

AA17 - Characteristics of Sodium Oxalate Precipitates from the Bayer Precipitation Process.

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Abstract:



Sodium oxalate is an impurity in the alumina production (Bayer) process. It circulates and accumulates in process liquor and at a critical concentration, precipitates in the precipitation area of the Bayer process, with negative impacts on product quality. The morphology and some characteristics of sodium oxalate precipitated under different Chinese refinery process conditions were studied with X-ray diffraction (XRD) and scanning electron microscopy (SEM). It was found that the oxalate from all process conditions examined precipitated as roughly spherical particles, although the size and other characteristics of the precipitated sodium oxalate particles varied with the different refinery process conditions. The oxalate precipitates examined contain two significant mineral components, sodium oxalate and aluminum hydroxide, which varied depending on the process conditions. This study's findings provide a useful input into the selection of sodium oxalate removal technologies for these refineries, and others with similar sodium oxalate precipitates.

Keywords: Sodium oxalate, aluminum hydroxide, precipitation, spherical particle, surface structure characteristics.

1. Introduction

Sodium oxalate is an impurity in the alumina production (Bayer) process, and mainly comes from two sources. The primary source is from the dissolution and decomposition of organics in bauxite during the bauxite digestion process [1], where organics are broken down under the conditions of temperature and high caustic Bayer liquor to produce dissolved sodium oxalate, among other organic salts. Another pathway is the further degradation of higher-molecular organics in the recycled Bayer process liquor during redigestion [2,3,4].

With continuous oxalate input from ongoing bauxite digestion, the concentration of sodium oxalate increases in the circulating liquor inventory until it reaches a relatively balanced concentration in the liquor. The equilibrium of sodium oxalate is dynamic, responding to changes in bauxite inputs, temperature and liquor caustic concentrations and other factors in the refinery process, causing its concentration to fluctuate within a small range. After bauxite is digested, the concentration of sodium oxalate in the process liquor is increased. As the liquor flows through the production process, it will be precipitated at a certain point or multiple points in the process. This can be on the walls of precipitation tanks, on the surface of aluminum hydroxide seed [5,6], on seed filters, and during liquor evaporation, and most commonly, it can precipitate as a discreet particle mixed with aluminium hydroxide seed. Due to the precipitation of sodium oxalate in the precipitation area, the concentration of sodium oxalate in liquor is at a lower level at the end of the precipitation cycle. As the Bayer cycle continues, more oxalate is added by bauxite digestion, through the process of both extraction of new oxalate from bauxite organics and degradation of recycled organics in the liquor, increasing the oxalate in the digestion liquor to a higher level.

The precipitation of sodium oxalate has a negative effect on the Bayer process. It will lead to shorter operating cycles for precipitation tanks due to higher scaling, lower the quality of alumina products, increased caustic consumption, and affect the alumina production rate of a refinery [7, 8]. At present, there are a variety of sodium oxalate removal methods, such as red mud washing [9], aluminum hydroxide seed wash with water, lime causticisation [10], crystallization from spent liquor, Bayer liquor calcination (liquor burning), Bayer liquor wet oxidation [11, 12], etc. Due to the large difference between these methods' economics, different refineries choose different oxalate removal technologies based on their own conditions and economics.

Among the multiple sodium oxalate removal technologies, sodium oxalate precipitation during aluminum hydroxide precipitation (or 'oxalate co-precipitation') has advantages over other methods, and is often considered to be a technology with a better overall performance. Sodium oxalate precipitates in various crystal sizes and shapes during the precipitation process. Where the precipitated particle size is significantly larger than that of the aluminum hydroxide seed, a screening device can be added to separate the precipitated oxalate particles from the Bayer liquor and seed, and in doing so, remove sodium oxalate from the Bayer process. During this study of oxalate precipitates in Chinese refineries, it was found that sodium oxalate particles precipitated under different liquor conditions showed differences in particle size, chemical composition and morphology. The morphology and some structural characteristics of the particles precipitated under these different liquor conditions are reported here, and provide a reference to inform a choice of sodium oxalate removal processes and technologies.

2. Material and Methods

2.1. Material

Sodium oxalate particles precipitated in a Chinese refinery using a high temperature (~265 °C) digestion to process diasporic bauxite are shown in Figure 1.



Figure 1. Sodium oxalate particles precipitated from diasporic digestion process.

Sodium oxalate particles from this high temperature process are relatively large, with a diameter of about 2-5 mm. The particles before drying are a dark red color, and after drying are an earthy yellow color. For easy reference, this oxalate from a high temperature process is referred to as

of the fibrous crystals, with many pits, and small amounts of aluminum hydroxide particles may be included during the growth process.

5. References

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