Votorantim Metais/CBA bauxite residue: challenges and solutions

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Abstract

Bauxite residue is a worldwide challenge for alumina refineries. Economic disposal for new residue disposal areas, increasing the life of the existing ones, as well as the utilization of bauxite residue as raw material in other industries remains an ongoing struggle, even after more than 100 years of Bayer process existence. No economically viable solution for large scale utilization has been developed yet. Votorantim Metais/CBA's bauxite residue disposal area's life ends in 2019 and there is no possibility for expansion. To avoid a new dam being constructed for its present wet disposal operation, a study was made to evaluate changing the disposal method and its benefits. The installation of press filters using the existing dam presented the best performance, increasing the bauxite residue disposal life to 2050. In parallel, in cooperation with Votorantim Cimentos, a technology to process and use up to 30 % of bauxite residue as raw material in cement production was developed. Good quality cement was produced and the developed technology showed economic benefits for both Votorantim Cimentos and Votorantim Metais.

1. Introduction

The Bayer Process dissolves gibbsite present in Bauxite with hot caustic soda to produce aluminum oxide. The remaining insoluble residue is separated by settling and increasing, filtration. After residue washing for alumina and caustic recovery, the washed residue is transferred to the disposal area. Companhia Brasileira de Alumínio (CBA) produces 420 ktpy of aluminum, generating about 600 ktpy of bauxite residue. This residue is pumped to a disposal area (dam), named Palmital, with remaining disposal capacity until 2019. Currently, the disposal area (Figure 1) contains about 2 million cubic meters of supernatant water. This study is to evaluate alternatives to increase the bauxite residue dam capacity and develop technology to make possible the use of bauxite residue in the cement production.

Figure 1. Companhia Brasileira de Alumínio dam (Palmital).

2. Concept Study

The bauxite residue disposal area was raised to its final elevation in 2008 and will have exhausted its useful volume, 30 million cubic meters, in 2019. The principal dam is 1 000 meters long and 102 meters high. The construction of a new disposal area will require a high investment and due to the local topography it has to be constructed far from the refinery. Obtaining the necessary environmental licenses for a new disposal area will also present a range of challenges. In the face of this scenario, a study was conducted in 2012 to identify and evaluate alternatives to increase the lifetime of the existing disposal area by means of changing the disposal method (Table 1).

Table 1. Disposal method comparison.

Disposal Method	Volume of deposited residue (m3 / year)	Lifetime (year)	Date of end lifetime Ref. Jan/2012
* Wet Disposal	1.347.782	7.5	June/2019
"Dry Stacking"	1.013.493	8.6	July/2020
"Dry Disposal"	748.870	38.2	Setember / 2050

"Dry Stacking" (60 % of solid content) and "Dry Disposal" (75 % solid content) were the alternative disposal methods considered in this study. Comparing different methods to the current CBA wet disposal method, Dry Disposal provided the longest disposal area lifetime (Table 1).

2.1. Dry disposal

"Dry Disposal" consists of the deposition, spreading and compaction of the residue with earthmoving equipment [3]. To make this possible, it is necessary to dewater the residue before disposal to a solid content in the range of 75 % to 80 %. Press filter technology is applied to achieve this range of solids content.

2.1.1. Press filter pilot test

A pilot test using a Filter Press (Figure 2) was performed to evaluate the performance of the equipment and set the specifications to design the full scale facility and produce bauxite residue for geotechnical evaluation (Figure 3) [3]. The filter press was fed with a suspension of bauxite residue with 45 % of solid content and 8 500 kg of residue with 75 % of solid content were produced.

The pilot test confirmed a volume reduction of 40 % in the bauxite residue and showed a caustic soda and alumina recovery of 92 %.

6. Conclusions

Using dry disposal technology with a press filter it is possible to increase the life of the existing disposal area, reduce the residue soda content and store the residue in a more secure and environmentally sound manner.

The new bauxite source, with very low impurities content, and the causticization process will allow use Palmital water with no problems to the refinery.

Adjusting the chemical composition of the bauxite residue is possible to transform it, using a traditional clinker production line, to produce a good quality pozzolanic material. This can be used to replace up to 30 % of the clinker in OPC while maintaining the quality of cement and concrete. When compared to clinker production, the use of bauxite residue to produce pozzolanic material can reduce CO_2 emission as well as decrease fuel consumption. This is due to lower carbonate content in the bauxite residue.

7. References

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