Boehmite Bauxite Usage at Low Temperature Digestion an Case of Study at Alumar Refinery

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Abstract

Boehmite and gibbsite are the major aluminum oxide components in bauxite. These minerals have different dissolution kinetics and solubility under Bayer process conditions and therefore, require different digestion conditions for optimal recovery. The amount of each mineral present in an ore defines the refinery conditions required, affecting mainly red side area design: milling, digestion and clarification. Boehmite is not dissolved under low temperature digestions and subsequent to digestion may promote precipitation of dissolved alumina, causing several impacts such as increasing mud loads on clarification and increased recovery losses. This paper describes the effects, financial impacts and operational strategy of using a boehmitic bauxite blended with gibbsitic bauxite processing in low temperature digestion at Alumar Refinery.

Keywords: Boehmite, Gibbsite, Alumina Refinery, Aluminium oxides, Bauxite processing.

1. Introduction

The most important aluminous minerals in bauxite are gibbsite ($Al(OH)_3$), boehmite (AlO(OH)) and diaspore (AlO(OH)), however gibbsite requires lower digestion temperature to be dissolved (typically ~145°C) as compared to boehmite and diaspore (typically >240 °C), Equation (1 – 2). Accordingly, alumina refineries are usually designed to specifically process one type of bauxite. While boehmitic bauxites are usually processed using ‘high temperature’ digestion conditions (to recover boehmite) in theory a boehmitic bauxite could be processed in a low temperature plant with no or minimal process impact if the boehmite levels were sufficiently low, even though this boehmite content is not dissolved [1], increasing residue amount to clarification.

$$Al(OH)_{3\,(s)} + NaOH_{(aq)} \leftrightarrows NaAl(OH)_{4\,(aq)} \quad (1)$$

$$AlOOH_{(s)} + H_2O_{(l)} + NaOH_{(aq)} \leftrightarrows NaAl(OH)_{4\,(aq)} \quad (2)$$

Alumar refinery (Figure 1) is a consortium owned by Alcoa, South 32 and RioTinto and is designed to typically consume gibbsitic Amazonian bauxite. Therefore, the refinery operates low temperature digestion to optimize alumina extraction and energy consumption.

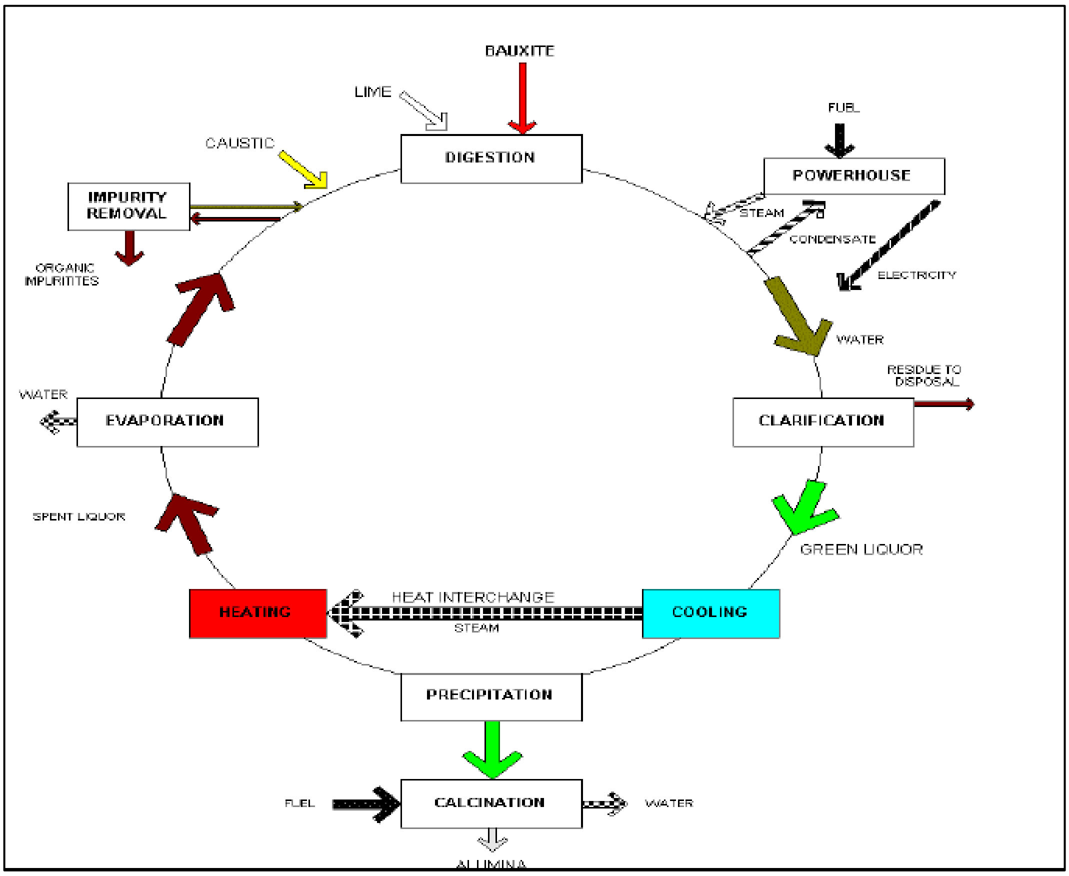

Figure 1. Alumar refinery flowsheet.

During 2017 Alumar received two shipments of bauxite with boehmite content above typical levels when compared to the current Amazonian bauxite. This paper describes the methodology used to process this bauxite and its impacts to the process at a low temperature digestion plant.

2. Methodology

Several risks were involved for the trial. Adding a different bauxite into the process presented operational risks that could result in adverse financial impacts. Therefore, laboratory trials were performed to identify and quantify the risks. The major risks were identified as increased residue load (due to lower available alumina), increased unextracted alumina (boehmite would not dissolve in the low temperature digesters), variations in settling behavior due to bauxite mineralogy and bauxite blending (a stable bauxite blend is required for optimal operation). A Design of experiment (DoE) was developed to quantify the risks and develop countermeasures to define optimal processing conditions. The DoE is summarized as showed in Figure 2 below:

case for the use of the new bauxite was not attractive at high blend ratios. The scope of the trial did not allow a detailed analysis of the root causes of these penalties. However, the trial indicated that the new bauxite could be processed at levels up to 15% with minimal operational disruption.

5. References

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