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TESTS WITH NEW FLOCCULANT FOR RED MUD DECANTING IN ALUNORTE

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Abstract

To produce alumina with high quality, competitive costs and high efficiency on caustic recover with low flocculant consumption has been a challenge for the filtration area in Alunorte. This area has 3 chains each with 5 washers for 7 production lines where together, handles about 4,4 Mtpy of red mud. Specifically at production lines 6 & 7, the washer chain has only high rate settlers and apart from that, they receive bauxite from Mineração Bauxita de Paragominas. The combination of these two aspects results on lower density in the settler underflows. One of the actions to increase underflow solids content was to replace the conventional polyacrylate flocculant by another one which could be capable to increase the density in the washer underflows. Among other trials were gotten good results from the use of FLOMIN OL 99 polymer in lab tests as well as in the plant. The discussion of these results is the main propose of this paper

Introduction

Currently Alunorte uses for the mud washing circuit, for production lines 6 and 7, two kinds of flocculants that are provided in the emulsion form : EM 1030 SP4 (SNF Floerger) and SUPERFLOC HX 200 (Cytec).

With the considerable increase in the consumption of flocculant, Alunorte initiated a study to evaluate technically and economically other polyacrylate flocculant able to promote better results compared with what used today, ie, another product that was able to improve the density of red mud for greater recovery of caustic and alumina to a more favorable cost condition.

Others polyacrylate flocculants were evaluated in laboratory and the objective was to find the desired results. Among the products evaluated was FLOMIN OL99 (SNF Floerger). After laboratory tests conducted under controlled conditions, the flocculant FLOMIN OL 99 presented results that allowed an evaluation in plant. This article presents the results obtained with plan test with this kind of flocculant that will be reported below.

Company Alunorte

The Alumina do Norte do Brasil SA (Alunorte SA), have 7 production lines that together achieve 6,300,000 tons per year of alumina[1]. With four washing mud chains, each with four washers in series, Alunorte processes 4.4 million tons of mud. Under these conditions the good efficiency of flocculation contributes significantly to the stability of the process.

After starting uses the second bauxite supplier, became a goal for Alunorte using a type of flocculant that contributes to a better density, to a better clarity of the overflow liquor and to a lower consumption, became.

Currently, Alunorte makes use of bauxite from Mineração Rio do Norte (MRN), that needs to go through the process of comminution to better dissolution of alumina available. Also, since 2007, has become a consumer of the bauxite from Mineração Bauxita de Paragominas (MBP). This bauxite is transported by pipeline and goes through a comminution process more improved than in its origin.

In addition to the chemical characteristics present some difference, physical characteristics are not equal between these bauxites, because coming from the MBP has a higher content of fine particles size distribution and superfine particles size distribution.

Under this condition, the newer lines of production (4 & 5 lines ; 6 & 7 lines), which process the MBP bauxite, went through an intense set of flocculant consumption, which rose considerably.

Development

- Laboratory Tests:

At this stage, been verified in the laboratory the behavior of the current poliacryate and three more types of polyacrylate flocculants proposed by three different suppliers, one of those was the own SNF FLOERGER that presented FLOMIN OL 99 [2].

The tests were performed by collecting samples of 1, 3 and 4 washers and conducting flocculation in a test tube, simulating what the best flocculant dosages for each product, so that the sedimentation rate was 15 m / h [2].

In this test, the OL FLOMIN 99 showed the best results being suitable for use in plant evaluation [2].

- Test plant:

The consumption of FLOMIN started on March 15th , 2011 being extended in all washing stages as the sole flocculant in feedwell except in a first stage where had co-dosing with the Cytec HX-200. The trial ended on May 3rd , 2011.

Analysis Tools

The analysis tools were used: Correspondence Analysis, Principal Component Analysis, Boxplot, Descriptive Statistics, F-test for two variances and t- test for two samples [3].

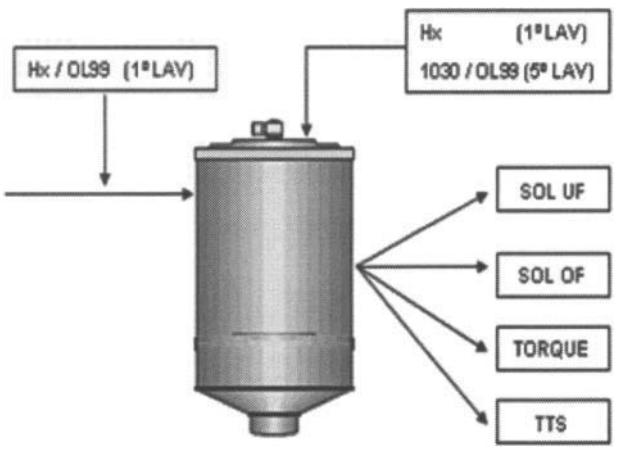
Results

The following results refer to the 1st and last washers. The evaluation techniques used in this study show a first overview of the results (Correspondence Analysis and Principal Components) and then presents a detailed overview of the effects on each importante result variable using Boxplots, comparison of means and variances.

