**NASTT's Manhole Rehab Webinar Archive**

**About 12 minutes and 30 seconds into the webinar we experienced technical difficulties with the audio for approximately 40 seconds. Below is the text transcription for this portion.**

10) "Why are manholes corroding?"

There are three common reasons why corrosion occurs in manholes and other wastewater structures. These include Microbial-Induced Corrosion (or MIC), corrosive soil conditions, and industrial waste dumping.

By far and away the most common culprit is Microbial Induced Corrosion, which affects the internal headspace of the manhole and wastewater system, but corrosive soil conditions can certainly cause a multitude of problems on the external portion of the manhole, which can be difficult to detect.

Industrial waste dumping is kind of the wild card here, as it can change the chemistry within the waste water stream and exasperate the corrosion conditions in manholes. I have seen situations where hydrogen sulfide levels have not been very high, but industrial waste has caused a corrosion condition within concrete manholes and pipelines if off the charts. A good example of this is glycol discharge at major airports and its effect on corrosion within a wastewater system.

11) So what materials can corrode in wastewater systems and what ones are non-corrosive? It is important to understand the overall make up of your system in order to develop a strategic plan to address corrosion issues.

Materials that do corrode include the following: Unlined concrete manholes, pipes, structures- anything Portland cement based; steel and metallic pipe, structures and components; as well as mortar in brick manholes and old brick pipelines.

Materials that do not corrode include PVC, HDPE, other plastics, fiberglass, FRP, composite pipe and lining material, clay pipe and bricks, high performance coating/ lining materials including rehabilitation products commonly used in wastewater systems, and polymer concrete.

12) Now let's take a look at microbial induced corrosion in more detail. This will be more of a cliff-notes overview of the process, but nevertheless will provide the audience with a better understanding of the mechanics behind the process.

A key point to understand is that corrosion attributed to MIC occurs almost entirely in the headspace environment, that is area above the water line. It is characterized and often detected by elevated levels of H2S, but it is important to note that H2S, although a corrosive gas in itself and a critical component the corrosion process, is not the main culprit that causes the extensive damage. H2S goes in and out of solution in the wastewater environment, released from the flow under turbulent conditions, which is why we typically see more corrosion occurring in these areas within a wastewater system.

It is the biological oxidation of the H2S into sulfuric acid within the headspace environment and the subsequent effect of sulfuric acid on the substrate surfaces, such as the exposed concrete matrix above the water line that causes the majority of the corrosion damage.

On the slide you can see the chemical reaction where H2S is oxidized by sulfide oxidizing bacteria into sulfuric acid.

For concrete specifically, the biological process involved goes like this. New concrete is basic in nature and has a high pH level when it is first installed. Over time, this pH level drops and neutralizes due to environmental exposure and other factors, eventually dropping into a pH level that is favorable for various strains of sulfide oxidizing bacteria to survive and thrive. As these bacteria go through their life cycle processes and excrete acid,  this in turn continues to drop the pH of the concrete substrate further, eventually leading to a such a severe condition where the predominant strain of thiobacillus sulfide oxidizing bacteria is really all that can survive. The thiobacillus bacteria are the really bad actors here that produce sulfuric acid and eventually drive the pH of the substrate down to around pH=1, which is very corrosive and damaging to the structure.

13) Now that we have a better understanding of the microbial induced corrosion process itself, we can identify the factors that contribute to corrosive conditions in a wastewater system. By knowing where these particular conditions exist within your system, you can start narrowing in on the trouble spots where corrosion is happening or likely to happen.

Common contributing factors include: Elevated sewer gases including H2S, CO2, ammonias, etc; turbulent flows – remember that turbulent conditions release H2S gas from the wastewater stream into the headspace and start the cycle; high sulfide levels in the wastewater; elevated temperatures – just about all biological activities increase in warmer conditions;  high BOD sources- food preparation facilities are a good example that provide nutrients for bacterial activity; industrial waste as we previously spoke about, such as glycol which can exasperate the corrosion conditions; and stagnant/ septic sewage. Sewage that has been sitting in wet wells for long periods of time and then is pumped is a classic example of this.

14) So where are the typical corrosion hot spots in a wastewater system? These are some of the areas where you may want to target in your inspection program.

These areas include: forcemain discharge locations- areas where septic wastewater is discharged and H2S and other gases can be released under turbulent conditions; other locations in your system where turbulent flows exist, and example being steep to flat transitions; areas with poor air handling- air gets trapped and can't ventilate properly thereby creating higher concentrations of H2S and other gases that can exasperate the corrosion condition in that localized area; drop manholes, siphons and junction structures- again back to the areas where turbulent flow conditions can exist; lift station wet wells- areas where sewage sits for extended periods of time and becomes septic. Higher temperature discharge locations are also areas where severe corrosion can exist- and example of this is food preparation facilities where food waste along with high temperature cleaning water is discharged together. As a rule of thumb, corrosion is typically more severe in larger systems, but I have seen many smaller systems with their fair share of corrosion issues, particularly if there are forcemains present.

15) We will now look at some examples of the damage caused by microbial induced corrosion. Here we see a typical corroded concrete manhole. Note the spalling that has occurred on the exposed surfaces and the exposed aggregate.

16) Next we see another image of a corroded manhole. It is not uncommon to have several inches of concrete material lost due to corrosion.

17) Here we see the effects of corrosion on mortar joints in a brick manhole. Remember that clay bricks don’t corrode, but the mortar holding them in place certainly can. This can cause severe structural problems in these types of manholes.

18) And as mentioned earlier in the presentation, metallic components are also susceptible to corrosion. Here are some images of corrosion damage that has occurred on a manhole frame and cover.