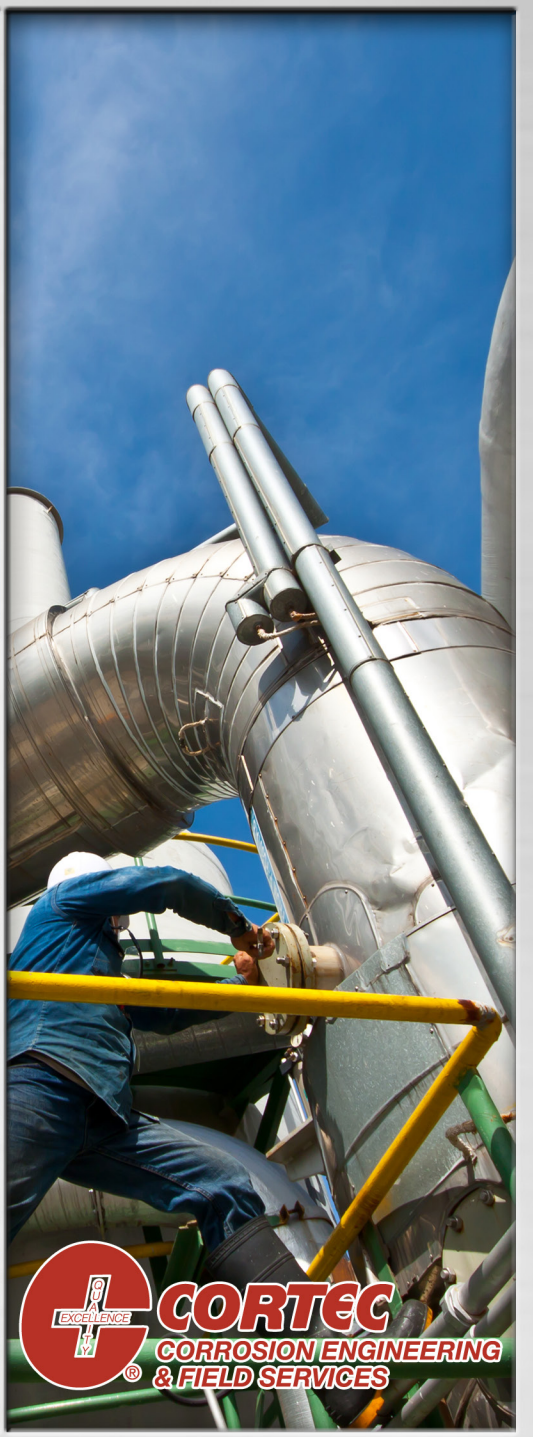
CorroLogic®

ISO/IEC-17025 LABORATORY TESTING CERTIFIED

ISO 9001 CERTIFIED QUALITY SYSTEM REGISTERED

ENVIRONMENTAL ISO 14001 CERTIFIED SYSTEM REGISTERED

Innovative Corrosion Inhibitor Systems



CORTEC® CORROSION ENGINEERING & FIELD SERVICES

CorroLogic® System for Above Ground Storage Tanks (AST)

Is a system of filling the interstitial spaces of double bottom above ground storage tanks. A growing number of Oil & Gas companies are embracing the CorroLogic® System approach for their ASTs. Data from the real-time corrosion rate monitoring equipment that is installed in each tank along with the VpCI®, proves the long term effectiveness of this solution. Cortec® completed a pilot project for the Saudi- Arabian Oil Company, Saudi Aramco, on an AST with an oil-sand tank pad at one of their critical Arabian Gulf oil export terminals. Product is used as a powder or string of Corrologic® Emitter powered with Nano VpCI®.

