Selection of an Alternative Acid for De-Rouging Activities

Rouge Removal and Passive Layer Maintenance Study

Confidential Client

STUDY OVERVIEW

A client desired to reduce the use of phosphorus-based cleaning agents for environmental considerations as well as internal sustainability goals. Cleaning agents such as phosphoric acid and CIP-200 (which contains phosphoric acid) were currently being utilized at the client site for rouge management and passive layer maintenance. The client requested a study from Hyde to identify alternative chemistries to replace the phosphorus-based cleaning agents while still maintaining the required rouge mitigation capabilities.

PROJECT DESCRIPTION

The Hyde Analytical Laboratory was contracted to support a client with an internal initiative to remove phosphorus-based agents from the facility by evaluating the feasibility of replacing cleaning agents such as phosphoric acid and CIP-200 with an alternative acid.

The study first screened the ability of nine alternative acids to remove rouge as compared to phosphoric acid.

From this testing, one acid alternative was selected for further testing. The next phase of testing included comparing the ability of phosphoric acid and multiple concentrations and temperatures of the selected alternative acid to remove lab-generated rouge from stainless steel coupons. Visual assessment was used to determine the time at which the rouge was removed from the coupon surface. The amount of rouge removed was quantified, and removal curves were generated to provide an indication of the duration required to fully de-rouge the surface. Additionally, the passivity of the coupons was assessed to determine the impact of each acid on the integrity and restoration of the passive layer.

SCOPE AND DELIVERABLES

Rouge Generation:

DA process was developed for the generation of rouge on small-scale surfaces, i.e., coupons. The rouge created at small scale included variations of Type I, Type II, or Type III rouge. The type of rouge of interest to the client was selected for all subsequent testing, which ensured results representative of full-scale applications.

Selection of Alternative Chemistry:

Nine candidates were selected for evaluation as a replacement for phosphoric acid for use at full scale. The candidates included a variety of organic acids as well as chelating agents.

Rouge Removal Comparison:

To establish a baseline for comparison, the capability of phosphoric acid to de-rouge stainless steel surfaces was quantified and compared to the ability of the candidates, resulting in the selection of a single acid.

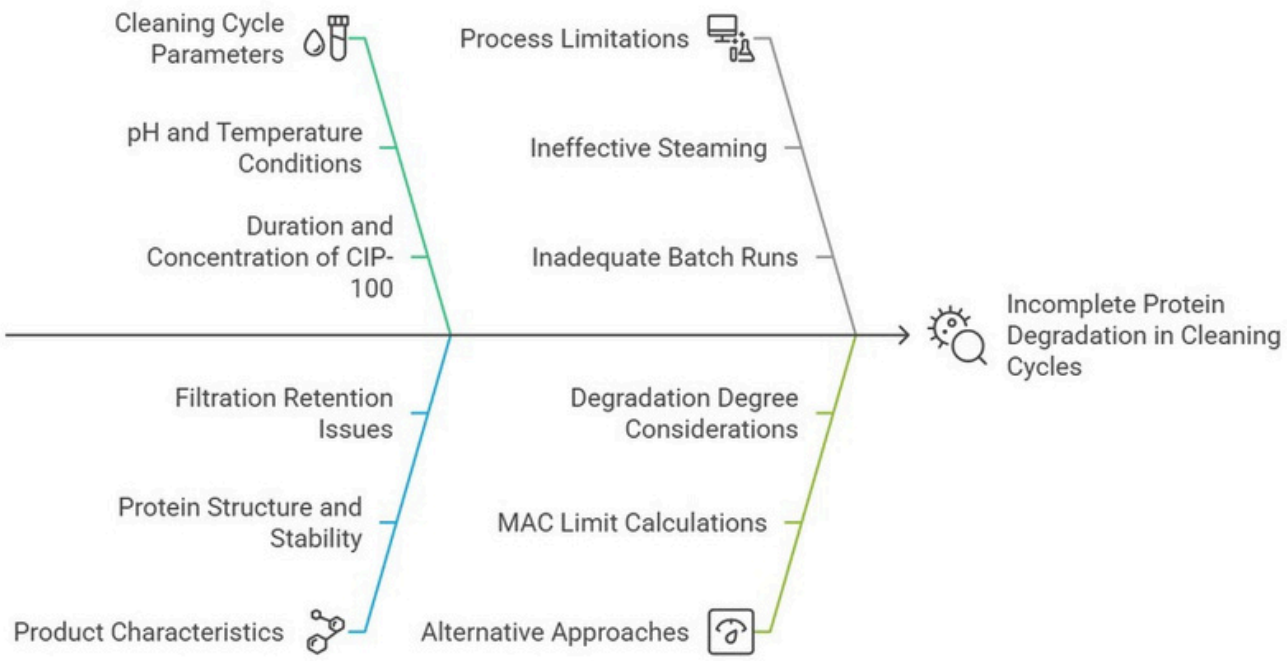
Rouge Removal Curve:

To better characterize the performance of the selected chemistry, a curve was generated to show the impact of acid exposure duration on the amount of rouge removed taking into account temperature and concentration. This curve provided knowledge of when the rouge removal would reach a plateau, what exposure duration is required for full rouge removal, and the magnitude of the impact of using higher/lower concentrations/temperatures of the alternative acid on the rouge removal.

Evaluation of Passive Layer Resistance:

To ensure that the passive layer of the stainless steel was not stripped by the selected alternative acid at the temperature, concentration, and duration planned for use at full scale, testing was performed to monitor passivity at multiple points on the test coupons.

ANALYZING PROTEIN DEGRADATION CHALLENGES IN CLEANING CYCLES



SOLUTIONS, RESULTS AND ACCOMPLISHMENTS

- **Determined an alternative acid suitable as a replacement for phosphoric acid.** All concentration and temperature conditions evaluated for the alternative acid selected for testing performed similar to or better than the phosphoric acid parameters that were currently being used at the client facility.
- **Provided a rouge removal curve.** This curve plotted the rouge amount removed by the alternative acid against the exposure duration. Curves were generated and compared for the various concentrations, temperatures, and exposure durations of acid tested. This provided the client with information for setting exposure durations at full scale, including when they could expect the rouge removal to plateau, reach complete removal, etc.
- **Identified optimized parameters for rouge removal.** Of the alternative acid conditions evaluated, certain conditions were shown to improve rouge removal. These optimized parameters were identified in the study and recommended for implementation at full scale.
- **Assessed the impact on the passive layer.** The study determined that the alternative acid parameters preferred for use by the client had no negative impact on the passive layer of the equipment surfaces.

lab@hyde-ec.com
www.hyde-ec.com
Louisville, Colorado, USA

Hyde ENGINEERING +CONSULTING