Performance Changes in Alunorte Bauxite Dewatering

Bruno Mendes[1], Bruna Melo [2], Enio Silva[3], Bruno Urakawa[4] and Evandro Leão[5]
1. Process Engineer
2. Process Engineer
3. Process Consultant
4. Process Manager
5. Technical Manager
Hydro Alunorte, Barcarena, Brazil
Corresponding author: bruno.mendes@hydro.com

Abstract

The bauxite from MPSA (Mineração Paragominas SA) is transported to Hydro Alunorte through a pipeline to the Barcarena Distribution Station (EDB), which includes three tanks and a clarifier. The bauxite slurry is pumped from the receiving tanks of the pipeline to the intermediate tank of the bauxite dewatering station. After the filtration process, the bauxite with up to 14.5 % moisture feeds the production lines. The study consists of the historical evaluation of dewatering performance parameters and bauxite quality parameters from 2019 onwards, through statistical comparisons of selected parameters that have been identified in the literature as potential influencers on filtration performance and, more systematically, in the red area process. The material profile during this period indicates changes in chemical parameters, such as a reduction in available alumina and an increase in silica content. Regarding the physical parameters, the comparison analysis of the particle size distribution shows a gradual reduction in particle size and lower pulp density. The concentration of fine materials is typically associated with poor filtration performance, as fine particles lead to smaller capillaries and low cake permeability.

Keywords: Bauxite, Hyperbaric filter, Particle size distribution.

1. Introduction

Bauxite is composed of an impure mixture of aluminum minerals, the most important of which are gibbsite ($Al(OH)_3$), diaspore (AlO(OH)), and boehmite (AlO(OH)). These minerals are known as aluminum oxyhydroxides, and their proportions in the rock vary greatly between deposits, as well as the type and amount of impurities in the ore, such as iron oxides, clay, silica, titanium dioxide, and others. Most economically usable bauxites have an alumina content (Al_2O_3) between 50 and 55 %, with the minimum content for usability being around 30 % [1].

At Hydro Alunorte, bauxites with a high content of alumina trihydrate (Gibbsite) are used due to the configurations installed for the extraction of alumina in the refinery. They are bauxite from Mineração Rio do Norte (MRN) company that arrives at the refinery via ships, needing to go through a milling stage before digestion, and MPSA that is transported to the refinery through a pipeline and already in ideal granulometry conditions for the digestion stage.

The bauxite from Paragominas in the southeast of Pará is sourced from the MPSA company and is transported through the pipeline to the Barcarena Distribution Station (Figure 1), which comprises three tanks and a clarifier. Two of these tanks are for pulp storage, and one is for trail out storage, with a unit capacity of 6,700 m^3 each. The bauxite slurry is pumped from the pipeline reception tanks to the intermediate tank of the Alunorte bauxite dewatering station, which feeds the hyperbaric filters. After separating liquid solids in the filters, bauxite with up to 14.5 % moisture is conveyed to digestion lines 4 to 7 or the bauxite storage yard, as required by the process.

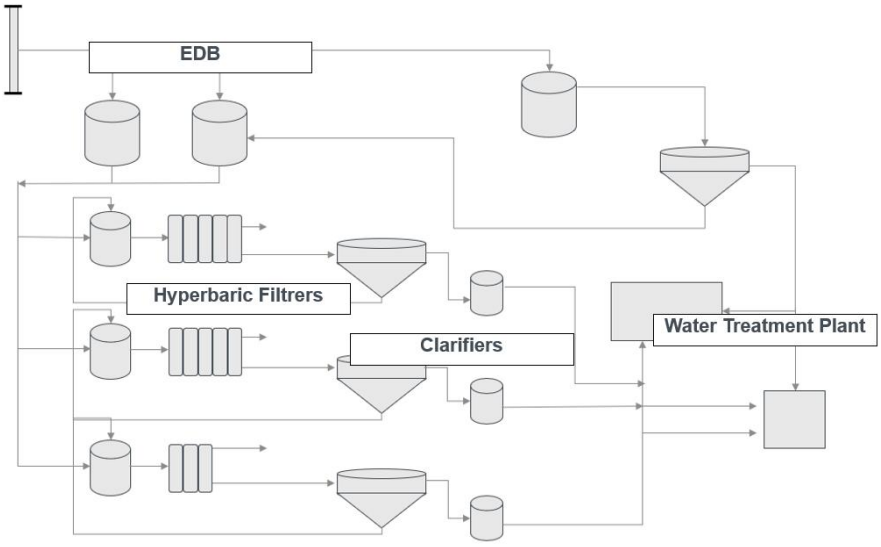

Figure 1. Process Flow of Dewatering Area.

1.1 Objective

The objective of this study is to evaluate the dewatering performance parameters and quality parameters of the bauxite that has been pumped since 2019, using historical data. Where applicable, statistical comparisons will be made for parameters selected based on the literature as potential factors affecting dewatering performance.

2. Bibliography

2.1 Bauxite Mineralogy

Gibbsite, boehmite, and diaspore are the most important minerals contained in bauxites, with the main impurities being kaolinite, quartz, hematite, goethite, rutile, and anatase. The primary distinction between boehmite and diaspore, in relation to gibbsite, lies in their crystalline structure. Gibbsite exists in a crystalline form, while the others are in monohydrate form. The most notable difference between these two types of bauxite is their Fe_2O_3 content. As a guiding principle, refractory bauxite is expected to have higher alumina content and fewer impurities.

The temperature at which bauxite is digested depends on the alumina mineral composition of the bauxite. The most readily extractable hydrate form is gibbsite. Gibbsite can be effectively processed at temperatures as low as atmospheric temperature, i.e., 105 °C. Typically, temperatures in the range of 135 °C to 150 °C are employed to treat bauxite containing gibbsite.

The form of alumina in the bauxite is of utmost importance in the Hydro Alunorte process, which is designed to treat gibbsite bauxites under specific temperature conditions. In this process, bauxite should ideally have a lower content of boehmite. Under the extraction conditions used for gibbsite, the digestion solution becomes supersaturated in relation to the less soluble boehmite. This means that while gibbsite is dissolving as sodium aluminate, alumina is simultaneously precipitating as boehmite on the original boehmite seed within the bauxite already undergoing digestion. Under certain conditions, boehmite can also serve as a catalyst for significant precipitation of gibbsite during mud separation. Fortunately, some boehmite occurs as partially agglomerated masses, reducing its surface area and, hence, its efficacy as a seed for alumina precipitation.

The pulp density, as indicated by the literature and presented in the case study, generally has a positive impact on the filtration process. Based on this scenario, several changes in monitoring and strategy were implemented, including:

- Operate with the high density of the MPSA bauxite pulp;
- Optimization in the monitoring and control of pulp density and recirculation;

The implemented changes yielded a positive impact, with a 6% increase in performance. As a complementary measure, it is recommended:

- Review the fabric specification of hyperbaric filters;
- Perform DOE to measure the impact in t/h of productivity on hyperbaric filters.

5. References

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