JEPCO NEWS

FALL by Ed Pennypacker 2010

TUNNEL TANKS

Joining sections of box culvert end to end to make a large storage tank has been known for years. In New England, sewage treatment plants have limited capacity due to old age and growing populations. Schools, hospitals, and factories store sewage all day and release it for treatment at night while the home owners sleep. Water for fire fighting and drinking is stored safely for later use. No matter the contents of the tank, they cannot leak! Different gaskets, wraps and coatings have been applied. Some use post-tensioning, some use bolt pockets to fasten the sections together. Arrow Concrete has solved the problem. With special thanks to Nic Reitzel, here are some of his tips, tricks, and techniques.

1. Make tight joints. It may be easier to join pieces with a lot of tolerance in the joint, but it invites leaks.
2. Set the boxes on a level,compact, stone base. "Close" is not good enough.

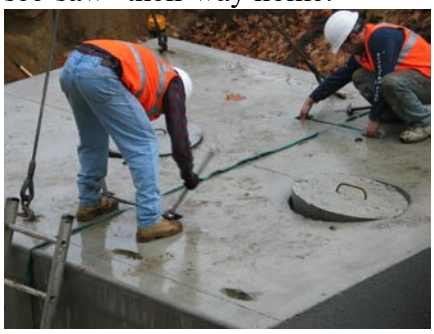
3. Send your own guys to install the tank. Trained, experienced precasters who know what to do and how to do it.
4. Put plywood under the joints during installation. This keeps things level and restricts dirt and stones from the joint.

5. Use primer. Apply the primer to good, clean concrete.
6. Dry fit the pieces. This "staging" will insure that the crane is in the right spot and can make a good fit on the first try. Use a come-along.

7. Make a continuous bead of ConSeal gasket. Cut the sealant and knead the ends together. Join the butyl away from corners.

8. Choose the best way to connect the sections. In Mid-Atlantic states it is common to post-tension box culverts. Cables, in each corner, connect the boxes. A power pack pulls each cable to a design load. In this case, 30,000 lbs.

Or use bolt pockets. It seems easier to evenly apply pressure with bolts. Tensioning is usually done with only one power pack which is moved from corner to corner. With tensioning it seems that the boxes "see-saw" their way home.



9. Use CS-235 Rapid Expansion water reactive sealant along with CS-102 Butyl gasket.

In this case the expanding sealant is placed "outside" the CS-102.

10. Test your work. A vacuum test is best. It helps pull the sections together, and it is done quickly. If there arfe leaks you can fix them. To do the vacuum test, make heavy plywood plugs, adhered with CS-367, to seal access holes and pipe entries. After the test, leave these plugs in place. They will protect

the interior of the tank and make it easier for the contractor to complete his work since there is less trash and debris that gets inside. As soon as you pass the vacuum test, present your bill. Anything that happens to the tank in the future is not your problem. Your tank is water tight!

MICROBIALLY INDUCED CORROSION (MIC)

Sewage carries Hydrogen Sulfide as a dissolved gas. Agitate it, stir it up, cause some turbulence, and the gas comes out of solution and floats in the air. It smells like rotten eggs. Once released, it can combine with water vapor and turn it into Sulfurous Acid, (H_2SO_3) Good, solid, concrete is attacked by the acid and crumbles into powder. Sulfurous acid is one oxygen atom shy of the much stronger Sulfuric Acid. Venting will not stop the reaction. Unless the air is rapidly moving, it cannot carry the Hydrogen Sulfide away. For years, it was the accepted explanation that Sulfurous acid and Carbonic Acid (formed when Carbon dioxide reacts with water) caused the damage seen in septic tanks, Distribution Boxes, the tops of sewer pipes, and manholes. Then somebody discovered Thiobacillus bacteria. These pesky bacteria are aerobic. They require oxygen. They also require Hydrogen Sulfide. They “eat” Hydrogen Sulfide and excrete Sulfuric Acid as a waste. Some of them excrete the acid in greater than 40% strength. One, Thiobacillus concretivorium , is named for its appetite for concrete. It does not matter whether it is Type I or Type II (sulfate resistant) cement that makes the concrete. Thiobacilli love the stuff. All they require is air, water, and Hydrogen Sulfide to live.

