

VACUUM SEWERS: TECHNOLOGY THAT WORKS COAST-TO-COAST



The Hooper, Utah, vacuum stations are clean, quiet, odor-free and almost indistinguishable from homes in the neighborhood.

Editor's note: I thank AIRVAC, Inc. for graciously providing this informative article, describing the process and their successful application in the Rocky Mountain region. Additional information on this system can be found at: www.airvac.com.

Vacuum sewers have provided cost-effective solutions for many communities in flat, coastal areas. While they are perfectly suited for these situations, vacuum sewers also have been used in places that are far from flat.

AIRVAC, Inc., a leader in vacuum sewer technology, has helped design systems for cities located in West Virginia, Pennsylvania, Texas, Oregon, Washington, New Mexico and Utah, among others. Vacuum sewers have been installed in rocky, mountainous areas, arid regions and flatlands. Vacuum sewers are a great option anywhere, especially places where high groundwater exists.

In this article, we'll examine installations in two western states that illustrate the functionality and efficiency of vacuum sewer technology.

VACUUM 101

Homeowners may not appreciate the many benefits of vacuum sewers, however, public works directors certainly do.

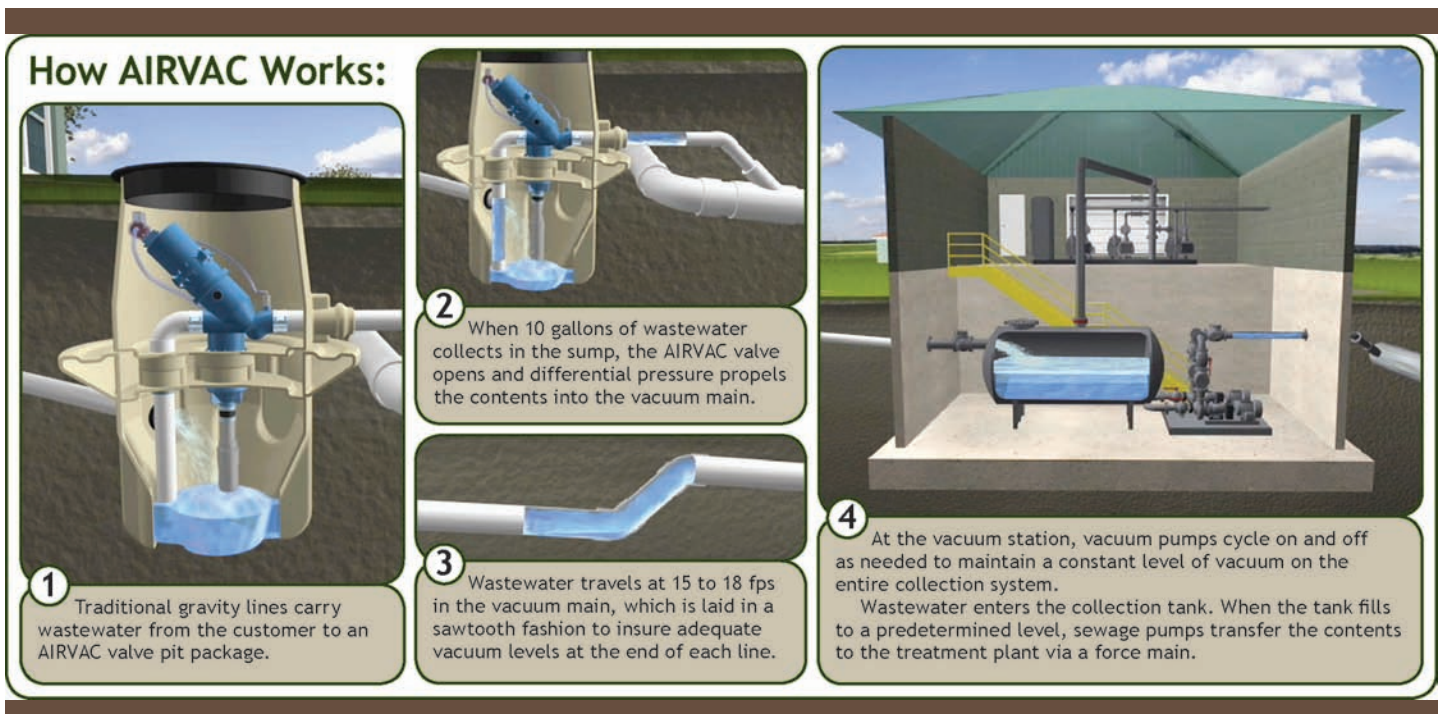
To the homeowner, a vacuum sewer system is like any other sewer; wastewater leaves the home and is transported elsewhere for treatment. Unless there is a problem, they probably won't even think about their sewer.

One of the biggest differences for the public works director is the fact that there will be fewer complaints from their customers. That's because vacuum sewers are extremely reliable, require little maintenance, are completely contained so there is no odor, are environmentally friendly and, in some cases, cost less to install and maintain than gravity or low-pressure grinder systems.

"Vacuum sewers offer some significant benefits to the city and the taxpayer," said Dave Molden of AIRVAC, Inc., a world leader in vacuum sewer technology. "In addition to the capital cost savings and low annual maintenance costs, they also offer many environmental benefits to a community, including reduced impact from construction, less operator hazard and energy savings. Plus, the system is completely contained so there is very little chance of polluting the environment."

For the homeowner, a vacuum sewer system works like any other sewer system. Gravity lines carry wastewater from the home to a buried valve pit that is typically located near the street. A vacuum valve located inside the valve pit operates pneumatically and requires no electricity. When 10 gallons of wastewater accumulate in the valve pit, the patented valve opens and differential air pressure propels the contents into the vacuum main.

