Importance of Chemical Cleaning for Precipitation Optimization

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Abstract

Precipitation circuits for alumina refineries such as Jamalco are responsible for producing the alumina trihydrate tonnage and alumina quality required to meet the organizations' contractual agreement. The successful operation of the precipitation circuit is dependent on the availability and optimization of critical equipment such as coolers, filters, and precipitators to attain the required yield and particle sizing. With the exposure of these equipment to varying hydrate slurry flows, liquor and solids concentrations, as corrosive materials, the ability to timely and effectively execute chemical cleaning is a key enabler for maintaining the circuit stability and effectiveness. This paper will explore the cleaning gaps identified and the strategies employed by Jamalco to optimize its caustic cleaning practices and the results attained. The impact of shell side acid cleaning of precipitation coolers will also be explored.

Keywords: Caustic cleaning, Acid cleaning, Free caustic, Precipitation, Scaling.

1. Introduction

The precipitation circuit within the Bayer process is known for its susceptibility to gibbsite and oxalate scaling [1] in the precipitator internals as well as in other key process equipment such as filters, heat exchangers, tanks, and lines. Scaling within these areas result in increased production losses due to lower precipitation yield and flow throughput capacity. Scaling mainly affects the precipitation yield by increasing settled solids within precipitators (reduced residence time), plugging of heat exchanger tubes and reduced equipment reliability affecting seed charge. The increase in settled solids for the precipitators result in equipment failures and increased downtime for descaling efforts [1].

It was recognized that the caustic cleaning practices within the precipitation circuit are critical to reduce the turnaround time for equipment on cleaning as well as prevent caustic embrittlement and the associated safety concerns. A revision of the precipitation caustic cleaning program was undertaken using the caustic soda service chart shown in Figure 1.

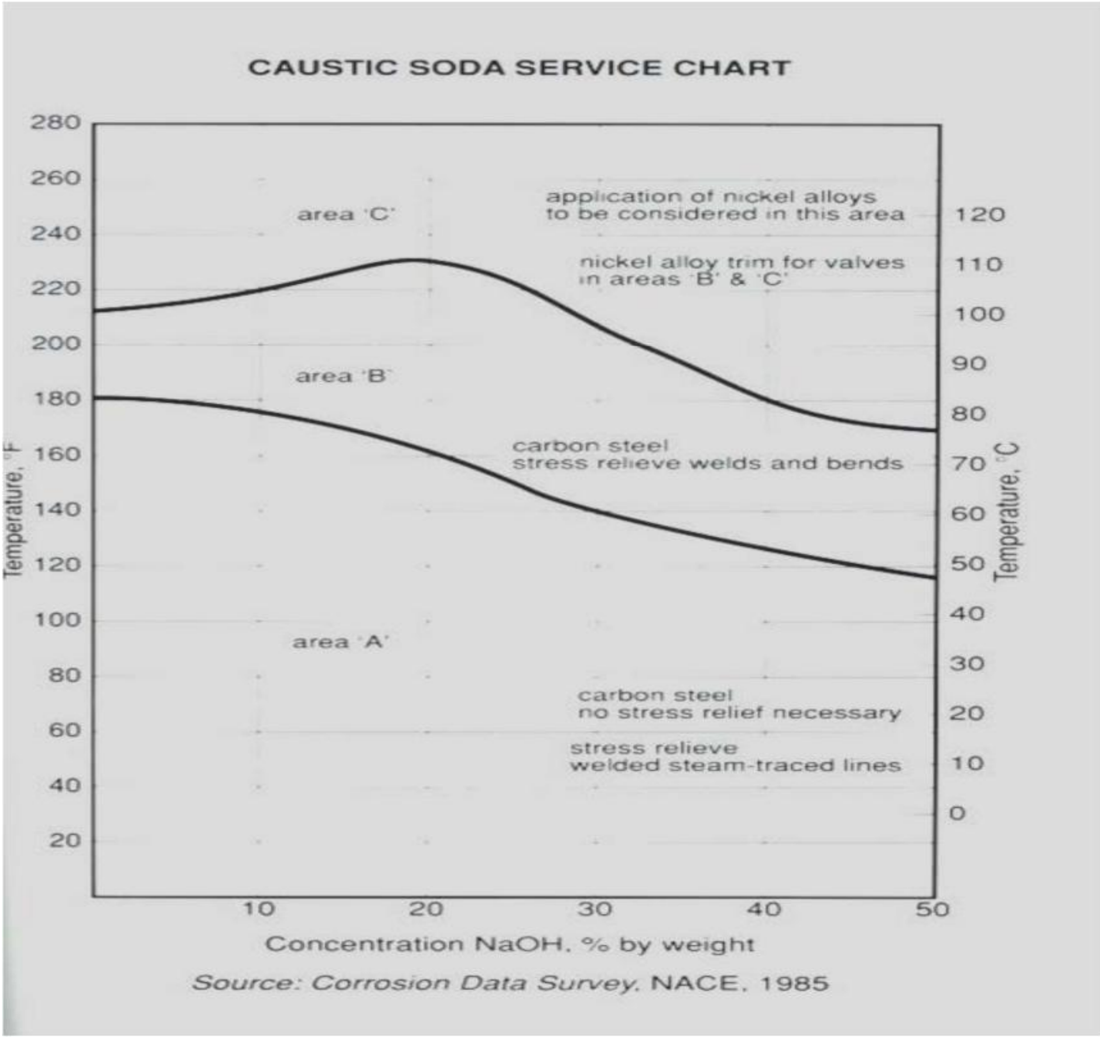

Figure 1. Caustic Soda Service Chart [2].

At Jamalco, a quality and yield critical parameter is the temperature of the 1st growth stage precipitators referred to as the 3rd tank temperature, these temperatures are affected by the performance of the Inter-stage coolers and volume management within the precipitation circuit (i.e. overflowing of the weir of the second seeded precipitators). One of the major limitations for the inter-stage cooler is shell side scaling due to the calcium carbonate levels within the cooling water stream. Scale composite analyses indicate up to 96 % calcium carbonate with the average level being ~64 % as shown in Figure 2.

Research shows that utilization of 10 % hydrochloric acid with a commercial inhibitor can effectively remove calcium carbonate scaling [3].

- Caustic Cleaning followed by mechanical cleaning;
- Caustic cleaning followed by hot water wash.

Jamalco utilizes the chemical and mechanical cleaning dual methodology to remove this type of scaling within precipitators.

4. Future Works

To further improve the chemical cleaning practices in precipitation, the installation of a clean-in-place system for acid cleaning is being considered and well as improving the caustic heater management through instrumentation and controls. The additional instrumentation for the caustic heaters will be used to improve the predictions for the Caustic Cleaning Decision Sheet.

Optimization of the precipitator injection systems will be undertaken to aid in sustaining lower settled solids within the precipitators.

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6. References

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