Protective Coatings for Underground Utility Concrete Structures

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Severe corrosion in underground utility vault

As our cities and municipalities grow older, the utility and wastewater infrastructure and corrosion preventive program for underground asset protection are aging with them. Municipalities and Utility Companies are struggling to handle rehabilitation measures and effective corrosion prevention programs to deal with prolonging the life of their buried assets. More municipalities are in the process of undertaking rehabilitation projects to restore underground structures and protect them against further corrosion. Many of these municipalities are taking a proactive approach. A few regions in the US, especially those in the southwest, gulf coast, and southeast are starting to require that the concrete manholes, vaults, large diameter pipelines, and structures first be lined with a corrosion resistant material before going into the ground. The warm, humid climate in these regions is a breading ground for significant corrosion in existing underground structures. Preventive maintenance programs are being initiated to prevent or slow the rate of corrosion and degradation and to ensure that utility work and wastewater construction cost are spent efficiently.

Precast concrete vaults, such as those used by sewage, electric, gas, steam, telecommunication, and fiber optic utility companies are not exempt from the effects of corrosion within their underground vaults. If ground water can leach in, the structure is susceptible to corrosion attacking the concrete. Concrete vaults are everywhere – under the streets & sidewalks, in our parks, and along our roadways. Road salt, de-icing materials, petroleum products, lawn fertilizers and anything blended with rain water and run-off can infiltrate these structures.

Precast vault before exterior coating

Precast concrete is still the most widespread choice when selecting a material for underground utility vaults. Precast concrete has several advantages over vaults made from steel, fiberglass, and cast-in-place concrete. First, precast concrete is non-toxic and noncombustible so it will not loose its structural integrity in the event of a fire. Second, due to their weight, they will remain in the ground and ground water will not raise the structure or move it creating disruption to the connections, lines, or service.

Vaults that are produced in quality controlled plants are now covered by ASTM Standards that regulate the design, installation and inspection of these vaults. They are manufactured to be water tight, environmentally sound, and will strengthen over time. Installation of these vaults is much easier and more cost effective over cast-in-place concrete, which is much more labor intensive and costly to install. With precast structures you are able to backfill right away and not have to wait 28 days until the structure is fully cured, adding to installation downtime.

Since water by nature can contribute to a corrosive environment, rust can be a major weakness in some underground storage systems. Concrete, by its nature, is vulnerable to cracking. In most cases, precast concrete tanks rely on sealants or adhesives to seal the seams of the tank. When there is ground movement around the tank causing a shift or settling effect, or when the tank is improperly installed, these seams are susceptible to leaking. Concrete tanks, whether precast or cast-in-place, are susceptible to deterioration if the steel reinforcement rusts or is exposed through cracks in the concrete causing both groundwater contamination and groundwater infiltrating into the tank. Exposure to hydrogen sulfide (H_2S) gases, present in wastewater tanks, will also

lead to corrosion damage to a concrete tank and steel reinforcement, thereby limiting the precast structure's or tank's useful life.

Precast Concrete Protective Solutions

A preventative maintenance program may add from 20 to 25 years or more to these structures. In addition, cost savings from rehabilitating these structures effecting overall maintenance, time and labor cost, and finally the cost of not having to treat ground water at the treatment facilities from Inflow and infiltration (I&I).

The annual cost of replacing corroded infrastructure including utility vaults, wastewater collection and treatment systems is estimated to be almost ten times more expensive than the cost to rehabilitate them. When adding service disruption, traffic control, and down time, the overall costs are even higher. It stands to reason that pre-lining these structures will lower long-tem cost and add years of reliable service to the precast structures.

Rehabilitation of Installed Vaults

When any underground structure is found to be deteriorated or damaged by corrosion, a sound and reliable rehabilitation plan is recommended for restoration, and protection of these assets.

Surface Preparation

All surfaces must be properly designed and must have sufficient strengths to support cured material. Surfaces should be made free of dirt, loose particles and previously applied paints or protective coatings by employing a 7,000-10,000+ psi hydroblast. All oils and grease should be removed by chemical cleaning prior to hydroblasting. Surface preparation in accordance with SSPC SP/NACE 6 must be completed prior to any restoration or coating work.

After completion of surface preparation, stop all active leaks. A water stop material or Hydro-active Polyurethane injection grout can be utilized to stop active leaks in the structures. Hydraulic setting cement is rapid setting and easily applied by hand for sealing active water leaks and small voids. For larger active leaks through cracks, voids, expansion joints, and pipe intrusions, chemical grouts are commonly specified because of their chemical resistance, expansion characteristics, and ease of application by injection method.


Concrete drainage vault before rehabilitation

Damaged concrete substrates may be resurfaced with several different repair materials. There are portland-based cements, calcium-aluminates, and epoxy mortars that can be applied to the thickness required in the specifications. The underlayment material that is selected should be moisture tolerant and designed for the restoration of structural integrity of the structure. The underlayment should also be compatible with any topcoat that will be applied for additional corrosion protection. Substrate repairs should be finished with a brush finish to provide a surface profile conducive for bonding to this top-coat.

Epoxies and urethanes are unique polymer lining systems that have been proven time and time again. They can be specifically formulated for municipal wastewater environments and offer an economical solution to corrosion and to high concentrations of sulfuric acid. Many epoxies are moisture tolerant allowing them to bond directly to damp concrete.

Conclusion

Corrosion is a very costly and persistent problem in the wastewater and the utility industries. With replacement cost being substantially higher than the cost of restoration or preventative measures, economic reason suggests that pursuing preventative or restoration methods to protect assets is an added benefit and long-term cost savings to municipalities and utility companies. Protective coatings and linings are one of the major

technologies for protecting underground concrete assets due to their corrosion resistance and low permeability.

About Sauereisen

Sauereisen manufactures corrosion-resistant linings, I&I barriers, and substrate repair materials for the protection and restoration of concrete infrastructure. The Company also addresses corrosion concerns in the power generation and chemical processing industries. Since 1899, Sauereisen's engineered solutions have been recognized by a growing community of engineers, contractors, and end-users worldwide.