Decentralised Wastewater Treatment with Chambers

By Dennis Hallahan

Shot of infiltrator chamber bed on lake in Canada (8 rows of chambers) Plastic leachfield chambers are used at this hunting and fishing park in Canada. This is an ideal onsite system, needing to handle large amounts of wastewater during busy seasons.

Introduction

The need of new approaches for wastewater management and environmental demands worldwide is challenging product manufacturers to develop advanced technology. Scientists, engineers and regulators are exploring innovative ways of testing new approaches and thinking about how to accomplish and manage decentralised wastewater treatment.

Another catalyst is a barrage of new health codes that regulate decentralised wastewater system design and installation. Growing awareness of nutrient loadings to the environment from nitrogen and phosphorus, aquifer protection, and the value of water as a resource have come to the forefront. These codes continue to be amended to preserve and protect public health and natural resources. Each year, decentralised systems discharge billions of gallons of wastewater. Home and business owners, regulators, and the community at large depend on these systems to do one specific thing for them - work. In fact, everyone involved, from an individual to the government, use and depend on these hidden systems to perform for periods of 20-30yrs with just routine maintenance and inspection.

The explanations of "working well" and "must perform" do not stop with simply discharging wastewater to the soil for treatment for all those years. These systems must maintain their structural integrity and storage capacity in order to function for the long term. Companies that manufacture integral components for these systems (tanks, distribution boxes, leachfield chambers, piping) design and engineer each component to last numerous years under various conditions for the best possible performance and structural integrity.

To reclaim wastewater, it is necessary for the designer to consider the wastewater treatment system and treated wastewater disposal system.

Ongoing Debate: Sewered vs Unsewered

The traditional centralised approach for water use and wastewater treatment involves extracting water, treating it, and sending it out through a potable water distribution system. Once the water is used, it is delivered back through a collection system to a treatment plant. The treated water is then discharged into a river where it is carried downstream. This treated and discharged water can add more pollutants to our already impaired waters and it is not returned to our underground aquifers. With a centralised approach, each dwelling or business in a development that goes on the sewer line exhausts more water resources. Due to transporting and collecting water, wastewater over vast distances, centralised approach is also energy intensive leading to a greater carbon footprint.

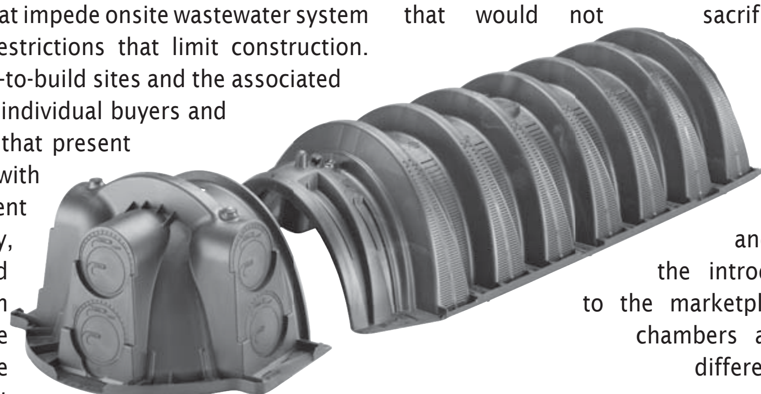
A decentralised approach to wastewater treatment provides a sustainable water use model. We can extract groundwater, consume it, treat the wastewater onsite and return it close to its point of origin to recharge the aquifer. The low energy requirements yield a lower carbon footprint compared to centralised systems. New decentralised wastewater treatment technologies that use natural approaches are less land intensive and provide suitable long-term treatment and are leading to better development practices. Due to the performance data now available that makes these systems increasingly popular with health officials, the new onsite wastewater strategies and alternative methods of treatment are often the only solution for engineers and developers to obtain a code-compliant system. This is particularly true on sites with difficult soils and tough terrain. The same scenario also applies to large recreational and commercial developments in environmentally sensitive areas where a combination of technologies must also be considered.

Factors that impact a site and cause it to be environmentally challenging include available space for treatment systems, soil conditions, proximity to bodies of water or environmental preserves, physical barriers that impede onsite wastewater system construction or regulatory restrictions that limit construction. The ongoing shortage of easy-to-build sites and the associated escalating prices are causing individual buyers and developers to purchase land that present construction challenges with onsite wastewater treatment and disposal. Additionally, regulations for decentralised wastewater treatment system sizing and construction have changed to accommodate challenging development conditions. In last 30 years, codes have recognised higher throughput rates of aggregate-free products with septic tank effluent, many codes now include the sizing of the leachfield based upon the level of treatment provided. Advanced treatment of wastewater allows higher acceptance rates by the soil.

