Septic systems 101

Facts about subsurface sewage treatment systems

Subsurface sewage treatment systems (SSTS), commonly known as septic systems, are soil-based treatment systems used by homes and businesses that are not connected to municipal sewers. The systems treat and dispose of wastewater generated on-site. More than 500,000 septic systems are in use in Minnesota, which includes 30% of the state's households. Septic systems treat approximately 25% of wastewater generated in the state.

Wastewater contains sewage, which includes bacteria, viruses, parasites, nutrients, and some chemicals. Correctly treating and disposing of wastewater is critical to protecting public health and the environment. More than two-thirds of Minnesotans get their drinking water from groundwater, and poorly built or ill-functioning septic systems can contaminate groundwater and other water resources. When constructed and maintained properly, septic systems are highly effective at treating sewage and keeping Minnesota's groundwater, lakes, and rivers safe and clean.

How septic systems work

SSTS treat sewage with a combination of biological, physical, and chemical processes. A system's design must account for several factors:

- The amount of daily wastewater generated on site
- Using gravity or a pump for distribution
- The site's soil conditions
- The need for developing a biological layer (biomat)

A typical SSTS includes a septic tank and a soil-based treatment system where liquid waste can come in contact with soils.

The septic tank

Sewage is piped from a home or business into a buried, watertight septic tank, which is sized to retain wastewater for 24 to 36 hours. The time allows the wastewater to separate into three layers in the tank:

- Solids sink to the bottom
- Greases, fats, and soaps float to the top
- The remaining liquid (effluent) flows out to the drainfield for final treatment

Baffles in the tank at the inlet and outlet help prevent the top and bottom layers from moving to the drainfield, where they can clog distribution pipes and cause premature drainfield failure. Over time, these layers will accumulate, and must be pumped out of the tank at regular intervals.

Anaerobic bacteria (bacteria that doesn't need oxygen) in the tank begin the process of breaking down organic matter in the sewage. But microorganisms and pathogens remain. Research shows that effluent leaving the septic tank contains high counts of bacteria (about 1,000,000 colonies per 100 ml) that must be further treated in the soil.

The drainfield/soil treatment system

The effluent from the septic tank moves to the soil treatment system, such as a mound, trench, or at-grade drainfield. A trained SSTS professional must take soil types and other factors into account when designing the correct type of septic system for a specific site.

The effluent moves either by gravity or using a pump, through distribution pipes in the soil treatment system, and down through the distribution medium to its base where the distribution medium meets the underlying soil. That's where a sticky biological layer (biomat) forms. The biomat slows the infiltration of effluent into the underlying unsaturated soil, and further filters out pathogens and solids. The biomat can slow effluent movement to as much as 100 times less than its normal flow rate; this helps maximize the contact time between the effluent and the surrounding soil particles.

Soil particles are negatively charged. Through a process called adsorption, they attract and hold the positively charged pathogens in the effluent. Once held, the pathogens are easily available to the aerobic bacteria in the air pockets between the soil particles. The aerobic bacteria, which are much more efficient than the anaerobic bacteria in the septic tank, continue treatment. Other forms of bacteria also begin to grow, producing slimy films over the soil particles, which act as additional filters to "grab" pathogens.

It is important to properly site the SSTS with the existing soil conditions to ensure maximum treatment occurs. If the site is not optimal for treatment (e.g., it has a high seasonal water table), it won't offer effective soil treatment and the risk of contamination increases.

SSTS regulations in Minnesota

The 1968 Minnesota Shoreland Act required septic systems to be evaluated and managed properly within shoreland areas to better control their impact on water quality. But the first state law specifically addressing septic systems wasn't enacted until 1994: the Individual Sewage Treatment Systems (ISTS) Act (Minn. Stat. §§ 115.55 and 115.56). It requires all new construction and replacement septic systems to meet minimum standards. It also enacted a system to upgrade failing existing SSTS before construction of an additional bedroom, and methods to replace failing SSTS within certain timeframes. The 1994 act has been amended in recent years, with major changes in 1996 and 2008. Regulations will continue to be amended as the SSTS industry advances.

More information

Visit the Minnesota Pollution Control Agency website at http://www.pca.state.mn.us.