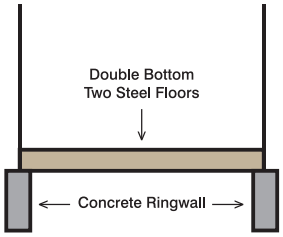
Corrologic® Powder powered with Nano VpCI® is 100% biodegradable in marine environment per OECD***306, BOD 28 Marine Test, Non-Toxic, Non-Polluting, and ROHS Compliant. It meets NACE Standard: RP0-087-2000, Military Standard: MIL-I-22110C VIA Test (Vapor Inhibiting Ability).

For high temperature applications for tanks holding liquids or solids above 200 deg C use Corrologic® Slurry HT VpCI® System.

Typical Tanks for Corrosion Inhibitor System

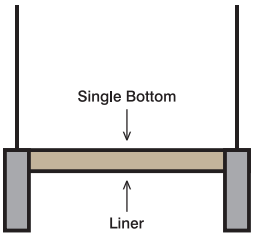
Double Bottom Tanks

- Retrofit on existing tanks.
- Easy to install on new tanks.



Single Bottom with Liner

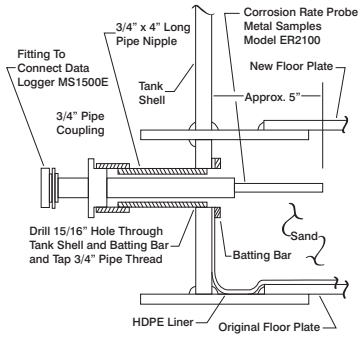
- Retrofit on existing tanks.
- Easy to install on new tanks.



Monitoring for Double Bottom ASTs

- Use magnetic base drill and pipe tap to create threaded ports in the dead shell at specified locations
- Insert ER probe and adapt secure with pipe fittings
- Read probes on specified intervals

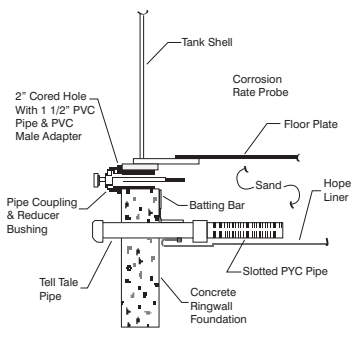
(Monitoring for Double Bottom ASTs)



Monitoring for Single Bottom ASTs with Liner

- Use a concrete core drill to core the ring wall at specified locations
- Install PVC sleeve through the corehole
- Insert a long ER probe so that probe tip extends into the sand

(Monitoring for Single Bottom ASTs with Liner)



CorroLogic® System for Insulated Pipe (CUI)

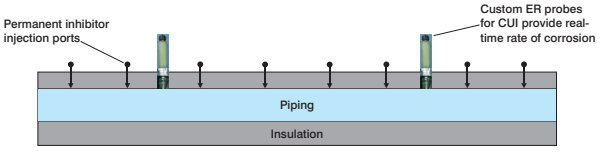
VpCI® products, processes, and equipment are used to mitigate CUI in a wide variety of environments. The equipment is capable of producing real-time measurements at the surfaces of insulated pipe and the processes are for application of VpCI® chemistry. CorroLogic® System will make a huge impact on mitigation of CUI with no service disruption, no recoating, and no insulation removal.

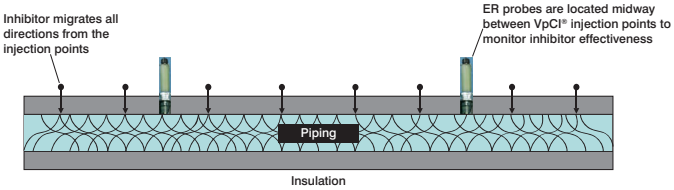
Conclusion:

- Cortec's CorroLogic® program provides a comprehensive, 4-phase, turnkey solution for resolution of CUI issues.
- The program does not require removal and replacement of the existing pipe insulation.
- The system incorporates the application of Cortec's proven multi-phase VpCI® chemistry on in-service piping systems to mitigate external surface corrosion.
- The system includes real-time corrosion rate monitoring to evaluate the corrosiveness of the insulated pipe environment and to evaluate the effectiveness of the corrosion inhibitor.
- Long-term control of CUI is engineered into the program through easy and conomical replenishment of VpCI® as needed at any time in the future.