To make responsible changes, regulators have to consider current research findings and integrate those findings into leachfield sizing and construction regulations. Historically, regulations for conventional stone and pipe leachfields were developed based less on science and more on a trial-and-error process. Many regulators are now reviewing the available scientific research findings and third-party testing data and reexamining onsite policy accordingly. This has resulted in a shift away from older onsite system designs to the approval of new technology and advanced applications for both treatment and disposal of wastewater. With the regulatory shifts have come further innovations in onsite wastewater systems, providing a dramatic increase in the number of options available. In combination with the shift to new technologies, regulators are revising codes that in turn affect land use policies. Adjustments to these policies have and will continue to be made based on local development and environmental objectives and philosophies.

New Products & Applications to the Rescue

One of the greatest recent benefits of environmental sensitivity has been a new generation of products that enhance treatment, ease installation, and reduce management dilemmas. Over the past 30yrs, chambers have evolved dramatically in design and are now commonly used for onsite treatment in basic and advanced applications. The first chambers to be used commercially were constructed of concrete and installed in New England in the early 1970s. These initial concrete "gallery" chamber systems or "ameration chambers" were more efficient than previous traditional stone and pipe systems. They were heavy and unwieldy to transport, and labor intensive to install. It became clear that an alternative material was needed to manufacture chambers that would not sacrifice strength, durability, and treatment performance. The rapid advancement of plastics technology made plastic the next logical step in the evolution in chamber design. Several years of research and design culminated with the introduction of plastic chambers to the marketplace in 1987. Today, plastic chambers are manufactured by several different companies and have become widely accepted by installers, designers, and regulators in many countries.



Infiltrator introduced the plastic leachfield chamber to the onsite wastewater industry. Here is a Quick4 Equalizer 26 chamber with end caps from Infiltrator.

Plastic chambers offer tremendous benefits over their concrete predecessors and even greater benefits when compared to the older methods of installations involving stone and pipe trenches.

Emerging Applications

Chambers in Water Reuse Systems: A serious problem faces society as the demand for clean water begins to exceed the available supply. Treating and reusing wastewater is becoming an acceptable solution to this problem. In the absence of sewers, onsite wastewater treatment systems are being designed to allow high water usage facilities to reuse wastewater. The systems discharge to the subsurface thereby replenishing dwindling groundwater supplies, and the system designs incorporate treated wastewater as reuse for toilet flushing.

Barriers to Reuse: The barriers to reuse are many. A key factor is the lack of information and understanding by the general public and the regulatory and design communities. In the United States, the most significant obstacle to the acceptance of water reuse is the lasting impact of the Clean Water Act. This act focused the wastewater industry on big treatment works and sewer networks. Worldwide, replacing previously steady financial resources are grants of lesser amounts that must be paid back if they are available at all. At the same time, the advent of technological innovation allows small-scale treatment facilities to treat to a high standard while sophisticated new products allow more efficient disposal. The industry is undergoing a paradigm shift and realising that there are other, and even better, alternatives.

Classifications of Reused Water: Reuse of treated water relates to water that has been used for sanitary or industrial applications and then subjected to those treatment steps necessary to allow it to be reclaimed. Reuse can be classified as either indirect or direct. Indirect reuse occurs when water receives enough treatment to be discharged back into the ground to build up water table or prevent seawater encroachment. Direct reuse requires that the treated wastewater be transported directly to point of reuse. Treated or reclaimed wastewater is currently actively reused for many purposes including industrial and limited domestic applications. These include:

- Recharging groundwater by directly injecting the reclaimed water into the ground or allowing it to percolate using ponds or drainage fields
- Augmentation of surface waters used for recreational and drinking water sources
- Creating barriers to salt water intrusion into groundwater
- Agricultural use for irrigation of nursery stock and cropland
- Irrigation of golf courses, parks, residential properties, roadway medians, public gardens and landscaped areas
- Other uses like toilet flushing in large buildings & stadiums, car & truck washing, dust control and decorative fountains
- Fire fighting
- Cooling tower make up

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Other Advanced Systems using Chambers

There are many acceptable technologies available for advanced wastewater applications including tertiary systems that treat the effluent from conventional secondary systems and stand-alone advanced wastewater treatment systems. Nearly all of them require multiple steps to remove organics, nutrients and ensure disinfection. A combination of technologies is used to treat and

Install shot of guy in trench and backhoe behind him (close shot)
Plastic leachfield chambers offer ease of installation and versatility for both residential and commercial treatment of wastewater.

recycle the wastewater, which is often unique to the individual system and the requirements of state and local codes.

