

raxair Services, Inc. has an emergent solution to a major challenge confronting many owner/operators of above-ground storage tanks (ASTs).

The challenge is control of tank bottom corrosion on the underside of a double- bottom tank upper floor and on a single-bottom lank with an HDPE secondary containment liner. The retrofit installation of cathodic protection systems for these ASTs is not typically practical, A logical and economical solution for control of floor plate corrosion within the interstitial spaces of these tanks is vapor corrosion inhibitor {VCI} technology.

Field data from actual VCI installations is encouraging. This update provides information related to:

- The installation of the Praxair Services Bottom LogicSM Corrosion Inhibitor solution in a 120-feet diameter tank was performed in December 2004,
- Recent data from 1 7 ASTs located in the southeastern US. that had corrosion inhibitor delivered into the interstitial space during 2000-2001.

Praxair Services 120- feet Diameter Tank Project. The tank had two steel floors separated by about four inches. An HDPE liner had been installed on top of the lower floor. then the interstitial space between floors was filled with sand. The VCI was delivered into the tank's interstitial space on Dec. 16, 2004.

Site Visit No. 1: Tasks completed prior to installation of corrosion inhibitor. Electrical resistance corrosion rate probes

were used to **provide** real-time calculated corrosion rate measurements of the double-bottom tank interstitial space environment. They yield a corrosion rate described in mils per year metal loss. These probes are installed at numerous locations between the tank floors. They are used to establish the corrosion rale of the interstitial space metals prior to installation of the inhibitor.

Once the inhibitor has been effectively delivered throughout the interstitial space, the probes are monitored until the inhibitor has achieved equilibrium in the interstitial space and a lower corrosion rate is established. Corrosion rate measurements are then obtained periodically to monitor the continual effectiveness of the VCI.

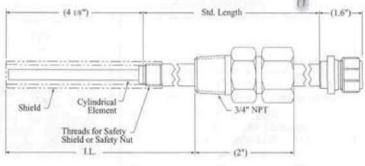
Determine Existing Telltale Pipe Configurations. This 120-feet diameter tank had 13 existing 1 -inch diameter perforated telltale pipes installed at varying distances into the interstitial space. A rod was pushed into each existing port to determine the undertank length of the telltale pipe. The distance between ports was about 29 feet. (Figure 1)

Install Four Access
Ports for Corrosion
Rate Probes into the
Interstice Between the
Upper and Lower
Floors. Four additional ports through the
tank shell were necessary for placement of
corrosion rate probes
into the interstitial

space. These were located between the telltale pipe ports as indicated on the plan view shown. Praxair Services has developed a special procedure for the safe installation of threaded ports in the tank shell without compromising internal HDPE liner integrity.

Installation of Corrosion Rate Probes into the Interstitial Space. The corrosion rate probes were installed and first read on Dec. 3, 2004. They were installed directly through the tank shell and into the sand a





few inches beyond the shell. A corrosion rate probe and digital meter used to analyze the probe are pictured above.

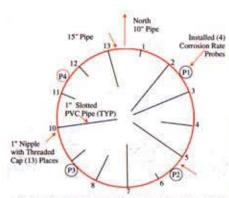


Figure 1: Distance between ports about 29 feet.

Site Visit No. 2: Installation of vapor corrosion inhibitors into the interstitial space. Establish the existing corrosion rate. Native corrosion rates for each probe were established prior to the corrosion inhibitor installation (see Table). This data was established after only 13 days, It would have been preferable to wait 30 days for the data, but project requirements did not allow this to occur.

Inhibitor Slurry Installation. A corrosion inhibitor, specially formulated for above-ground tank interstitial space metals by the premier inhibitor manufacturer in the U.S., was used. The inhibitor was delivered to the site in a powder form, then mixed with water on-site to produce a slurry. A total of 600 pounds was mixed with approximately 900 gallons of water.

On Dec. 16, 2004, predetermined quantities of the slurry were slowly pumped into each telltale pipe around the tank. This was accomplished as follows:

- A manifold assembly was built to allow flow of the slurry into three telltale pipes simultaneously. Individual in-line flow meters were used to track the volume introduced into each telltale.
- The slurry was pumped slowly into the telltales allowing sufficient time for distribution.
- The slurry injection process into each telltale pipe was stopped once the desired quantity of slurry had been delivered.

Final Testing

Just prior to leaving the project site, corrosion rate probe readings were obtained at each probe.

Continuing Data Collection

Corrosion rate probe readings are being collected weekly by a local Praxair contractor. The weekly readings will continue until the data stabilizes. At that time the interval between readings will be extended.

Corrosion Rate Probe Data

The table provides corrosion rate calculations based upon the data acquired from the probes. Note that the native corrosion rate of the interstitial space metals on the 120-foot tank appears to have been very aggressive. After 56 days the corrosion rate has been reduced 67% to 76%.

Date Probe # Calculated % Decrease
Mils/Year in
Corrosion Rate Corrosion
Rate

			11010
Native corre	osion rat	e after 13 day	s.
12/16/04	P1	21.2	
	P2	16.5	
	P3	28.5	U. V.
	P4	17.3	9.0
Corrosion ra	te 21 da	ys after inhibitor	installation.
1/6/05	P1	12.4	42%
	P2	9.5	42%
	P3	10.7	62%
	P4	5.9	66%
Corrosion ra	te 56 da	ys after inhibitor	r installation.
2/10/05	P1	7.0	67%
	P2	3.9	76%
	P3	9.4	67%
	P4	4.8	72%

Data From 17 Double-Bottom ASTs With VCI Installed Four To Five Years Ago.

A major project utilizing vapor corrosion inhibitor technology for the control of double-bottom AST interstitial space corrosion was completed in 2000-2001. VCI slurry was pumped into the interstitial space of 17 large-diameter ASTs with double-steel floors. The space was filled with the liquid VCI slurry and held full for about 60 days. The telltale pipes were then uncapped and the slurry was allowed to drain to the level of the telltale pipes.

A single electrical resistance corrosion rate monitoring probe was located within the interstitial space of each tank near the center to evaluate the VCI effectiveness. No corrosion rate probes were located near the tank shell.

Data from the corrosion rate monitoring probes obtained in March 2005 indicated a corrosion rate for all 17 tanks ranging from 0.150 mils per year to 0.720 mils per year.

This data indicates very good corrosion control and no significant depletion of inhibitor effectiveness even after four to five years.

Summary

Many above-ground tank owner/operators have identified a widespread need to satisfy their corrosion-control challenges for double-bottom tanks and tanks with secondary HDPE liner containment. This need is driven by state and federal regulations as well as economic considerations. In the absence of effective corrosion-control systems, it is likely that double-contained ASTs will experience aggressive corrosion due to containment of moisture and other factors.

Maintenance of a reduced soil side corrosion rate will contribute to an extended useful life of the upper tank floor and significantly reduce tank floor repair/replacement costs. This is evolving from an emergent technology into a proven, commercially attractive alternative to cathodic protection systems for doublecontainment tanks. **P&GJ**