Fighting Corrosion in Wastewater Treatment Plants

Constant moisture and contaminants at a wastewater treatment plant create highly corrosive conditions that attack metal and concrete structures, causing deterioration and forcing early repair or expensive replacement. Even corrosion resistant metals such as aluminum and galvanized steel become casualties of the harsh elements flowing through a wastewater plant. Conditions are worse still when the treatment plant is located in a humid coastal environment exposed to salt spray. Continued oversight and preventive maintenance is critical to minimizing corrosion and maximizing the longest service life possible for costly plant assets.

Hydrogen sulfide (H2S) is one especially common wastewater contaminant, causing so many corrosion problems for wastewater treatment facilities that it warranted an EPA report on the subject. The report noted how H2S causes corrosion and premature failure of tanks, railings, walkways, electricals, instrumentation, air conditioning and ventilation units, electronics, and other metal or concrete structures. The result is less reliability, additional maintenance, and high replacement costs.[1]

Fortunately, a combination of corrosion inhibiting coatings, migrating corrosion inhibitors, and vapor corrosion inhibitors can be used to counter a variety of corrosion attacks and extend the life of metal, concrete, and electrical assets at wastewater facilities.

Coating Metal Structures

For most metal structures, a good corrosion-inhibiting epoxy coating such as Cortec's VpCI-395 will go a long way toward protecting metals in extreme wastewater treatment conditions. VpCI-395 is a waterborne epoxy primer with very low VOCs, making it easier to comply with environmental regulations when using it. The coating could even be used in potable water structures if desired because of its certification to meet ANSI/NSF Standard 61. VpCI-395 protects in environments permeated with HCl, SO2, CO2, and H2S vapors. The coating provides excellent adhesion in salt spray and immersion conditions with good long-term protection against corrosion on steel and cast iron. VpCI-395 can also be used to protect galvanized and aluminum surfaces if a thin wash primer such as Cortec's VpCI-373 Green is applied first. Both coatings dry quickly after application and can be easily cleaned up with soap and water.

For components exposed to harsh outdoor conditions where UV protection is needed, a urethane system like VpCI-384 is sometimes preferred. This solvent-based VCI coating has excellent UV resistance. It incorporates a complex mixture of organic corrosion inhibitors for protection that competes with many paints and zinc-rich primers. If a water-based clear coating is desired, a UV resistant acrylic topcoat such as VpCI-386 can be used. This coating possesses an environmentally friendly, low-VOC formulation while still providing strong corrosion resistance via a unique package of organic corrosion inhibitors. These aspects allow VpCI-386 to be competitive with most paints and industrial coatings.

Good surface prep is vital to maximizing the performance of a coating but is difficult on structures that have already started to corrode. Rather than sandblasting, it is easier to prepare and reclaim rusty surfaces by applying a passivating water-based rust primer called CorrVerter. After removing any loose rust, this primer can be applied to convert the remaining rust into a hydrophobic passive layer through the use of a special chelating agent. The primer does not contain tannic, gallic, or phosphoric acids and leaves a black layer that can be painted over with a solvent or water-based anti-corrosion topcoat (such as VpCI-386) for further protection.

Protecting Reinforced Concrete

Reinforced concrete is another common material used at wastewater treatment plants in tanks, floors, and other structures. Exposure to harsh wastewater chemicals accelerates deterioration of these surfaces, eventually attacking embedded steel reinforcement, leaving it rusty and exposed to further deterioration.

Indoor floors and walkways can be protected against corrosion and deterioration by applying a 100% solids novolac epoxy coating such as MCI-2026 to seal out contaminants. This coating provides excellent chemical and abrasion resistance in high traffic areas. Other concrete structures can be protected at the level of the embedded reinforcement by applying migrating corrosion inhibitors, either as an admixture during construction or as a topical treatment to existing structures.

Migrating corrosion inhibitors work their way through the concrete pore structure to eventually adsorb in a protective layer on embedded steel reinforcement. The chemistry utilized to achieve this include "mixed" inhibitors which discourage corrosion reactions at both the anode and cathode of a corrosion cell. Migrating corrosion inhibitors extend the time it takes for corrosion to start and reduce corrosion rates once started.

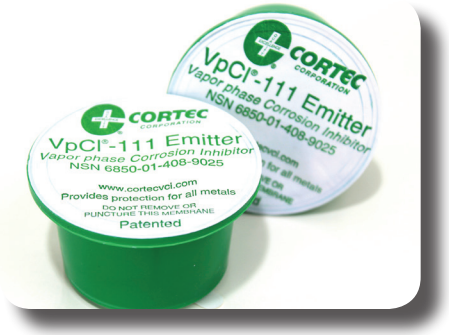
Ideally, a migrating corrosion inhibitor admixture such as MCI-2005 should be dosed into the concrete at the time wastewater treatment tanks and structures are built. Using this admixture inhibits corrosion from the start without compromising the concrete's physical properties. It is suitable for both wastewater as well as drinking water tanks because of its low water-solubility (it does not readily leach into water) and its certification to meet ANSI/NSF 61 Standard for use in potable water structures.

