World Water

Chambers transforming decentralised treatment

The need for onsite wastewater treatment (WWT) in North America has been driven by high land prices and environmental regulation. ***Dennis F Hallahan****, technical director of US WWT specialist Infiltrator Systems explains how innovations in the technology make it suitable for a wide range of applications.*

The onsite WWT industry in the US has evolved dramatically over the past 15 years, spurring the need for new approaches to decentralised applications. Along with tightening environmental regulations, rising urban land costs have challenged scientists, engineers, regulators and product manufacturers to develop new ways of managing wastewater.

The relative ease or difficulty of onsite development can be a function of the standards by which onsite wastewater systems are sized and constructed. If regulations can keep pace with scientific and technological developments, historical constraints on single-family home construction can be responsibly amended or reduced through adjustments to regulations.

Adjustments to regulations may include approving new treatment and disposal system technologies, for example, leachfield products, such as plastic leaching chambers, which provide a more efficient means of delivering wastewater to the subsurface.

Historically, regulations for conventional stone and pipe leachfields were 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.

With the regulatory shifts have come further innovations in onsite wastewater systems, providing a dramatic increase in the number of options available.

Innovative projects

Installers are relying on advanced systems and technological innovations to maintain their business. Where repair work is an installer's mainstay, chamber systems and advanced treatment options can provide a means for upgrading a failing system by using reduced space and with minimal site impact.

It is increasingly difficult to find quality building lots for development, so engineers and designers are moving toward innovative, space-saving and flexible technologies that can be easily adapted to site conditions. For example, an articulating chamber product can be installed at a reduced size and contoured to match the available landscape.

Chambers

Over the past 30 years, 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 in the US were installed in New England in the early 1970s.

These concrete ameration chambers were more efficient than previous traditional stone and pipe systems. However, they were heavy and unwieldy to transport, and labour-intensive to install.

The rapid advancement of plastics technology made plastic the next logical step in the evolution in chamber design and plastic chambers were introduced in 1987. It is estimated that one-in-four wastewater treatment systems constructed in the US today is a chamber system.

While the principals of treatment remain the same, plastic chambers offer tremendous benefits over their concrete predecessors and even greater benefits when compared with the older methods of installations that involved stone and pipe trenches. In addition to the traditional use in septic system leaching trenches and beds, chambers have been used in sand filters, mound systems, ET beds, community (cluster) systems, constructed wetlands, large-scale wastewater treatment plants, with pretreatment devices, and even on toxic waste remediation sites.

New chamber designs offer even more flexibility in system design and installation and provide enhanced onsite wastewater system treatment. In actuality, plastic chambers are going through their fourth generation of evolution with the most current design one that offers maximum flexibility in installation, while retaining the highest levels of infiltration possible.

Manufacturers have listened to their customers and the feedback over many years from contractors, regulators and designers. Improvements now allow the chamber to articulate at each joint, they are easier to handle, install and transport, and are less prone to soil intrusion.

In the future we will see many new system designs and advanced treatment options developed in response to changing environmental and economic needs. Chambers will be at the forefront of innovative solutions to the world's wastewater problems.

A community cluster system at Crescent Bar, a resort community in Quincy, Washington. ***Image: Infiltrator***

The Fields of St Croix wetland system being installed at Lake Elmo, Minnesota. ***Image: Infiltrator***

Advanced chamber system designs and applications

Community systems

Engineers designing large community systems specify chambers because of their large storage capacity and improved infiltration capacity. They also have more confidence in an engineered product rather than the unknown stone quality.

Commercial facilities can be subject to large peak flows that the chamber can readily retain. These decentralised cluster septic systems can serve multiple residential dwellings or commercial establishments.

They use technologically advanced filters, pumps, tank configurations, and chambers to provide a higher level of treatment. Decentralised cluster systems treat wastewater and return it to the ground very near to where the wastewater was generated as opposed to transporting it long distances to a centralised sewer facility.

The driving force behind this trend is the high cost of sewers and lack of quality land available nationwide. However, chamber systems do need a responsible management entity (RME) to operate and maintain the system.

Sand filters

Sand filters have been designed using the benefits of chamber technology. Chambers provide increased distribution coverage, allowing the effluent to be applied over the entire surface area of the bottom of the chamber. A sand filter is a type of packed-bed filter and newer packed-bed technologies consist of peat, textile, or foam media and are generally very reliable, providing stable treatment.

ET systems

Another common application for chambers is their use in ET systems. In the arid western regions of the US, systems have been specifically designed for ET. With these systems, people have had the misconception that the solid arch at the top of the chamber would inhibit ET.

However, upon investigation of the physics of water and air movement through soil, it can be understood that ET occurs with chambers for the same reasons it occurs in stone trenches. Once ponding occurs in the trench, the effluent will flow laterally out the trench sidewall, allowing capillary action in the soil to take place.

By capillary action, water is pulled upward in the soil matrix. The water then changes to vapour which allows it to move vertically through the soil pores to the atmosphere.

Wetland treatment systems

Natural wetlands have been used as convenient wastewater discharge sites for as long as sewage has been collected. Wetland treatment systems are typically used to polish wastewater, and are often designed as multi-function treatment and wildlife habitat systems.

These systems may be large commercial or community systems, or small wetland treatment cells serving an individual home. One of the most common types is the subsurface flow (SSF) constructed wetland.

Effluent is treated through shallow subsurface channels in which emergent plants are established. The treatment cells produce a high quality treated effluent that is required to be disposed to the subsurface.

Chambers have frequently been specified for the wetland cell and the subsurface disposal applications due to cost savings and chamber reliability as compared to older traditional construction options. In areas with sensitive soils, the ease and speed of installation and minimal construction traffic (less time to be exposed to rainstorms and construction machinery) can protect the structure of the soil and its infiltration capacity.

WWT facilities

A great example of the use of chambers in extending the life of WWT facilities is in Bayham, Ontario, at the Port Burwell Sewage Treatment Plant, where the outfall discharges to a creek in close proximity to Lake Erie. Expansion of the plant required a major upgrade to the outfall, but, since the creek could not assimilate the increase in minimum contaminants, an outfall to the lake was proposed.

After an extensive investigation of options, an onsite solution was recommended to convert the outfall to an exfiltration bed using chambers. The chamber system saved considerable cost and also provided additional phosphrous removal.

Biofilters

Chambers are also now being specified in odour-removing biofilters. Odorous air vented from compost facilities, rendering operations, and pumping stations can be passed through a biofilter, removing ammonia and reducing sulphur compounds such as mercaptans, amines, and VOCs.

Remediation site clean-up

Environmental clean-up sites have many treatment schemes, one of which is known as 'pump and treat' where contaminated groundwater is pumped to the surface, treated and recharged into groundwater levels to maintain flow patterns. The size of the recharge bed is determined by the infiltration rate of the soil and the quantity of flow.

Previous methods of recharging groundwater included stone beds, however, the fines associated with stone can have a significant adverse affect on the infiltration rate, thereby increasing the size of the recharge bed. Engineers have determined that, if chambers are installed as the recharge solution, the concerns regarding the adverse affect of fines can be minimised.

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The wetland system at the Fields of St Croix after completion. *Image: Infiltrator*

The installation of chambers at the Port Burwell Sewage Treatment Plant in Ontario. *Image: Infiltrator*