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IMPROVEMENT ON THE OPERATION MANAGEMENT SYSTEM OF VERTICAL PRESSURE FILTERS

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Abstract

Polishing filtration is one of the most crucial step of the Bayer process present in alumina refineries. In Hydro Alunorte, five of the seven production lines use Vertical Pressure Filters (VPF) in the polishing filtration and an excessive consumption of filter cloth was observed. The aim of this paper is present the improvements in the VPF operation management system. The actions were done on the process parameters in order to gain durability of filter cloths used in VPF filters. Process control variables, such as solids in the filtered pregnant liquor, filtration rate and VPF pressure were evaluated and become the limiters for programming the filters operation cycles. An automatic preparation control of the caustic wash solution, used to wash filter cloth at the end of filtration cycle, was also done. The useful life of filter cloth increased by 25% and it means about 12% of reduce in operation costs.

Introduction

The polishing filtration area is very important for quality control of alumina because in this phase occurs the removal of the oxides contaminants. In Hydro Alunorte there are 7 production lines that together produce 6,300,000 tonnes per year of alumina [1]. 5 of 7 lines using vertical pressure filters for polishing operation the liquor rich in sodium aluminate (pregnant liquor). The operation of this type of filter requires operational discipline and a good process control, otherwise certainly be noticed impact on quality, production and consequently in the costs.

As Hydro Alunorte is supported by a vast resource of automation, the use of SDCD as a tool to manage the process has contributed to results in stability and reduction of operating expenses. This article is intended to present the results obtained from the optimization of the management process of polishing filtration area of pregnant liquor by automating some routine operations.

Polishing Filtration

After the dissolution of alumina present in the bauxite - which occurs at elevated temperature and pressure conditions - the material containing liquor rich in sodium aluminate goes through a process of series expansions which causes reduction of temperature and also the pressure up to ambient conditions.

Together with the rich liquor are the bauxite residues that remain in the solid phase. This material is composed of various oxides known as red mud.

To obtain the alumina is needed to cool the pregnant liquor for subsequent crystallization of sodium aluminate forming the alumina trihydrate (hydrate). In this crystallization process is critical that the pregnant liquor is at the lowest possible concentration of impurities because such impurities are agglomerated together with precipitating particles and contaminates the final product.

For this purpose, there are process steps which occurs the separation of red mud. Since the red mud has a wide particle size distribution, the first step separates the largest particles and consists of the decantation mud. In this step, the pregnant liquor overflow the settler tank still have a solids concentration in range from parts of solids per million in the liquor. Even still it is necessary to use another process step that filters the liquor reducing this 96% solids concentration. This filtration area suffers serious consequences in terms of production and quality when the liquor has high solids concentration, so the quality control of feeding liquor filtration is critical in the process dynamics.

Figure 1 shows the flow of the pregnant liquor through decanters and vertical pressure filters battery on production lines 4 and 5 where, for each one has six filters operating in parallel.

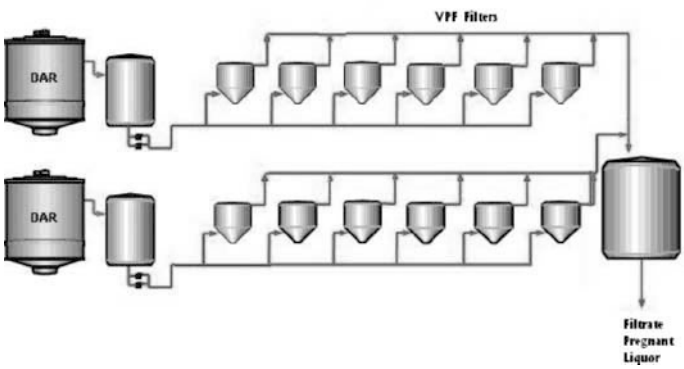

Fig 1. Pregnant Liquor Flow.

The pregnant liquor filtration using vertical pressure filters consists of mixing of the pregnant liquor decanters overflow with filter aid. This mixture enables the formation of a cake on the fabric surface with adequate permeability to guarantee flow filtration to occur without clogging the fabric. After the run operation of the filter, cleaning is required to remove the cake formed on the surface of the fabric, called washing spray, and next this material is drained for the beginning of a new filtration cycle. As the filtrate presents an unstable condition, crystals of alumina trihydrate are deposited on the filter cloth, so the caustic washing step is essential for maintaining the life of the fabric.

Operational management and process this area is quite complex if all items considered to be controlled. Among the items

control this area, some by their relevance in Alunorte Hydro demanded more attention to the study in question and these items were:

1- Pressure filter control;

2- Caustic concenytration of cleaning solution from the filter cloth;

3- Filter AID and mud relation;

Due to the extensive automation framework that has Hydro Alunorte, operational management and process filtration pregnant liquor made use of automatic controls aimed at operational stability of the área.

Development

Pressure filter control

Given that the vertical filter operation with high pressure leads to an increase in solids concentration of the pregnant liquor filtrate to tear in the fabric filter and also hinders control of the availability of filters in the area, we developed an interlocking which forces taking action by the operator when the filter is operating at high pressure.

This interlocking comprises:

When in high pressure, the operator must make a decision in 30 minutes for the pressure to reduce the upper limit specified in the control logic. This decision may be removing the filter or reduce the flow of power temporarily this filter preparing the area to remove it in an emergency, ie, before the time of normal operation. The operator is not complying with the conditions of the filter alarm, it automatically closes the filtration cycle by cutting the flow of liquor power, releasing the valve opening automatic feed liquor only after 40 minutes when the entire sequence of opening and closing of valves automatic spray washing and draining occurs.

