Reduction of nitration aggressiveness with Sulfamic Acid

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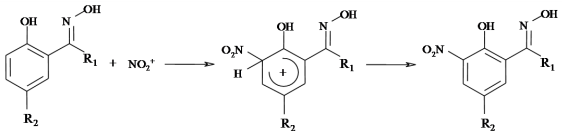
Problem Statement

- A copper SX plant in Chile was experiencing highly aggressive nitration conditions, which resulted in deficiencies in the SX process (e.g., higher residual Cu, higher viscosity, lower production), despite of the nitration-resistant extractant formulation they were using.
- Under these conditions highly favorable to the formation of nitronium ions (cause of nitration of the oxime), there was an imbalance generated between the amount of protector in the organic phase and speed of formation of nitronium ions. This resulted in a fast consumption of the protector and therefore an increased extractant consumption to replenish the protector and maintain the target production levels.
- Solvay was asked to investigate and propose alternatives to reduce the aggressiveness of the nitration phenomenon.



R_1 H or CH_3 (aldoxime or ketoxime)
R_2 C_9H_{19} or $C_{12}H_{25}$ (nonylaldoxime or dodecylaldoxime)

Figure 1 – Oxime nitration mechanism

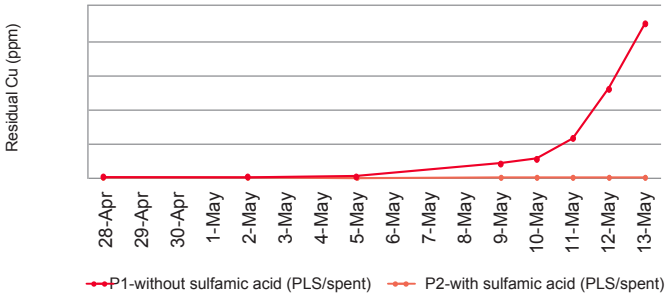


Figure 2 – Pilot plant test in real solutions, validation

Solvay's Approach

- Solvay studied different approaches to either reduce or consume the nitronium ions formed in the SX feed solution (PLS), using the TAP Test analysis tool (nitration aggression indicator).
- Results showed that nitronium ions were being consumed by sulfamic acid added to the PLS, thereby decreasing the chances of nitrating the oxime present in the organic phase.
- In parallel to the pilot tests validating the protection of the oxime through measurement of residual Cu, we carried out compatibility tests on the organic phase to verify the additive bore no negative effects on the SX.

Results

- With the results obtained in the pilot plant, the customer implemented the solution developed by Solvay of adding sulfamic acid to the PLS.
- The operational results showed a reduction of oxime nitration of approximately 30%, confirming the results obtained in the pilot plant with similar aggressive condition, comparing 2015 results (without sulfamic acid) with 2018 results (with sulfamic acid).
- The application of sulfamic acid, has enabled the customer to cope, in a controlled environment, with the current period of highly aggressive nitration
- This generated annual cost savings in extractant consumption of $1.4 million, in addition to maintaining a stable plant and being able to fulfill the copper transfer target of the SX plant.

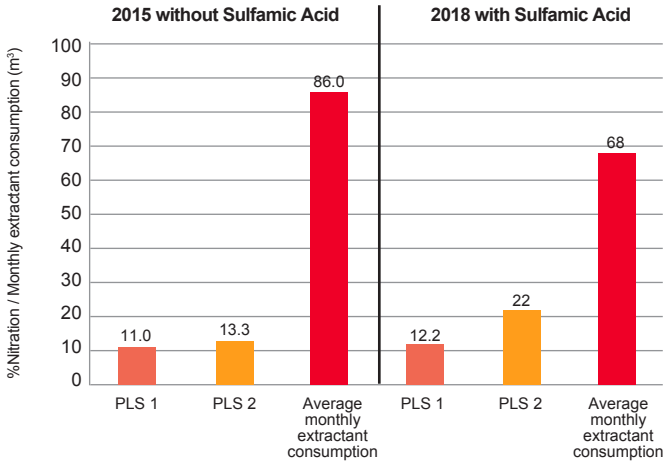


Figure 3 – Levels aggressiveness PLS (TAP Test) vs monthly Extractant consumption (m_3)