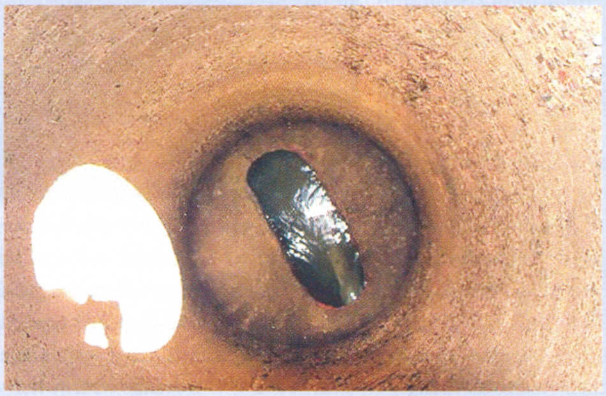
THIOBACILLUS AND MICROBIAL INDUCED CORROSION

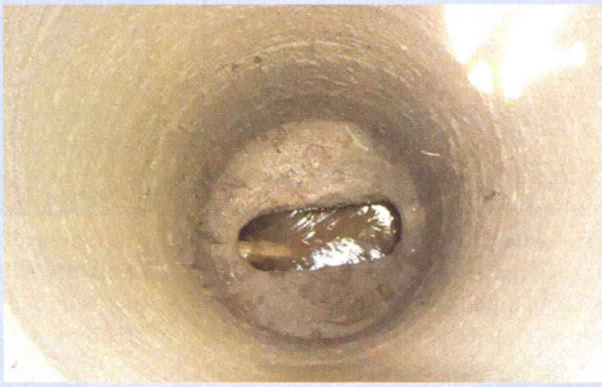
By Syndee Holt

There are more than 20,000 wastewater systems in the United States and about 40 percent of those are constructed of concrete. This concrete is under constant attack by a vicious unseen enemy called Thiobacillus bacteria, which undermines the structural integrity of concrete and causes millions of dollars in repairs annually.

According to an article by Paul Ramsburg in *The Concrete Producer*, C.D. Parker first described this microbial warfare as Microbial Induced Corrosion (MIC) over 60 years ago. MIC is still often incorrectly described as "corrosive gas problems." Rather, MIC is more correctly described as "a process by which sulfuric acid (H_2SO_4) is produced in sewer systems when hydrogen sulfide gas (H_2S) and Thiobacillus bacteria interact." Thiobacillus has the unique ability to convert hydrogen sulfide gas to sulfuric acid when there is oxygen (O_2) present. The sulfuric acid produced by this interaction eats into, or corrodes, the concrete.

But where does the hydrogen sulfide gas come from in the sewer systems? Hydrogen sulfide gas is produced by the non-air breathing bacteria that is present in the sewer effluent. The amount of this bacteria is controled by factors such as temperature, amount of oxygen, retention time, and turbulence. In fact, the more turbulence the effluent has, the more hydrogen sulfide gas is released into the sewer environment. Typically, one of the most turbulent areas in a sewer is found near manholes, leading to increased concrete corrosion in those areas, as demonstrated in the accompanying article, "Manhole Coatings Repair." The hydrogen sulfide gas mixes with the carbon dioxide gas (CO_2) present in the sewer to create a mild acid solution made of thiosulfuric ($H_2S_2O_3$) and polyphonic acid and





carbonic acid (H_2CO_3) respectively. These acids mix with the calcium hydroxide ($Ca(OH)_2$) present in the concrete, reducing the pH content on its surface and allowing colonization of the Thiobacillus bacteria within the concrete itself. Thiobacillus primarily attacks the gypsum present in the concrete, leaving a pasty white mass just above the effluent level in the sewer.

And the battle is on.

Several methods of attacking this bacteria have been used with relative success throughout the years. One method involves prevention of gaseous buildup in the sewers by a regular and continuous insertion of several chemicals and oxygen into the effluent. This method, while successful, is costly and time-consuming.

As demonstrated with the epoxy applied to Casa Grande's manholes, protective coatings can also be used to prevent the bacterial invasion. However, if the coating fails, Thiobacillus is very happy to take up residence underneath the coating and further corrode the concrete below.

In 1996, anti-microbial agents were introduced that are capable of molecularly bonding with the concrete when mixed directly into the concrete admixture to effectively prevent the Thiobacillus growth throughout the concrete and permanently protect the pH of the concrete. Applied under the coating — in the accompanying article the anti-microbial agent is found in the ConmicShield — it molecularly bonds with the concrete's aggregate. The concrete itself becomes deadly to the Thiobacillus bacteria. And, although it is deadly on microbial life, it's safe for humans and animals. It is EPA-approved and will not leach out into the city's sewage or water systems. When coated, the rehabbed manholes are ready for years of service. CP