

Nalco Water's ScaleGuard Treatment and SCRAMO Realtime Scaling Rate Measurement in Settlers and Washers

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Abstract

Red mud clarification has always been an area of high scaling potential, particularly in Settlers and 1st Washers, and as refineries have strived for higher supersaturation to push rates of alumina production. Nalco Water has developed a chemical treatment program, known as ScaleGuard™, which can significantly reduce the rate of scaling in this area of the refinery and allow for extended vessel life even under high supersaturation conditions.

Along with the ScaleGuard™ chemical treatment program, Nalco Water has also developed scale rate monitoring equipment, known as SCRAMO, which enables the real time determination of scaling rate online in vessels. In refineries that have been using ScaleGuard™ chemical treatment program, SCRAMO has proved to be beneficial with maximising the effective control of ScaleGuard™ dosage and performance. The SCRAMO scale rate monitoring equipment is now also providing refinery operations with real time insight into how changes to liquor chemistry and process conditions is also impacting ongoing operation in clarification.

Trials of ScaleGuard™ chemical program when dosed from the start of a settler campaign were able to reduce scaling rates from a baseline of 142 to 27 g/d (grams per day) as measured by the SCRAMO instrument. The SCRAMO unit was also able to demonstrate a reduction in scaling through a switch to RRA (Reduced Reagent Addition) from powder floc in the lead washer from 66 to 29 g/d and the beneficial use of caustic to control supersaturation, reducing scaling from 264 to 233 g/d.

Keywords: Scaling, Clarification, ScaleGuard™, SCRAMO, Supersaturation.

1. Introduction

Clarification vessel life has always been a major issue with refinery operations especially in the settlers and front-end washers where high rates of scaling occur and vessel life is the shortest [1–3].

For many years now Nalco Water has been providing chemical solutions in the form of ScaleGuard™ to refinery operations which slows down the scaling rate, lowers alumina reversion (loss) and subsequently extends the vessel life. Extending the life of these vessels allows for fewer unplanned outages, maintenance of production rates, lower alumina loss and increased caustic recovery.

In conjunction with the ScaleGuard™ chemistry approach Nalco Water has developed online real-time scale measuring technology “SCRAMO” which supports the efficient application of the

ScaleGuard™ chemistry and is now also being recognised as a valuable tool for day-to-day monitoring of clarification operations.

In this paper we will provide some examples of how the SCRAMO technology is assisting clarification operations.

2. Background

The ScaleGuard™ chemistry for reducing scaling rates in clarification has been in use for over ten years with its initial use in the refineries of Australia with particular use 1st Washers where it was used to extend the vessel life, minimise alumina loss and increase caustic recovery [4, 5].

Subsequent use of ScaleGuard™ materialised in some of the refineries of India and again with its use focussed on the 1st Washer.

With the use of ScaleGuard™ it is recommended that the scaling rate in the 1st Washer be measured to ensure efficient use of the chemistry. Scale coupons were used to measure the scaling rate and involved immersing a mild steel coupon into the liquor in the washer and weighing the amount of scale growth over time. This process of re-weighing the coupon every few days and the inherent risks involved with performing this task made Nalco Water look for an alternative method to measure scaling rate. From this review a prototype scale rate measurement device was developed and after some minor alterations the SCRAMO instrument has now been produced and is readily available for industry wide use.



Figure 1. Installed SCRAMO unit on operating washer.

The SCRAMO unit utilises load cell technology to continuously monitor the scaling rate in real-time, whilst using modern telecommunication systems, Nalco 3DTraser and Ecolab3D data management systems, to present the scaling rate data back to refinery operations. The scaling weight is determined every hour, instead of whenever the scale coupon was physically removed and weighed, providing real-time information that can be directly related to liquor chemistry,

vessel performance and ScaleGuard™ dosage rate. The real-time availability and high frequency of data collection offered using SCRAMO provides greater understanding and interpretation of events occurring with the operation of these vessels and does lead onto some inciteful findings.

Typical data received from the SCRAMO unit is presented in Figure 2, which is for a Settler operating without any application of ScaleGuard™ – so blank data. The scaling rate was determined by linear line of best fit through the linear portion of the data and from this was calculated at 143 g/d.