CorroLogic® System for Control of Corrosion Under Insulation (CUI)

- Install permanent Cortec® Vapor phase Corrosion Inhibitor (VpCI®) liquid injection ports along the length of each insulated piping section.
- Install Electrical Resistance (ER) probes intermittently between liquid injection-points.
- Spacing & configuration of VpCI® injection ports & ER probes vary according to pipe diameter and a variety of factors.
- Apply Cortec® Corrologic® CUI VpCI® System per specified dosage.
- Intermittently obtain real-time corrosion rate data from the ER probes and evaluate effectiveness of corrosion inhibitor.
- Replenish Corrologic® CUI VpCI® System in the future as indicated by ER probe data.

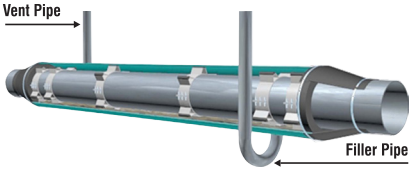




CorroLogic® System for Pipeline Casings (CPC)

CorroLogic® Filler product that is applied as a liquid into the annular space between the carrier pipe and the casing which quickly sets into a gel. Options for corrosion rate monitoring are also available. Cortec® is providing the Oil and Gas industry with unique choices for carrier pipe corrosion control.

"Meets requirements of NACE SP0200-2014 Standard Practice: Steel Cased Pipeline Practices"



Cortec® CorroLogic® VpCI® System for Carrier Pipe Corrosion Control

***Patent Pending**

Corrologic® System for Fire Suppression Equipment Corrosion Inhibition (FSI)

VpCI® Effectiveness Factors

Vapor Pressure

- The pressure exerted when a solid or liquid is in equilibrium with its own vapor.
- VpCI® vapor pressure is lower than water.

Diffusion

- Natural process by which VpCI® molecules travel from an area of high concentration to an area of low concentration until equilibrium is reached. (e.g. scent of an air freshener traveling through a room)

VpCI®-649

- Effective combination of vapor phase and film forming corrosion inhibitors
  - Protects in liquid, vapor, and inter phase
- Contains an anti-scalant
- Protects ferrous and non-ferrous metals
- Vapor phase and film forming protection for drained systems
- Contact protection for wet pipe system

VpCI®-649 Compatibility

- Compatibility with common elastomers
  - Natural rubber
  - Synthetic rubber (EPDM, Neoprene, Buna)
  - Silicone
  - Polypropylene
  - Fluoroelastomers (Teflon, Viton, Fluorosilicone, Dyneon Fluoroelastomer)
- Tested in the lab and field to ensure no negative effects
- ASTM D 471
  - Standard test for determining fluid effects on rubber properties
  - Determine the change in mass and shape after 7 days of immersion

VpCI® in Suppression Systems

- Does not cause skin sensitization
  - 72 hour exposure test
- Compatible with many biocides
- Effective in low dosages
- Best performing inhibitors ever tested by Cortec® Laboratories.
- Non-Toxic and ROHS Compliant

Deluge System

- Corrosion leads to leaks in piping and blockages in nozzles.
- Field testing with 5% solution of VpCI®-645 led to 98% decrease in blocked sprinkler nozzles in the first year and 99% decrease after 2 years.