Correspondence Analysis

It is presented as a interdependent technique to visualize as a geographical map, the similarities and dissimilarities of the result variable in the test. It uses the chi-square to standardize the frequencies and form the basis for the desired associations.

Below the figure 1 shows the flow between the input variables, ie, the point of addition of flocculant and the type of flocculant used. It also presents the outcome variables that are: Solids Content at underflow (SOL UF), clarity (SOL OF), the washer torque (TORQUE) and caustic content (TTS or NaOH).



The figure 2 shows the results with respect to the time of operation using the product OL 99 compared to time using the standard flocculant for both 1st and last washer. It can check the points on the graph where there was distance between the respective data for both washers. Although the main effect of distance has been verified in the last washer, it appears that the two washers, while using the FLOMIN OL 99, there were differences in the results of set of variables. What does it mean that the process behaved differently.

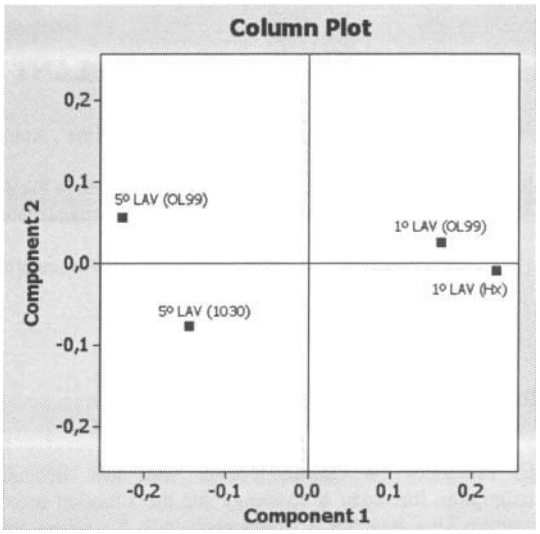


Figure 2. Graph representing the results obtained with the flocculant in the test were different than the current results with the flocculant.

Pricipal Components

The analysis tool had previously presented the difference in results as a whole, now this tool measures the power of each variable on its respective component, which reduces the number of variables most impacted in the process. The amount of information explained by each principal component is its own variance. Following are the results for both the 1st and last washing.

- Effect on the 1st Washer

The figure 3 shows that the variables that were more varied was the solids content in underflow that represents the thickening mud and the washer torque. As for torque, it is expected that it varies with the variation of solids concentration, because this condition will influence the resistance to rotation of the rakes in the tank.

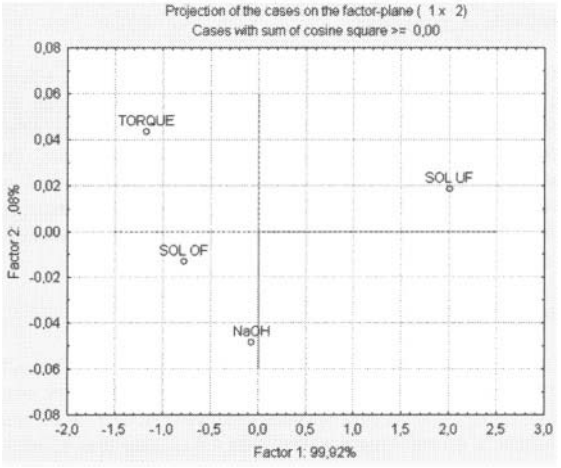


Figure 3. One of the outputs of the principal component analysis shows that greater variation of solids in the underflow and torque.

Whereas one of the main purposes of FLOMIN OL 99 is to improve the thickening mud, Table 1 is another output of this statistics tool and shows that the solids in the underflow contributed 67.2% of the total variability of the process under study.

Table 1. Effect of each variable on the total variability of the process.

	Case contributions	
Case	Factor 1	Factor 2
SOL UF	67,18004	7,20672
SOL OF	10,07561	3,62906
TORQUE	22,67669	39,38612
NaOH	0,06767	49,77810

Statistical tests for comparison of means showed that the greatest density was obtained with the product FLOMIN OL99, and specifically to the first washer, such condition was obtained with a similar flocculant dosage to another product.

- Effect on the last washer

For the last washer, Table 2 shows that the variable with the greatest weight was also solid in the underflow, contributing 74.43% of the total variation of the process under study.

Table 2. Effect of each variable on the total variability of the process.

	Case contributions	
Case	Factor 1	Factor 2
SOL UF	74,43483	0,50615
SOL OF	6,58583	35,67536
TORQUE	12,83662	58,21045
TTS	6,14273	5,60804

The result of the comparison test between means shows that the product FLOMIN OL 99 provided greater density, and this condition was achieved with a lower flocculant dosage, equivalent to half dosage consumed with the current product.

