Different Types of Corrosion

- Recognition, Mechanisms & Prevention

Stress Corrosion Cracking (SCC)

Recognition of Stress Corrosion Cracking

What is stress corrosion cracking? Stress-corrosion cracking (SCC) is a cracking process that requires the simultaneous action of a corrodent and sustained tensile stress. This excludes corrosion-reduced sections that fail by fast fracture. It also excludes intercrystalline or transcrystalline corrosion, which can disintegrate an alloy without applied or residual stress. Stress-corrosion cracking may occur in combination with hydrogen embrittlement.

The image of stress corrosion I see
Is that of a huge unwanted tree
Against whose trunk we chop and chop,
But which outgrows the chips that drop;
And from each gash made in its bark
A new branch grows to make more dark
The shade of ignorance around its base,
Where scientists toil with puzzled face.
(by S P Rideout 1967)

Mechanisms of Stress Corrosion Cracking

What causes stress corrosion cracking? Stress corrosion cracking results from the conjoint action of three components: (1) a susceptible material; (2) a specific chemical species (environment) and (3) tensile stress. For example, copper and its alloys are susceptible to ammonia compounds, mild steels are susceptible to alkalis and stainless steels are susceptible to chlorides.

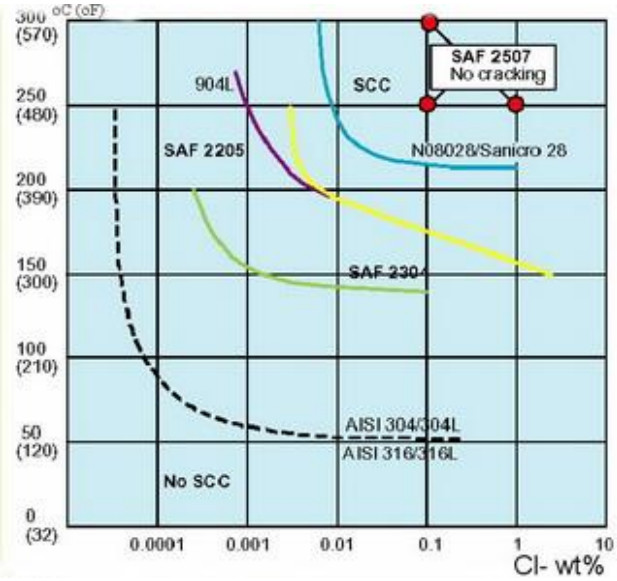
There is no unified mechanism for stress corrosion cracking in the literature. Various models have been proposed which include the following:

- Adsorption model: specific chemical species adsorbs on the crack surface and lowers the fracture stress.
- Film rupture model: stress ruptures the passive film locally and sets up an active-passive cell. Newly formed passive film is ruptured again under stress and the cycle continues until failure.
- Pre-existing active path model: Pre-existing path such as grain boundaries where intermetallics and compounds are formed.
- Embrittlement model: Hydrogen embrittlement is a major mechanism of SCC for steels and other alloys such as titanium. Hydrogen atoms diffuse to the crack tip and embrittle the metal.

Prevention of Stress Corrosion Cracking

How to prevent stress corrosion cracking? Stress corrosion cracking can be prevented through:

- Avoid the chemical species that causes SCC.
- Control of hardness and stress level (residual or load).
- Introduce compressive stress by shot-peening for example.
- Use of materials known not to crack in the specified environment.
- Control operating temperature and/or the electrochemical potential of the alloy.



For more details on Stress Corrosion Cracking

Where can I learn more about stress corrosion cracking? More details on stress corrosion cracking are included in the following corrosion short courses which you can take as in-house training courses, course-on-demand, online courses or distance learning courses:

Corrosion and Its Prevention (5-day module)
API 571 Damage Mechanisms Affecting Fixed Equipment in the Refining and Petrochemical Industries (5 days)
Environmental Cracking (HB/HIC/SWC/SOHIC/SSC/SZC/HSC/HE/SCC): Recognition, Mechanisms and Prevention (5 days)
Corrosion Inspection, Testing and Monitoring: Techniques and Applications (5)
Corrosion, Metallurgy, Failure Analysis and Prevention (5 days)
Marine Corrosion, Causes and Prevention (2 days)
Materials Selection and Corrosion (5 days)
Stainless Steels and Alloys: Why They Resist Corrosion and How They Fail (2 days)
Corrosion Control and Prevention in Seawater Desalination Plants (1 day)

If you require corrosion expert witness or corrosion consulting service on stress corrosion cracking, our NACE certified Corrosion Specialist is able to help. Contact us for a quote.