This control is intended to force an operational discipline saving the area to further complications delaying the action of the filter removed for immediate recovery, it was observed that amid rising pressure problems that can occur or due to an increase in solids concentration in the pregnant liquor supply or due to deviations in relation filter aid : mud or due to deviations in the quality of filter aid, the faster the filter is removed for cleaning spray or even caustic, the faster the recovery area.

Caustic concenytration of cleaning solution from the filter cloth

The caustic cleaning of the filter cloth is prepared by the operator of the filtration area via control room and consists of a mixture of industrial water with caustic soda. Although there is a tank level indication and the procedure of operation, as the operator during the preparation of the caustic solution, must give the command to each valve in time in addition to continue watching all the other displays of the other areas it operates many often the cleaning solution is prepared outside the control limits caustic concentration.

For low concentration caustic cleaning solution prepared has an impact on the efficiency of cleaning the filter cloth, resulting in the increase of filtration resistance and shortens the life of the fabric. For high concentrations of caustic embrittlement consequently force fabric also reduces its lifetime.

This control comprises:

Mobilizing feed valves industrial water and caustic soda as an indication of tank level caustic solution.

Filter AID and mud relation

For a good operation of filter is required the use of filter aid also called TCA. The addition of TCA should have a ratio so as to ensure the permeability of the filter cake, but also there is no wastage. As the addition of TCA occurred at constant flow, or for any variations in flow of pregnant liquor feed of the filters or the solids concentration of the liquor so as TCA, TCA proportion of solids by solid slurry varied.

Therefore was created a logic to vary the flow of TCA occurs as any variation or discharge of pregnant liquor, or liquor solids concentration or rich in solids concentration of TCA.

Results

Figure 2 shows, for each filter at a given time, the minutes per day worked on the filter with a pressure greater than 3.0 kgf / cm ^{2}.

With the implementation of inter-locking, small problems that caused pressure rise had to be investigated and eliminated for ensuring the production and no more effort than tissue when working with high pressures. With that, today is quickly search the correct action taken by any problem, preserving the equipment is not possible to go unnoticed maintaining production of the filter with high pressure.

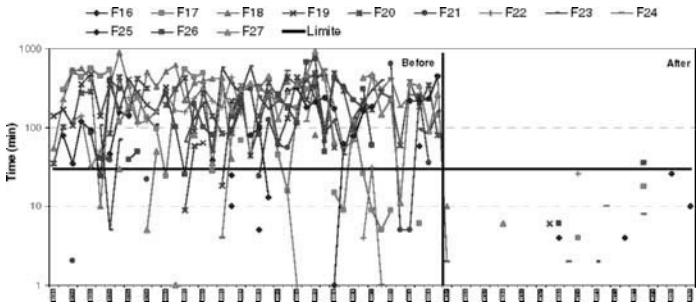

Fig 2. Logaritmic Grafic of Time with High Pressure

Figure 3 shows the plot quality control caustic concentration of cleaning solution from the filter cloth. This graph shows the variability of individual values caustic concentration of cleaning solution, and also evaluates the variability of the sample dispersion to the graphic moving average. On the chart you can

see the wide variation when the preparation procedure manual and the difference was when the procedure was automated generating a significant reduction of the control limits [2].

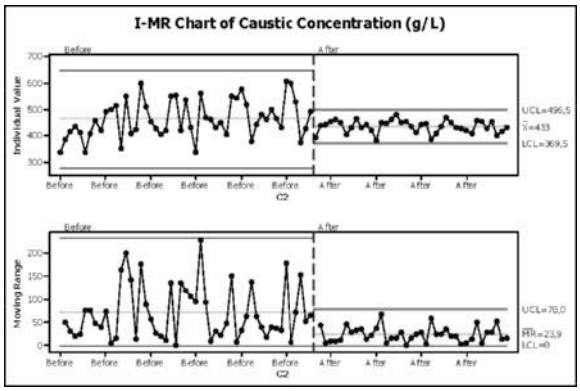

Fig 3. Control Chart of Caustic Concentration of Cleaning Solution

Figure 4 presents the economic results obtained with the improvements implemented in the area of filtration pregnant liquor. The gain can be verified by reducing the number of annual trade fabric 56 to 43.5 equivalent to increasing the number of cycles of operation per year of the filter fabric 108 to 138.

Considering the current cost with filter cloth, annual gain financial was U.S. $ 75,936.00 (seventy-five thousand nine hundred thirty-six U.S. dollars). That represents a considerable portion of the annual budget with filter cloth.

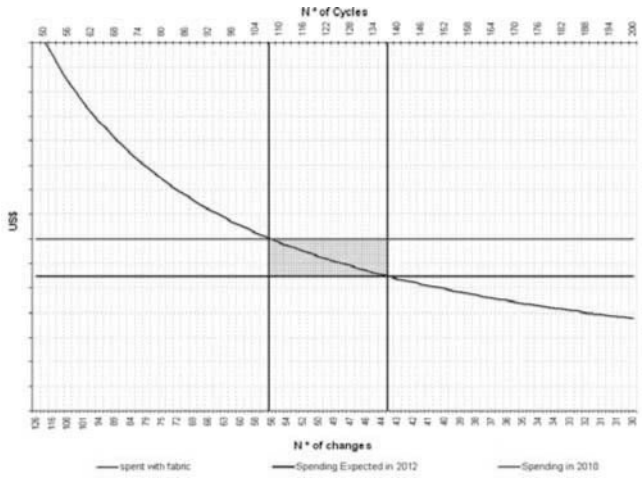

Fig 4. Economic Results

Conclusion

The use of simple control logic has allowed us to improve process controls in Hydro Alunorte. The automation of some routines has allowed the reduction of variabilidadae process due to standardization of operation. The use of this resource without increasing cost has contributed to gains in stability as well as reduced spending.

References

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