WaterWorld®

Vacuum Technology Provides Alternative to Gravity Sewers

Everyone wants clean water. You don't have to be a committed environmentalist to realize that we must protect our waterways. However, every day millions of Americans contribute to the contamination of our water, and they may not realize it.

According to the Environmental Protection Agency, about one in five housing units in this country – approximately 26 million homes and apartments – are served by soil-based septic systems. While septic tanks are fine for the treatment of sewage on a limited basis, they are problematic when there is a large concentration of them in heavily populated areas, especially if those areas have sensitive environmental issues or high groundwater tables.

There's a reason why so many communities rely on septic tanks for sewage treatment: modern collection and treatment systems are very expensive and disruptive to install. In recent years many municipalities and public works districts have turned to vacuum sewer technology to solve this problem. In the right application, vacuum sewers have proven to be easier to install and less expensive that other collection system alternatives.

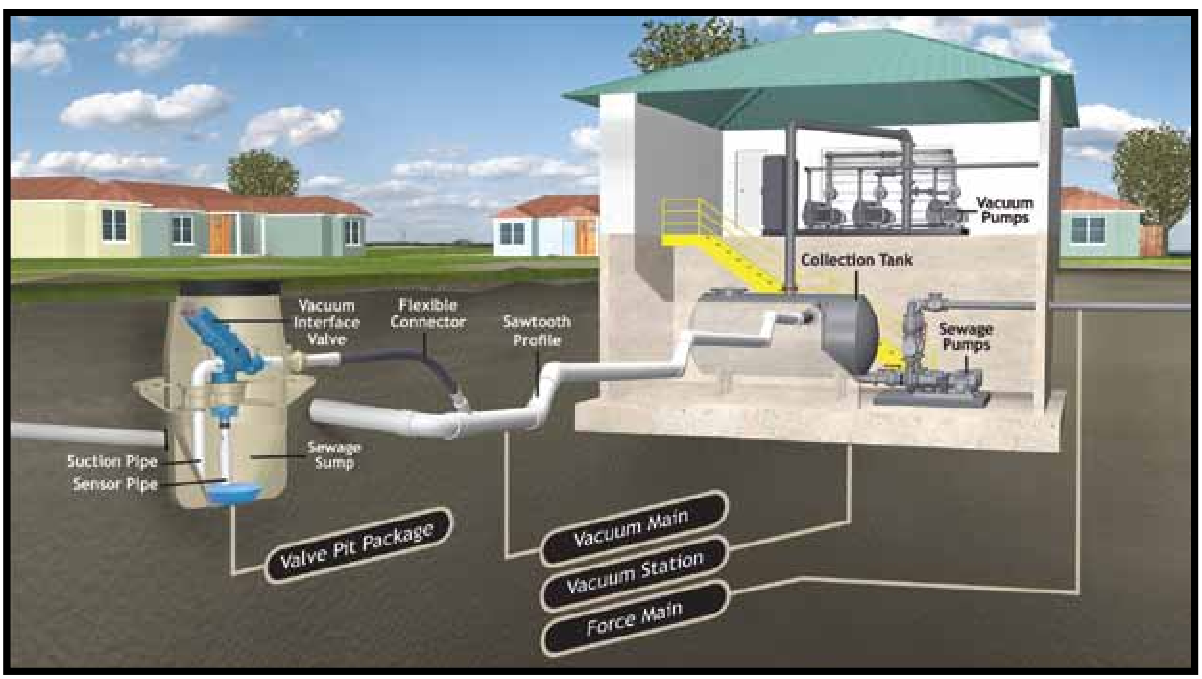
Almost half (47 percent) of the homes currently on septic systems are located in growing suburban areas, and the number of housing units on septic systems has increased by almost two million since 1985, so the situation is gradually getting worse, not better.

An example is Hooper, Utah, which is located near Ogden and Salt Lake City. Once a small community with a few scattered farmhouses, the town grew rapidly during the 1990s, reaching a population of more than 4,000 by the time it incorporated in 2000. Upon incorporation it became the largest unsewered city in Utah. A Board of Health study in 2001 indicated that sewage from Hooper's septic systems was finding its way into local waterways, creating health and environmental concerns.

Hooper's flat terrain and a high groundwater table created significant design problems for the civil engineers working to create a collection system. Gravity sewer lines would have to be buried 20-25 feet deep to attain the necessary grade. Contractors would need to shore up and dewater the trenches. Traffic would be disrupted for weeks due to the trench work and heavy equipment, and they would have to build multiple lift stations along the way. The cost of the project was staggering.