How, among the result variables analyzed, the solids content had a higher significance, below, will be shown in more detail the differences in these variables results, both the first washer and for the last.

- Solids in underflow and flocculant dosage at the first washer

In the period before the use of FLOMIN OL 99 in the 1st washer should consume 1030 SP4, was with the flocculant HX-200 for control of overflow solids. When the test began with FLOMIN OL 99, there was no problem with the replacement of the HX-200 in feed line. The results of the underflow solids concentration showed a significant increase when in use the FLOMIN OL 99, as shown in Figure 4. For the figure, note that there was an increase of 15% of the reference value of underflow solids.

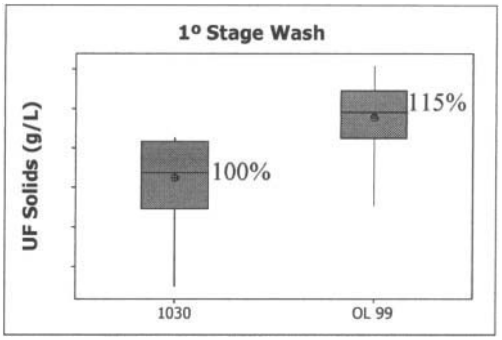


Figure 4. Concentration of underflow solids in the first washer.

- Solids in underflow and flocculant dosage at the last washer

With the use of FLOMIN OL 99 flocculant, the consumption of flocculant in the last washer reduced by 52% of the reference value. Although flocculant consumption has reduced, the solids in the underflow increased by 10% of the reference value. The figure 5 represents the distribution of sample results on the same scale and by boxplots, it can check the differences between the descriptive statistics.

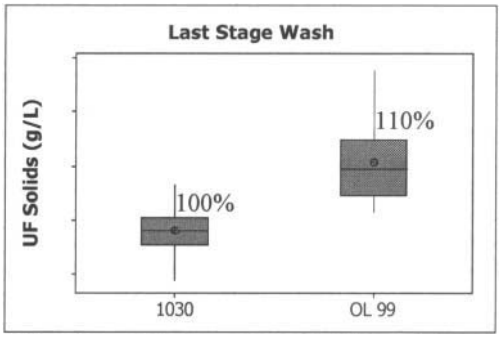


Figure 5. Concentration of underflow solids in the last washer.

Another important variable analyzed to evaluate the performance of flocculant is clarity. Although the principal component analysis has shown that there was no significant difference, due to its importance in the evaluation of flocculant, will be presented following more detailed results of this variable.

- Evaluation of clarity in the 1st washer

Regardless of the type of flocculant used, there was no statistical difference in the clarity of the liquor in an overflow washer, and in both cases the values were below the upper limit, as shown in Figure 6.

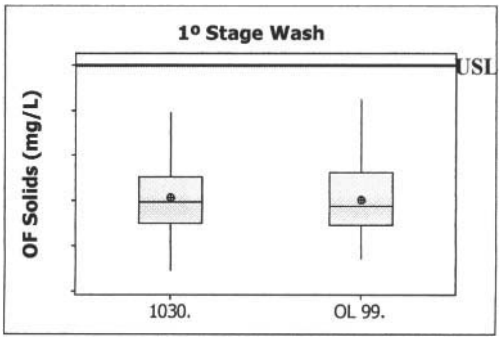


Figure 6. Concentration of overflow solids in the first washer.

- Evaluation of clarity in the 1st washer

In the last washer, using the FLOMIN OL 99 can observe a significant improvement in the clarity of results the order of 31% reduction. The figure 7, it is clear that the results that eventually reach the upper limit for solids overflow reduced both average and in variance.

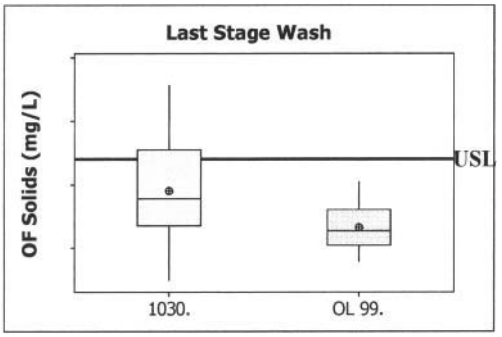


Figure 7. Concentration of overflow solids in the first washer.

Conclusion

During the evaluation in plant of the product FLOMIN OL 99, that can be seen the stability of the process and can appreciate that this product has adapted to the Alunorte's process providing more satisfactory results than those obtained with the current flocculant and that are consistent with the objective of the evaluation of this new product, ie, the washers had a higher density of the mud sedimented and can reduce the consumption of flocculant without affects the clarity, on the contrary, in the last washer to improved clarity.

References

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