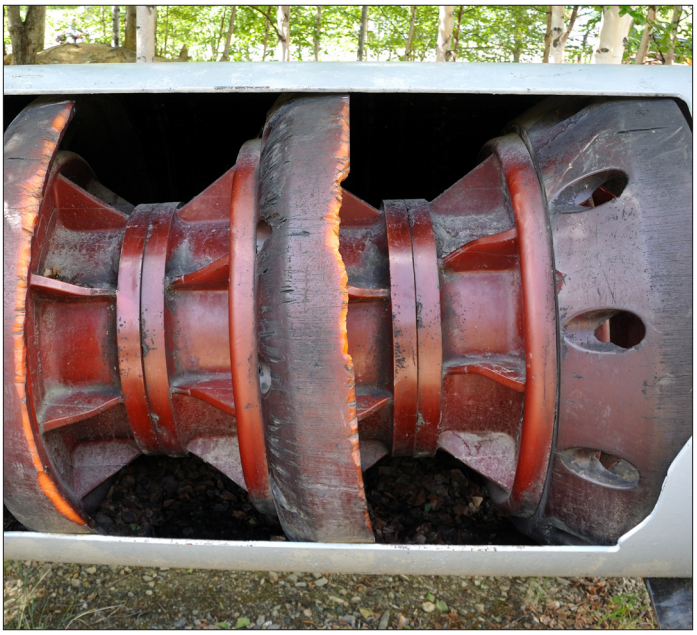
Conclusions

- VpCI® products reduce corrosion in fire suppression systems thereby reducing the risk of pipe leaks and nozzle blockage.
- Protects from corrosion in stagnant water and drained systems.
- VpCI®-649 is environmentally friendly and non-hazardous
- It is safe and effective for use in most sprinkler systems.

CorroLogic® System VpCI®-639 & VpCI®-639 HFB for Hydro testing and Pigging of Pipelines

CorroLogic® VpCI®-639/639 HFB System are oils soluble, water dispersible, fast acting, long-term, corrosion inhibitors for multiple oil field applications. Designed to provide continuous corrosion protection against severe conditions encountered in petroleum/natural gas production and processing they are effective for a wide range of refined hydrocarbons, crudes, and oil/water ratios. They will form an effective anti-corrosion barrier even at low concentrations for metals in the presence of water, halogens, and corrosive gases such as dissolved oxygen, sulfur dioxide, carbon dioxide, and hydrogen sulfide. And even protects areas that are inaccessible to direct solution contact.

VpCI®-639 HFB is recommended when a customer needs a product with high flash point and the ability to stop or minimize bio-growth progress.



Recently, a major US pipeline company successfully used CorroLogic® VpCI®-639 HFB, for the lay-up of transporting pipeline and corrosion protection during their hydro testing. The slug of VpCI®-639 HFB was run between two pigs to achieve full coverage of the internal surface of the pipeline. VpCI®-639 HFB provided excellent corrosion protection during hydro testing, the lay-up period following hydro testing, and it was also beneficial when the pipeline was going back into service. The preservative used in the formula suppressed bacteria usually present in pipes transporting petroleum including anaerobic sulfate reducing bacteria. The customer appreciated the relatively low cost of application; instead of inhibiting the whole volume of the water used for hydro-testing VpCI®-639 HFB was only used in a limited amount that provided a tenacious protective film on the inner walls of the pipeline.

		Technology of Application	
System	**Corrosive Medium**	**Method of Application**	**Frequency of Application and Dosage**
Pipelines and collection systems for petroleum	Crude oil, emulsions, water, and/or petroleum containing CO_2 and H_2S	Injection of the inhibitor “as is”	Intermittent treatment - Add for 48 hr. period, 4 times a year at 2000 ppm or use continuous treatment at 5 - 15 ppm
Oil wells and equipment	Crude oil, emulsions, water, and/or petroleum containing CO_2 and H_2S	Injection of the inhibitor “as is”	Periodic injection - Add for 48 hr. at 400-800 ppm every 2-2.5 months

CorroLogic® System Top for the Line (TOL) Corrosion Protection of Pipelines

VpCI®-637 TOL is one of the best performing inhibitors ever tested by Cortec® Laboratories, Inc. and provides a cost effective solution for corrosion protection. As a part of Corrologic® System – "solutions custom engineered to fit", developed by Cortec® Engineering & Field Service (CEFS), it combats corrosion in Top of the Line (TOL) Corrosion Protection of Pipelines application.

