To Treat or NOT?

38th Annual Corrosion Short Course

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2026

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Internal Corrosion Specialists

This Should be Called…..
How Do I Design My Internal Corrosion Program?

My Internal Corrosion Control Program

Oh (“_ _ _ _ “) I have evidence of Internal Corrosion

Not dealing with any Stress Corrosion-Stress Cracking Corrosion (SCC), Sulfide Stress Cracking (SSC),Hydrogen Induced Cracking (HIC),

What type of corrosion am I dealing with-Pitting/Uniform

Where are my risks – High Consequence Areas

Corrosion occurring – Top, Bottom, Throughout the line

How do I mitigate my internal risks

Know Your System

- Identify the corrosive constituents and environment of the product your moving – **Oil / Condensate, NGL**
  - Sulfur content - <0.5 wt% classified as sweet
  - TAN total acid number - >0.5 mg is considered high for crude oil
  - Paraffin/Asphaltene
  - BS&W
  - Continual or intermittent flow
  - Flow velocities when pumping
  - General topography – where are the low spots
  - History of leaks

Know Your System

- Identify the corrosive constituents and environment of the product your moving – **Gas**
  - CO_2, H_2S, O_2 content
  - Flow velocities = Flow pattern (where's the water)
  - General topography – where are the low spots – water and deposits
  - History of leaks / cut-outs

You Have Identified the Issue – What are the Possible Solutions?

- Physical
  - Pull liners / Coated pipe
- Operational (Make changes to the system)
  - Pigging
  - Change Velocities
    - Higher velocities to help sweep water from low areas
    - High velocities can increase solids impingement
  - Pressures
    - Increase/Decrease pressures to change velocities and flow patterns
  - Intermittent Flow to Continuous Flow – Oil/Liquids

Possible Solutions

- Change the Water Content and Quality of Crude or Gas
  - Tighter control on BS&W
  - Dehydration System
  - Molecular sieve
  - CO_2, H_2S scavenger Towers
  - O_2 Tighter control of what we are buying – hydrate inhibitor/less methanol
  - Amine Unit

Possible Solutions

Possible Solutions

- Make the Lines piggable
  - Install launcher / receiver
  - Argus Pigging Valve
  - Create and maintain a pigging schedule
  - Use the appropriate type of pig for the job

Modernize Your Pigging Stations.

ARGUS
Manufacturing Intelligent Solutions

Possible Solutions

What type(s) of internal corrosion have I identified/suspect and therefore plan to mitigate or reduce to acceptable levels

Pigging if possible is an important mitigation method

- Proper pig selection to remove water/liquids and deposits
- Pigging in conjunction with chemical treatments
  - Effectively distributes chemical thorough the line
  - Spray pigs to apply chemicals to the top of the line

Possible Solutions

- Move the coupons and monitoring tools to areas in the line that won't show high corrosion rates! (No – please don't do that…)