Biofilters: Chambers are also now being specified in biofilters. A biofilter is a bed of organic media that is used to remove objectionable odors from the air. According to Lew Naylor of Black and Veatch, chambers used in biofilters can improve air distribution through the media, provide more efficient drainage, increase media life, ease of construction of the biofilter, and simplify media replacement.

Remediation Site Clean Up: Environmental clean up sites have many treatment schemes, one of which is known as "pump and treat". In this, contaminated groundwater is pumped to the surface, treated, and then discharged subsurface to recharge groundwater levels and maintain flow patterns. Engineers have determined that if chambers are installed as the recharge solution the concerns regarding the adverse affect of fines can be minimised.

Wastewater Treatment Facilities: A great example of use of chambers in municipal applications is in extending the life of municipal wastewater treatment facilities, and providing effective treatment in community-wide wastewater treatment systems.

Performance Testing and Predictive Tools Increase in Importance

Clemson University In-Situ Volume Measurement Study: Testing in the actual situation a system will be expected to perform is integral to obtaining true, accurate results. This in situ testing allows real world conditions to be replicated. A 2004 field study by the Clemson University Department of Entomology, Soils, and Plant Sciences measured the in-situ liquid storage capacities of chambers, multi-pipe systems, and synthetic aggregate bundles, as compared to a conventional, 36-inch-wide, 14-inch-high stone trench. The study showed substantial differences in storage capacity between manufactured drainfield products and the stone trench. Included in the study were plastic leaching chambers (many sizes) widely used in the US and Canada, stone and pipe trench, multi-pipe systems, and synthetic aggregate bundles. Figure 1 shows storage capacities for the products tested.

In the study, the Infiltrator chamber products tested provided a storage capacity that exceeded the storage capacity of a comparable width stone trench. ISI's Standard chamber models, designed for installation in a 36-inch-wide trench, provided more than two times the storage of a 36-inch-wide stone trench at the inlet pipe invert height. ISI's Equalizer® 36 chamber model, designed for installation in a 24-inch-wide trench, provided a total storage capacity equal to a 36-inch-wide stone trench at the inlet pipe invert height. The Equalizer 24 chamber is intended to

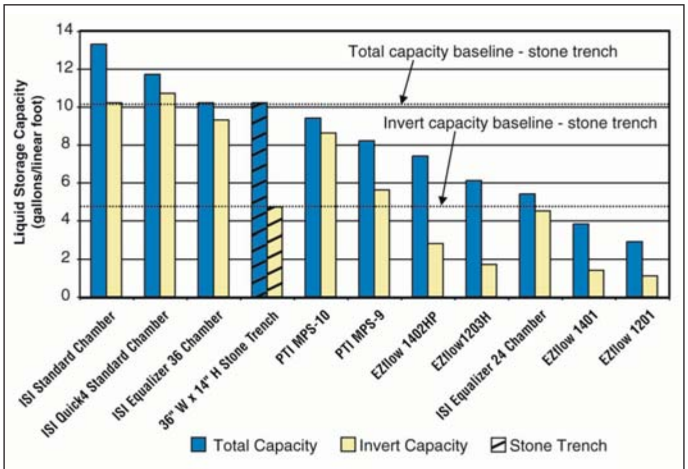

Figure1: Total and Inlet Pipe Invert Storage Capacity

be compared to a 2ft wide stone trench so it is not an apples-to-apples comparison to include it with the 3ft wide trench products. The results provide a practical tool for the designer to select a product that can address storage capacity. This offers a larger factor of safety during peak flow events to the homeowner (or commercial facility) when chambers are employed for design.

Conclusion

As the need to develop areas away from sewers increases, there has been much progress in the development and the acceptance of advanced onsite systems and the science behind these technological advances. Most regulatory bodies including local health departments have created or revised regulations that accommodate advanced onsite systems. The introduction of chamber technology over 30yrs ago was a revolutionary step in the increased effectiveness and acceptance of standard and advanced onsite systems. The benefits of chambers are becoming recognised by many disciplines to solve a myriad of problems. Community systems have benefited with the increased storage capacity, sand filter performance has been improved by better distribution coverage, and wetland treatment systems reliability has been enhanced. In the future, we will surely see many new system designs and advanced treatment options developed in response to changing environmental and economical needs. As regulators, designers and engineers are challenged to create innovative solutions to the world's wastewater problems, chambers will continue to be in the forefront of those solutions.

About the Author

Dennis Hallahan is working as Technical Director for Infiltrator Systems Inc. He has over twenty years of experience with on-site wastewater treatment systems design and construction. He has authored several articles for on-site industry magazines and has given numerous presentations nationally on the science and fundamentals of on-site wastewater treatment systems. Dennis also holds patents for on-site wastewater products.

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