Enhancing Sanitary Sewer Pump Station Performance

By Joshua Herchl

Systems fabricated from engineered plastic pipe add capacity, provide security & flexibility

Today's utilities often find that existing pump stations do not have the necessary power or capacity to meet demand. Frequent breakdowns and electrical outages often shut down the stations, causing flooding, creating financial burden and destroying communities.

There is a trend gaining momentum that enables cities and towns to economically control sanitary sewer overflow. The traditional method of installing pump stations throughout a system is being augmented with underground detention systems. Made from large-diameter polyolefin pipe, the systems are economical, easy to install, can be configured to conform to any layout, meet capacity needs, and can last 50 to 75 years or longer.

Most sanitary sewer systems count on pump stations, which are installed at intervals within the collection system. Some collection systems lift sanitary sewage 20 to 70 ft to the treatment plant because the pipe has to be deep in order to continue a gravity flow. This can be expensive. The design, components and installation are costly.

Aside from the cost, pump stations can be mechanically unreliable. Even if they are brand new, they can get overloaded. Electric pumps do not work well when they are flooded. During Hurricane Sandy in September 2012, at the Bay Park Sewage Plant in East Rockaway, N.Y., on the south shore of Long Island, failure of the pumps due to flooding caused an environmental problem, with 100 million gal of raw sewage flowing into the adjacent bay and the surrounding residential area. When pump stations flood, municipalities flood and sewage backs up.

Most municipalities have multiple pump stations that often have pumps of different sizes, from different manufacturers or with different components.

A municipality has to maintain those pumps, which requires manpower, expertise, spare pumps, spare pump seals, spare pump breaker boards and electrical components. This inventory naturally ties up capital and can mean an additional expense for taxpayers. There also is personnel to consider. Someone must be available at 2 a.m. on a Saturday or a holiday when the pump shuts down.

CSO Mandate

Municipalities are required to maintain a clean water system through the Clean Water Act and to keep their NPDES permit for treating storm water.

The U.S. Environmental Protection Agency's (EPA) combined sewer overflow (CSO) control policy is a national framework for controlling CSOs through the NPDES permitting program. It provides guidance on how communities with CSOs can achieve Clean Water Act goals in a flexible, cost-effective manner.

When it rains, storm sewers can overflow into the sanitary portion of the combined sewer, and sanitary sewage is dumped into waterbodies. Water quality storage systems help meet EPA and NPDES requirements by holding back the storm water to alleviate flooding in the storm sewers so the effluent can be stored and treated later.

For some municipalities, it can be too expensive to separate the systems. Residents often do not want their roads torn up to put in the new pipeline, so the systems remain combined and storm water is held in a detention system.

For a city of 40,000 residents with a wastewater treatment plant rated at 2.5 million gal per day (mgd) of sanitary sewage overflow—standard for a city of 40,000—there might be upwards of 3 mgd of water typically going through the wastewater treatment plant. But during a rain event, that flow can reach up to 6 mgd and the plant has no way of treating the extra water. A bypass system may be designed to flow into a lake or stream, but the municipality is not permitted to outlet to that body of water. Doing so would result in a fine.

One major problem for the pipe in a sanitary sewer system is hydrogen sulfide gas. When the sewage is exposed to oxygen, mainly above the flow line, it starts to decompose, emitting hydrogen sulfide. Then, combining with oxygen and water condensed on the pipe walls, the hydrogen sulfide creates the highly corrosive sulfuric acid. Our nation's concrete sewers are rotting due to naturally occurring hydrogen sulfide gas and the resulting sulfuric acid.

The development of high-density polyethylene (HDPE) and polypropylene pipe provided a solution with favorable economics and was inert to the effects of both hydrogen sulfide as a gas and sulfuric acid as a liquid.

Consider a car battery. Liquid sulfuric acid is inside a car battery, and the casing is made of polypropylene. SaniTite HP pipe also is made from polypropylene. Traditional materials cannot stand up to the corrosive nature of the acid. PVC is equally resistant to the effects of hydrogen sulfide, but the PVC industry cannot fabricate the type of fittings that are needed for many projects. Advanced Drainage Systems (ADS) provides an inert product resistant to hydrogen sulfide and sulfuric acid corrosion, while also making fittings and a manifold system that is more cost-effective than a precast tank.

The pipe provides a smooth interior and exterior wall design supported by a corrugated structural core for stiffness and beam strength to minimize deflection and enhance long-term performance. It meets ASTM F2736, ASTM F2764 and exceeds ASTM D3212 for water tightness with dual-gaskets and banded reinforced bell.