Force mains, where sewage is pumped into the pipes, are ideal environments for these bacteria. The first two or three manholes downstream from the force main are worst affected. The damage diminishes as distance from that junction increases. Turbulence is the reason. Force mains are by nature very turbulent, and therefore rich in Hydrogen Sulfide, air and water. Further downstream, the turbulence

subsides and the life of Thiobacilli species is harder to maintain. Ironically, force mains that run FULL of sewage are rarely damaged. There is no free air space above the sewage, and the scouring of the flow actually cleans the surfaces. Conversely, pipes with very little flow are more susceptible. One New Jersey shore resort town, built their sewage system to handle the million people who come to town every year Summer. In the Winter, the population dropped to less than 100,000. Sewage sat in the pipes and fermented. The environment was very humid, and the Thiobacilli thrived. Within two years, the crowns (tops) of the pipes were so badly damaged that the town had to pay to have plastic pipes threaded through the sewer mains. Further complicating the issue is that one complete system may see severe damage in a part of the piping, but other sections seem immune. Variations in temperature, flow, humidity, and unknown other factors can be at work. And there are a lot of other bacteria that do their damage too. Thiobacillus need Sulfur compounds (Thionates), others are Halophyllic (love chlorine) which thrive in chlorinated waters. Bacteria are very versatile, There are ones that thrive on iron, others that "eat" oil. Add in fungi: molds, yeast, and mildew and we start to see a rich and varied environment in our waste water systems.

Septic tanks without an inlet baffle are turbulent with every flush. They are more susceptible to damage above the water line. Turbulence in drop boxes in septic systems can cause the same damage from Thiobacilli and Hydrogen Sulfide gas.

Not all corrosion in manholes and septic tanks is due to MIC. A few years ago, a septic tank on a dairy farm was eaten away internally. It was found that the farmer cleaned up the milking parlor with undiluted Muriatic Acid twice a day. When this was washed into the floor drains it went straight into the septic tank. This damage was worse **below** the waterline. Whether or not salty water-softener backwash causes damage is still debated. Try a Google search on that topic and you will see general agreement that it does not damage the tank, nor its function. One hypothesis claims that the heavier salt water sinks to the bottom of the tank and lifts the sludge layer. Another claims that rather than sink, the salt water mixes to raise the specific gravity of the tank water, which makes more solids float. Whether sinking without mixing or mixing without sinking, to raise the specific gravity, neither hypothesis has enough scientific substance to elevate it to the status of accepted theory.

HOW CAN MIC BE CONTROLLED?

Fresh concrete starts at PH 12.0-13.5, very alkaline. But in waste water environments, with Carbon Dioxide (CO_2) mixing with water vapor to make Carbonic Acid, .the Hydrogen Sulfide reacting with water vapor, and the Thiobacilli making Sulfuric acid, the PH is lowered dramatically, damaging the concrete

Coatings can protect the concrete. Keeping in mind that 40% solutions of Sulfuric Acid are very strong, the coating selection becomes very important. Trying to coat after the problem is found is a nightmare. Anyone would prefer to coat the concrete in the plant rather than enter the sewer after a year's use. By accident, for years and years, Coal Tar Epoxy has been used for sewer manholes. Kopper's 300-M is one of the most recognized brand names. Specifying it for use on the OUTSIDE of the manhole is a waste of time and money. It is the inside which needs the protection. Coal Tar is a deadly poison. It is known to cause cancer in mammals and it outright kills bacteria, including our villains, the Thiobacillus . But, because it is so risky to humans, it is avoided nowadays.

Other epoxy coatings, some water based acrylic coatings, like ConSeal's CS-55, and thermoplastic liners are effective barriers to the acid damage from Thiobacilli. The key is to provide a barrier between the bacteria and the concrete.

Another strategy is to kill the bacteria by incorporating a bactericide into the concrete mix. This is risky too. If the bactericide leaches into the water it can destroy the proper functioning of the sewage treatment which requires good bacteria to digest and process the waste water.

Or, you can make the environment inhospitable to the Thiobacilli. This shows real promise. While the technology is still young, it seems to work. Certain chemicals , when added to the batch of concrete during mixing, maintain an electrical charge that repels the bad bacteria. The air, water, and Hydrogen Sulfide are still there in the turbulent environment, but the bacteria cannot establish themselves on the concrete surface.

Densifying agents, which may be batched with concrete, or painted on later, like XYPEX, may help some too. They hinder the bacteria from migrating deeper into the concrete. Sodium Silicates and similar solutions mate well with concrete to form a dense matrix.

Since septic tanks are only affected by MIC above the waterline, where there is an aerobic environment, the cost to prevent the damage is limited to a treatment in that area. Plastic liner, coatings, or other treatments, need only be applied to a band around the upper portion at the waterline of the tank and the underside of the top. Distribution boxes are small, the cost to protect them is negligible.

MIC is a problem for many materials other than concrete. Steel is a victim too. To get a scare, "GOOGLE" the words "microbially induced corrosion"

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OWN YOUR OWN VACUUM TEST RIG: JEPCO and Plug-it Products offer a test rig to precasters at a very affordable price of $1,775.00. This includes a 26 inch plate, 20 feet of hose, a 0-10 inch gauge and a venturi pump. Use your compressor, even an air brake compressor.

DRILL BITS: SDS MAX &WACKER HEX
"Shorties" in either format (top two on left) are specially made to drill I" inch diameter holes in tight places. Great for step holes in manholes. Standard 1" inch bit is three times as long. Each bit has Quad-Carbide tips for durable, fast drilling