

PRINTED CIRCUIT HEAT EXCHANGER BULLETIN **EXTERNAL CSCC OF UNS S31803 (DUPLEX ALLOY 2205)**

There has been a recent incidence of chloride stress corrosion cracking on the hot external surfaces of UNS S31803 (Duplex 2205) material used in an offshore heat exchanger. Whilst the track record of duplex offshore is generally reported to be good, in this case the damage was severe and rapid: extensive cracks of depth greater than 20 mm developed in 16 months of operation.

Pertinent facts are as follows:

1. The cracking occurred in:
 - a. Wrought, forged (flange) and weld material, but predominantly remote from the welds. Wrought material was 16 mm thick, and cracks tended to follow an angled path through it.
 - b. Material operating at about 160EC, but not in identical material operating substantially below 100EC
 - c. Upward-facing and, to a lesser extent, sideways-facing material, but not in downward-facing material.
2. The heat exchanger was installed on the cellar deck of a platform. The external surfaces were not coated or under insulation, but were covered by heavy salt deposits as a result of deluge system testing and salt spray. Staining of the surface with rusty deposits suggests rain, process water or deluge water from structural steel and/or pipework above found its way on to the salt encrusted external surfaces.
3. TWI has inspected the cracking, and their preliminary report concluded:
 - a. "Each of the sections shows very similar cracking features. Cracking is through both phases with numerous branches..."
 - b. The cracking features in each area are strongly indicative of chloride stress corrosion cracking. No evidence of any other mode of cracking has been found...
 - c. No obvious crack initiating features have been found. No pitting corrosion has been found and there is no evidence of crack initiation at stress concentrators...
 - d. Overall, there is no sign that there was any microstructural "problem" that could have had a significant influence on failure."

RECOMMENDED ACTIONS:

1. Inspect external UNS S31803 material, preferably with ACFM (Alternating Current Field Measurement). Priority should be given to inspection of uncoated material operating at temperatures above 100EC which might be subject to wetting.
2. For duplex material at risk, consider the options of:
 - a. A regular program of inspection for external cracking, and/or
 - b. Protective coating with thermal aluminium spray. (ACFM can be applied through such coatings if required.)