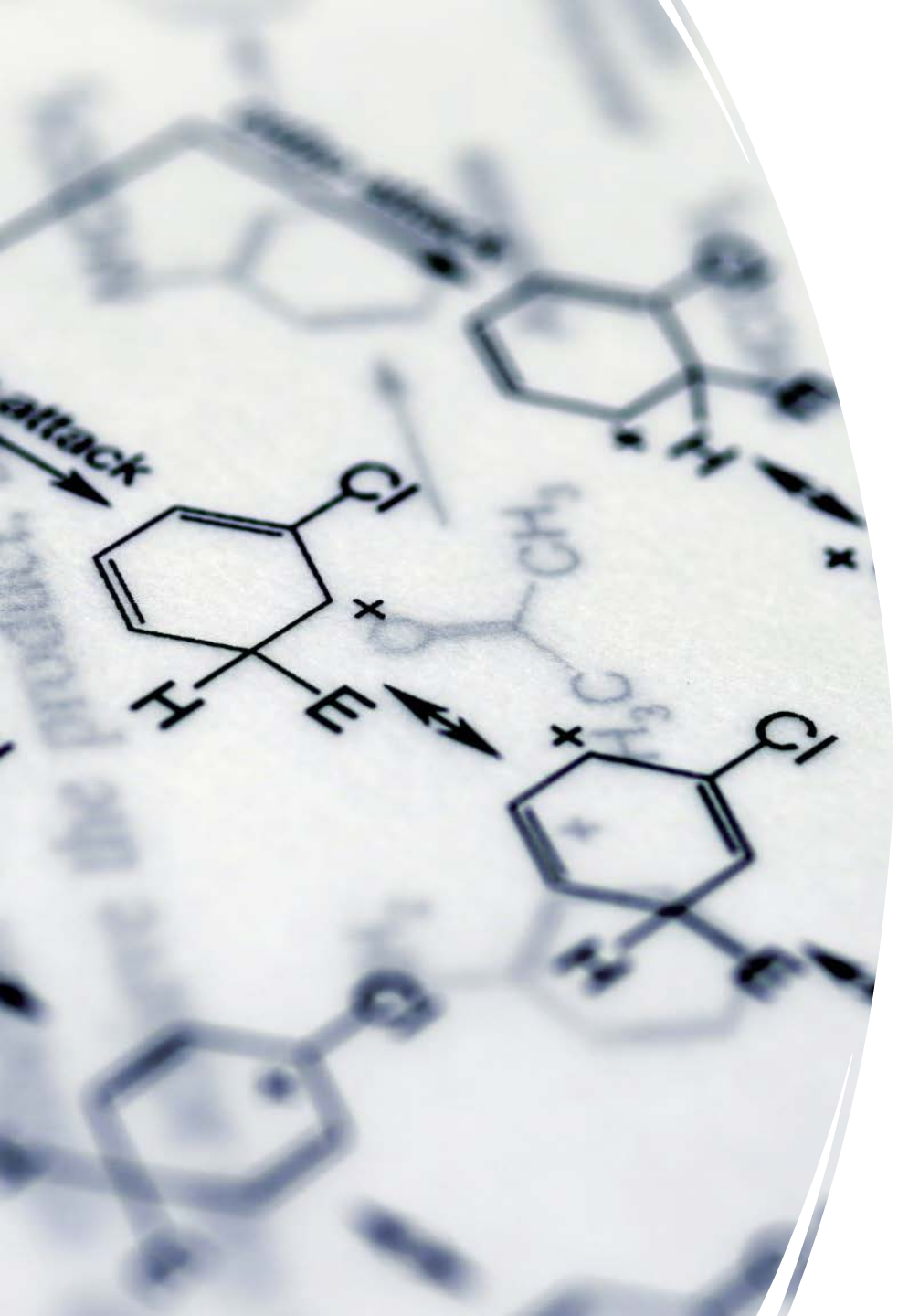
Or

- Start and monitor a chemical treating program
  - What do I need to use
  - How often
  - At what doseage
  - How am I going to apply it
  - How am I going to prove my program is working
  - Do I have background data?

Solutions – Chemical Application

Common Chemical Application Methods

- Continuously inject a calculated amount of chemical
  - Scavengers – CO_2, H_2S
    - Scrubbers / Amine Units a more economical option most of the time
    - Contiously injectiong scavengers may have other side effects
  - Paraffin solvents / Paraffin inhibitors
  - DRA's
  - Emulsion Breakers
  - Antifoulants and Cleaners
  - Corrosion Inhibitors and Biocides



Chemical Application Methods

- Continuously inject a calculated amount of chemical
  - Corrosion Inhibitors
    - Must have enough velocity to carry inhibitor through the line
    - Will be chosen for the method of dispersion (water soluble, oil soluble, dispersable, etc)
    - Need a monitoring method to assure the inhibitor gets to the end of the line ata sufficient quantity to be protective-residuals
  - Biocides
    - Not typically recommended for continuous injection in pipelines unless lines are pigged
    - Intermittent injection can be used to treat tanks and sump
    - Contact time is a key variable
  - Pigging operations may affect continuous injection inhibition films

Common Chemical Application Methods

- Batch chemical treatments with pigs
  - Corrosion inhibitors, Paraffin cleaners, Biocides, Line cleaning chemicals
  - Chemical pill batched between two pigs
    - Chemical pill volume calculated to cover surface area of the pipe
    - Used with oil solubles to “coat” the entire circumference of the pipeline
    - Used if there is a potential for top of the line corrosion
  - Chemical pill batched in front of pig
    - Chemical pill volume calculated to cover surface area of the pipe
    - Often used with surfactants to “lift” solids in front of the pig
  - Chemical pill batched behind a pig
    - Used with biocides to allow more contact time
    - Used with water soluble products

