

## Methods to Reduce Carbonate Content during Alumina Producing Process

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### Abstract

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Reaction of carbon-bearing raw materials during digestion process is the main source of carbonate in alumina production. High carbonate content in the liquor brings serious problems like negative effects on the production, deterioration of process efficiencies, resulting in alumina production cuts and rising costs. At present, carbonate removal mainly depends on the high concentration evaporation crystallization salt removal method, while red mud washing liquid causticizing and barium salt causticizing methods are also being investigated. To reduce the carbonate during alumina production process, in addition to strictly control the raw materials with high carbon content, we should also conduct laboratory research on different bauxite, understanding the anti-causticisation behavior of the ore in the process of digestion, and study the most appropriate way of evaporation crystallization precipitation and discharge, to provide theoretical support for production practice; tracking and establishing data analysis database to find out the influence law of carbonate index. Based on the laboratory results, "high temperature and low calcium" digestion process is proposed, except for adding tablet alkali and liquid alkali to assist evaporation-assisted salt removal.

**Keywords:** Carbonate, Carbonate Removal, Anti-causticisation, High-temperature, Low Calcium, Vaporation-Assisted Salt Removal.

### 1. Sources of Carbonate during Alumina Producing Process

The main sources of carbonate during alumina producing process including the anti-causticization reaction of calcium carbonate, magnesium carbonate, and magnesite containing in bauxite and lime during digestion process, that reaction between carbon dioxide in the air and liquor, in addition companies involved in sintering or chemical alumina processes may also transfer carbon-based alkaline solutions into bayer process systems.

CaO mass content in Henan bauxite is 0.6-1%, while that of MgO in Jinbei and Guizhou is about 0.5%. CaO and MgO are likely to exist in the form of limestone, magnesite and dolomite, which can react with caustic during high-temperature digestion process, resulting in caustic loss and carbonate content increasing, which is the cause of Nc/NT is higher than 10% in Huajin Aluminum using Henan bauxite, Shanxi Northern bauxite and Guizhou bauxite.

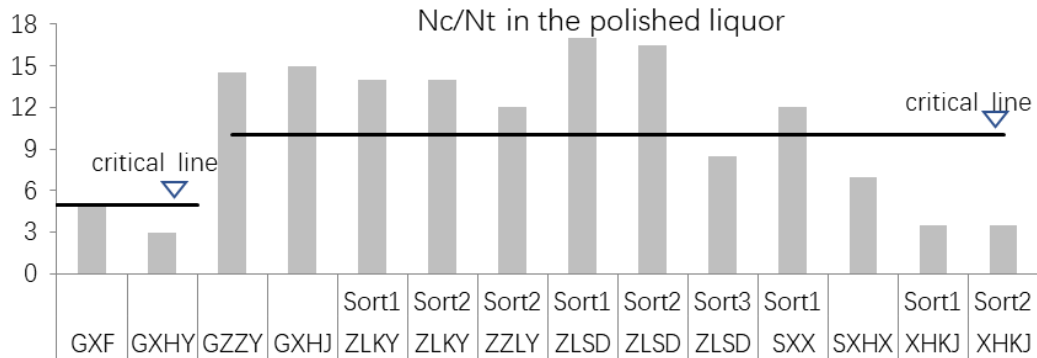
Bauxite in Shanxi Xiaoyi also contains a certain CaO, such as Chinalco Shanxi new material bauxite contains 0.9-1.3%, Xing 'an Chemical bauxite also contains 0.5-1.0%, but the total carbon ratio of these two enterprises is less than 6%, of which the form of CaO in bauxite is not limestone, but calcium salt in other minerals.

Another source of carbon alkali is the poor quality of lime as a leaching additive, which contains much unreacted limestone. Unreacted limestone content is directly related to the quality, the

chemical composition, particle size, calcination conditions of limestone, which will conduct anti-causticization reaction during digestion process.

### 1.1 Effects of Carbonates on the Bayer Process

In the Bayer process, Nc/Nt generally has a critical point, lower than which will not have a great impact on the production system, while higher than the point, generally will have a great impact on the production system. Detailed information are shown in Figure 1.



**Figure 1. Nc/NT index in the polished liquor from some alumina production enterprises.**

The critical point of polished liquor changes with the Bayer systems, for instance, based on the Figure 1, it can be seen that the critical point of two alumina enterprises in the south is about 5.5 %, while the critical point of other alumina enterprises is about 10 %.

