

## Study on New Technology for Alumina Production from High Carbonate Bauxite

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### Abstract



In the production of alumina using the Bayer process, high concentrations of sodium carbonate in the circuit will cause a series of problems such as operational instability, increased energy consumption and decrease in product output. This paper explores the utilization of high carbonate bauxite and a wet removal method to remove most of the carbonate from the ore before the digestion process. Data suggests that the removal rate of carbonate in bauxite can exceed 81.06 % which reduces the adverse effect of carbonate in ore on production process. This removal process provides a new idea for the efficient application of high carbonate bauxite.

**Keywords:** Carbonate, Bauxite, Wet removal.

### 1. Introduction

With the development of the alumina industry in China, the bauxite quality in China has decreased rapidly. It is noted that the variability of the gangue mineral type and constituent profile within the ores has increased gradually, especially as it relates to their carbonate content. In the process of alumina production, the carbonate in bauxite reacts with the alkali solution through slurry preparation, pre-desilication and high-pressure dissolution; these reactions generate sodium carbonate [1]. This sodium carbonate generation results in the increase of the sodium carbonate concentration within the process leading to a series of problems related to the refinery production. This phenomenon is observed in the smoothness of the flash steam discharge; if sodium carbonate precipitates in the digestion slurry flash process, water or washing liquor injection is used in many instances in the last few stages of flash process to ensure the continuous system operation. The water addition results in the heat balance of the leaching process being broken and the digestion steam consumption is increased.

With the increase of sodium carbonate, the viscosity of slurry and liquor in Bayer process increases resulting in the increase of power consumption related to conveying slurry and liquor as well as the deterioration of filtration performance and the production capacity of vertical plate filters, flat plate filters, and the increase of filters cleaning times. With the viscosity of sodium aluminate solution increased, the precipitation efficiency and alumina production decreases. In the evaporation process, due to the increase of sodium carbonate, the salt discharge pressure of forced circulation is increased, which leads to the increase of evaporation steam consumption and decrease of evaporative capacity; the evaporator cleaning cycle is also shortened.

There are three common ways to eliminate sodium carbonate from a production system. The first approach is evaporation crystallization to eliminate the salt in high concentration. In this process the liquor is evaporated to a high concentration to achieve the supersaturated state crystallization and eliminate the salt. This is one of the widely used methods for alumina plants; though effective,

some implications of this method are higher implementation cost and reduced evaporation capacity thus making this method unsuitable for long-term operation. If the exhaled salt causticity is not complete, it will return to the process [2-5]. The second method is the causticization of the red mud washing liquor to eliminate sodium carbonate. This method involves utilizing suitable red mud washing liquor for causticization under the required process conditions to produce sodium hydroxide from sodium carbonate. The process is simple and the operational cost is low, however, the reduction of the sodium carbonate content in Bayer process has a slow effect, and the alumina loss rate will increase correspondingly when the causticizing efficiency is pursued. It is difficult to achieve the desired effect in a short period by applying this method, and it needs to be used in combination with other carb-alkali exclusion processes [6-8]. The third method is causticizing by using barium salt to eliminate sodium carbonate. This method takes advantage of the characteristics that most salts of barium are insoluble in sodium aluminate solution to eliminate sodium carbonate. However, Ba(OH)<sub>2</sub> and BaO are expensive and the process has higher operational costs; additionally, gases and dust harmful to human health are produced in the process of calcination of BaCO<sub>3</sub> and BaSO<sub>4</sub> for regeneration, which pollutes the environment [9-11].

In this paper, a high carbonate bauxite from Guizhou, China is taken as the object. Through laboratory research, the influence of different operating conditions on the carbonate removal from high carbonate bauxite is discussed. It is thought that if most of the carbonate is removed before the bauxite enters the digestion system, it can effectively reduce the adverse effects of carbonate on the Bayer process.

## 2. Test Raw Materials

### 2.1 Bauxite

The bauxite was obtained from an alumina plant in Guizhou, China., the main chemical composition of the bauxite (%) are: Al<sub>2</sub>O<sub>3</sub> 47.19, SiO<sub>2</sub> 9.25, Fe<sub>2</sub>O<sub>3</sub> 27.63, TiO<sub>2</sub> 2.13, K<sub>2</sub>O 0.72, Na<sub>2</sub>O 0.024, CaO 0.26, MgO 0.49, TC (total carbon) 0.78, TOC (total organic carbon) 0.21, TIC (total inorganic carbon) 0.57. The main mineral composition (%): diaspore 46, chlorite 16, illite 7, kaolinite 5, hematite 15, siderite 8; anatase, 1.7, rutile 0.4. The alumina content in the bauxite is 47.19 %, the total inorganic carbon content is 0.57 %, the main aluminum bearing mineral is diaspore, and the carbonate mineral is siderite. The X-ray diffraction pattern of bauxite is shown in Figure 1.

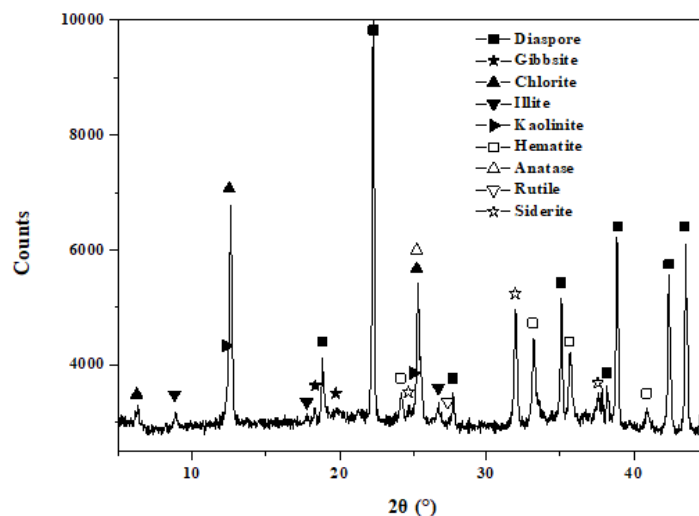


Figure 1. X-ray diffraction pattern of bauxite for the test.

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