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Onsite wastewater treatment systems

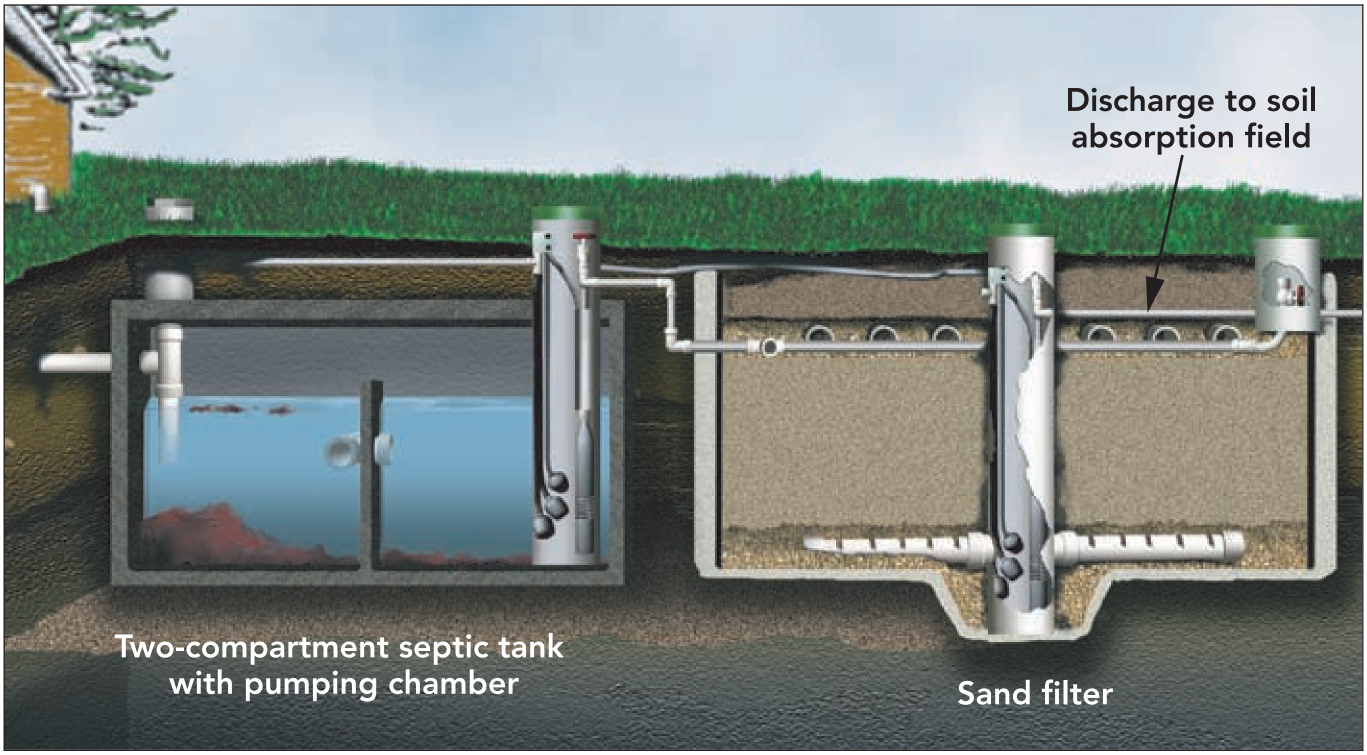

Figure 1: A sand filter system.

Sand filter

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Sand filtration is one of the oldest wastewater treatment technologies known. If properly designed, constructed, operated, and maintained, a sand filter produces a very high quality effluent.

Sand filters are beds of granular material, or sand, drained from underneath so that pretreated wastewater can be treated, collected, and distributed to the final treatment and dispersal system. They are normally used to polish effluent from septic tanks or other treatment processes before it is distributed on the land. All on-site systems are "no-discharge," meaning the wastewater must stay in the system and not leave the property. The wastewater cannot enter surface water, streams, ditches, or any water resources. After the filtrate is collected by the sand filter's under drains, it is then disposed of by a soil absorption system.

The typical sand filter is a lined watertight box, generally concrete- or plastic-lined, and filled with a specific sand material. Types of sand filters include:

✓ **Intermittent sand filter**, in which wastewater is applied periodically to a 24- to 36-inch-deep bed of sand that is underdrained to collect and discharge the effluent. The bed is underlain by graded gravel and collecting tile. Wastewater is applied intermittently to the bed's surface through distribution pipes.

✓ **Recirculating intermittent sand filter,** which filters wastewater by mixing filtrate with incoming septic tank effluent and recirculating it several times through the filter media before discharging it to a final treatment and dispersal system. This filter's components are similar to the intermittent sand filter components.

Wastewater applied to the sand filter should be pretreated, such as in a septic tank

Sand filters can be free access (open to the surface) or buried in the ground (buried filters). Free access sand filters are generally above ground and usually have a lid that eases access to the sand system. Landscape design helps the system blend into its surroundings. A buried sand filter is completely covered and easily blends into the landscape.

Treatment

A sand filter purifies the water in three ways:

- ✓ Filtration, in which particles are physically strained from the incoming wastewater;
- ✓ Chemical sorption, in which contaminants stick to the surface of the sand and to the biological growth on the sand surface; and
- ✓ Assimilation, in which aerobic microbes eat the nutrients in the wastewater. The success of treating wastewater depends on these microbes. Air must be available for these microbes to live.

Sand filters are often partially or completely buried in the ground, but may be built above ground where there is a high water table or bedrock. Especially in areas with much rain and long periods of subfreezing temperatures, the sand filter should have some form of cover.