Pipe provides flexibility in many areas, including diameters, length of runs, and configuration, such as L-shaped designs. It can be installed wherever needed, especially near easement lines and in shallow ground. A pipe detention system does not necessarily negate pump stations. Instead of requiring a large pump capable of pumping a 30-in.-diameter sewage line, the pipe system can reduce that pump station requirement to a more standard 8-, 12-, 16- or 18-in. pump. The city can have 50 of the same 8-in. pumps all across its collection system, for example. With all the same pumps, the utility or municipality does not have to carry a variety of parts. Maintenance is much easier, saving labor and electricity.

A Worthington, Ky., project sought to minimize sanitary sewer overflows into the Ohio River with 860 ft of 60-in.-diameter pipe installed in a three-row configuration.

There are more and examples of this way to economically handle excess sanitary sewer and emergency overflows. Some of the more recent projects include:

American Applications

Fort Madison, Iowa, elected to install a disinfection system near one of its CSOs into the Mississippi River. The treated water needed to have residence time to disinfect and purify it. Originally, the city considered a concrete vault to hold 20,000 cu ft of sewer water, but because of concrete's high costs, it decided to use an underground pipe detention system made up of 1,000 ft of 60 in. diameter pipe with fabricated fittings. SaniTite HP was chosen for the project due to pipe strength and for its long-term service life, which is based on its corrosion and abrasion-resistant nature. It also has a dual-gasket joint system, and the ability to fabricate the pipe into bends and convert RCP tee manholes into cost-efficient HP pipe with risers.

In Worthington, Ky., the city needed to minimize sanitary sewer overflows into the Ohio River from a small pump station on the bank of the river. The project consisted of 860 ft of 60-in.-diameter SaniTite HP pipe. Installed in a three-row configuration, the fabricated manifold fittings with 24-in. Nyloplast inline drains were constructed at the ADS plant and delivered to the site ready for installation.

As part of the ongoing CSO program in North Vernon, Ind., the surcharging of one lift station was solved by using long, parallel runs of large-diameter pipe instead of replacing or enlarging the lift station.

Located on the Muscatatuck River in the southeast corner of the state and just north of the junction of Indiana, Kentucky and Ohio, the city's southwest lift station—Lift Station Number 22—would overflow several times each year. With three pumps, each with a flow of 634 gal per min, to service 988 acres, it is the largest of the 21 stations in the system. The new pipe system temporarily stores wet weather volumes upstream from the lift station. The water will flow from the pipes to the lift station and be pumped to the treatment plant. The pipeline was designed to handle a 10-year, one-hour event, which required a storage volume of 128,000 gal—a capacity that also took into account the existing pumping capacity. The new pipe system provides more than 147,000 gal of storage.

SaniTite HP polypropylene pipe was used. It was approved by the Indiana Department of Environmental Management in 2010. At project completion, the system was tested with no leakage.

The design called for twin 316-ft runs of pipe for half the design and then three, 335-ft lines further upstream. A total of 1,600 ft of 48-in.-diameter pipe was used. There are eight risers and cover ranges from 3 to 4 ft. Fabrication of all fittings was done at the ADS manufacturing plant.

Water stays in the detention pipe system for one to two hours depending on the severity and volume of rain. It flows to the station, then to another sub-basin, and then by gravity to the treatment plant.

"The advantage of this offline storage detention system is its relative simplicity," said Michael Gangstad, P.E., senior project engineer of Lochmueller Group Inc. "It's a passive, gravity-flow system. There are no mechanical or electrical controls. And the operation and maintenance costs are low."

Industrial Plant Optimization

The method of using pipe to construct a sanitary sewer system is not limited to utilities. Industrial facilities also are finding this method to be valuable help in controlling wastewater. A plant in Ohio constructed a system for a lift station using 416 ft of 48-in.-diameter SaniTite HP pipe to carry water used to rinse and cool parts during the manufacturing process. The pipeline was installed 15 ft deep with minimal slope from the plant to a new lift station. The hot water contains pollutants that cannot be discharged in to the storm sewer system. The line is over-sized so it can store the wastewater for a period of time, and then engage the lift station to pump it into the municipal sewage collection system for treatment. SaniTite HP was used in this application because of polypropylene's chemical resistance and inertness to the effluent, redundant double gasketed joint and cost-effectiveness.

Enhancing sanitary sewer pump station performance is now possible with the addition of a high-volume detention system constructed of large-diameter pipe. For decades this method was successful in taking care of storm water runoff. Now, engineered grades of polypropylene material, the design and construction of the pipe, watertight joints and favorable installed costs have extended the use of detention systems to even the most caustic sanitary sewer application. WWD

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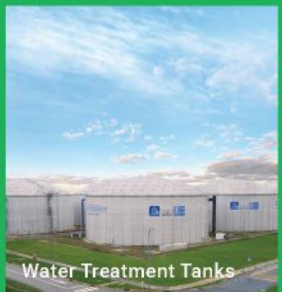

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