Surkein Corrosion
Mike Surkein
mike@surkeincorrosion.com
Surkein Corrosion
10632 Jackson Hole Lane
McKinney, TX 75070
+1-281-989-4134
www.surkeincorrosion.com

# PHMSA R&D Forum 2021

## Breakout Tanks

## Prevent Corrosion of Tank Bottom

**Corrosion Control Designs To Optimize Equipment Integrity**
**"Rust Never Sleeps“**

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Surkein Corrosion LLC
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mike@surkeincorrosion.com

# Corrosion Protection – Breakout Tanks

## Available Technology for Bottom Corrosion Protection

- Fabricate from noncorrodible material
- Internal surfaces
  - Cathodic protection (CP)
  - Linings
- External surfaces (bottom)
  - Cathodic protection
  - Coatings
  - Vapor corrosion inhibitors (VCI)
  - Foundation design
    - Concrete, oiled sand, ring wall, secondary containment liner, etc.

# Proof Corrosion Control Technology Works

## How is bottom corrosion control proven successful in real time?

- "In service" vs "out of service" tank
- Available proven and accepted inspection technology?
- Inspection technology memorialized in technically accepted standards?
- Standards accepted by regulators?

- **Cathodic protection (worldwide accepted standards and long record)**
  - Install insitu/removable CP reference electrodes (how many, where?)

| Tank Diameter | | Number Reference Electrodes |
|---|---|---|
| m | ft | |
| 6–12 | 20–40 | 3 |
| 12–18 | 40–60 | 4 |
| 18–30 | 60–100 | 5 |
| 30–45 | 100–150 | 6 |
| 45–76 | 150–250 | 7 |
| 76–107 | 250–350 | 10 |

- Reference life?
- Reference placement?
- Reference type?
- Reference performance?
- Contact with electrolyte?

A lot of questions?

# Proof Corrosion Control Technology Works

- Vapor Corrosion Inhibitors (VCI)
  - Long track record in many industries
  - Numerous suppliers and formulations
  - Fairly new application – under tank bottoms or between double bottoms
  - How to prove effectiveness
    - Inservice – use corrosion probes (short term) – local area
    - Out of service – NDE (long term) – entire bottom
- Industry Practices
  - AMPP Test Methods, i.e.. TM0208-2018-SG "Laboratory Test to Evaluate the Vapor-Inhibiting Ability of Volatile Corrosion Inhibitor Materials for Temporary Protection of Ferrous Metal Surfaces“
  - Many corrosion inhibitor users qualify products prior to use – i.e.. pipelines
  - Is there any available test applicable to tank bottom undersides?

# Complexity with Underside Bottom Technology

- Types of tanks and foundations
  - New vs existing
  - API 651 mentions numerous types of tank cushion
    - Sand, oiled sand, continuous concrete (maybe slotted or not), crushed limestone or clam shell pad, continuous asphalt or native soil
  - Presence or absence of impervious external liner under the tank
  - High or low resistance tank cushion (CP impact)
    - Cushion properties change over time
  - Contaminants in sand cushion such stones or clay balls
  - Double bottoms with or without liner between
  - Ability of CP to function with all types of foundations ???
  - Ability of VCI to function with all types of foundations ???
- Industry/public wants effective technology to prevent corrosion and other deleterious repercussions of corrosion

# Need to Prove Technology

- Identify different types of tank foundations (new and existing)
  - Evaluate factors that may impact corrosion with various types of foundations (API 651 and API Technical Report 655 would be helpful)
    - Might be a large matrix so may need to prioritize
  - Determine when VCIs are feasible to provide corrosion control and how to categorically prove success (field analysis vs lab)
  - Develop foundation/tank design specific test procedures to prove ability of VCI
    - Large size vs small scale
  - Since many tanks also have CP, examine simultaneously
    - Need to add contaminants to cushion material?
  - Initiate Industry Standard development to qualify VCI

# Path Forward Summary for VCI Use

- Qualification of VCI capabilities under tank
  - Numerous foundation types
  - New vs existing
  - Interaction with CP
  - Double bottoms
  - Develop VCI qualification procedure/s for underside tank bottom corrosion control to be memorialized in industry standards
- Qualification of VCI contractor and inspector
  - CP has industry accepted qualification procedures
  - Coatings/linings have industry accepted qualification process
    - Applicator and technologist
  - Suggest development of qualification process