Phosphorus Reduction Potential of Modified Onsite Wastewater Treatment Systems

A study sponsored by the U.S. Environmental Protection Agency's Chesapeake Bay Program to determine appropriate technologies to achieve a net reduction in end-of-pipe performance standard for phosphorus. These standards support the 1987 Chesapeake Bay Agreement strategy to reduce the amount of phosphorus entering the Bay by 40% by the year 2000.

The Problem

Excess phosphorus (P) entering the Chesapeake Bay can create significant water quality problems and is causing millions of dollars of damage and lost revenue annually. Phosphorus pollution can also degrade groundwater, and can contribute to adverse health effects in drinking water. While phosphorus pollution may come from many sources, individual septic systems can be a significant contributor.

In 2009 the Maryland Department of Environment (MDE) established a requirement that all new residential onsite wastewater treatment systems employ approved "best available technologies (BAT)."

Phosphorus Reducing Technologies

The wastewater treatment system examined in this study used a multi-compartment septic tank, plastic media, aeration and recirculation. The effluent was then discharged into an expanded shale drainfield.

Drainfields using expanded shale, or other medium, are effective phosphorus traps, or means of reducing phosphorus levels as part of advanced onsite wastewater treatment systems. They facilitate phosphorus removal via precipitation, adsorption and biological assimilation. Their use offers a promising low cost, relatively low maintenance, appropriate technology in many wastewater treatment situations.

The monitoring program deployed in this study determined that over a year's time this engineered system achieved phosphorus reductions of 89%.

Background

For one year, a residential onsite wastewater treatment system was monitored for its effectiveness in reducing phosphorus. The original system was modified by replacing a failed single compartment septic tank with a multi-compartment tank. A plastic media filter was added and aeration was achieved by recirculating a portion of the wastewater back into the first chamber of the tank, and once again through the media filter, prior to being discharged from the tank. The effluent then enters an expanded shale bed dispersal area constructed with a low pressure pipe (LPP) distribution system to further reduce Phosphorus.

Composite samplers used in this study.

Objective

The primary objective of this study was to evaluate phosphorus reduction in an advanced onsite wastewater treatment system to determine if it achieved a net reduction in Phosphorus.

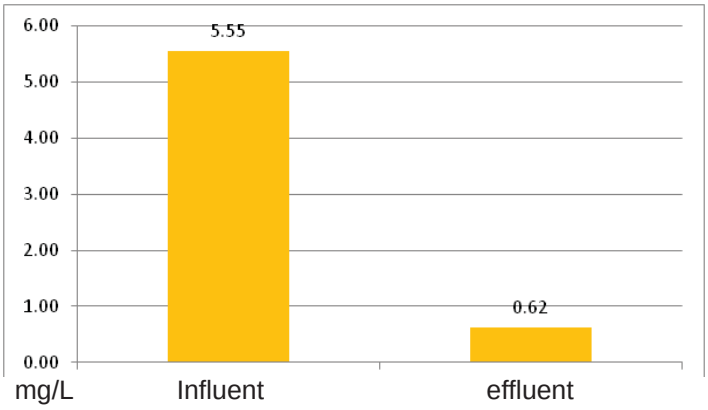
Methods

• Automatic composite samplers were set up to take samples from the influent tank port on the system's primary treatment component and effluent at the LPP distribution pipe end in the drainage bed.
• Samples were collected for a 24-hour period one day a week for one year.
• Sample analysis was performed at an EPA-certified laboratory.
• Samples were analyzed for Total Phosphorus (mg/L).

Results

Net phosphorus in the test system was reduced 89% with average phosphorus levels decreasing from 5.55 mg/L to 0.62 mg/L.

Low pressure distribution system in the expanded shale leach bed.



Average total phosphorus from influent and effluent

Operation and Maintenance

• These systems use a pump and blower which require approximately 86 Watts of electricity to operate.
• The system's tank should be pumped every 3 years for residences with 2-4 occupants.
• Systems should be routinely inspected twice a year to ensure recirculation is operating properly.
• Expanded shale drainfields have a limited effective lifespan so they need to be inspected annually and replaced if necessary.

Conclusions

• When the systems were operating properly, the technologies used in this study consistently and reliably reduced net phosphorus.
• Periodic maintenance is necessary to ensure systems are operating properly.
• Engineered systems using these technologies can significantly reduce phosphorus from residential wastewater thereby reducing the amount of phosphorus entering the Chesapeake Bay or groundwater.

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