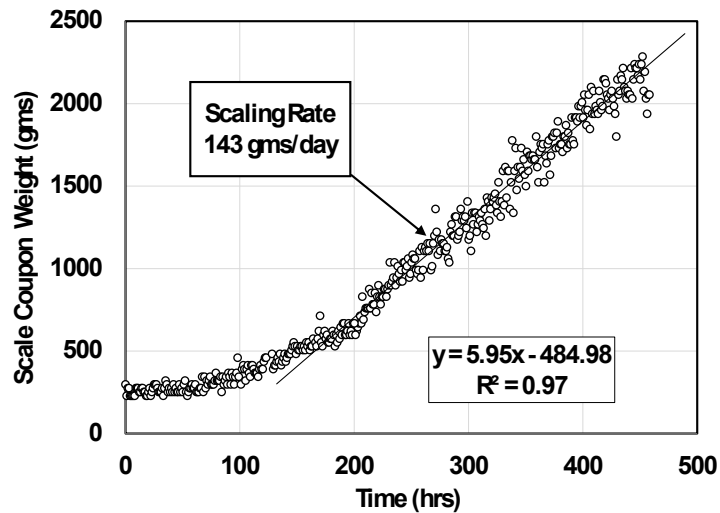


Figure 2. Typical data received from a SCRAMO unit.

Recent examples of how the SCRAMO unit has exceeded expectations is presented as follows.

The first example is a 1st Washer ScaleGuard™ application and a change of flocculant type, the second example in a Settler ScaleGuard™ application when feed to the settler was taken off for 24 hours and the third example is when the addition of caustic to a 1st Washer was ceased.

3. Example 1 – Change of 1st Washer Flocculant Program

The SCRAMO prototype unit was in use on a 1st Washer to assist with the ongoing monitoring of ScaleGuard™ use. The refinery at the time was using a powder flocculant on their 1st Washer. Nalco Water RRA flocculant was also available for use as it was being used on their Settlers.

There was a need to carry out unplanned maintenance on the flocculant pump feeding the powder flocculant to the 1st Washer, so the refinery converted over to the Nalco RRA Settler flocculant whilst they went about the flocculant pump maintenance.

The SCRAMO instrument was operating through this change of flocculant and subsequent operation on the Nalco RRA flocculant. The SCRAMO instrument recorded a distinct reduction of the scaling rate when the conversion of flocculant supply took place, as shown in Figure 3 below which shows scale weight versus time. The scaling rate was determined by measuring the linear slope of the weight of scale, with the rate changing from 66 to 38 grams per day.

A change of coupon also confirmed this change in scaling rate of 66 down to 38 g/d with the scale rate of the new coupon being 29 g/d.

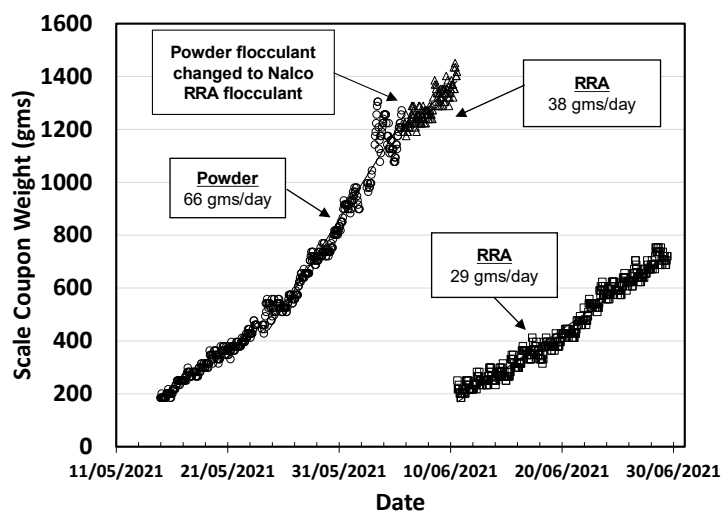


Figure 3. Change of flocculant and impact on scaling rate.

The SCRAMO unit was able to pick up the change in scaling rate and by analysis of the SCRAMO data it was determined that the scaling rate reduced by 42 % with the change to the Settler flocculant, Nalco RRA. The now preferred flocculant for the 1st Washer is the Nalco RRA Settler flocculant.

4. Example 2 – Introduction of ScaleGuard™ Chemistry to a Settler.

The SCRAMO unit was used on a Settler to measure scaling rate with and without the application of ScaleGuard™. Figure 4 below shows the resulting scale coupon weight increase and changes in scaling rate with time.

Without the addition of ScaleGuard™ the scaling rate was determined to be 142 g/d. ScaleGuard™ was turned on to the Settler at a dosage of 3 ppm and the scaling rate dropped to 97 g/d – this was measured using the same coupon that was already in place within the Settler.

After several days of using ScaleGuard™ the feed to the Settler was stopped for upstream maintenance and the addition of ScaleGuard™ also stopped. The SCRAMO unit continued to operate and record scale deposition, which increased to 226 g/d – again using the same coupon that was already in place within the Settler. This large increase in scaling rate was at the time attributed to the liquor in the Settler cooling during the maintenance period - which was limited to 24 hours.

