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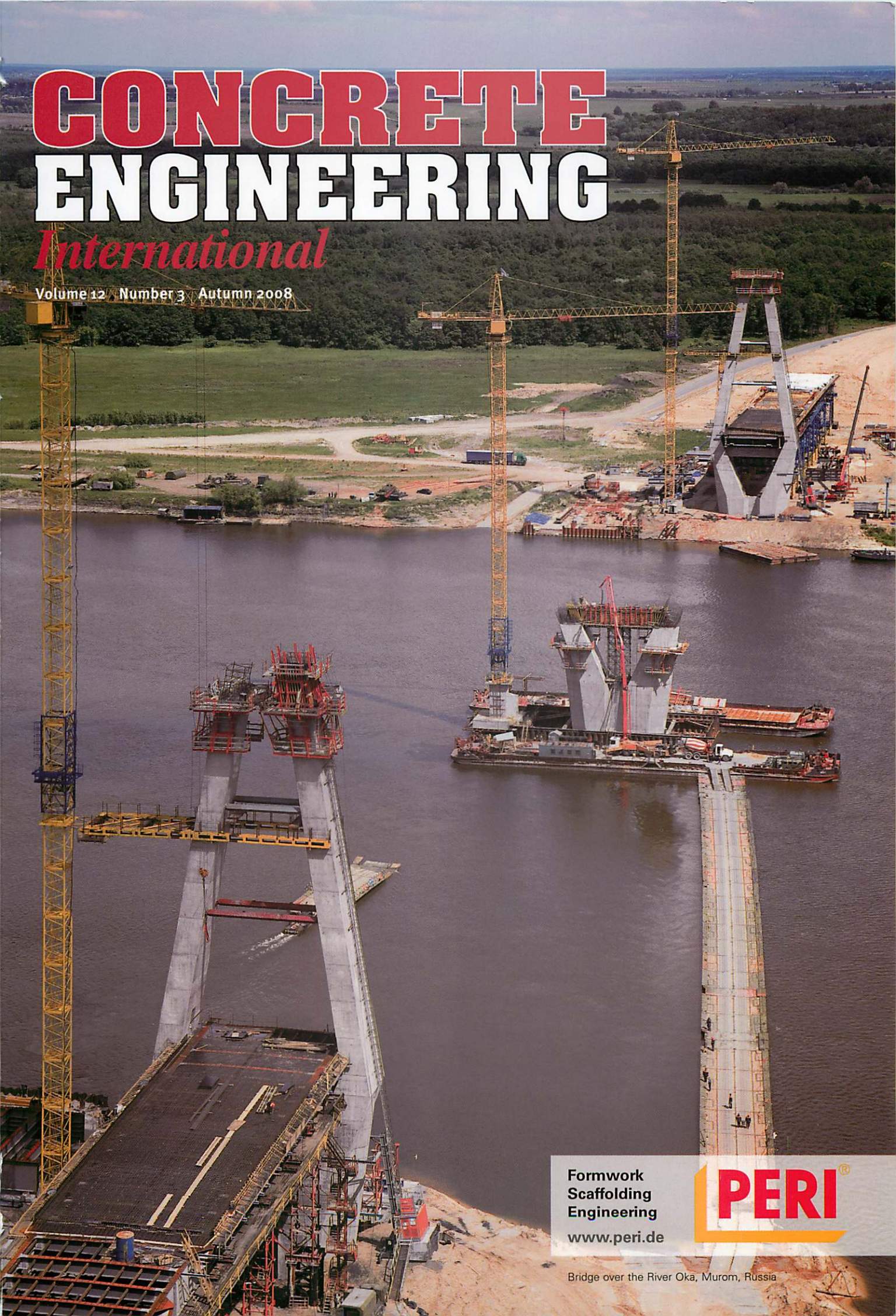

Bridge over the River Oka, Murom, Russia

An analysis of inflow and infiltration from unsealed septic tank access ports

Watertight tanks are generally overlooked as a solution to inflow and infiltration problems in municipal and decentralised wastewater systems. The use of watertight tanks can dramatically reduce treatment costs, reduce overflow events and help contain the ever-increasing problem of inflow and infiltration (I&I).

