By Stephen P. Dix, P.E.

Onsite Wastewater Treatment:

A Technological and Management Revolution: Part 1

The onsite wastewater industry is alive with new technology and research findings that challenge many traditional strategies and policies. With more than 37 percent of new development in the United States utilizing onsite septic systems, everyone involved in the industry is working to keep up with the latest advances in septic system design, product innovations and management strategies. Innovation is affecting everything from low flush toilets to septic tank filters and even soil absorption system sizing.

Significant household product innovations during the last decade have led to improvements in onsite wastewater management systems. More efficient fixtures in the home including low-flow toilets, dishwashers, washing machines and showers are being designed for the mass market. While some of the home technology innovations are good natural resource conservation, others may actually be at the expense of the septic system. Anti-bacterial soaps, higher concentrations of bleach in washing detergent, water-soluble salad oils, luxury Jacuzzi tubs and backwash from water treatment systems are negative forces in the onsite wastewater treatment process. Lifestyle changes also challenge the system with working parents finding little time other than weekends to do all their laundry.

Increased training for industry professionals, environmentally sound regulation, and improved system installation and professional operation of more advanced systems have led the way toward more positive installation control. Some states have required contractors and regulators to take exams and become "certified" to improve quality on installations. Regulators also have increased the frequency of inspections during the construction of more advanced systems. Additionally, manufacturers have provided more detailed explicit installation instructions to assist installers in the field.

The greatest advances in the industry have come from new septic system products. These include several types of pretreatment devices, improved septic tank designs and septic tank filters that now are required in many areas. Better system management also has come to the forefront. New monitoring devices can electronically measure the solids grease layer and water levels in the tank with modems reporting on a preset schedule to solids management contractors or a management authority. Smart pump systems track flows and unusual environmental conditions and even effluent quality can be checked remotely via phone modem.

Enhancements to the Septic Tank

Enhancements to the septic tank that aid in processing waste and improve environmental performance are being developed every day. The focus here is on new technology that allows for the enhanced treatment of effluent before it leaves the tank.

Filters

The addition of filters to a septic tank can play two roles: improved effluent quality and forced maintenance. Filters are being used on individual systems and extensively with effluent sewers. Filters are physical devices that trap solids particles and protect downstream components from potentially debilitating a pump or distribution system. Many units fit inside a common four-inch outlet baffle. Larger units are specified for commercial applications. They have greater surface area and storage and longer operating times. Ideally, a filter should operate for three to five years, or for the period between tank inspections.

One of the concerns with filters is premature clogging and effluent backup. To overcome this concern, one manufacturer added a level sensor that will warn the homeowner of high flow rates before it becomes a serious concern. Many states

Construction of the Jackson Lake State Park in Colorado was begun in 1994.

now require filters and the industry is now manufacturing filters of various shapes and sizes. The National Sanitation Foundation also has a certification program that provides a minimum standard for structural integrity and hydraulic performance. Given the dynamics of septic tanks, the performance seems to vary with the greatest benefit demonstrated when a tank is "upset" or seriously overloaded. A consensus on how well septic tank filters work and whether they improve tank operation has not been reached. More research is needed to quantify the value of filters in the overall treatment process.

The Filters' Role in Maintenance and Management of the Septic Tank

Effluent quality is not the major reason for requiring filters on septic tanks. Filters, if sized properly, can serve as a forced maintenance tool rather than just a treatment mechanism. Today, very few communities require regular septic tank inspection. Leaving the responsibility to the homeowner results in delayed management. In a majority of cases, the pumper is not called until there is a problem. A clogged filter will result in reduced discharge and often a backup of effluent in the tank or even into the house. This is an early warning to the homeowner of the potential for tank overload and the need to call a septic professional. By requiring filters as an integral part of an onsite wastewater management system, timely maintenance can be ensured before the leachfield is adversely affected with excessive solids.

D-Box Renaissance

Innovations in d-box design address the settling problems that have plagued the d-box over time. D-boxes are preferred for communities with level lots that manage septic systems via operating permits or inspection at the time of sale. This is the case in Massachusetts where the state requires a complete evaluation and certification that the system meets the current state requirements at the time of property transfer. D-boxes are an essential element of this code and generally provide greater control of the dispersion and evaluation of the absorption system.

Zoeller's new plastic box allows the system manager to "tune up" the box by adjusting an internal leveling device. This process can be done from the surface, making it easy to clean and adjust the levels. While this device has yet to be certified, it offers a significant advancement in the art of effluent distribution. States such as New York that require d-boxes even on sloping sites would find this improved splitting device a quick problem solver for homes plagued by uneven distribution and overloaded weeping trenches. Outlet controls such as a Dial-a-flow or Speed Levelers are even better. Adding this control to the d-box outlet pipes on a system can give the manager the option of resting the overloaded trench.

Serial Loading with Outlet Controls

Plastic d-boxes are becoming more common, replacing the larger concrete

The construction of the evapotranspiration bed includes wicking sand placement over the chambers using a lightweight track machine.

boxes. They come in a wide variety of shapes and sizes with risers that bring them closer to the surface for ease of inspection. For sloping sites, serial loading is normal. Advances in outlet controls such as dial-a-flow are used in conjunction with chambers.

Chamber technology is an advancement in pretreatment in the serial systems. Unlike the old stone-age systems, chambers follow the engineering principles for plug flow used by sanitary engineers designing the municipal treatment process. The long, high-volume units operate like a very long sedimentation tank. They are actually much better than a third compartment if added to a septic tank. A 100-foot High Capacity Infiltrator® chamber holds about 1,600 gallons. This is 50 percent more than a standard septic tank. For an average family of four, the effluent will be retained for about eight days. This is not the case for gravel-filled trenches that typically short circuit the effluent onto the next line via the four-inch pipe.

Leachfield Systems

Leachfield design and product innovations are constantly being developed. Advances in chamber technology and tailored applications for difficult sites aimed at enhancing septic leachfield performance are a focus of engineers, designers and researchers throughout the onsite wastewater management industry.

The measuring stick by which all leaching systems traditionally have been compared has been the stone trench. However, the shortcomings of stone in the leachfield have been well documented. Stone can reduce permeability by soil compaction from stone becoming embedded in the soil matrix, the presence of fines blocking pore entries and the effects of "stone shadowing." Stone also significantly reduces storage and will not prevent the intrusion of fine soil particles from the sidewalls during rainfall events.

Chambers have gained favor with regulators because they give the site inspector uniformity in all dimensions. When viewing the installed chambers prior to backfilling, the regulator can be assured of a level trench bottom and uniform trench width, length and height. Concerns over depth of stone in the trench, stone quality and fine content are eliminated. Regulators also have favored the lightweight plastic chambers because they can be certain that the contractor has kept site disturbance to a minimum including the compaction of soils caused by heavy equipment hauling and the installation of stone.

▲ Pressure tests were conducted on the polishing filter distribution network prior to placement of chambers.

Chamber systems continue to evolve as they are combined with other current technology to better protect the environment. Research and documented system trials and peer-reviewed, published papers support chamber system sizing and water quality protection with space saving soil absorption systems. An estimated 600,000 home septic systems utilize chambers with up to 12,000 homes per month installing chamber technology. Today, plastic chambers are manufactured by four different companies and have become widely accepted by installers, designers and regulators.

▲ During pressure testing, chambers disperse the effluent, transforming the high-pressure jets into a fine mist that will ensure unsaturated flow through the naturally sand media.

Part 2 of this article offers scientific validation for chamber systems in leachfields and discusses management issues and strategies as well as the future of the industry.

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For more information on this subject,