Increased Flow Rate and Reduced Filtration Cost by Using Scale Retardant Filter Technology for Bayer Liquor Clarification

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Abstract

Alumina pregnant liquor clarification is carried out in horizontal and vertical pressure leaf filters. In dependence of Bauxite composition and conditions of digestion, scale containing different elements can crystallize on the filtration equipment. The scale reduces volume of tanks, flow in pipes and throughput of filter media. In order to maintain the flow rate through the filter media, a regular caustic cleaning is performed. However, despite cleaning cycles, an unavoidable reduction of liquor flow is observed from cycle to cycle. Eventually, scale growth reduces the flow rate to a minimum value that triggers the need for filter refurbishing. For plants, which experience bad control of flocculation, it can instantly clog the filter media and decrease the flow. This requires a rapid replacement of filter bags, since the combination of flocculent and scale makes the flow recovery almost impossible. Sefar x-Scale filter media technology was developed with the aim to delay scaling on the filter bag surface during clarification operation. The solution comes from combining optimized spinning parameters with an improved yarn formulation and from using EPDM components for filter bag manufacturing. The results presented in this paper show the liquor flow rate achieved with x-Scale filter media is more constant and decreases slower when compared to conventional filter bags. The improvement of flow, along with the service life increase, provide a reduction in filtration cost. This paper describes the approach and field results achieved, using Scale retardant filter technology.

Keywords: Bayer liquor clarification, pressure leaf filter for alumina, Sefar x-scale technology, scale retardant filter media.

1. Introduction

1.1. Scale Composition

Bauxite is an ore of variable composition containing often-undesired elements. Silica and Titania are, for instance, among these undesirable elements. Once solubilized in the conditions of digestion of the Bayer process, these elements react very quickly to form crystalline solids. The products of crystallization, combined with aluminum hydrate ($Al(OH)_3$), can form a hard layer on equipment and filter media surface, commonly known as scale. Scaling during pregnant liquor clarification is a major issue for filter equipment and filter media used in the Bayer process. It limits the service life of filter bags and consequently increases the cost of ownership and maintenance efforts. The scale forms particularly in the filtration area during the liquor clarification process, when the alumina- saturated solution starts to crystallize on any available surface (Figure 1).

Figure 1. Scale on top of the pressure leaf filter before filter bag refurbishing.

Depending on the bauxite origin and composition, the scale normally contains alumina trihydrate ($Al(OH)_3$) but can also contain other solids like iron oxide (Fe_2O_3), tricalcium aluminate ($3CaO{\cdot}Al_2O_3{\cdot}xH_2O$) or sodalite $Na_6[Al_6Si_6O_{24}].2NaX{\cdot}6H_2O$, where X can be OH^-, Cl^-, NO_3^-, ½ CO_3^{2-}, or ½ SO_4^{2-}. Figure 2 shows the scaling on the filter bag surface at the end of filter bag lifetime.

Figure 2. Scale on the filter bag during filter refurbishing.

1.2. Impact of Scaling on Clarification Process

Even though periodical sodium hydroxide cleaning sequences in between filtration cycles are performed, the few soaking hours in 200 - 450 grams per litre of Na_2CO_3 solution at 80 – 100 °C can't completely regenerate the filter media. The hydrate crystals strongly attach to the filter media yarn surface, seeding scale growth (Figure 3) and slowly but consequently block the filter media pores.

A similar based EPDM material was used for multichannel pressure leaf filters (i.e Diastar). The Figure 17 shows two bags on the same collector at end of lifetime. One bag has a regular neck made of woven fabric and the others are made from Sefar x-Scale EPDM. Again, there is a clear effect of EPDM, reducing the scaling and the time needed to refurbish the filters.

Figure 17. Effect of Sefar x-Scale EPDM closure on scaling.

3. Summary and Conclusions

Scaling is a major issue, which increases overall cost of filtration during clarification process. Together with major alumina refineries, Sefar has developed an answer for better handling of scaling, called the Sefar x-Scale technology - a dedicated range of filter media and filter bag closures. Sefar x-Scale technology has proven to delay scale growth and to meet the desired flow rate and liquor clarity- taking into account the particle size of the pre-coat filter aid (TCA or hydrate) used. The following advantages were proven in the field experiments:

- Reduced, delayed overall scaling
- Increase of liquor flow rate (up to 25 %)
- Improvement in service life of filter bags (up to 20 %)
- Better capability to handle over flocculated liquor
- Reduction in filtration cost per ton of alumina produced

4. References

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