PROJECT EXPERIENCE

Steam Plant Piping Corrosion

Failure mechanism driven by ineffective oxygen removal exacerbated by erosive calcium sulfate

A steam generating plant supporting an associated thermal recovery project in the Middle East was experiencing through-wall corrosion of carbon steel lines. In some locations this was aggressive enough to corrode through replacement piping in as little as two months. Downtime in the steam plant was reducing heavy oil production and increasing OPEX. GATE was invited to the site to take a closer look at the operation and management of the system and determine how corrosion could be more effectively controlled.

SYSTEM REVIEW & RESULTS

A review of system design and operational data prior to the site visit minimized disruption to ongoing steam generation and associated production activities. By working with the Client to align the visit with a planned maintenance shutdown of part of the facility, GATE was able to gather samples of corrosion product and scale from key vessels and piping segments for subsequent analysis without incurring further downtime.

The nature of the corrosion product and the corrosion morphology on the affected equipment indicated oxygen corrosion, with large amounts of iron oxide and iron hydroxide present. However, larger vessels also contained particulate calcium sulfate, believed to originate from prior contamination of upstream water processing equipment. This suggested a failure mechanism that was driven by ineffective oxygen removal from the steam feed water that was subsequently exacerbated by the carry-over of erosive calcium sulfate solids to the steam system and the subsequent preferential failure of carbon steel elbows.

TECHNICAL ACHIEVEMENTS & BENEFITS

- As for many corrosion problems, both the cause and the solution were found to be in process control. Added condition monitoring locations to high-risk locations and added a corrosion coupon point to the system.
- Optimized oxygen scavenger type and injection locations for increased residence time and the protection of carbon steel portions of the system. Added sampling locations for routine sampling of oxygen and scavenger residuals, after identifying a suitable field test for diethylhydroxylamine (DEHA) oxygen scavenger measurement.
- Cleaned the upstream equipment that was the source of the calcium sulfate solids.
- Ensured that the operations staff, the chemical vendor and the integrity management staff interfaced so that all stakeholders were aware of system performance and operation and would be able to react to operational excursions and upsets in a coordinated manner.

LOCATION

Middle East

CHALLENGE

Identify operational improvements that would enable a steam plant to reduce corrosion-related downtime and so increase production and revenues from an associated thermal enhanced oil recovery development.

SOLUTION

Improved process control, including system monitoring and sampling, oxygen scavenger type and injection location, and the selection of appropriate condition monitoring locations.