Common Chemical Application Methods

- Slug Treatments
  - Treatment volume calculated and pumped into the line
    - Treatment typically diluted with solvent or water
    - Chemical volume is calculated to be enough to cover the length of the line
  - Slug treatments are used primarily on non-piggable lines
    - It is hard to get uniform coverage

Corrosion Inhibitor Selection

Corrosion Inhibitor selection depends on what is being transported, what type of corrosion I am trying to mitigate, where are the areas the corrosion is of concern

- Oil and other liquid products
  - Water, Paraffin/Asphaltene content, density
  - Flow velocities – laminar, transitional, turbulent
  - Continuous flow vs intermittent flow
  - Compatibility with system fluids and downstream processes
  - Application – Batch, Slug or Continuous injection

Corrosion Inhibitor Selection

Corrosion Inhibitor Selection

- Natural Gas
  - Water content (lbs/mmcf)
  - Flow velocities – flow pattern
  - Temperatures – gas temp vs pipe temp – TLC
  - Compatibility with system fluids and downstream processes
  - Application – Batch, Slug or Continuous injection

Biocide Selection

Biocide selection depends

- Oil and other Liquid Products
  - BS&W content
  - Time Kill Studies – Contact time with biocide/concentration of biocide
  - Source of bacterial intrusion – sumps, tanks contamination
  - Compatibility with system fluids - DRA
  - Application – Batch or Slug
  - Usually best to treat the source if possible

Biocide Selection

Biocide selection depends

- Natural Gas
  - Water content –lbs/mmcf
  - Time Kill Studies – Contact time with biocide/concentration of biocide
  - Source of bacterial intrusion – Drips, Laterals feeding certain line(s)
  - Compatibility with system fluids
  - Application – Batch or Slug
  - Usually best to treat the source

Corrosion Inhibitor Types

Corrosion Inhibitors

Most common are nitrogen based polar amines-attracted to the metal surface

- Water soluble – Soluble in water phase
  - Form a barrier between aqueous phase and pipe surface
- Oil soluble – Soluble in oil phase
  - Used widely where water is the only liquid phase, or there is very little free water
  - Generally have a greater film persistency (sometimes called Gunkers)
- Oil soluble / Water dispersible
  - Soluble in oil phase, yet disperses into the water phase
  - Widely used in crude lines

Corrosion Inhibitor Types

One-off Corrosion Inhibitor Treatments
Some binary corrosion inhibitors have a greater film life

- Two-part inhibitors once mixed have an application window – curing time
- Must be applied using pigs
- Storage fields where lines can only be treated certain times throughout the year
- Be-directional flow lines – small window to treat line(s)
- Aggressive pigging cannot be used with this mitigation method

Corrosion Inhibitor Types

One-off Corrosion Inhibitor Treatments-Gas

Un-piggable line treatments on low flow wet gas lines – gathering lines primarily

- Designed to treat to the entire length of the line
- Slug treatment
- Treatment volume calculated based on 15-20% line fill
- Slug treatment consists of corrosion inhibitor, biocide and or a foamer
  - The foamer or biocide helps to carry the treatment to the end of the line
- Benefits
  - Distributes treatment to the end of the line
  - Helps unload the stagnant water from the line

Components To Monitor

pH and Alkalinity
- Corrosivity of the water

Deposits
- Periodic analysis of deposits tell us what the corrosion by-products are

Bacteria
- Planktonic and Sessile

Coupons
- Corrosion rates – general mpy and pitting mpy

Chlorides
- Periodic check of the salinity of the water

Iron and Manganese
- Test for changes upstream and downstream, as well as the ratio of Fe/Mn (roughly 50:1)

Scaling Tendency
- Test for potential scale formation (both acid soluble and acid insoluble scales)

Monitor System and Program Changes

Monitor changes when you make changes to the mitigation program

- Started or changed a pigging program
  - Are the solids analysis generally the same
  - Is there a decrease in the amount of solids
- Increased/decreased amount of gas / oil moving through the line
- Added laterals feeding line
  - Monitor the quality of new or added
- Started or changed a chemical program
  - Coupon mpy's/pitting mpy's improved to acceptable levels
  - Bacteria counts improve
  - Chemical residuals
  - Solids increase or decrease

THANK YOU FOR
YOUR LİSTENİNG

DO YOU HAVE
ANY QUESTİONS?

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