Settling Ability of Jamaican Bauxite Residue based on Bauxite Feed Constituents and Vessel Design

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Abstract

Since 2015, the bauxite feed to the Jamalco refinery has undergone significant changes in composition, mainly in terms of the available alumina, reactive silica, goethite and phosphorous content. This shift in composition has drastically impacted the plant's alumina recovery, causticity, mud circuit performance and by extension, liquor chemistry and alumina yield. With higher bauxite impurities (mainly reactive silica and goethite), the plant has experienced increased scaling in the vessels, as well as reduced compaction and higher mud viscosity throughout the mud circuit. Other impurities (such as phosphorus), have impacted the plant liquor stability by reducing the available calcium in the circuit. The challenge of bauxite availability for blend specifications is significant and affects the overall production capacity and capital planning of the location. This paper explores the impact of the impurities in Jamalco's bauxite reserves on its mud circuit operation and efficiencies. Furthermore, it seeks to highlight the impact of the inverted cone washer design on the approaches taken for mud settling to maintain the alumina and caustic losses at desired levels.

Keywords: Bauxite residue, goethite, reactive silica, mud settling, available alumina.

1. Introduction

Jamaican bauxite residue is known for its difficulty to settle due to its small particle size and soil-like composition. The associated bauxite feed is typically red in colour but ranges from yellow to dark red based on the relative concentration of the constituent iron minerals, namely goethite and hematite. Jamalco, a low temperature digestion plant, has experienced significant changes in its bauxite feed since 2015. This change has impacted the plant's operations and associated costs due to the feed's constituent iron mineralogy, available alumina, phosphorus [5], and reactive silica.

Research shows that Jamaican bauxite can be categorized into three classifications: Jamaica – 1 (boehmite < 3 %), Jamaica – 2 (boehmite > 3 % and 30 % to 80 % iron mineral as goethite) and Jamaica - 3 (boehmite > 3 % and 90 % of iron content as goethite) [3]. With the decrease in available Jamaica – 1 bauxite reserves, the blending and processing of available pits to meet bauxite specification has become increasingly difficult; which poses challenges for low temperature plants such as Jamalco.

Jamalco's assigned reserves are found in Clarendon, St. Catherine and Manchester in the center of the island, where deposits are interspaced between limestone deposits. This orientation makes the shape and size of the pits irregular, deep and narrow in shape as well as increases the variability of the minerology within the pits. These irregularities underscore the need for efficient and effective bauxite blending strategies to ensure that the correct grade of bauxite is sent to the refinery for processing on a consistent basis.

The deterioration in the quality of the bauxite feed to process has led to a reduction in available alumina from a peak of 44 % in 2015 to a low of 39.6 % in 2018. This is in conjunction with a reactive silica increase from a low of 1.40 % in 2015 to a peak of 3.87 % in 2018 as shown in Figure 1 below. Throughout the period, the plant has experienced a shift in the aluminous minerals present in the bauxite feed, with an increase in the boehmitic content (AlO(OH)), also called monohydrate, from a range of < 1 % in 2015 to 1 - 1.6 % between 2017 and 2018 as well as increase in goethitic content. It has been noted that a strong correlation exists between the goethitic content in bauxite and the soluble phosphorus present [2]. This deterioration in the grade of the bauxite constituents and subsequently the bauxite residue constituents, has resulted in increased mud circuit instabilities. This change has been indicated by increased turbid levels and reduced flocculant efficacy, as well as higher alumina and caustic losses throughout the circuit.

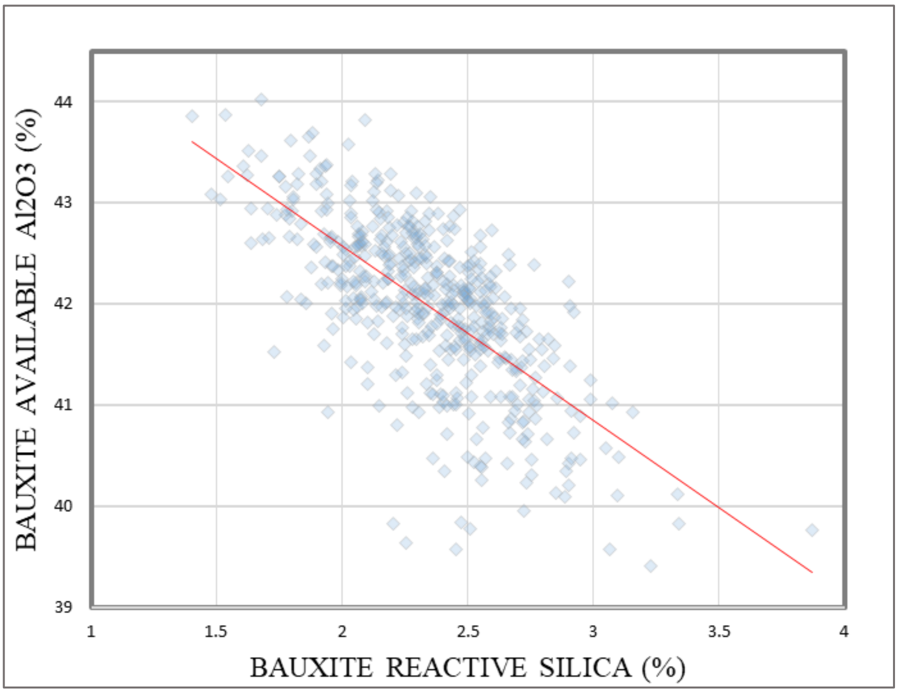

Figure 1. Available alumina and reactive silica in bauxite feed to process.

At Jamalco, it has been recognized that the design of the mud washer plays a critical role in maintaining stability within the washing circuit. Jamalco operates an inverted cone, tangential discharge washer or flat bottom washer as shown in Figure 2 along with high rate last washers. It has been recognized that with the flat bottom washers, the mud is accumulated in front of the rake at the periphery of the vessel, while the mud is accumulated in the cone of the high rate washers. The ability for the rake to push the mud around the flat bottom vessel is the linchpin of the vessel design. This design utilizes two mud discharge outlets (45°) apart, making the movement of mud in the underflow of each vessel dependent on the rake rotation; this means, most of the mud mass at the vessel discharge is removed with the passing of a rake arm infront of the discharge points making the conical bottom design more robust and efficient for mud movement.

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9. References

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