Sulfuric Acid / Sulfur Storage Tank Inspections

AIChE Central Florida Annual Convention
Sulfuric Acid Workshop
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JWD
Typical Causes of Corrosion

• Material defects
• Weld – heat affected zone
• Weld – high porosity
• Weld – lack of full penetration
• Hydrogen grooving
Tank Protection Methods

- Maintain low acid storage temperature
- Anodic protections systems
- Coatings
- S.S. nozzle liners
- Painting (external)
- Routine Inspection & Maintenance
- Life Expectancy: 15-25 years
Inspection Topics

• Inspection frequency – API Code (?)
• Full internal inspection:
  – Close visual inspection (“shadow” technique)
  – Vacuum check all welds
• External thickness checks:
  – Target the “T” weld areas
  – As close to welds as possible
• Destructive v. Non-Destructive
Sulfuric Acid Tank – Shell Wall
Heat Affected Zone Corrosion
Heat Affected Zone Corrosion
Material Defect – Shell Wall

030723 se tk north side - washout in shell - worst that was seen this is at 6 1/2 foot level
Material Defect – Floor Plate
Shell Plate – Material Defect
Material Defect – Shell Wall

SW TANK 2/24/03
HOLE AFTER USING
SE VACUUM HOSE
Material Defect - < 1-year

SW TANK  NEW SHELL PLATE
2/25/03

PIT IN PLATE APPROX.
3/8" DIA X 1/4" DEEP
NEW 7/8" BOTTOM SHELL PLATE INSTALLED 2002
Corrosion Undercut of Weld Seam

looking up
030723 se tk north side - horizontal weld seam
at first and second courses

2nd plate
shadow from weld
weld
1st plate
shadow here is due to corroded plate
Weld Undercut
Corrosion Along Weld Seam

030723 se tk north side vertical seam
not erosion corrosion to the left of the seam
Weld Porosity Defects
Weld Porosity Defects
Weld Porosity Defects
Weld Porosity Defect
Weld Porosity
Destructive Testing – Material Defect
Reverse Side – Same Hole

SW TANK 2/24/03
BOTTOM OF PLATE

CORROSION AREA BOTTOM OF PLATE - DEFECTIVE PLATE???
Coated v. Non-Coated

030723 se tk nw nozzle top rt of coated and uncoated areas

slight eddy currents of corrosion
Thickness Check the Weld “T”
Sulfur Tanks

• Internal heating coils introduce moisture source
  – Permanently mounted on floor or shell
  – Hanging style removable for repair/replacement
  – External style removes moisture from the equation

• External Insulation
  – Missing insulation can result in cold spots and solid sulfur formation against tank walls.
External Inspection
Internal Inspection
Internal Shell Wall & Floor

Photo #7 Corrosion Areas in Wall
Formation of Pyrophoric Iron Sulfides

• Hydrogen Sulfide – H\textsubscript{2}S
• Moisture – H\textsubscript{2}O
• In presence of Iron (Fe) produces Iron Sulfide (FeS) and Iron Oxide (Fe\textsubscript{2}O\textsubscript{3}) in an autocatalytic reaction.
• The iron sulfide formed under anaerobic conditions can react in a highly exothermic reaction when exposed to oxygen resulting in a fire or explosion hazard.
Sulfur Tank Roof Internal Corrosion
Sulfur Tank Roof Corrosion
Internally Mounted Coils

STORAGE OF MOLTEN SULPHUR
Hanging Removable Coils
Externally Mounted Coils

MAKE SULPHUR TANK CORROSION A THING OF THE