Internal Corrosion Monitoring to Evaluate Chemical Programs

Period #5

Internal Corrosion Course
2017
“Corrosion is the deterioration of a substance (usually a metal) or its properties because of a reaction with its environment.”
What Causes Internal Corrosion?

- H₂S  hydrogen sulfide
- CO₂  carbon dioxide
- Cl  chlorides (salt)
- O₂  oxygen
- MIC  bacteria

NO WATER – NO CORROSION
Forms of Corrosion
MIC Corrosion

[Images of MIC corrosion examples]

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Jane Nicole Brown & Jerry Brown
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Paraffin Problems
Hydrate Problems

Ice

Choke
Hydrate Block Failure

![Image of hydrate block failure]

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Pipeline Failures!

TOP

BOTTOM

TOP

BOTTOM

BOTTOM
Pipeline Failure Onshore
Pipeline Failure Onshore
7 Methods of Corrosion Control

- Material Selection
- Design of the Structure
- Coatings
- Cathodic Protection
- Alteration of the Environment
- Inhibition
- Repair and/or Replace
Corrosion Control – Mature Assets

1. Material Selection – Too Late!
2. Pipeline Design – Too Late!
3. Coatings – Repair Only – Not Internal!
4. Cathodic Protection – Must be Maintained!
5. Alteration of the Environment – Maybe?
6. Filming Chemicals – Best solution!
7. Repair or Replace – Cost Study!
7 Methods of Corrosion Control

- Material Selection
- Design of the Structure
- Coatings
- Cathodic Protection
- **Alteration of the Environment**
- Inhibition
- Repair and/or Replace
Alteration of the Environment

Temperature

Liquid Removal

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Pigging – Cleaning & Inspection
7 Methods of Corrosion Control

- Material Selection
- Design of the Structure
- Coatings
- Cathodic Protection
- Alteration of the Environment
- Chemical Inhibition
- Repair and/or Replace
Production, Pipeline & Downstream Methods of Corrosion Control

The use of chemical corrosion inhibitors & other chemicals for carbon steel pipelines has been & still is the preferred method to protect these assets from internal corrosion.
Production, Pipeline & Downstream Methods of Corrosion Control

Both onshore & offshore chemicals must be injected into pressurized pipelines & vessels in the upstream, midstream & downstream areas.
ONSHORE CHEMICAL INJECTION
ONSEHORE PIPELINE CHEMICAL INJECTION

- Reservoir
- Level Gauge
- Valves
- Remote Readout
- Injection Point
- Power
- Pump
- Stand
OFFSHORE CHEMICAL INJECTION

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Typical access fitting for chemical injection
The effectiveness of the Chemical Treatment has been monitored by:

1. Leak records
2. Coupons & Probes
3. Sampling
4. Residual checks
5. Inspections
SAMPLING

Sample Bottle
However.....

Failures have (and are) occurring due to internal corrosion.

Is the inhibitor working?

Is it the correct amount?

Is the monitoring/sampling working?
Internal Corrosion Monitoring Equipment

- Internal Corrosion Monitoring Equipment
  - ER, LPR, Galvanic, Bio Probes & Instruments, etc.
- Coupons & Coupon Holders
- High & Low Pressure Retrieval Equipment
Corrosion Coupons – Baseline Data

• Most common monitoring method in the world.
• 30-90 day exposure.
• Tells corrosion rate BUT does not tell why or when.
• Main function – are corrosion allowances being exceeded & are the inhibitors working.
• Excellent back up device for Probes
Weight Loss Corrosion Coupons
ER Probes & Coupons
Hydrogen Permeation Monitoring
Variety of suppliers, manufacturers for access, coupons, probes & instrumentation
A novel approach to determine if the chemical inhibitors are effective & for the proactive management of internal corrosion
A micelle is a nanoscale aggregate of corrosion inhibitor that forms when a system has reached saturation i.e. corrosion inhibitor has adhered to every available surface (pipe, solids & interface).
Micelle Measurement

Micelles are directly measured using a fine stream of fluids passing through a flow cell. A laser then detects the particles & software distinguishes the size, shape, & chemistry of the particle.

We can then analyze the concentration series of the Critical Micelle Concentration (CMC), if required, but this technology relies upon measuring micelles rather than the CMC.
Chemical Inhibition & Micelle Detection

- Under-dose
- Optimal-dose
- Over-dose

Corrosion Inhibitor
Fluids from an inter-platform pipeline were tested for the presence of corrosion inhibitor micelles.

Typical materials were taken to the asset & fresh samples were provided by the asset staff.

Testing of samples in the offshore laboratory with the instrument only took a few minutes.

The data from the testing of the “input” fluid indicated the presence of micelles but these were not apparent in the fluid reaching the destination platform (“output”).

The analysis provided information to the operator, beyond that already available from probes & residual monitoring. To better understand the corrosion risks that exist in the pipeline.
Details on Using this Technique

For onsite use; so avoiding sample degradation associated with transit time to the central laboratory and subsequent inaccurate results.

Samples are tested (i.e. it is not an online instrument).

Simple to perform (mix sample and marker, place in instrument, read signals).

Quick to perform (minutes).

Data analysis (micelle interpretation) conducted by trained personnel for robustness.

All chemicals and consumables provided in kit.
Effective Internal Corrosion Control Monitoring will tell the chemical vendor, and the operator, that the chemicals are working as designed, and the proper amounts are being used.
All piping systems are only as good as the weakest link!
Sticking your head in the sand is never the solution. Good Corrosion Control & Proactive Management of system internal corrosion will optimize your integrity efforts & significantly impact your chemical programs.
Thank YOU for your attention!

Any questions?

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