Considerations to Prevent External Stress Corrosion Cracking with Austenitic Stainless Steel

One of the greatest threats, sources of system failure and maintenance/replacement costs to mechanical systems is corrosion to the metallic surfaces of piping and equipment. For corrosion to occur, three (3) elements are required: metal, air (oxygen) and water (electrolyte). Since metal and air are constant, the contributing factor to corrosion is the introduction of moisture. The corrosion process is accelerated with an insulated system when moisture becomes trapped between the insulation and metallic surface. This condition is known as corrosion under insulation (CUI).

While mechanical insulation is not the primary source of corrosion, insulation can serve as a vehicle to facilitate corrosion. Corrosive ions, such as halogens (i.e. bromines, chlorides, fluorides, iodines and sulfides) in the insulation, metal contaminants (dirt, flux, grease, oil) on the pipe, cleaning chemicals, air pollution (exterior) and ground water contaminants (direct-buried), when exposed to moisture can become corrosion accelerators.

Insulation system design and selection are important, however the specified system must be installed correctly to prevent water vapor from penetrating the insulation system in the first place. Regardless of the insulation type, all adjoining seams and terminations must be sealed with the manufacturer's adhesive to provide a vapor seal. An additional preventive measure is to install vapor dams/stops to minimize corrosion propagation under insulation. Depending on the insulation type, line temperature(s) and operating environment, vapor retarders (jackets or coatings) may also be necessary to manage the constant vapor drive.

Austenitic stainless steel is often specified for high-performance industrial applications. Like other metallic piping types, such as copper and iron, stainless steel is susceptible to a type of corrosion known as external stress corrosion cracking (ESCC). With system cycling temperatures in the 140°F to 250°F range, the lower temperatures can generate moisture and the upper temperatures accelerate the corrosion process when corrosive ions are present.

When selecting a mechanical insulation product for stainless steel applications, there are three (3) industry standards to reference:

- ASTM C692 – Standard Test Method for Evaluating the Influence of Thermal Insulations on External Stress Corrosion Cracking Tendency of Austenitic Stainless Steel
- ASTM C871 – Standard Test Methods for Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate and Sodium Ions
- ASTM C795 – Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel

Essentially, ASTM C795 requires a Grade 3 halogen-free closed cell flexible elastomeric foam insulation that complies with both ASTM C692 and ASTM C871.

Of primary concern with elastomeric insulation applications over stainless steel substrates is a condition known as chloride leaching. When chlorides (a halogen) present in the insulation come in contact with water vapor, chloride can act as a corrosive ion. Varying levels of chlorides, by manufacturer, are necessary to pass the primary fire safety standard in the building industry – ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.

Although there are “non-halogen” elastomeric foam insulation products available, their ability to pass ASTM E84 are limited by thickness. It’s important to note that ASTM C692 recognizes the presence of soluable chlorides, in addition to corrosion inhibitors that have the ability to offset the potential for chloride leaching, in non-halogen grade insulation materials that also offer compliance with ASTM E84 up to 2” thick.

Aeroflex USA independently tested the AEROFLEX® brand of EPDM closed cell flexible elastomeric insulation according to ASTM C692 and passed by not contributing to ESCC. Choosing AEROFLEX® EPDM to insulate austenitic stainless steel surfaces will not contribute to external stress corrosion cracking and will provide the expected long-term thermal performance when properly specified and installed.

To learn more AEROFLEX® EPDM, please visit
https://www.aeroflexusa.com/aerocel-hvac-pipe-insulation