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Ideally, the amount of treated sewage effluent should be less than the amount of total purchased water. Activities such as watering the lawn, washing the car and consuming water all account for effluent wastewater being less than purchased water. If the opposite is true, then the sewage collection system is experiencing infiltration.

The two systems analysed here are decentralised on-site wastewater collection systems. The septic tanks used for both systems were manufactured in a National Precast Concrete Association (NPCA) certified plant. The NPCA plant certification programme assures a high degree of excellence in plant facilities, production processes and quality control operations. Both tanks provide assurance of being watertight and should provide a successful on-site wastewater collection system.

The collection and treatment processes for both systems are handled by a recirculating sand filter. Both systems are comparable in physical size, customers served, weather patterns and geographical location, and both are serviced by a public utility that provides the public drinking water and sewer collection for each house. The drinking water is metered at each house and monitored monthly for billing purposes. The sewage effluent is pumped to a central treatment facility, where the total treated effluent is also metered.

During a six-month period, water meter readings and treated sewage effluent were carefully monitored for Systems 1 and 2. At the end of the six-month period, the total purchased water and treated effluent for each system were evaluated to determine the treated effluent as a percentage of water purchased. These data provide a basis for predicting future performance while giving a monthly performance snapshot, which allows the utility to be proactive in combating I&I along with other issues that may arise.

Figure 1: The access port that was allowing the water to leak through.

System evaluation

Since recirculating sand filters are not significantly impacted by rainfall events, it is assumed that all treated effluent originates from the septic tanks.

System 1 showed an excess of sewage effluent that entered and was treated in the recirculating sand filter (see Table 1). In other words, the total water exiting the recirculating sand filter was greater than the purchased water amount.

During the same period, System 2 showed the total treated sewage effluent to be less than half the purchased water. Only 44% of the purchased water was entering the recirculating sand filter (see Table 1), which demonstrated the system was not experiencing I&I of any significance.

Table 1

	System 1 – Trouble System	System 2 – Good System	System 1 – Trouble System Post-Fix
	Six-month period		Six-month period after fix
Total water purchased	253,800 gallons	164,700 gallons	245,600 gallons
Total sewer treated	327,432 gallons	73,202 gallons	147,300 gallons
Per cent of purchased water treated	129% (bad)	44% (good)	60% (good)

Diagnosing the problem

With System 1 experiencing severe inflow and infiltration problems, the system was analysed for failures. Tanks used in both systems were provided by a NPCA-certified plant, ensuring proven quality construction methods for producing watertight tanks. Having tanks designed and constructed for watertightness from an NPCA-certified manufacturing facility helped reduce the number of areas to inspect for I&I due to the high confidence level earned from the plant certification programme.

If a manufacturer without a recognised quality assurance programme had supplied

the tanks, the cause of I&I could have been more difficult to find. Common types of failures that lead to I&I are cracked tanks due to no reinforcement; inferior, permeable, low-strength concrete; or the total lack of a high-quality sealant in the joint line. A combination of these problems would require replacing the entire tank with a watertight design that had a plant certification programme behind it.

A review of the specifications for the two systems revealed only one difference in the tank requirements – the specification for sealing the inlet access port lid. System 1 did not require the concrete inlet access port lid to be sealed prior to installation, while System 2 did.

After a brief discussion and consultation with the tank manufacturer, engineer and field personnel, it was decided that the first place to check in the collection system would be the tanks. The access ports that were not sealed would be uncovered and inspected first. If the access ports had not shown any signs of I&I, the inspection would be expanded, which would require uncovering and visually inspecting any and all seams and joints on the tanks, risers and inspection ports.

However, when the first tank was uncovered, it was immediately apparent that the inlet side access port lid (see Figure 1), which measured 460mm in diameter, was allowing surface water to enter the tank. All of the tanks showed varying degrees of I&I during the inspection.

