Question 24: What is your engineering design practice for selecting metallurgy for hydroprocessing unit's amine systems? How does chloride level impact the metallurgy selection?

JOE RYDBERG (CITGO)
At CITGO Lemont Refinery, the base practice is to install post weld heat treated carbon steel piping for the main run of the pipe upon initial fabrication. For a set length downstream of control valves, 304 stainless steel is installed to try and mitigate the corrosive effects of flashing across the valve. However, in recent years, there has been a notable increase in the amount of corrosion that has been observed on the carbon steel lines. In areas that have been found to be corroding rapidly, an installation of 304 stainless steel has been put in place of the carbon steel. The concern of chloride content and its cracking potential in the circulating stream has been weighed against the risk of carbon steel corrosion. Thus far, the very localized corrosion of carbon steel and its difficulty of detection by common NDE methods has been deemed riskier than chloride cracking concerns, and the installation of 304 stainless steel has taken place.

The reason for choosing 304 stainless steel over 316 stainless steel is the damage that has been observed is mostly localized corrosion at heat affected zones (welds). While 316 is generally better for pitting resistance in aqueous systems, the benefits it has over 304 in a general wall loss scenario are not significant enough to warrant the additional cost. We have found 304 stainless steel to be adequate in resisting corrosion (as we have a long history of its use just downstream of control valves in this very environment) to an acceptable degree. That is the primary driver behind the choice to use 304 stainless steel.

JIM JENKINS (Shell Global Solutions)
For "normal" amine service, carbon steel (CS) is the material of choice. However, hydrotreater applications that operate at higher pressure will have higher acid gas pick up in the amine. This causes higher temperatures in the contactor. For applications where temperatures exceed about 90?C (194?F), austenitic stainless steel (SS) is normally selected for the bottom 1/3 or ½ of the tower.
When chlorides are present, SS can experience chloride-induced stress corrosion cracking (CSCC) at temperatures above 60?C (150?F). Alternate materials not subject to CSCC include alloy 825, alloy 625 and alloy 2205 (duplex).
The industry generally limits the amount of chlorides in the circulating amine system. When high pressure hydroprocessing units require SS contactors, the chloride content of the amine is generally limited to 250 ppm (maximum).
In summary, recommended materials of construction for amine systems that contain chlorides:

Service	**MOC**
Lean Amine	CS
Rich Amine < 90 ^{o}C	CS
Rich Amine > 90 ^{o}C	Alloy 825, alloy 625 and alloy 2205 (Duplex)

CHRIS WOZINAK (Honeywell UOP)
Historically, UOP has designed Amine Scrubbers with Killed Carbon Steel that is post weld heat treated (PWHT) and has additional corrosion allowance. Due to the corrosive nature of the rich amine, the trays are upgraded to 304SS and the mesh blanket is typically 316SS. While most customers have seen success with this design, even with feed sulfur levels exceeding 3%, there are some who have seen accelerated corrosion on the wall opposite the rich gas inlet line. Typically this location will receive weld buildup, followed by application of stainless steel patch plates or weld overlay, followed by PWHT. If the unit contains chlorides, UOP is concerned about the potential for chloride stress corrosion cracking (Cl-SCC) of any austenitic stainless steels (300 series) and so we will upgrade the 304SS and 316SS to Alloy 400 (also known as Monel), which has good resistance to chlorides and H2S at moderate levels.

Print as PDF:

Tags

Amines

Year

2019

Submitter

Operator