PENFLEX

ENGINEERING BULLETIN #135

How to Avoid Stress Corrosion Cracking

Stress Corrosion Cracking (SCC) happens at the intersection of a susceptible material, stress—either working or residual—experienced above the SCC threshold and a corrosive environment. The cracks that develop under this unique set of circumstances would not have developed under the stress or within the given environment alone.

Bridges have collapsed, ceilings have fallen in and the list of fatal structural failures caused by SCC goes on. Leaks caused by SCC have also led to catastrophic failure. Typically, such failures are seen in pressure vessels, pipework, highly stressed components and in systems when an excursion from normal operating or environmental conditions occurs.

The problem with SCC is that it seems to happen 'unexpectedly' during a period of satisfactory service. As the environment is generally mildly corrosive to the service material, cracks can easily go undetected. Metals or alloys can look bright and shiny despite being filled with microscopic cracks.

To control SCC, engineers must first select a material that is not susceptible to the service environment and then ensure that any temporary changes to the environment do not alter that material's susceptibility. Cleaning would be an example of a temporary change with potentially adverse effects given residues that can be left behind.

Material and environmental pairings where SCC is most likely to occur include:

- Brass and Ammonia
- High-Strength Steels and Hydrogen
- Stainless Steel and Chlorides

However, as mentioned earlier, it isn't just the impact of environmental corrosion on a material but the combination of environmental corrosion and the application of a tensile stress above critical values that leads to SCC.

The stresses that contribute to SCC are produced either as a result of the use of the component in service or as a result of the residual stresses introduced during manufacturing. When the likelihood for SCC is high, engineers must carefully design piping systems to minimize stress concentrations and may suggest various heat treatments to reduce residual stresses.

Other means of controlling SCC include using corrosion inhibitors during cleaning operations, employing a closed system to control the environment and coating the material to isolate it from the environment.

It's important to remember that while SCC is a type of corrosion, not all types of corrosion are classified as SCC.

For further reading on environmental corrosion, please see:

- Engineering Bulletin 119: Corrosion of Common Alloys in Dry Chlorine (Cl2)
- Engineering Bulletin 115: Environmental Corrosion of Stainless Steel
- Engineering Bulletin 105: Chloride/Chlorine Levels and Stainless Steel Alloy Selection

If you have any questions, please contact us.