The importance of temperature control in caustic cleaning routines in a Bayer plant

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Abstract

In Bayer process, extracted alumina is 50 % of dry bauxite weight. The remaining consists of impurities, such as, iron oxides, silicon, calcium, titanium and organic material. Some of these impurities are dissolved and they can precipitate in the form of complex compounds in different parts of the Bayer process. This study shows: 1) The importance of temperature control for the efficiency of caustic cleaning. If the temperature of the solution falls below 75 °C there will be formation of complex compounds ($C_4ACO_2H_{11}$) decreasing the efficiency of the solution; 2) Cleaning routines where the solution is prepared with mixing virgin caustic soda and water; the temperature control is essential because this crust in the tissue is formed predominantly by sodium tricalcium aluminate (TCA); 3) In caustic cleaning routines where the solution is prepared using a mixture of virgin soda and spent liquor dissolving capacity is significantly lower. The results of the studies show that increasing the caustic cleaning time will not be a compensation factor. In this case, the temperature control becomes even more important.

Keywords: Bayer process caustic cleaning; temperature control in caustic cleaning.

1. Introduction

Most alumina refineries clarifies bauxite digested pulp using a combination of sedimentation and filtration. More than 99 % of the sludge solids are removed in the decanter, while the remaining solids in the overflow of the decanter are removed by filtration under pressure. The study presents the characterization of mud a decanter, summarizes the process of crust formation in Bayer plant, comments the filtration process and caustic cleaning routines used in the refinery. Caustic cleaning processes were simulated in the laboratory and applied experimental design to measure the influences of variables.

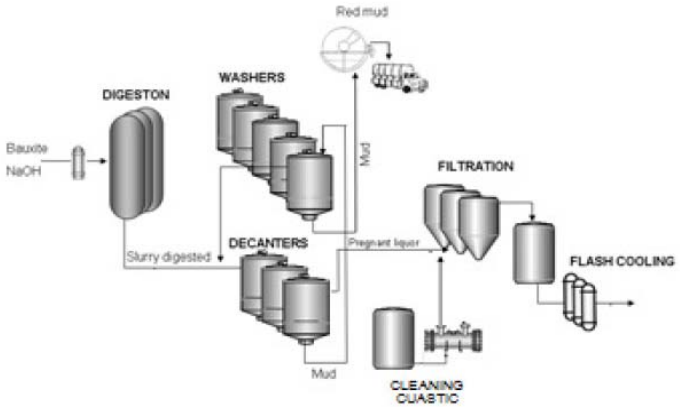

Figure 1. Summary of process.

2. Materials and methods

2.1. Mud characteristic of decanters

Analysis of the decanters overflow of mud were made using scanning electron microscope and a system of dispersion spectroscopy.

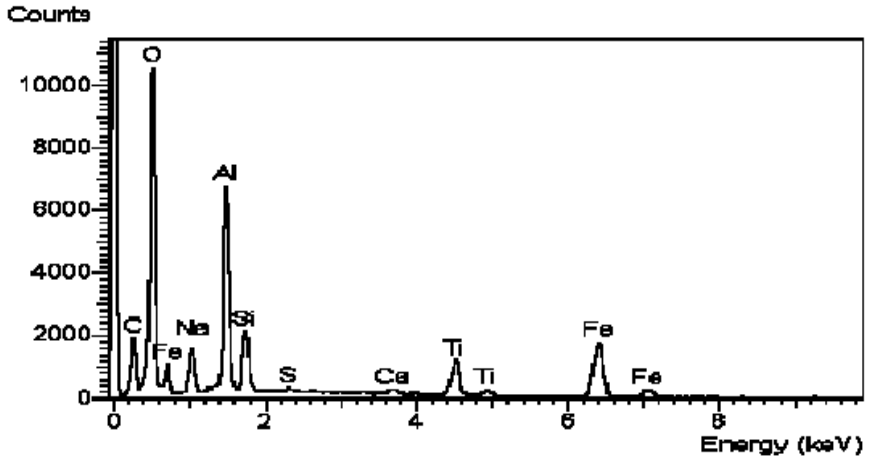

Figure 2. Analysis of the total area. C = carbon, O = oxygen, Na = sodium, Al = aluminum, silica Si =, S = sulfur, Ca = calcium, titanium and Ti = Fe = iron.

2.2. Crust formation in Bayer Plant

In the Bayer process extracting alumina is 50 % of the dry bauxite. The rest consists of impurities such as oxides of iron, silicon, calcium, titanium and organic matter. Some of these impurities are dissolved and can precipitate in the form of complex compounds in different parts of the Bayer process. These compounds and some salts contained in industrial water form different types of crusts in the equipment causing problems in pipes, heat exchangers and tanks.

2.3. Factors influencing the speed of crusting

The operating parameters that determine the composition and rate of formation of crust in the Bayer process are: 1) the composition of bauxite and liquor; 2) temperature of the liquor streams and pulp; 3) stirring so the tanks and speed of liquor / pulp in the pipes; 4) the cooling water of the composition and the lime slurry.

2.4. Filtration

The principle of filtration is to cake formation where the two filtered flows through porous media in series (the cake and the filter medium). The cake grows continuously throughout the operation input by the suspension, and the pie properties depend on the position relative to the filter medium and the filtration time. Of the seven production lines of Hydro Alunorte five use of vertical pressure filters, which are simultaneously fed by the overflow of the decanter and flow of TCA (sodium tricalcioaluminato) system called body-feed. For a good filterability operates with an excess of TCA.

2.5. TCA (sodium tricalciumaluminate)

TCA is prepared by reaction of lime or lime quenched with sodium aluminate solution, usually with pregnant liquor prepared according to the following reactions:

The laboratory apparatus does not reproduce in full the cleaning conditions of the area by the absence of flow. Tests showed that a large part of the crust was dissolved. After cleaning, a simple manual manipulation caused the crust gives off the screens. If there was the possibility to reproduce in the laboratory an incidence of flow possibly this crust on the screens would be removed almost entirely. Soda will be lost if the solution temperature is below 75 °C because the formation of compound $C_4ACO_2H_{11}$ reducing the efficiency of the solution. This phenomenon did not occur during cleaning due to strict control of temperature by 90 °C.

Figure 18. Aspects of the conditions of the sample after caustic cleaning wire mesh 15 hours with the total amount of crust removed.

4. Conclusion

Temperature control is fundamental to the caustic cleaning efficiency in a Bayer plant. If the temperature of the solution is much below 75 °C there will be a loss of control of the caustic concentration, it occurs the formation of complex compounds such as $C_4ACO_2H_{11}$ (calcium aluminate hydrate tricalciumaluminate), soda-consuming and greatly decreases the efficiency of the solution. In tissue rejuvenation routines where the cleaning solution is prepared by mixing virgin soda and water, the temperature control is essential because the crust is predominantly present in the tissue formed sodiumtricalciumaluminate (TCA). In cleaning routines where the solution is prepared by mixing virgin soda and spent liquor, the dissolution capacity is significantly lower. In this case, the temperature control becomes even more critical.

5. References

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