The wastewater slug travels through the buried vacuum line at speeds up to 18 feet per second, scouring the line along the way. Negative pressure in the collection line is maintained by vacuum pumps (photo next page) located at the vacuum



station. The vacuum station is typically a small building that looks much like the surrounding architecture (see page 14). At the vacuum station, wastewater empties into a collection tank. When liquid in the tank reaches a specified level, wastewater pumps activate and transfer the contents into the force main and on to the treatment plant.

The vacuum sewer system is completely self-contained.



Negative pressure in the collection line is maintained by vacuum pumps located at the vacuum station.

ranches that used to dot the countryside. Most of the homes were beyond the reach of the city's services, so the families there relied on septic tanks and well water.

Over time, a number of these septic systems began to fail, increasing the amount of sewer discharge that was polluting the valley's groundwater. By 1990, the situation had become serious. The need to install a sewer collection system was obvious, however the area's high groundwater made trench digging a difficult and expensive project.

In 1993, work began on a new vacuum sewer system for Bernalillo County. Vacuum sewers were easier to install because the collection lines could be placed in shallow trenches, only four to six feet deep. There was no need for deep-trench excavation or dewatering.

"The cost of installing the vacuum sewer system is much lower in this type of flat topography," explained Bob Paulette, P.E., an engineer with Wilson & Company who worked on Albuquerque's vacuum sewer project for 10 years. "You avoid all the issues and costs associated with deep trench excavation. There is also the fact that we can serve about 1,000 homes with a single vacuum station, as opposed to about 15 lift stations to serve the

Wastewater can't escape and groundwater can't enter the collection network. There is no odor and maintenance crews almost never come in contact with raw wastewater. The system is easy to install, easy to maintain and very dependable. The oldest vacuum systems in service in the United States are now more than 30 years old and still going strong.

ALBUQUERQUE, NEW MEXICO

Albuquerque is a picturesque city astride the Rio Grande River and bordered by the Sandia Mountain Range. The city's natural beauty led to significant population growth in the unincorporated areas of Bernalillo County. Small communities replaced the farms and



An AIRVAC valve pit operates pneumatically, no electricity is required. When the wastewater reaches a predetermined amount, it discharges into the vacuum main and sent to the vacuum station. (Albuquerque, NM installation)



Shallow trenches and lightweight PVC pipe make installation fast and less disruptive.

Great Salt Lake and within a few miles of the Wasatch Mountains. It was much like many western settlements – friendly neighbors, plenty of space and limited local infrastructure.

Hooper began to change in the 1990s as the nearby cities of Ogden and Salt Lake City expanded into the area. What was once a loose collection of farmhouses, separated by acreage, became a small town. Between 1990 and 2000, Hooper's population grew by 17 percent, from about 3,400 to more than 4,000. It incorporated as a city in 2000. Today, there are more than 5,600 (2008) people living in Hooper, and the town continues to grow.

When it incorporated in 2000, Hooper immediately became the largest unsewered city in Utah. At the time, almost all Hooper residents were relying on septic tanks and drain fields for wastewater treatment. A study conducted by the Weber-Morgan (counties) Board of Health in 2001 raised significant concerns about the amount of wastewater and gray water that was entering the groundwater supply.

Hooper clearly needed a municipal sewer system, however, designing and installing it would be far from routine. Although Hooper is typical in many ways to other small towns, it is unique in both geography and geology. The community sits on what is essentially a peninsula in the Great Salt Lake, surrounded on three sides by wetlands. The terrain is extremely flat and the water table is high. Their situation is much like that of low-lying coastal communities; flat ground with water just below the surface.

same number of homes with a gravity system. Station maintenance alone is a big savings."

Vacuum sewer technology also provides an important ancillary benefit to the engineers. Vacuum collection lines do not leak, so if the line is cracked or punctured, negative pressure within the line prevents wastewater from escaping and polluting the environment. This made it possible for the city to obtain permission from New Mexico's environmental authorities to install the lines next to potable water pipes. There was little trenching and fewer easement issues.

Now, more than 15 years after the initial installation, Albuquerque has eliminated one of its major sources of groundwater pollution and the system is being expanded into additional neighborhoods.

HOOPER, UTAH

For more than 150 years, Hooper, Utah, was a small, unremarkable, rural community near the eastern shore of the

Given their geographic situation, it quickly became obvious that gravity sewers would be very expensive and disruptive to install. Tracy Allen, P.E., of J.U.B. Engineers, Inc. (consulting engineers for the City of Hooper) and his team

chose vacuum sewer technology. Because the vacuum collection mains do not require a continual downgrade slope like gravity mains, they can be buried in shallower trenches, usually 4-6 feet in depth. The vacuum collection mains are also smaller in diameter. This means faster installation, less heavy equipment and no dewatering or trench boxes.

Hooper can expect more growth in the coming years because the city now has a modern sewer system that is cost effective and reliable. Property values are already increasing and that is a good sign for Hooper's homeowners and business leaders.

NATIONWIDE

Civil engineers across the country are learning that vacuum technology is a great solution anywhere groundwater is high or there are difficult installation issues. Vacuum sewers are environmentally sound, cost effective and easy to maintain – and you don't have to live in a coastal area to get the benefits of vacuum sewers. ❖



AIRVAC vacuum mains have a "sawtooth" profile that helps maintain negative pressure within the pipeline and allows for shallow burial depths, typically 4-6 feet deep.