External Stress Corrosion Cracking on Pipelines

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Preview

• SCC basics
• What does SCC look like?
• What does SCC NOT look like?
• Q & A
Definition of Stress Corrosion Cracking

- Form of corrosion
- Susceptible material
- Specific corrosive medium
- Tensile stress
Pipeline SCC

- Buried pipelines under C.P.
- Aqueous carbonate/bicarbonate environment (classical SCC)
- High tensile stress
- Disbonded coatings
- Potentials $-600 \text{ mv}$ to $-700 \text{ mv}$ vs. SCE
- Temperature is very important
History of Pipeline SCC

• Major problem in North America since 1965

• Extensive research by PRCI

• Limited occurrences in Saudi Arabia
Pipeline SCC at Saudi Aramco

- Water injection lines – 18 cases 1974-1981
- 1979 8” flowline to Qatif
- 1990 14” AHT-1
- 1992 14” AD-2 hydrostatic test leaks
- 1994 22” QA-2 hydrostatic test rupture
- 1995 QA-7 service leak, suspected SCC
- 1997 AD-2 SCC detected, no failure
- 1998 AD-1 hydrostatic test leaks
- 1999 32” ADJ-1 service rupture of gas line
Recent gas pipeline rupture due to stress corrosion cracking
What does SCC look like?
Wet Fluorescent Magnetic Particle Inspection
AD-2 SCC, metallographic cross-section
AD-2 stress corrosion cracks broken open
ADJ-1 Pipeline Rupture – mating fracture edges
ADJ-1– numerous stress corrosion cracks parallel to fracture edge
SCC parallel to fracture
Stress corrosion crack broken open
ADJ-1 Typical stress corrosion crack, as polished specimen
ADJ-1 SCC – Note intergranular crack path
What does SCC NOT look like?
Pipe mill surface imperfections
Pipe mill “slivers”
Pipe “slivers” – note orientation at angle to pipe axis.
What do you want to discuss?

- Methods for finding SCC.
- Recognizing & confirming SCC.
- Mitigation measures.
- Other questions?
Recent gas pipeline rupture due to stress corrosion cracking
Definition of Stress Corrosion Cracking

- Form of corrosion
- Susceptible material
- Specific corrosive medium
- Tensile stress
Pipeline SCC

• Buried steel pipelines
• Aqueous carbonate/bicarbonate environment (classical SCC)
• High tensile stress - frequently
• Disbonded coatings - frequently
• Potentials –670 mv to –770 mv
• Temperature is very important
Mitigation Techniques

GENERAL PRINCIPLES

• FIND CRACKS
• REPAIR PIPE AND COATING
• LOWER STRESS
• EXCLUDE ENVIRONMENT
Mitigation Techniques

SPECIFIC MEASURES – traditional

• Routine surveillance
• Special excavations and NDT
• Investigation of failures
• Hydrostatic testing
• Pipeline coating rehab
• Pipe repair and replacement of segments
• Replacement of line with new FBE-coated pipe
Mitigation Techniques

SPECIFIC MEASURES – new developments

• Instrument scrapers for detecting cracks
• PRCI protocol to prioritize sites for SCC
• Remote detection of coating disbonds (ID-02/99-T)
• Other PRCI and GRI research
• PIRAMID – pipeline risk analysis for maintenance and inspection decisions (C-FER)