The increase of carbonate in alumina production will cause steam with alkali during evaporation process, making production difficult. The influences of carbonate rise on Bayer process are as follows [1]:

1. Increasing material stream traffic, affecting the increase of power consumption. Making the fluidity of materials poor, separation and filtration difficult, decomposition increasing, and the performance deteriorated.
2. Reduced cycle efficiency.
3. Making the preheater and evaporator scarred, which affects the heat transfer efficiency, increases the steam consumption and reduces the dissolution rate.
4. Influencing the granularity and grading efficiency of AH products.

## 2. Methods to Carbonate Removal

There are three common ways to remove carbonate from the production system, including high concentration evaporation crystallization, red mud washing liquid causticization, and barium salt coprecipitation methods.

### 2.1 High Concentration Evaporation Crystallization Method

High concentration evaporation crystallization method is to evaporate the seed mother liquor to high concentration through the evaporator, so that the sodium carbonate reaches the supersaturation state of crystallization precipitation, which is discharged in the form of filter cake through sedimentation filtration, followed by dilution with water, lime causticization,  $\text{Na}_2\text{CO}_3$  is converted into NaOH and returned to the production process.

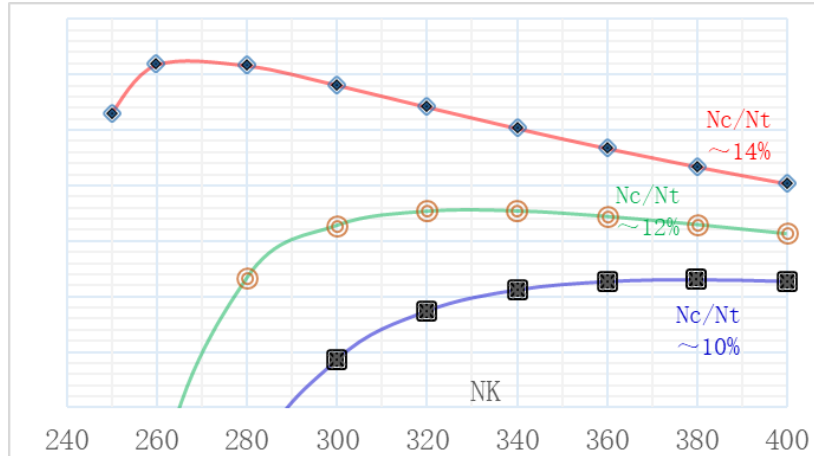


Figure 2: Effects of Nc/Nt on the appropriate salt disposal concentration

According to the production system Nc/Nt situation, determining the appropriate salt solution concentration, too high or too low are not appropriate.

e. Solid and liquid alkali assisted evaporation

It is necessary to add solid and liquid alkali continuously and evenly to stabilize the concentration of solution. Under the condition of constant solution concentration, the lower the concentration of alkaloid, the lower the amount of carbon alkaloid precipitated. With the same salt discharge concentration, the order of salt amount precipitated from low to high with different incoming chemical caustic soda is: flat plate washing liquor < using evaporative stock liquor < using flash discharge material < using liquid alkali < using solid caustic soda.

f. Causticizing efficiency

Caustic index: Nk of caustic stock is 30 g/L ~ 50 g/L, Nc/Nt of caustic stock is 0.5 ~ 0.7, Nc/Nt of caustic liquor is about 0.06 ~ 0.08. Causticizing time and temperature: duration time 2-4 hours, temperature of greater than 85 °C. Caustic liquid whereabouts: caustic slurry settlement separation, overflow back to the evaporation liquid, bottom flow sent settlement two washing tank.

#### 4. Conclusions

Through strengthening raw material control, increasing red mud take away, strengthening salt removal using evaporation. In order to reduce the carbonate in alumina production system, controlling the carbonate entering, while increasing the carbonate discharge and causticizing efficiency. The solution of "high temperature and low calcium" is beneficial to maximize the removal of carbonate together with red mud, determining the optimal concentration range of carbonate fishing, strict technical conditions of carbonate causticizing, and improving the causticizing efficiency are conducive to deal with carbonate problem during Bayer process.

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