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Ohio Contractor Embraces High-Tech Vacuum Sewers

Want to make a public utilities contractor really uncomfortable? Just mention project overruns, delays and change orders. They get grumpy almost immediately.

Contractors hate to think of those type of things that cost money and damage their reputation. Successful contractors are those who know how to manage, or better yet, avoid problems. When too many problems pile up, a contractor can lose business and money.

That's why contractors become almost giddy when they find a new method or technology that helps them avoid problems and provide smart solutions to their clients. Joe Musgrave is one of those happy contractors.

Musgrave is the general superintendent for Kirk Brothers Company in Alvada, OH. His company specializes in water and wastewater projects.

"You have to stay with what you know, and we've stayed with water and wastewater work for a long time," said Musgrave. "We're as good as anybody and better than most, in my opinion. That's the key to success, I think."

Kirk Brothers has been successful, and their customers happy, because the company has been willing to embrace new and better technologies. In 1997, Kirk Brothers had its first experience with vacuum sewers. Although the technology was not actually new, vacuum sewers were not widely used for municipal applications in the Upper Midwest at the time. Virtually all cities were on gravity sewers and a few had low-pressure grinder pump systems.

"At first I was intimidated by it," said Musgrave of vacuum technology. "But there is really no reason to be intimidated. It's very easy to understand. Over the past seven years we installed Airvac vacuum sewers numerous times and now we have great confidence in the technology."

Musgrave's most recent experience with vacuum sewers was in the small town of Forest, OH, (population 1,500). They completed Phase One of a sewer reconstruction project in 2002 and are now in the process of completing Phase Two. The two projects will provide modern vacuum sewer service to almost 250 households.

Top: *Many vacuum sewer components can be installed by hand, saving equipment costs and reducing installation time. Here, two workmen lower a vacuum valve pit into place in a Forest, OH, neighborhood.*
Bottom: *A contractor uses a trailer-mounted vacuum pump supplied by Airvac to test the line that was installed that day.*

"Phase One has performed very well. We've had very few problems with our vacuum sewers for over two years now," said Chuck Brunkhart, village administrator for the city of Forest.

Those are exactly the type of comments contractors like to hear, which is one of several reasons Musgrave is more than happy to recommend vacuum sewer technology whenever the situation is suitable.

"I've recommended vacuum sewers to a lot of the communities around here," said Musgrave. "The owners have been thrilled with the day-to-day operation of the system, and vacuum sewers typically cost less to install. It doesn't take a rocket scientist to figure out this is the way to go."

Money matters

In the case of Forest, OH, money was a crucial factor in the decision of what type of sewers to install. Forest has two issues that make trenching extremely difficult – many large trees and a layer of bedrock under the town. When engineers began exploring design options, they quickly realized that a gravity sewer would be extremely expensive and very disruptive.

"The best use of vacuum technology is when you have an existing community, because of the flexibility of vacuum sewers," explained Tom Stalter, P.E., of Poggemeyer Design Group's Bowling Green, OH, office. "Vacuum sewers are excellent anytime you have rock or there is a lot of buried utilities that you may not know about. Vacuum sewers are typically shallower than gravity sewers, so there's less disruption. It's the most flexible system I've ever worked with."

In the case of Forest, some of the gravity lines would have required trench depths of 22 feet, compared to an average trench depth of about five feet for vacuum lines. The excavation costs alone would have made gravity sewers extremely expensive.

Brunkhart noted that the cost estimate for new gravity sewers in Forest came in at $6.5 million. Vacuum sewers, by comparison, cost about $3.1 million. The cost savings resulted from easier installation and the fact that the vacuum system required only one vacuum station, compared with the need for two lift stations for a gravity system.

Tom Stalter of Poggemeyer Design Group listens as Chuck Brunkhart, village administrator for Forest, OH, discusses his town's new vacuum station.

Contractor, engineer and municipality worked together to provide the citizens of Forest, OH, a state-of-the-art sewer system.