The fix

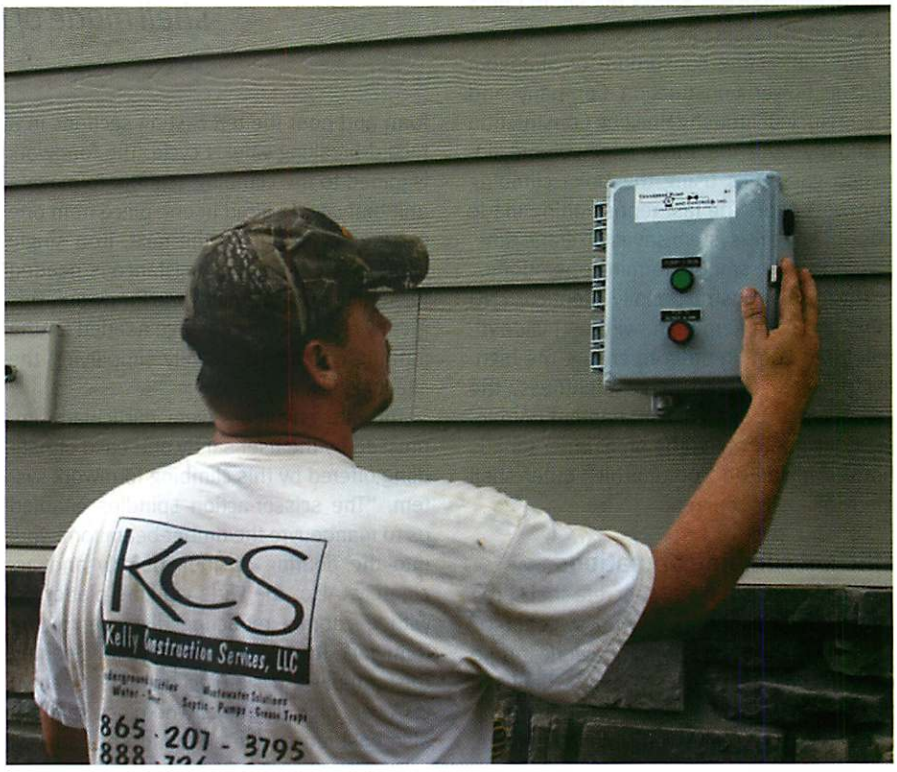
The next step was to seal each of the inlet access port lids on each tank in System 1 with a high-quality butyl sealant to ensure a watertight seal. Fortunately, the unsealed lid was close to ground level, allowing an easy fix. System 1 and System 2 tank specifications were now identical to each other and should perform equally well against I&I into the collection system. After evaluating the following month's meter readings, the success of applying the butyl sealant on the inlet access port lids became evident, as System 1 showed a dramatic decrease in treated sewage. Sixty per cent of the total purchased water was now entering the sewage treatment facility, cutting the treated wastewater by more than half. This validated that the I&I problem originated from the unsealed access port lids. Table 1 shows the purchased water and treated effluent comparisons.

Conclusion

Sewer collection systems are only as good as the weakest component. In this case, failure of the utility to specify proper sealing of the tank totally negated the tank's watertight design and construction and resulted in the tank being the weakest component in the entire system. Overlooking such a simple precaution to both specify and properly seal a watertight tank can be catastrophic for all sewage collection systems, resulting in system overloads and significantly increased operating costs.

Since the breakdown of communication between the utility district and the precast concrete manufacturer leading to the failure described above, the precast concrete manufacturer now reminds each customer at the time of product delivery that the proper sealant must be used on every tank supplied in order for the tank to be watertight. This fact is repeated at regional industry meetings as a way to help utilities install and operate systems successfully.

In addition, breakdown in system performances such as I&I can result in overloaded sewage treatment facilities. Based on data collected in this study, systems with 1000 septic tanks and/or grease interceptors that contain at least one unsealed access port lid per unit could produce as much as 20 million gallons per year of added liquid effluent into the treatment system. To provide long-term system improvement, utilities should ensure that properly designed, properly sealed, durable watertight tanks are installed for wastewater applications. ■



Figures 2 and 3: A typical system being installed by a contractor for a utility.

Further information:

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