Alternative Method of Moisture Determination in Bauxite Residue from Press Filters

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Abstract

The moisture in bauxite residue is the main metric for filter performance and a key parameter in a variety of refinery key performance indicators (e.g. processing capacity, dried residue factor, alumina recovery, etc.). In day to day operations, the moisture must be regularly monitored to guarantee filtration stability and protect against other process disturbances. This parameter is typically monitored by thermogravimetric analysis to evaluate if the filters are delivering the residue according to design. Although this method provides good accuracy, it takes a long time to provide any information, delaying the operation's ability to respond to a process upset. This paper will present the results of the development of an alternative procedure, the infrared weighting method, which has reduced processing time by approximately 87 %, while preserving accuracy based on standard statistical methods. This reduction in processing time has allowed the operations team to respond to process disturbances in a timely manner, guaranteeing more stable operations.

Keywords: moisture, bauxite residue, infrared weighting, thermogravimetric analysis.

1. Introduction

The moisture control of bauxite residue from an alumina refinery is critical to several operational and strategic decisions. From this value, it is possible to estimate the capacity, consumption factors, scheduling labor on disposal, etc. Since August 16, the Hydro Alunorte Refinery started the commissioning phase of its new techolonogy for filtration of Bayer process residue, replacing the existing drum filters. The new Press Filters provide a number of advantages related to soda recovery and reduced cake moisture, which will be an important enabler for residue disposal safety. A good knowledge of the material properties is one of the important prerequisites to make good decisions about residue area operations [1].

The most common method to determine moisture in solids is thermo-gravimetric, which consists of weighing the wet solids, followed by drying under controlled conditions, and re-weighing after the drying period. The weight difference is considered to be a measure of free water (or 'moisture'). This techinique allows good accuracy, however, it does demand a delay (typically several hours or more) to provide results. This can cause delays in identifying and rectifying operational and equipment performance issues and/or decision-making.

For other applications, determining moisture using micro-wave weight scales has been adopted, and provides the moisture value in a much shorter time [2]. Determination of moisture content in freeze-dried solids is typically done by Karl Fischer (KF) titration, thermogravimetry (TG) or gas chromatography (GC). These methods are all time-consuming, invasive and destructive. Moreover, the sample to be analyzed may suffer contamination if the measurement is not carried out under appropriate conditions [3].

Until 2013, Hydro Alunorte Refinery used the gravimetric method for all solids in the process. Several studies were done to replace this method due to the differents characteristics of the solids. It was verified that infrared heating was interesting due to the speed of analysis, particularly for product quality of shipments. The method has been applied to hydrate solids, due to the advantages regarding the time of analysis.

The aim of this paper is to present an alternative to the standard thermo-gravimetric method with the minimum difference between the results.

2. Experimental

To evaluate the differences between both methods, the equipment from Hydro Alunorte's Lab were used. The samples used for this study were collected during to the daily routine. Subsamples were taken for analysis by both methods. Figures 1 and 2 show, the dryer used for the gravimetric method and the infrared scale, respectively.

Figure 1. Hot air blower dryers.

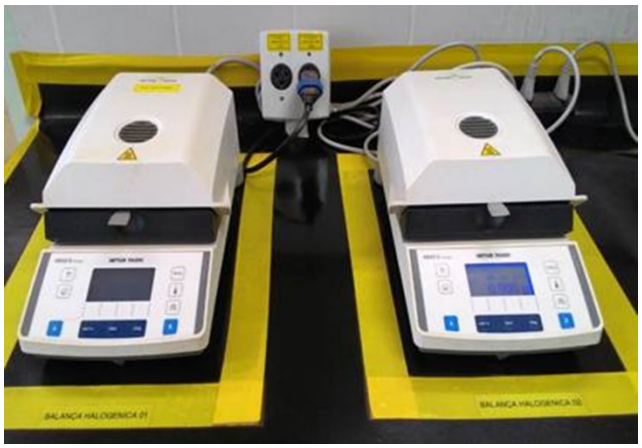

Figure 2. Infrared balance.

For both methods the mosture is calculated using the classical equation for moisture as follows:

$$\% M = \left(\frac{w_f - w_i}{w_f}\right) * 100$$

Where:

w_i Initial weight of sample, g

balance can be used with a 95 % confidence level. This is a great result for Hydro Alunorte, considering there are 7 press filters in operation.

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