Vacuum sewer lines typically require much shallower depths (4-5 feet) than do gravity-flow sewers. The shallow trenches mean less neighborhood disruption, greater worker safety and lower installation costs.

According to Brunkhart, they considered a low-pressure grinder pump system but decided against that option because grinder pumps require electricity. "We didn't want to put electric motors into such a hazardous environment," he explained. "It would have been very high maintenance compared with the vacuum valves, which don't require electricity and are relatively easy to maintain."

Brunkhart also said that with vacuum technology, they could often "field engineer" a solution when they ran into an unexpected underground obstacle. "In an older town like Forest, you never know what you will run into when you start digging," said Brunkhart. "With a vacuum system, you can simply route the line around most obstacles. You can't do that with a gravity system."

Easy does it

Because trenches for vacuum sewers are generally shallower than trenches for gravity sewers, the installation of a vacuum sewer system creates less inconvenience for the residents.

"There are a lot of reasons we like Airvac," said Musgrave. "We don't need 100,000-pound excavators and a half-dozen extra trench boxes. We can use excavators in the 50,000 to 60,000 pound class. There is less disruption of traffic and that makes everyone happier."

"Any time you go underground you face risks," Musgrave noted. "With a vacuum system, there are less risks because you're not digging as deep and the system offers more design flexibility."

In a vacuum sewer system, a central vacuum station maintains vacuum pressure within the sewer collection lines. Wastewater flows from each house by gravity line to a vacuum valve pit nearby. Up to four homes can be connected to a single valve pit.

Each valve pit is equipped with a vacuum interface valve that activates when wastewater in the lower sump reaches a predetermined level, typically 10 gallons. When the valve activates, wastewater enters the collector line followed by a volume of air. The wastewater forms a slug that is driven by the air due to differential pressure. Operation of the valve pit is completely pneumatic, so external power is not required. The sewage moves so rapidly through the line that buildups of grease or sludge are rare.

Most communities with a new vacuum sewer system will need some training and support for the local maintenance team. Musgrave said that the learning curve for Forest was easy.

"Airvac has a very good week-long training seminar that I highly recommend to anyone who is going to maintain a vacuum sewer system," said Brunkhart, who supervises the maintenance of the vacuum system. "You get in-depth instruction and they let you work on actual units so you learn to make repairs yourself. We actually have a test bench for testing and repairing valve pits. We do the repairs on them ourselves."

Another nice benefit of vacuum sewer technology is that it is cleaner to work with than gravity or low-pressure systems. And if a leak ever occurs, vacuum pressure keeps the wastewater in the line rather than allowing it to enter the environment.

"There are two chambers in each valve pit," explained Brunkhart. "The bottom chamber contains the septic wastewater and that section is sealed off so that you never have to put your hands in sewage. And you just don't have I/I (inflow and infiltration) problems. I think the EPA really like the fact that vacuum systems are closed systems."

Anyone who does public works contracting knows that gravity sewers and low-pressure systems have their place. Sometimes they are the best solution for a city's wastewater issues. But for an increasing number of communities, vacuum sewers are the best way to go. Just ask a contractor who has installed one.

"On several occasions we've called engineers and recommend they entertain the idea of using vacuum sewer technology," said Musgrave. "We know what the costs are like and we know that public works crews love them. Why not promote 'em? They make everyone's life easier."

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2. When 10 gallons of wastewater collects in the sump, the AIRVAC valve opens and differential pressure propels the contents into the vacuum main.
3. Wastewater travels at 15 to 18 fps in the vacuum main, which is laid in a sawtooth fashion to insure adequate vacuum levels at the end of each line.
4. Wastewater enters the collection tank. When the tank fills to a predetermined level, sewage pumps transfer the contents to the treatment plant via a force main. Vacuum pumps cycle on and off as needed to maintain a constant level of vacuum on the entire collection system.