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## Infiltration-and-Inflow Abatement Made (Relatively) Easy

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Ed Grieser and Andy Buchan — Oct 10, 2007

The hidden and not-so-hidden costs of infiltration-and-inflow (I/I) can occur for many reasons, but most of the causes stem from aging infrastructure that need maintenance or replacement.

The most common means of infiltration is through cracked or deteriorated manhole chamber walls due to long-term exposure to hydrogen sulfide gas and chamber fracture that is caused by ground movement and constant trafficking. Other causes include surface water runoff through manhole covers and down the sides of the frames because of cracked road surfaces, broken grade rings between the chamber cone and the manhole frame and cracked pipes and leaking joints.

Essentially, I/I becomes a headache for municipalities looking to reduce or maintain costs and ensure their processing facilities remain within the design capacity. When rain or groundwater enters the sewer system, the necessary processing of the additional water in sewage treatment facilities often costs more than \$3 per 1,000 gal.

Exacerbating the cost issues are the strict environmental standards municipalities must meet. These include capacity management operations and maintenance (CMOM) regulations that require elimination of sanitary sewer overflows (SSOs) and improved overall system efficiency, and new U.S. Environmental Protection Agency (EPA) requirements for protection of floodplains, creeks, ponds and other sensitive environmental areas.

Towns trying to resolve chamber leakage often apply coatings to the inside of the chamber and the grade rings, protect the outside of the chamber with rubber shields and repair cracks on the outside of the chambers through external repair. These tactics need to be carefully considered to ensure they are appropriate for achieving the desired outcome. While these solutions may be effective, they often require specialist installation or external chamber application. This makes maintenance on existing systems difficult without expensive excavation around the chamber.

### Options

What repairs can the municipality perform that are quick, efficient and still reduce infiltration? There are many options available, but for the purposes of this article we will consider solutions that are 'in the line of sight.' Line of sight means being able to evaluate the chamber from aboveground. While the bottom of a manhole chamber is not literally in the line of sight, a manhole chamber is the easiest part of the sanitary sewer system to assess its condition. The manhole chamber is also the easiest and fastest part of the system to repair.

It's estimated that as much as 50 percent of the total I/I enters the system via leaking and deteriorating manhole chambers. While there are many options for manhole renewal or repair, with each having advantages in specific situations, chemical grouting has several distinct advantages that are worthy of discussion.

If complete replacement of the infrastructure is impractical, chemical grouts can be used. There are many different types of polyurethane grout available. Closed cell grouts are like a series of bubbles that are attached to each other. Therefore, closed cell grouts do not allow water to pass through the material. Open cell grouts are similar to a sponge. Without being overly technical, the two main types of polyurethane are hydrophilic and hydrophobic. Hydrophilic grouts require water to be present to react and to maintain the expanded state. Dual component hydrophobic grouts do not require additional water to react and have the additional advantage of not requiring water to be present to remain expanded. Pre-polymeric hydrophobic (single component) grouts use water to begin the reaction but expel it in the final phase of reaction. Hydrophilic grouts typically shrink over time.

One such product, SealGuard II, is a two-component polyurethane grout. SealGuard II has been used for more than 25 years in the mining industry, as well as in water sealing applications for the past eight years, in both above- and below-grade structures.



With a chemical grout and a commitment to a consistent repair program, a tremendous amount of progress toward I/I abatement can be accomplished in a short period of time. One of the advantages of a product such as SealGuard II is that it does not require specialized contractors or equipment to rehab manholes. This, in turn, saves money for the municipality. Expanding polyurethane grouts repair the outside of the chamber from within the chamber. A plastic 'bubble' replaces the void outside the chamber and seals the leak path. SealGuard II does not affect any coatings subsequently applied to the chamber, resolving the issue of chamber breakdown via hydrogen sulfide gas exposure.

Rick Schooley, center sanitary sewer manager for Leesburg, Va., was able to stop contracting out his manhole grouting work and instead put in place a dedicated two-man crew that, since January 2004, grouted 186 manholes in the town, stopping 531 gpm (764,640 gal).

### Technique

Dan Englander of the Soos Creek Water and Sewer District, a municipal corporation of King County, Wash., has more than 25 years of experience in chasing water in leaking manhole chambers. Before the district began a program with SealGuard II, it used oakum and quick set cement. This technique was little more than a temporary patch, so Englander moved on to pumping a single component grout into the manhole. This was certainly a step forward, but there were still several problems. Cleanup time for equipment was an issue. The inability to inject the grout into a flowing leak without the material washing out before the grout would expand, slowed the repair process. The number of lines for the material, which made an already small chamber workplace that much smaller, made Englander continue to look for a better solution.

Soos Creek Water and Sewer District has a crew of two that is responsible for more than 10,000 manholes. Given the small crew, Soos Creek has a structured maintenance and repair schedule that has drastically reduced the number of line plug ups. The small but efficient crew is extremely focused on maintaining the system with the goal to keep the service rates down.

Englander likens fixing leaks to a chess match. The first challenge is to determine where the water is coming from. The source of the leak may be on the opposite side of the manhole from where the water is running out. Our experience is that SealGuard II follows the leak to the source of the water.

Englander said Soos Creek has not had a problem with shrinking or decaying and there have been no repeat leaks in the areas where SealGuard II was applied. Moving to the top of the chamber, the most obvious solution when replacing access covers is to choose products that will help prevent the problem in the first place. Some choices include the PAMREX access covers from CertainTeed. These covers provide inflow resistance and do not utilize secondary devices such as infiltration dishes, which can often cause additional problems. A gasket on the inside helps eliminate routine traffic shock which protects against road surface and chamber breakdown (conditions that can cause an increase in I/I).

Municipalities resolving cover inflow often use secondary devices such as 'rain dishes.' These dishes are available in both plastic and stainless steel, and while effective for the most part, they are not always reliable. The plastic ones are often not durable under trafficking and the expensive stainless steel ones are attractive to thieves. Worse yet, both types risk falling into the chamber and blocking sewer lines, thereby causing SSOs.

XSeal is a product that creates a watertight seal between adjusting rings and the manhole frame. Current technology involves using butyl rubber to create a seal between each of the rings and frames. Unfortunately for butyl rope to bind securely, all surfaces must be clean and dry. Clean and dry are two words that are seldom used to describe the workplace when repairing or resetting manhole frames.

### Summary

In the process of researching this article, there is not one recorded case of any individual who enjoys strapping confined space safety gear and crawling down a manhole. Unfortunately, the reality is that there is a huge benefit to taking a look below and performing the necessary maintenance and repairs as described above. Make no mistake, the methods described above are not new. Clearly with the proper tools and planning, the functional life of the manhole chamber can be extended at a fraction of the cost of replacement.

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