



## Grand Rapids Eight Year Test Demonstrates Benefits of Con<sup>mic</sup>Shield® Additive for Corrosion Protection of Concrete in Sewers

By Chuck Schroeder, Hydraulic Engineer

"The proof is in the pudding," but in this case it was in the concrete. Even sewer systems in the upper Midwest experience corrosion in sanitary sewer systems and Grand Rapids, Michigan is no exception. The City wanted to determine what could be done to protect concrete pipe and manholes in its sewer system from corrosion generated by hydrogen sulfide gas. With the cooperation of Premarc Industries, a local precaster, the City had a test manhole installed in August 1999 on a highly corrosive sanitary sewer line to evaluate different products by direct comparison.

The test manhole consisted of four sections over a highly turbulent sewer. The top three sections included protective measures where they would be exposed to the maximum hydrogen sulfide (H<sub>2</sub>S) gas bubbling out of solution from the waste stream. The bottom section of the manhole that was subject to frequent scouring and inundation from the force mains was treated with a densifying-recrystallization additive. The mid-section of the manhole was precast with calcium aluminate cement while the two top sections contained the Con<sup>mic</sup>Shield® additive.



The manhole was precast by Premarc Industries, Inc. headquartered in Durand, Michigan. When the manhole was inspected eight years later in August 2007, the two barrel sections with the Con<sup>mic</sup>Shield® additive looked like the day they were installed. In contrast, the barrel section cast with calcium aluminate cement was clearly corroded. Since water drowns the bacteria, the bottom section was not expected to grow bacteria or corrode. Upon close inspection, there was no significant degradation from MIC corrosion of this bottom section except for portions above the water line.

Two sanitary sewer force mains discharge into the test manhole every fifteen minutes during the day. This creates a significant turbulence and an abundant release of hydrogen sulfide (H<sub>2</sub>S) gas into the upper sections of the manhole. Turbulence, moderately high temperatures and septic sewage create certain conditions that are ideal for bacteria and subsequent sulfuric acid (H<sub>2</sub>SO<sub>4</sub>) production. Sulfuric acid is formed when aerobic (air-breathing) bacteria on the walls of the concrete metabolize hydrogen sulfide gas and oxygen. Their waste by-product is sulfuric acid, which results in the rapid decay of concrete. The technical name of this process is *microbiologically induced corrosion*, abbreviated as MIC.



Calcium aluminate cement is designed to inhibit bacterial growth and, thereby, diminish production of the acid. The Con<sup>mic</sup>Shield® additive is unique, however, in that it *kills* the acid-producing bacteria on contact. It does more than slow the growth of the harmful bacteria, it destroys it. Without bacteria, there is no bacterial metabolism of the hydrogen sulfide gas and no sulfuric acid can be produced.



Long-term studies provided to the City show that the Con<sup>mic</sup>Shield® additive does not lose its potency over time. It is not a chemical kill so the bacteria cannot develop an immunity with repeated contact. Rather, the Con<sup>mic</sup>Shield® additive physically kills bacteria by rupturing its cell wall when the bacteria physically contact any treated portion of the concrete. The Con<sup>mic</sup>Shield® additive is throughout the entire concrete thickness, both on the aggregate and the cement so more than just the surface is protected. Even if there is abrasive wear or other surface damage, the MIC protection is not diminished. In addition, the Con<sup>mic</sup>Shield® additive does not change the physical properties of concrete. It is mixed with water and is added to concrete as a one-to-one replacement for water in the mix. The dosage depends upon the specific concrete design mix.

Our sewer corrosion occurs mainly at the end of the force mains where the turbulence is greatest; but, as we continue to reduce inflow and infiltration, we know that our undiluted sewers will make MIC much more common. The City of Grand Rapids has decided not to risk future corrosion. Con<sup>mic</sup>Shield® has proven it protects our concrete manholes.

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