
Question 86: What is the panel experience with polythionic acid stress corrosion cracking of the regenerator and/or flue gas system? How rapidly can it occur? What preventative measures can be practiced? What might cause the corrosion to occur soon after equipment commissioning?

Tom Lorsbach (UOP)

Due to high temperatures and limited moisture, polythionic acid stress corrosion cracking (PASCC) in FCC regenerators and flue gas systems are relatively rare. A specific set of criteria must exist before PASCC of austenitic stainless steel is possible. First, sulfide scale, liquid water and oxygen must be present. Next, the microstructure of the material must be sensitized. Finally, there must be a tensile stress applied to the sensitized area. PASCC occurs when polythionic acid attacks and corrodes a sensitized area of stainless steel where a stress is, or will be, applied. Lack of any one of these conditions will prevent the cracking from taking place. The potential for PASCC is greatest during shutdown and start-up of the FCC unit when water from steam or humidity, oxygen, sulfide films, and thermal expansion stresses can all co-exist.

PASCC can occur quickly if all the prerequisite conditions exist. The most effective preventive measure is to avoid allowing liquid water to condense and exist in the regenerator and flue gas system. Keeping temperatures above dew point, inerting the surrounding environment and soda ash washing the material are all helpful in preventing PASCC especially during start-up and shut down situations.

As stated earlier, PASCC requires five conditions (sulfide, liquid water, oxygen, sensitized steel and tensile stress) must be present simultaneously, so if equipment is corroding soon after commissioning it likely that liquid water is present, or the corrosion cracking is not actually PASCC. For example, flue gas and regenerated catalyst standpipe expansion joint bellows elements are susceptible to sulfuric acid corrosion and cracking due to low bellows element temperature allowing sulfuric acid condensation in the expansion joints.

NACE has recommended procedures to prevent polythionic acid stress corrosion cracking, as outlined in RP-0170.

Dwight Agnello-Dean (BP) We have had areas in our flue gas systems where polythionic acid stress corrosion cracking (PTASCC) has been reported. From our internal and external review, we believe deadlegs or ingresses of wet steam or water are the most common areas where PTASCC have been identified. As such our internal list of preventive measures includes.

- Eliminate deadlegs. If this can't be done purge deadlegs preferably with a dry gas.

- Use stabilized stainless steels

- For components such as expanders or waste heat recovery units, that may have bypass lines, a minimal flow through the bypass lines should be maintained. As far as startup and shutdown, most sites do not do anything to specifically prevent PTASCC.

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