Question 36: Can you provide insight to best practices for prevention and repair as it relates to chloride stress cracking and polythionic acid stress cracking of stainless steel equipment in hydroprocessing units?

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Specific to hydroprocessing units, chloride stress corrosion cracking (Cl SCC) is really only an issue on the outside of piping and equipment. During normal operation the process side of units that have austenitic stainless steel operate too hot for liquid water to be present; a requirement for Cl SCC to occur. Chlorides can get to the outside of austenitic stainless steel in one of two ways; either leaching out of the insulation, or from a sea-coast atmosphere. Addressing the former, UOP specifies that thermal insulation to be used in contact with austenitic stainless steel be in accordance with ASTM C795, Standard Specification for Thermal Insulation in Contact with Austenitic Stainless Steel. This specification has two major requirements; (1) conduct a stress corrosion cracking test in accordance with ASTM C692, and (2) conduct chemical analyses in accordance with ASTM C871, and report levels of chloride, fluoride, sodium and silicate. pH must be ? 12.5. As for chlorides from a sea-coast atmosphere, UOP does not provide specific direction as this is addressed on a case-by-case basis. One Gulf Coast refiner used a high-temperature paint on the austenitic stainless-steel piping in their hydrocracking unit, however, whether this has been successful is not known. Also, this approach is not common.

With regard to Polythionic acid stress corrosion cracking (PTA SCC), UOP directs its customers to NACE Standard Practice SP0170, Protection of Austenitic Stainless Steels and Other Austenitic Alloys from Polythionic Acid Stress Corrosion Cracking During Shutdown of Refinery Equipment. For PTA SCC to occur, five conditions must be met simultaneously. These are: (1) a sensitized microstructure, (2) a metal sulfide scale on the surface, (3) stress (either residual or applied), (4) liquid water, and (5) oxygen. Remove any one of these five conditions and PTA SCC cannot occur. Due to the nature of the process, asensitized microstructure and a metal sulfide scale on the surface can never be eliminated. Stress also cannot be eliminated since residual stress is enough to drive PTA SCC. In some cases liquid water can be eliminated. For example, a pilot burner in a fired heater can be lit to keep the firebox well above the water dew point. In some cases oxygen can be eliminated by, for example, purging out the oxygen with nitrogen and maintaining a nitrogen blanket. However, if none of the five conditions can be eliminated (which is frequent), then soda ash washing is required. This is covered in detail in NACE SP0170.

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2014