and other minerals. The main iron minerals are alumogoethite, hematite, ilmenite and magnetite.



■ Gibbsite ; ★Alumogeothite ; ○ Hematite ; ▽ Ilmenite ;
◆ Anatase ; ▲ Kaolinite ; ● Quartz ; ◢Magnetite

Figure 1. XRD of Laos's bauxite.

3.1.1 Alumogoethite

Alumogoethite is a mineral produced by in-phase replacement of aluminum. It is common for iron to be replaced by aluminum in goethite of gibbsite to form alumogoethite. Due to the different amount of substitution, the morphology of the formed alumogoethite is not very similar and is mainly present as heterogeneous and amorphous aggregates.

The replacement rate of aluminum can be determined by:

- Alkali treatment, washing, filtering, and then acid treatment, washing, filtering, drying of a weighed amount of sample to produce a certain amount of residue.
- Analysis of the chemical composition of the residue, to obtain the d value of the diffraction peaks of the (111) and (110) crystal planes of the goethite by XRD [5]
- Calculation of the displacement rate of aluminum in the alumogoethite: Al mol % = 21, and the molecular formula of alumogoethite can be determined as $Al_{0.21}Fe_{0.79}OOH$.

the influence of iron minerals on the dissolution conditions of bauxite assists in understanding their possible interaction in industrial production. The results reveal that higher levels of goethite can affect red mud settling velocity, and that high temperature digestion can significantly improve the dissolution of the Laos bauxite, confirming that the bauxite can meet the requirements of industrial production when processed under a certain alkali concentration and digestion temperature, followed by the addition a certain amount of flocculant when red mud is separated.

5. References

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