Wastewater applied to the sand filter should be pretreated, such as in a septic tank. The effluent from the septic tank is then distributed uniformly on the sand surface.

To distribute the wastewater, a dosing siphon can be used with splash plates. Another approach is to pump the effluent under low-pressure, controlled doses through a network of small-diameter pipes. The pipes are placed in a bed filled with gravel on top of the sand. The effluent leaves the pipes, trickles down through the gravel, and is treated as it filters through the sand.

A gravel under-drain collects and moves the treated wastewater to either a second pump chamber for discharge to a pressurized distribution system or to a gravity flow soil absorption field. The second pump chamber may be located in the sand filter.

Design

The typical sand filter is a concrete- or PVC-lined box filled with a specific sand material. The media depth ranges from 24 to 42 inches.

It's important that the sand particles all be about the same size. If the grain sizes vary greatly, the smaller ones will fill in the spaces between the larger particles, making it easier for the system to clog.

The larger the grain size, the faster the wastewater moves through the sand and the more wastewater that can be filtered. Small media slow the water movement and increase the chance of clogging. The grain size also affects how deep the solid particles penetrate the filter and how clean the final effluent is.

Different types of sand filters can handle different amounts of wastewater. Buried sand filters generally can handle 1.2 gallons of wastewater per square foot of sand filter surface area per day (gpsfd). This low loading capacity results from the system's limited maintenance needs. Using a buried sand filter, a three-bedroom home with a flow of 240 gallons per day would require 200 square feet of sand filter (about 14 feet by 14 feet).

An intermittent recirculating free access sand filter can have loading rates of up to 15 gpsfd. To reduce the size of the sand filter, the designer may use a free access sand filter with a higher loading rate, but the higher rate generally means more maintenance requirements. For this system, a three-bedroom home (240 gallons a day) with a sand filter loading rate of 10 gpsfd would have a 24-square-foot sand filter (6 feet by 4 feet).

How to keep it working

Several factors affect the filter's performance, including two important environmental conditions: aeration and temperature. Oxygen

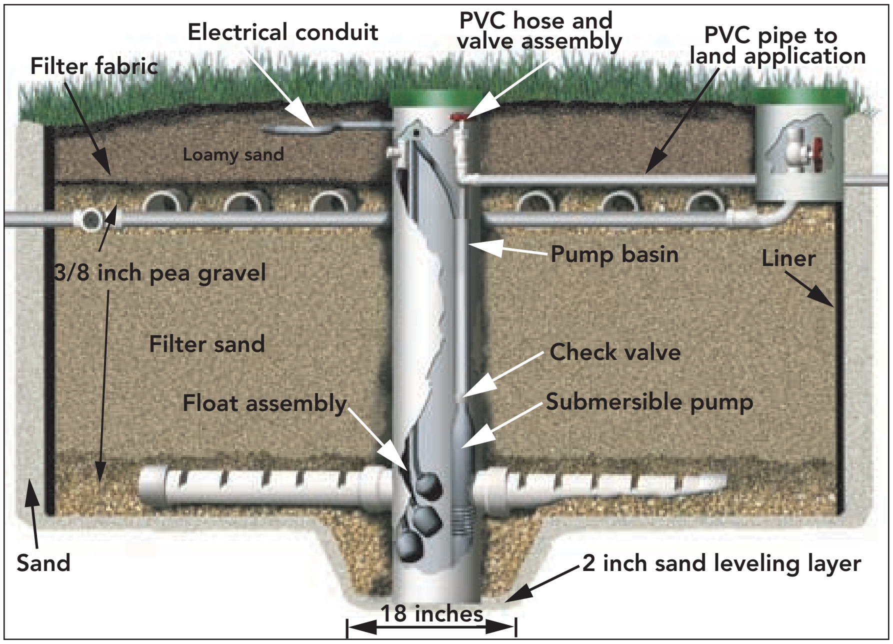

Figure 2: A sand filter.

needs to be available within the pores so that microbes can break down the solids in the wastewater. If the filter has poor air movement, such as when it is covered with heavy clay, the system can clog.

Temperature directly affects the rate of microbial growth, chemical reactions, adsorption mechanisms, and other factors that contribute to the stabilization of wastewater. Lower temperatures usually slow the rate of material breakdown.

Maintenance requirements for sand filters depend on the type of filter. Buried sand filters are designed to limit the need for maintenance. The most important maintenance for them is to make sure the pretreatment system is working properly. Applying solids, grease or scum to the surface of a buried filter greatly reduces its life. Otherwise, a correctly designed and installed buried sand filter should require no additional maintenance.

Free access sand filters need more maintenance because they handle higher loading rates than buried sand filters. This kind of sand filter can be maintained regularly and regenerated if the media become clogged over time.

The sand filter can become clogged because of physical or biological factors. Physical clogging occurs when solid materials accumulate within or on the sand surface. Biological clogging is caused by excessive microbial growth within the filter. The filter clogs faster when biological slimes accumulate and wastewater contaminants entrapped there decompose slowly.

Here's how to regenerate a clogged free access sand filter:

- ✓ Rest the sand filter, allowing it to dry and break down the biological materials growing there.
- ✓ Rake the surface layer to break the crust that develops on top of the sand filter because of the accumulation of fine materials. This allows water to filter into the sand.
- ✓ Remove the surface layer of sand from the filter when it is clogged with fine particles.
- ✓ Replace the sand if the bed cannot be regenerated or if the sand layer is too shallow after the surface layer is removed.

It's important that the sand particles all be about the same size

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