BR02 - Bauxite Residue Disposal: One-Step Towards Conversion from Wet to Dry Disposal

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Abstract

CBA has invested in projects and research to further improve its bauxite residue disposal process. One ongoing project will use filter presses to dewater bauxite residue sending the residue to the existing dam, moving from wet to dry disposal system. The project, in addition to further increasing the dam's safety, will lengthen the dam life by 20 years and will increase the caustic recovery from bauxite residue. Recovering the existing liquor inside the dam is an essential condition to dispose and stack bauxite residue processed by filter presses. This condition must be reached before the filters start-up. Several studies were conducted to find the best alternative to achieve this goal. Re-utilizing the liquor in the Alumina Refinery was the best option due to its benefits in recovering caustic and dissolved alumina present in the solution. However, the impurities in the liquor, especially sodium carbonate, must be managed before sending the liquor back to the plant. CBA has developed an improved causticization process. Based on optimum reaction conditions and the use of a 10 tph filter press to separate the calcium carbonate from the causticized liquor. The start-up of this technology allowed returning more than 1.6 million cubic meters of liquor to the refinery, representing around 70% of total liquor volume inside the dam with minimal effects to the process. The calcium carbonate produced by the 10 tph filter press presents a very low moisture content and high purity composition. A study was carried out to verify the compatibility of this material for soil amendment. CBA applies it at Miraí mining, in the environmental rehabilitation process of mined areas, representing an excellent example of circular economy. This paper presents the development, implementation and results of the causticization process. The use of calcium carbonate as soil amendment and its application at CBA bauxite mine is presented as well.

Keywords: Causticization, bauxite residue, calcium carbonate, bauxite mining, environmental rehabilitation.

1. Introduction

Significant technology improvements have taken place in bauxite residue disposal lately. The drivers for these changes are environmental and safety performance, operational efficiency and capital expenditure (Capex) optimization.

Technologies such as dry disposal with filter presses and dry stacking through high solids discharge in thin layers or mud farming are being implemented in many refineries around the world [1].

Companhia Brasileira de Alumínio (CBA) has been working to improve its bauxite residue disposal process. Currently CBA's bauxite residue is filtered in drum filters and then reslurried and pumped to a dam [2]. A project to convert its bauxite residue storage area from wet to dry disposal system, using filter presses, has showed viable and it will increase the dam's safety, will lengthen the dam's lifetime by 20 years and will increase the caustic recovery from bauxite residue [3].

An essential condition to implement the filter presses system is to remove the existing liquor inside the dam. There were more than 2.0 million m³ of liquor. This condition must be reached before the filters start-up.

Several studies were carried out to find the best alternative to achieve this goal. Alternatives like neutralization & discharge and evaporation of the liquor were studied but they are costly and Capex intensive. Re-use the liquor in the plant has proved to be the best option due to its benefits in recovering caustic and dissolved alumina present in the solution. However, the impurities in the liquor, especially sodium carbonate, must be managed before sending the liquor back to the plant.

The effects of sodium carbonate in the Bayer process are very well known. There are many studies presenting and quantifying these effects. A special attention must be given to hydrate precipitation area where the impact of the sodium carbonate can be more harmful [4]. Precipitation yield decrease and the critical sodium oxalate concentration close to the refinery operating conditions are the main effects and they must be avoided. It is important to keep the sodium carbonate concentration as low as possible.

Sodium carbonate removal processes have been studied for a long time. There are different technologies and alternatives to achieve this goal. The formation of the dessilication product (DSP) is a natural removal process. Sidestream and internal causticization, high temperature causticization (HTC), tricalcium aluminate (TCA) inhibitor and salting out evaporation are techniques that could be used to remove the sodium carbonate from the liquor [5].

CBA analyzed all of these possibilities regarding its own facilities and has found an opportunity to use and to improve the traditional causticization process.

A causticization unit with one agitated tank operated with slaked lime and washers overflow in typical sidestream configuration.

Laboratory test were carried out to find the best causticization reaction conditions using liquor from the dam and determine the necessary modifications to the existing unit. An important role is played by a 10 tph, 1.5 × 1.5 m, filter press installed to conduce the bauxite residue characterization, geotechnical studies, and to acquire operation and maintenance knowledge. This filter, showed in Figure 1, was implemented to support the future disposal method conversion based on the use of filter presses to process 100 % of the bauxite residue. With all these studies concluded, the 10 tph filter press has an opportunity to be used in a new role.

The 10 t/h filter press set up was adjusted and the equipment connected to the existing causticization unit. In this way, the calcium carbonate precipitated could be separated with a low moisture and low caustic content allowing a new utilization.

Figure 22. Calcium Carbonate applied at Miraí Mine.

4. Conclusions

An optimum causticization reaction condition was determined in laboratory. It could be replicated in the pilot tests. The results were consistent to those found in the literature.

Filter press could be used to separate the precipitated calcium carbonate with a low moisture and caustic content.

Minor modifications were necessary in the plant and in the filter press set up to causticize the liquor from the dam.

The precipitated calcium carbonate was studied as soil amendment. This study shows that CBA product has the specific characteristics for a safe use as an agricultural corrective for soil acidity, adequately replacing conventional limestone.

These results allowed:

- The re-utilization of the causticized liquor in plant, significantly reducing the volume of liquor inside the dam, reaching the necessary condition to proceed with the disposal method change;
- The use of the calcium carbonate as soil amendment in Miraí mine in the environmental rehabilitation process of mined areas.

5. References

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