For maintenance and repair of existing structures, migrating corrosion inhibitors can be applied to concrete surfaces as a liquid and allowed to work their way through the concrete pores down to the rebar surface first by capillary action and then by vapor diffusion. Migrating corrosion inhibitors can be applied in a "pure" inhibitor-only form (MCI-2020), or combined with a 100 or 40 percent silane sealer for combined water repellency and inhibitor action (MCI-2018 and MCI-2019, respectively) depending on project and budget requirements.

Migrating corrosion inhibitors can be combined with other materials to extend the lifetime of a concrete repair. In one case, a reinforced concrete wastewater tank/effluent trough system had experienced severe corrosion due to high levels of H2S and other acidic gases that lowered concrete pH, deteriorated the concrete surface, and accelerated rebar corrosion and exposure. In this case, migrating corrosion inhib-

itors were applied to sound concrete after loose concrete was removed via water jetting and sandblasting. With the sound concrete properly treated, patch application was able to proceed uninterrupted. Non-deteriorated concrete surfaces were cleaned with water jetting and sand blasting before also receiving a dose of migrating corrosion inhibitors. In all cases, an epoxy/sealer coating system was applied over the repaired areas for added water resistance.[2] By following this procedure, the repair team provided an extra line of defense against corrosion, discouraging premature failure of the repairs.

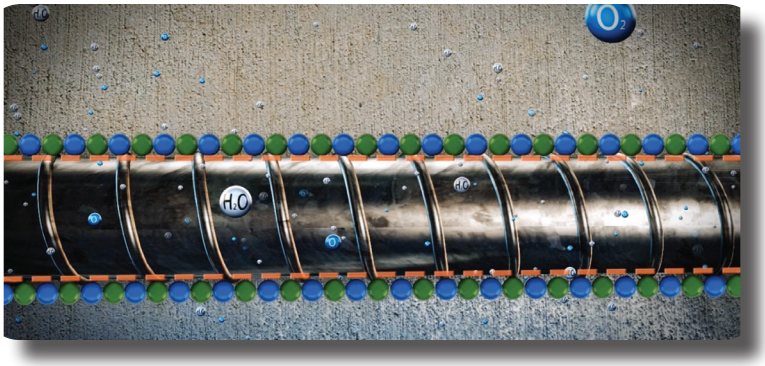
VpCI-111 Emitters release a corrosion inhibiting vapor that forms a protective molecular layer on metal surfaces such as wires and electrical contacts in enclosed spaces.



Extending Service Life of Electricals and Electronics

Electricals and electronics are critical to the operation of a wastewater plant. However, the corrosive wastewater environment puts these sensitive components under severe attack that can speedily deteriorate junction boxes, electrical connections, and circuit boards. To minimize downtime, boxes or conduits can be protected externally with the coatings previously mentioned. Internally, vapor corrosion inhibitor (VCI) technology is an effective way to protect electrical contacts, wire ways, and other electrical or electronic components with minimal effort.

Application of VCI technology can be as easy as placing a self-adhesive VpCI-111 emitter cup inside an electrical cabinet and closing the door. The cup releases corrosion inhibiting vapors that fill the electrical cabinet and condense on the metal surfaces inside. This invisible molecular layer protects the metals from interaction with moisture, airborne salts, H_2S, SO_2 NH_3, or other contaminants that could accelerate corrosion and deterioration of the components. VCI emitters can be supplemented with Corrosorber cups, which absorb and reduce the overall amount of H_2S and other corrosive gases in the air.



Migrating corrosion inhibitors work their way through concrete pore structures to form a protective molecular layer on embedded steel reinforcement. Image Credit:

Staying Ahead of Corrosion

Constant upkeep is necessary at a wastewater treatment plant where the harsh environment aggravates corrosion of plant assets. To slow this process, equipment and structures should be regularly monitored and a variety of anti-corrosion materials applied as needed. Application of anti-corrosion epoxy, urethane, or acrylic coatings on metal surfaces; migrating corrosion inhibitors on reinforced concrete; and VCI emitters in electrical/electronic boxes and wire ways are a few important maintenance procedures that can go a long way toward countering the constant attacks of a wastewater treatment environment and minimizing repair and downtime.

References:
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