Question 32: Where are ammonium chloride and amine hydrochloride salt found in your crude unit? What is your best practice to monitor and mitigate the resulting corrosion and fouling?

XIOMARA PRICE (SUEZ Water Technologies & Solutions)
Ammonium chloride and amine hydrochloride salts can form in the top section of the Atmospheric and Vacuum Towers, and the overhead exchangers of the tower. The formation of these salts is a function of partial pressures which dictated by the concentrations of ammonia, amines, chlorides in addition to operating conditions such as overhead temperature, pressure, steam flow rate and hydrocarbon flow rate.

There are a range of tools in the industry that are used to predict salt formation temperatures, and some provide guidance on safe operating conditions/envelopes. Based on the outputs of these tools, action(s) must be taken to help mitigate the formation and deposition of these salts.

The primary path for mitigation should be to control salt formation downstream of liquid water formation / injection. Based on experience this often requires multiple mitigation steps such as:

- Reduction of overhead chlorides
    - Improved desalting
    - Caustic addition
    - Reduction/elimination problematic amines
    - Change to a lower temperature salting amine
    - This can be either the overhead amine and/or the amine for the refinery steam condensate system.
    - Amine removal at the desalter
    - Removal of stream that is introducing the amine
    - Reduction/elimination of ammonia
    - Change to neutralizer with lower salting temperature and easier pH control
    - Remove stream that is introducing contamination
    - If ammonia is coming from inefficiency at the SWS (via the desalter wash water), improve the removal efficiency there
    - Maintain salt formation temperatures below the tower top temperature and/or the dew point temperature below a reasonable safety margin to avoid undesirable salt formation
    - Margin targets vary by operating company, but common targets range from 15-30°F
    - More recently, improved analytics has enabled the appropriate safety margin to be determined dynamically based on operating and chemical conditions of the unit.
    - Change operating parameters that drive undesirable salt formation (depends on distillate yield production objectives vs. reliability)
    - Increase overhead temperature
    - Increase stripping steam rate
    - Increase reflux and/or top pump-around rate
    - Reduce shock condensation

- Reduce tower top pressure
- Removal of high amine containing crudes
- Typically treated with H2S scavengers that are the source of the amines
- An economic/scheduling decision

A water wash program can be an effective part of the mitigation solution in the atmospheric overhead system. Salts will form at some point in the overhead system. A water wash that provides the right amount of water required to have plenty of free water, that is in the right place, is injected with the right nozzle, and has sufficient disengagement time from the condensed naphtha is critical for its effectiveness for corrosion and fouling control.

SAM LORDO (Independent)

The location of NH4Cl and amine salts deposition in a crude unit can be routinely found:

- Tower overhead line and exchangers
- Top pumparound circuit (exchanger and associated tower section
- Ability to recycle brine for mudwash water source
- Vacuum tower overhead exchangers
- Vacuum top pumparound circuit

The above areas are the typical locations, but essentially it can be any location when the formation conditions are favorable for salt formation. These conditions include: system pressure, system temperature, concentration of HCl, and ammonia and the concentration and type of Amine.

Mitigation can be one by:

- Waterwash
- Changing one or more of the process conditions to reduce the salt formation potential
- Use of a chemical salt dispersant
- Monitoring would entail
- Exchanger heat transfer monitoring
- Circuit pressure drop trending (flow corrected)
- Increase frequency of strainer clean outs

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Amines

Chlorides

Corrosion

Heat Exchangers

Reliability

Vacuum Tower

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