Caustic cleaning quality: Condition crucial to increased system availability in a Bayer plant

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Abstract

Caustic cleaning is critical to the routines of a Bayer plant, guaranteeing the cleanliness of equipment and system availability. The control of temperature and caustic concentration is essential to the solution efficiency. This study shows that: 1) Caustic cleaning time in decantation tanks and mud wash is decreased by 50 % after rigorous control of the temperature; 2) Caustic cleaning time in crust filter is decreased by 80 % after rigorous control of the temperature; 3) Increase of the caustic cleaning time as compensation for loss of temperature will not increase the efficiency of the solution and will compromise the availability of the equipment; 4) There will be no control of the caustic concentration without temperature control. Formation of some complex compounds (for example calcium aluminate hydrate - $C_4ACO_2H_{11}$) significantly decreased the efficiency of the solution in caustic cleaning solutions at a temperature below 75 °C.

Keywords: Bayer process caustic cleaning; control of temperature and caustic concentration; temperature of caustic cleaning solutions.

1. Introduction

Most alumina refineries **cl**arifies 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. This study shows laboratory tests that indicate the importance of temperature control in caustic cleaning process, some caustic cleaning routines that increased cleaning time compromising system availability and industrial tests that have significantly reduced cleaning time with rigorous control the solution temperature above 75 °C.

2. Materials and methods

2.1. Decanting and mud wash

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.

2.2. The composition of bauxite as an important factor in the speed of crusting

The process of problems associated with scale formation would be insignificant if the gibbsite and boehmite were attacked by pure caustic soda and then the precipitated alumina trihydrate was. However, the real situation is quite different from the ideal. Quantities silica variables and organic matter, depending on the quality of bauxite and liquor composition, will dissolve and precipitate. When processing a high reactive silica bauxite (> 1.5 %), it is readily dissolved and reprecipitated in the form of Bayer sodalite. On the other hand, when an ore processing with a low reactive silica content, this dissolves, but is not easily

precipitate in the liquor. In addition, a liquor concentration of soda and the alumina/causitc can retain high levels higher SiO_2 in solution than a soda liquor concentration and ratio alumina/caustic lower. Similarly, bauxites with higher content of organic ash will result in higher concentrations of carbon and sodium oxalate in the liquor. High concentrations of both silica as oxalate, will help to increase crusting speed tanks and pipes.

2.3. The temperature as an important factor in the speed of crusting

The temperature exerts strong influence on the precipitation of silica, hydrate and oxalate. The solubility of silica decreases as the temperature increases. On the other hand, the solubility of the oxalate hydrate and increase with increasing temperature for a given liquor. As the main component of the sodalite crusts, especially in the case of heat transfer surfaces, factors that determine their formation must be studied in more detail. The relative speed of dessilication Bayer different solutions can be calculated from the equations that describe the kinetics of the reactions.

2.4. 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.

2.5. Caustic cleaning routines

Decanters and mud thickener -The solution is prepared with virgin soda and water and pumped into the heated interior of the filter. Heat exchangers guarantee the maintenance of the temperature in the specification. The quality of the cleaning solution is assessed by ratio alumina/soda.

2.6. The influence of temperature and caustic concentration in the cleaning process

Figure 1 (laboratory tests) shows the Pareto chart that ranks the effects on the ratio alumina/caustic in order of significance. The conditions which bars exceed the red line have significant effects. The big influence was the association between the variables caustic concentration and temperature. The isolated variables as well as other associations between variables, did not exercise significant influence.

Figure 2 (laboratory tests) shows the response surface plot for dissolution rate with the cleaning solution prepared with virgin soda and spent liquor, where the maximum response region occurred in the conditions under which the solution parameters were maximum value: 487 g/L, 90 °C and 6 hours. The dissolution rate in the intermediate condition was 90.8 %, also higher than the other studied conditions. This confirms the strong interaction between temperature and caustic concentration. In caustic cleaning solutions at a temperature below 75 °C occurs the formation of some complex compounds (for example calcium aluminate hydrate - $C_4ACO_2H_{11}$) significantly decreased the efficiency of the solution.

2.7. Examples of increase in caustic cleaning time to compensate for the lower temperature of the solution

2.7.1. Routine cleaning filter crust

The cleaning time is seventeen hours. It is not necessary to control the temperature within specification and may decay to below 75 °C. The filter crust is to protect the mechanisms of the

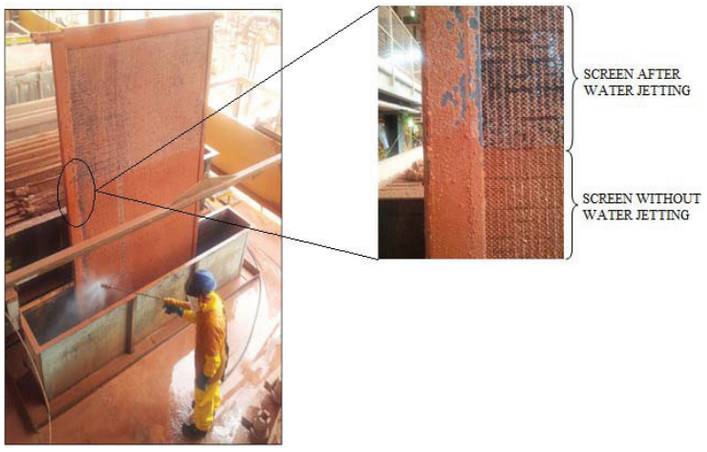

Figure 18. The metal screen conditions after caustic wash 18 hours after blasting with water to remove the present in the interstices crust.

4. Conclusion

The quality of the caustic cleaning solutions in Bayer refinery is monitored by the ratio alumina/caustic. Temperature decrease occurring below 75 °C soda loss occurs due to the formation of complex compounds and a false indication of efficiency. The study showed that it is a mistake to increase the cleaning time to compensate for the decontrol of temperature. This action contributes to deconcentrate the solution and compromises the system availability. The industrial-scale tests have shown that strictly controlling the caustic concentration and temperature of the cleaning solution was greater than 50 % in the availability of equipment. These results point to the need for investments in heat exchangers to ensure the heating of the solutions in the specification 80 ± 5 °C.

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