An Operators View on Approaches to MIC Threat and Failure Assessment

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Thursday, Feb 7, 2019 from 8:45AM - 11:30AM

Forum on Assessment of Microbiologically Influenced Corrosion (MIC) Threats and Failures: Approaches and Challenges

Outline – MIC Assessment

- Existence of Threat
- Magnitude of Threat
- Assessing MIC (RCA/diagnosis)
  - Discussion
  - Case Study

Existence

- Existence of threat is informed by:
  - Sampling and testing → Bacteria are (nearly) everywhere
  - Experience → A small number of confirmed instances of MIC
  - Presumption → Rapid corrosion with no other explanation
  - Industry knowledge → Constantly being refined/improved

Magnitude

- Magnitude of threat is informed by:
  - Monitoring → ILI is principal tool for mainlines
  - Experience → Rapid corrosion is (thankfully) rare
  - Monitoring → Near real-time SCADA analysis of operations
  - Experience → Customized flow models/surveillance
  - Monitoring → Pig trash is analysed for microbial activity
  - Industry knowledge → Constantly being refined/improved

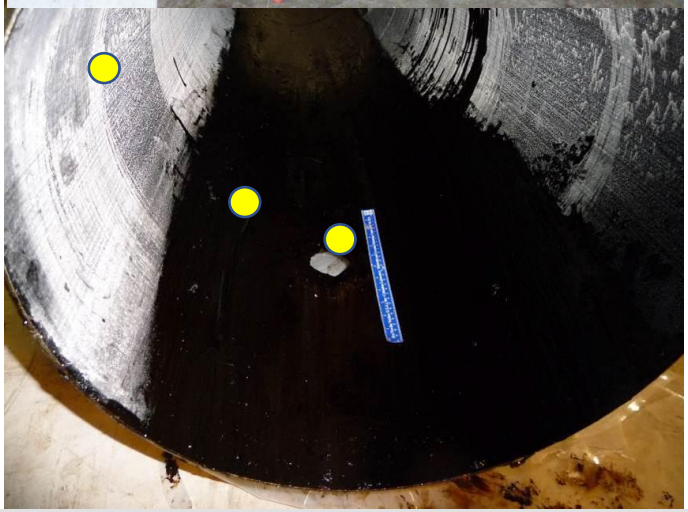
Assessing MIC (diagnosis)

- Presence of bacteria is not enough!

- Three supporting legs for MIC determination:
  - There are higher populations of bacteria at the failure site than in the environment, or at other non-corroded areas
  - There are corrosion product or chemical species consistent with the type of microorganisms observed
  - The corrosion (rate) can not be explained by other causes

  - genoMIC provides unique opportunity for world class analysis

Case Study – 1 (2012)



- Relief piping (~no flow)
- 6.35mm w.t.
- 19 years old
- Relative low spot (utility underpass)
- Lots of bacteria on bottom
  - Culture / microscopy
- More APB at leak compared to all other locations

- Dead leg, low spot, UDC
- MIC considered ‘likely’

Case Study – 2 (2017)

- Manifold end (~no flow)
- mm w.t.
- years old

- Enhanced investigation:
  - Careful sampling
  - Preservation/storage
  - Expediting to lab
  - Clear/simple instructions
  - (some luck)

Results

	Analysis of Field Samples				Laboratory Cultures	
Location	pH	Iron (mM)	Acetate (mM)	XRD	Sulphate consumption	Pitting severity
Leak site	6.92	343	17.26	$FeCO_3$: 45-55% Fe_9S_8: ND Fe: ND $CaCO_3$: 1-8%	3 mM/month	Most severe
Adjacent location	6.95	57	20.59	$FeCO_3$: 20-30% Fe_9S_8: ND Fe: 1-10% $CaCO_3$: 25-35%	2 mM/month	Moderate
Non-corroded area	6.67	12	2.42	$FeCO_3$: ND Fe_9S_8: 1-10% Fe: ND $CaCO_3$: 1-10%	1 mM/month	None

Conclusions

- Fermentative organisms producing organic acids figured prominently
- Biofilm formers also present in large numbers
- Organisms associated with EMIC were present (at lower numbers), and may have contributed to the corrosion at this site