VpCI®-637 TOL provides internal corrosion protection for gas flow and gas transmission lines.The product has superior effectiveness against water, corrosive gasses and chloride contamination. It is a combination of vapor phase, neutralizing, and film-forming corrosion inhibitors to combat the broadest range of corrosive attack from moisture and condensation, oxygen, carbon dioxide, hydrogen sulfide, and other corrosive contaminants in natural gas.

These non-emulsifying formulations offer the benefits of filming inhibitors that form a tenacious protective film on metal surfaces, neutralizing inhibitors that combat corrosive fluid formation, and vapor phase inhibitors that reach areas inaccessible by direct contact to protect areas subject to varying flow ratios.

The unique chemistries of VpCI®-637 TOL allow it to provide excellent protection in "sweet/sour" saturated carbon dioxide/hydrogen sulfide environments. According to results obtained from the Wheel Test (NACE test method publication ID182), VpCI®-637 TOL provides excellent protection in both continuous and intermittent treatments, due to exceptional film persistency.

VpCI®-637 TOL provides maximum control over long distances for highly corrosive systems having a high ratio of water-to-hydrocarbons, including low areas in systems where water collects and extreme corrosive attack occurs. It will not cause foaming or upsets in gas sweetening or glycol dehydration processes and it does not contain heavy metals, chlorinated hydrocarbons, or volatile amines.

It is very effective in gathering systems containing a significant amount of water or as a corrosion inhibitor for secondary oil-recovery operations, where the water is a carrier. CorroLogic® VpCI®-637 (TOL) conforms to MIL-I-22110C VIA Test (Vapor Inhibiting Ability), NACE RP 0487-2000,

Pipeline section shows active VpCI® protection at the liquid phase, vapor phase, and the interphase: partition and emulsion barriers.

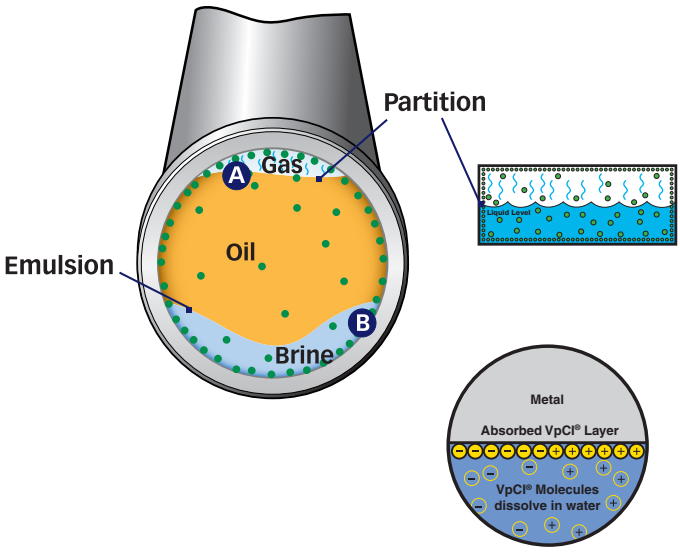
Corrologic® VpCI® meets requirements of NACE RP 0487-2000, TM0208-2008, and is ROHS Compliant. NACE RP0487-2000 Selection Criteria for Vapor Phase Corrosion Inhibitors, TM0208-2008 Standard Test Method for Vapor phase Corrosion Inhibitors.

*Wheel Test, NACE test method ID 182 (Film persistency-90+% protection, Continuous Treatment-90+% protection)

* Corrosion Loop Test, method of Continental products of Texas, "Specialty Oilfield and Water Chemical Solutions"

* Rotating Cylinder Electrode Test, ASTM G-170-01 , "Standard guide for evaluating of Qualifying Oilfield and refinery Corrosion Inhibitors in the Laboratory", 95+% of protection

Reference: M. Shen, M. Kharshan, A. Furman, and T. Whited: Vapor phase Inhibitors for Top of the Line Corrosion, Materials Performance (NACE), August 2013 and Paper #2509, NACE 2013, Orlando.