The price tag for a gravity sewer system led Hooper's engineers to seek collection alternatives. Their research led them to the vacuum sewer systems offered by AIRVAC. Because vacuum sewer lines can be buried in shallower trenches, installation costs can be 25 percent less than a comparable gravity or low-pressure sewer system.

The systems are especially attractive to coastal communities with geographic



Typical layout of an AIRVAC wastewater collection system.

issues similar to Hooper – flat terrain and high groundwater. Fripp Island, SC, saved more than $1.6 million by installing vacuum sewers. In another project, York County, VA, solved a significant problem with septic systems by choosing an AIRVAC system. Albuquerque, NM, met an important government mandate by installing a vacuum sewer in 1993 and has expanded their system several times since.

Vacuum Systems 101

Public works directors and civil engineers who are unfamiliar with vacuum technology may think that the systems are complex and fragile. In fact, the opposite is true. Vacuum systems operate on simple principals of physics and have proven over many years to be extremely reliable.

Homeowners usually don't notice the difference between vacuum sewers and other systems because gravity is used to transport wastewater from the home or business to first collection point, the vacuum valve pit, which is usually buried near the street. The valve pit consists of a small collection sump and a pneumatic vacuum valve mechanism located in a chamber above the sump. One or two homes are typically connected to a single valve pit.

When the wastewater in the valve pit sump reaches a predetermined level, usually around 10 gallons, it triggers the pneumatic valve that releases the wastewater into the vacuum main where negative pressure propels it at speeds up to 18 feet per second toward the vacuum station. The speed of the wastewater helps scour the line and break up solids.

Vacuum Mains

The piping network connects the individual valve pits to the collection tank at the vacuum station. SDR 21 PVC pipe, with special O-ring gaskets made for vacuum use, typically is used. Typical sizes include 4", 6", 8" and 10". Lifts or vertical profile changes are used to maintain shallow trench depths as well as for uphill liquid transport. These lifts are made in a saw-tooth fashion.

Resilient wedge gate valves (division valves) are used to isolate various sections of vacuum mains thereby allowing operations personnel to troubleshoot maintenance problems in a timely fashion.

Vacuum Station

A vacuum station functions as transfer facility between a central collection point for all vacuum sewer lines and a forcemain leading directly or indirectly to a treatment facility. The wastewater from the vacuum mains empties into the collection tank which is a sealed, vacuum-tight vessel made of carbon steel, fiberglass, or stainless steel. Vacuum gauges are used on all incoming lines to allow the operator to monitor the vacuum levels of each vacuum main.

The bottom portion of the tank acts as the wet well. Wastewater is stored here until a sufficient volume accumulates, at which point the tank is evacuated by the discharge pumps. The discharge pumps are typically non-clog, dry pit pumps. Redundancy is required, with each pump capable of providing 100 percent of the design capacity.

Vacuum, produced by the vacuum pumps, is transferred to the vacuum mains through the top part of the tank. Vacuum pumps typically are the sliding vane type. Redundancy is required, as design capacity must be met with one pump out of service.

The vacuum system control panel houses all of the motor starters, overloads, control circuitry, and the hours run meter for each vacuum and sewage pump. The collection tank level control and fault monitoring equipment are also normally located within the vacuum system control panel. A chart recorder is used so that system characteristics can be established and monitored.

The vacuum station equipment is housed in a protective structure. Materials of construction are the choice of the consulting engineer and typically are selected to match the architecture of the surrounding community.

An emergency (or standby) generator is a must. It ensures that on-lot flooding or backup will be prevented through the continuing operation of the system in the event of a power outage.

Conclusion

Public works crews who maintain AIRVAC systems quickly learn to appreciate the advantages of vacuum technology. If a vacuum collection line is ever damaged, the repair is simplified by the shallow burial depth of the line. Vacuum valve pits are virtually maintenance free and are easily accessed for repairs. Vacuum stations are relatively clean environments; workmen almost never come in contact with raw sewage.

As for long-term reliability, the first vacuum sewers installed in the United States are now approaching 40 years old and are still providing reliable sewer service.

There is little disagreement that reducing the number of septic systems in the United States will ultimately produce cleaner water, but transporting and treating wastewater is expensive. Vacuum sewer technology can be a cost-effective alternative for many municipalities. **WW**

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The World Leader in Vacuum Sewer Technology

Go to airvac.com to see a video of how the system works.
Inquiries: Tampa, FL 813-855-6297