The coupon was then changed out for a new coupon and the dosage of ScaleGuard™ recommenced. The scaling rate with the ScaleGuard™ on and a new coupon in place was measured to be 27 g/d, a significant reduction.

It is also worth revealing that when the ScaleGuard™ was in use on the Settler there was a prominent improvement in liquor flow through Security Filtration. The increase in liquor flow and liquor stability gained, using ScaleGuard™, was exploited by allowing Digester blowoff ratio to be raised without detrimental impact within Settler operation and Security Filtration and thereby alumina production increased.

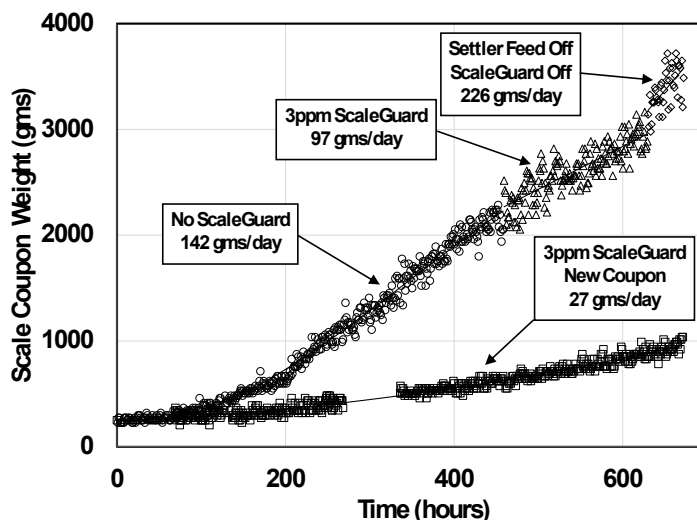


Figure 4. Application of ScaleGuard™ to a settler.

5. Example 3 – Cessation of Caustic Addition to a 1st Washer plus ScaleGuard™.

The SCRAMO unit was being used on a 1st Washer during a trial on the ScaleGuard™ chemistry. During the use of SCRAMO there was a period when the caustic, that was usually added to the washer feed to manage supersaturation, was turned off. The scaling rate as determined by linear regression of the data showed an increase when the caustic was turned off and a decrease when the caustic was turned back on. Subsequent addition of 10 ppm ScaleGuard™ also showed a notable reduction in scaling rate, somewhat more than the addition of caustic alone.

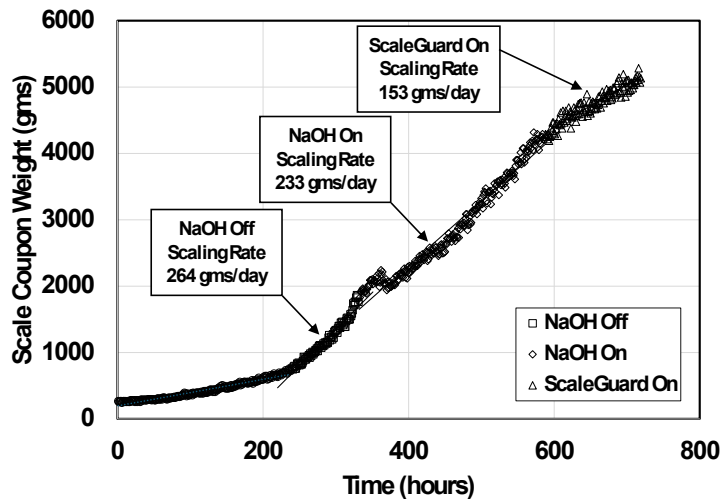


Figure 5. Caustic off/on and application of ScaleGuard™ to a 1st washer.

Once again, the sensitivity of the SCRAMO instrument is sufficient to pick up the impact of changes to liquor chemistry and the impact of the addition of ScaleGuard™ to the Washer.

6. Conclusions

Nalco ScaleGuard™ chemistry is now gaining increased use within refineries that are pushing super-saturation levels to increase refinery productivity. With this increased use of ScaleGuard™ comes the need to optimise its use to ensure economic return.

In one refinery the addition of ScaleGuard™ to a Settler has realised an improvement in liquor filtration through Security Filtration which can be taken advantage of via increased flow and/or increased blow off ratio.

Online and real time measurement of scaling rates using the “SCRAMO” scale rate monitor unit has allowed the optimisation of ScaleGuard™ and alleviated the traditional labour intensive and infrequent method of daily measurement of scale coupon weight and scaling rate determination.

The “SCRAMO” unit has also become a handy device to measure changes in scaling rate that can be triggered by other events that can occur from the day-to-day operation of a clarification circuit.

7. References

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