Turnkey Corrosion Control

EQUIPMENT PRESERVATION

Cortec® has provided turnkey support for many years for equipment preservation projects - now we can provide engineering needed through the final application of all preservation technology and products required to effectively mitigate corrosion during downtime.

- This includes preservation during shipment, storage, temporary shut-down, or long-term mothballing.
- Corrosion protection is provided to all surfaces, both internal and external through the multiple delivery systems available with Cortec® vapor phase Corrosion inhibitor (VpCI®) technologies.
- VpCI® preservation applications include a variety of cleaning products, surface coatings, powders and liquids for fogging of large spaces, additives for lubricants and process liquids, as well as films for total encapsulation.
- With CEFS, real-time corrosion rate monitoring systems for critical assets are available.
- Assistance with removal of preservation products is also available during future equipment recommissioning.

PLANT LAYUP AND MOTHBALLING

Cortec® CEFS specializes in turnkey corrosion control engineering and applications services for comprehensive lay-ups of individual units or entire plants, and is augmented with implementation of a comprehensive plant layup package that could include:

- A corrosion audit for identification of all facility corrosion control requirements.
- A comprehensive plan to mitigate internal and external corrosion on all plant assets - both above ground and underground.
- Turnkey application of all corrosion control systems.
- Monitoring and maintenance of corrosion control systems during the layup period.
- Future assistance with the transition from the layup phase to plant commissioning.
- All information can be found at www.CortecMothballing.com

CONTROL OF EMBEDDED REINFORCEMENT IN CONCRETE STRUCTURES

Cortec® is committed to enhancing the delivery and utilization of the outstanding array of Cortec® Migrating Corrosion Inhibitors (MCI®) products and technologies available for mitigation of embedded reinforcement corrosion. Turnkey concrete corrosion control solutions include:

- Comprehensive plans for the mitigation of embedded reinforcement corrosion on any type of structure.
- Custom engineered corrosion monitoring systems designed to evaluate the corrosion rates of embedded reinforcement.
- Turnkey application of Cortec's numerous MCI® products on any structure

SURFACE COATINGS

Utilization of Cortec's advanced suite of coatings products containing VpCI® technology provides us with unique solutions for surface coating challenges.

- Both temporary and permanent coatings programs can be provided.
- Coatings systems that do not require sandblasting or other rust removal provide interesting options.
- Custom colors are available.

Quality Management System (ISO 9001 Certified)

World Class Product Offerings
An innovative producer of leading edge products.

World Class Customer Service
A positive, long-lasting impression through every link of our company.

World Class Environmental Commitment
Cortec® commits to continued development of processes and products that are useful, non-hazardous to the environment, and recyclable whenever possible.

An Ethical and Respectful Company Culture
Respect and treat our colleagues, customers, and vendors as we would our own family members.

Cortec® Corporation World Headquarters:
Worlds Largest VpCI®/MCI® Synthesis Plant

Environmental Management System (ISO 14001 Certified)

Cortec's strong environmental concern is demonstrated in the design and manufacturing of products that protect materials of all kinds from environmental degradation. A strong commitment to produce recyclable products made from sustainable resources has been and will be our future policy. This brochure can be recycled.

Laboratory Accreditation (ISO/IEC 17025)

Ensures quality testing services, and to continually improve the effectiveness of the Quality Management System. It is Cortec® Corporation's goal to encourage active participation of all employees in quality planning and continual improvement efforts to meet all quality and service objectives. Cortec® Laboratories is the only lab in our industry that received ISO/IEC 17025 Certification providing for lab testing, calibration, and interpretation of test data.

Visit our websites for more information on Cortec® Corporation.
CortecVCI.com and CortecMCI.com

LIMITED WARRANTY

All statements, technical information and recommendations contained herein are based on tests Cortec® Corporation believes to be reliable, but the accuracy or completeness thereof is not guaranteed.

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CORTEC CORPORATION
Environmentally Safe VpCI®/MCI® Technologies

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