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A newsletter to apprise you of operational issues

Replacing or augmenting your gravity sewer system with low pressure sewers may make operations more economical

By Richard P. Michael, P.E., Vice President

Until 30 or 40 years ago, the only means of collecting wastewater was through gravity sewers coupled with high pressure force mains. Today, alternative systems offer economical solutions to difficult wastewater collection challenges. Among the more commonly implemented of these technologies are low pressure sewers.

Low pressure sewers

Low pressure sewers use pumps to move wastewater through pipes as small as 1½ inches in diameter to a common collection point. These sewers are designed to operate at 15 pounds per square inch, although topography may require higher pressures. The low pressures allow the use of one-third to one-half horsepower pumps at each wastewater source to force the flow to its destination. The cost of pumps varies, but generally the capital investment is less than $500 per unit.

Two types of low pressure sewer systems are in use today: grinder pump systems and septic tank effluent pump (STEP) systems. Both offer many advantages.

Installing low pressure sewers in Charlotte County, Florida.

Grinder pump systems

As the name implies, grinder pumps grind wastewater solids into bits that can pass through 1½-inch-diameter pipe. All of the solids and their associated biochemical oxygen demand (BOD) are pumped to the wastewater treatment facility.

In grinder pump systems that serve residential neighborhoods, household wastewater is collected in a fiberglass container (typically 3' x 5' in size). These collection chambers can be installed in basements or in the yard, depending on site conditions and the local plumbing code. The pipe leaving the pump and the collection pipes are sized to create at least two feet per second velocity when the pumps are operating. Pipes range in size from 1½ inches to 4 inches in diameter.

The grinder pump system is arranged in a branch fashion with only one way for the wastewater to travel enroute to a pumping station or treatment plant. Great care must be taken to ensure adequate flow velocities during the life of the system. Maintaining velocities in new neighborhoods that are less than 50 percent built-out can be a problem. One way to overcome the problem is to install flushing connections in the larger pipes to allow maintenance crews to discharge high volumes of water into the system periodically. Installing double check valves at each residential unit is important to prevent accidental discharge of flushing water into home systems.

STEP systems

The septic tank effluent pump system functions with a conventional septic tank. No grinding is necessary because the large solids have been settled in the tank. The STEP system has more flexibility, but re-

Low pressure system advantages

Lower installation cost (as much as 30 percent less than the cost of gravity sewers)

Possible directional drill installation

No manholes

Expandable without concern for surface grades

STEP system:

Lower BOD and suspended solids (typically half of raw wastewater)

Flows equally well uphill as down

Can be installed where septic tank/leach fields exist with minimum disruption of neighborhood

No infiltration

Disadvantages

Maintenance of pumps (replace every five to seven years)

Wastewater ages in pipes and septic tanks

Odor control may be necessary at pumping station and wastewater treatment plant

STEP system:

Septic tank must be pumped

Deterioration of gravity system downstream of low pressure system due to hydrogen sulfide release

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quires the installation of a septic tank and pump at each residence.

The pipes that carry the wastewater can be of any practical size because little or no solids remain in the waste after passing through a septic tank. For example in Florida, where housing construction continues at a rapid pace, Charlotte County Utilities has standardized on 1 ½ inch pipes from the effluent pump to the street main and 4- or 6-inch pipes throughout the remainder of the low pressure collection system. STEP systems have been in operation there since 1975. Today, more than 200 miles of low pressure sewers have been installed in Charlotte County. A STEP system was selected due to the presence of shallow rock and groundwater, and flat terrain. Gravity sewers become deep after just 2,000 feet of pipe when there is no surface elevation change. Charlotte County owns and maintains the septic tanks, pumps, and all of the pipe in the rights-of-way.

Unlike the grinder pump collection system, the STEP collection system can be constructed much like a water distribution system. Low system heads are maintained over a wide range of flow conditions due to the multiple paths the wastewater will travel. In addition, large tracts of land with initial low densities can be served without intermediate booster stations. Attachment points for future high pressure pumping stations are constructed; however, they need not be built until system pressures approach the capable head of the residential pumps.

Both types of low pressure systems are constructed of PVC or polyethylene pipe. Pipe restraints or restraining blocks are necessary at all valves and bend fittings, however, fittings can often be avoided due to the small bending radius of 4-inch or smaller diameter pipe. In warm climates, the pipe can be laid at a depth of 30 inches. Cold climate installation requires burial below the frost line. Where soil conditions allow, directional drilling of polyethylene pipe has proven cost-effective. This construction method is useful when a collection system is installed in an older neighborhood with driveways and established landscaping.

Avoiding the pitfalls

The pitfalls for low pressure sewers are not difficult to avoid when you are aware of them. The following examples cite common problems and their solutions:

- Solids settling in pipes before all users are connected to the system can be removed by flushing the pipes (grinder pump system).
- Separation of unrestrained pipe, especially at the ends of directional drill pipes, can be avoided by the use of pipe restraints.
- Pump failures due to lack of scheduled maintenance can be avoided by having a community operated maintenance program.
- Septic tank solids entering the low pressure system can be reduced by scheduled septic tank solids removal (STEP system).
- Odor from stale wastewater can be reduced by discharging low pressure sewers into master pumping station wet wells below the low water level.
- Enforcement of maintenance requirements, if septic tank and/or pump is privately owned can be eliminated by having the utility own and maintain the septic tank and pump. This service is funded through utility bills.

Low pressure sewers probably will never replace gravity sewers as the predominant means of moving wastes to a central location for treatment. However, their flexibility of construction and lower capital costs make them an appealing choice in certain circumstances. The decision for their use will depend on site conditions and economic factors.

For more information about low pressure sewer systems, contact Richard P. Michael, P.E., in Dufresne-Henry's Port Charlotte, Florida office at 941-627-3366 or send e-mail to rmichael@dufresne-henry.com.

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