Minnesota Pollution Control Agency

Soil-Based Sewage Treatment Systems

Facts About Subsurface Sewage Treatment Systems

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Introduction

Subsurface SewageTreatment Systems (SSTSs) are commonly known as septic systems. They are soil-based treatment systems used by homes and businesses which are not connected to municipal sewer. SSTS were formerly called Individual Sewage Treatment Systems (ISTS). Even though their name has changed, their purpose has not; to treat and dispose of the wastewater generated on site each day by non-municipal homes and businesses.

The wastewater contains sewage, which in turn contains bacteria, viruses, parasites, nutrients and some chemicals. Therefore, proper treatment and disposal is necessary to minimize the potential for disease transmission and environmental contamination from the sewage.

How SSTSs treat sewage

SSTSs treat sewage through a combination of biological, physical and chemical processes. They are designed to account for the daily wastewater flow, the type of distribution system (gravity or pressure), soil conditions of the site, and need the development of a biological layer (a biomat) for proper wastewater treatment. When properly designed, constructed and maintained they provide a high degree of sewage treatment and are a proven method of controlling the negative environmental effects of untreated sewage.

A typical SSTS consists of a septic tank followed by one of many different types of a soil-based treatment system, such as a mound, trench or at-grade drainfield.

The septic tank

A buried, watertight septic tank is the first component of a SSTS. Sewage is piped from a home or business to the septic tank, which is sized to retain wastewater for 24 to 36 hours. This retention time allows three distinct layers to develop inside the tank:

- The heavier solids sink to the bottom.
- The lighter greases, fats, and soaps float to the top.
- The remaining middle layer (effluent) flows out to the drainfield for final treatment.
    - The amount of effluent that flows out to the drainfield will equal the amount that flows into the tank each day.

Baffles inside the tank at the inlet and outlet connections help prevent the heavier and lighter layers traveling to the drainfield, where they can clog the distribution pipes and cause premature drainfield failure. Over time, these heavier and lighter layers will accumulate, and must be removed at regular tank pumping intervals.

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Bacteria inside the tank begin the biological process of breaking down the organic matter in the sewage. The tank bacteria are anaerobic, meaning they do not need oxygen. Anaerobic processes provide some treatment, but are not as efficient as aerobic (with oxygen) processes.

The septic tank alone does not remove all the microorganisms and pathogens. Research results indicate that effluent leaving the septic tank contains high counts of bacteria (about 1,000,000 colonies per 100 ml). Therefore, the effluent must be further treated. In conventional SSTS, this occurs in the soil treatment system.

The soil treatment system

The effluent flows from the septic tank to the soil treatment system either by gravity or by being pumped. Once in the soil treatment system, the effluent moves through the distribution pipes across and down through the distribution medium to its base. Here, at the interface between the distribution medium and the underlying soil, a sticky biological layer (biomat) forms.

The biomat acts as a valve to slow the rate of effluent flow 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.

As an example: a gravity-fed trench SSTS with a mature biomat will frequently have ponded effluent in the trench while the soil a few inches outside of and below the trench will be unsaturated. This type of environment promotes effective effluent treatment by aerobic bacteria in the soil. If the soil has a limiting condition such as a high seasonal water table, known as a periodically saturated zone in the soil, effective soil treatment does not occur.

It is important to properly site the SSTS with the existing soil conditions to ensure maximum treatment occurs.

If the bottom of a SSTS is at or near the highest level of the periodically saturated zone in the soil, there will be a 'less aerobic' condition in the soil. This situation reduces the treatment effectiveness and increases risk of contamination. Also, being at or near the periodically saturated zone allows pathogens to move quickly through the soil without being adsorbed or filtered, thus polluting the shallow ground water. The shallow ground water can then infiltrate into deeper aquifers, contaminating wells or discharging into lakes and streams, where the public can come into contact with disease-causing organisms.

More information

For additional SSTS information, please visit our Web site at http://www.pca.state.mn.us/programs/ists/ or call us at 651-296-6300, toll free 800-657-3864.