Application of Low Molecular Weight Dextran for Improved Security Filtration

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Abstract

Low molecular weight dextran can be used to improve liquor stability during security filtration. The precipitation of alumina prior to (and during) filtration restricts the level of liquor supersaturation targeted in digestion, impacting the efficiency of production of alumina tri-hydrate. The addition of ppm levels of Alclar® 5000, a low molecular weight dextran, to the filter feed slurry may facilitate increased liquor productivity, a reduction in filtration scaling events, reduced flow losses in filtration and reduced maintenance costs and process upsets. This paper presents an overview of the implementation of Alclar® 5000 at Alcoa's Wagerup refinery in Western Australia using several liquor characteristics and Alcoa's stability model to demonstrate the efficacy of Alclar® 5000.

Keywords: Security filtration, dextran, Bayer liquor productivity.

1. Introduction

The unwanted precipitation of alumina tri-hydrate during security filtration is known as autoprecipitation. Kelly type filters and sand filters are prone to autoprecipitation which causes filter cloth blinding and cementation of the sand bed resulting in flow losses, filtration scaling events, reduced liquor productivity and increased operating costs.

Security filtration of red mud thickener overflow aims to limit the solids in the filtrate to ensure that targeted product quality is achieved [1]. There are many strategies available to overcome the challenges associated with security filtration; refineries may increase the frequency of maintenance, increase the amount of equipment sparing, increase availability of operations support, but most significantly refineries operate with conservative supersaturation conditions. These strategies lead to inefficient processing conditions and adherence to an operational window for liquor supersaturation that is less than optimal, which increase costs and decrease productivity.

Dextran has a long history of use in the Bayer process, as a flocculant and a filter aid and is often used in combination with other reagents to increase settling rate and underflow density, to reduce overflow solids, improve security filtration and scale control.

Patent WO 2012/031316 A1 [2] describes the addition of ppm levels of a low molecular weight dextran, to security filtration feed slurry increases the stability of liquor with respect to alumina tri-hydrate precipitation during filtration, without affecting the controlled precipitation of alumina tri-hydrate during downstream processing. Increased liquor stability during filtration

allows the upper limit of the operational window for supersaturation to be increased without affecting filter availability.

This paper outlines the findings of laboratory test work, a pilot plant application and a refinery trial of Alclar® 5000, a low molecular weight dextran, at Alcoa's Wagerup refinery in Western Australia.

2. Experimental

2.1 Laboratory Methods

A matrix of laboratory stability tests was conducted where the hot pregnant liquors propensity to autoprecipitate was measured by the change in A/TC ratio. Dose response tests were conducted using thickener overflow liquor collected from the D-tanks (surge tanks prior to filtration). The liquor was dosed with the desired ppm level of Alclar® 5000, then transferred to either a 3 L stirred reactor or divided into 250 mL bottles and placed in a rotating water bath, along with un-dosed control samples, at temperatures ranging between 95 °C and 103 °C (salt was added to achieve higher temperatures).

Samples were taken from each bottle/reactor at regular time intervals and analysed by titration for alumina and caustic (A/TC ratio). Replicate bottles were required to avoid errors due to excessive sampling.

The efficacy of Alclar® 5000 at a particular set of conditions was determined by monitoring the difference between the A/TC ratio at the start compared with the A/TC ratio at each sample time.

2.2 Pilot Trial

Pilot plant trials were completed under controlled conditions at Alcoa's Wagerup refinery in Western Australia. Two, almost identical 'Kelly filtration' pilot rigs that are $1/100^{th}$ of the scale of full operating vessels were run with and without the addition of Alclar® 5000. The pilot plants are plumbed directly into refinery process streams including liquor and filter aid and are able to have modified liquor and operating conditions.

Liquor from the thickener overflow tanks was piped to the feed tank on each rig, this liquor did not have filter aid dispersed into it. A separate filter aid line was provided to each rig so that the filter aid dose could be strictly controlled. Lakewater and caustic wash solution from the plant were also available to the rigs. A schematic of the Kelly filtration pilot rigs is shown in Figure 1.

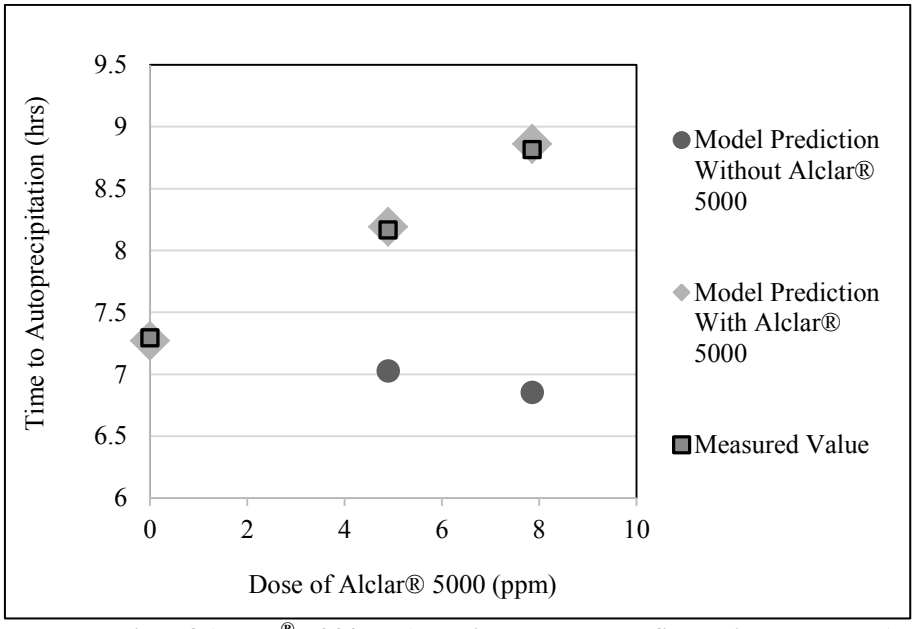

Figure 5. Plant trial of Alclar® 5000 at Alcoa's Wagerup refinery in Western Australia.

The process benefits resulting from the application of Alclar® 5000 include increased liquor productivity via reduced flow interruptions from filter cake scale or via increasing A/TC ratio in digestion. Additionally, reduced maintenance costs and reduced process upsets and troubleshooting associated with process upsets are realized.

4. Conclusion

Depending on refinery design and operating conditions, Alclar® 5000 can be used to improve liquor stability in the D-tanks prior to security filtration. Increased liquor stability allows one or more of the following process and cost benefits to be realised:

1. Increase liquor productivity
2. Reduce flow losses in filtration
3. Reduce filtration scaling events
4. Reduce maintenance and costs related to process upsets

5. References

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