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On-site wastewater treatment systems

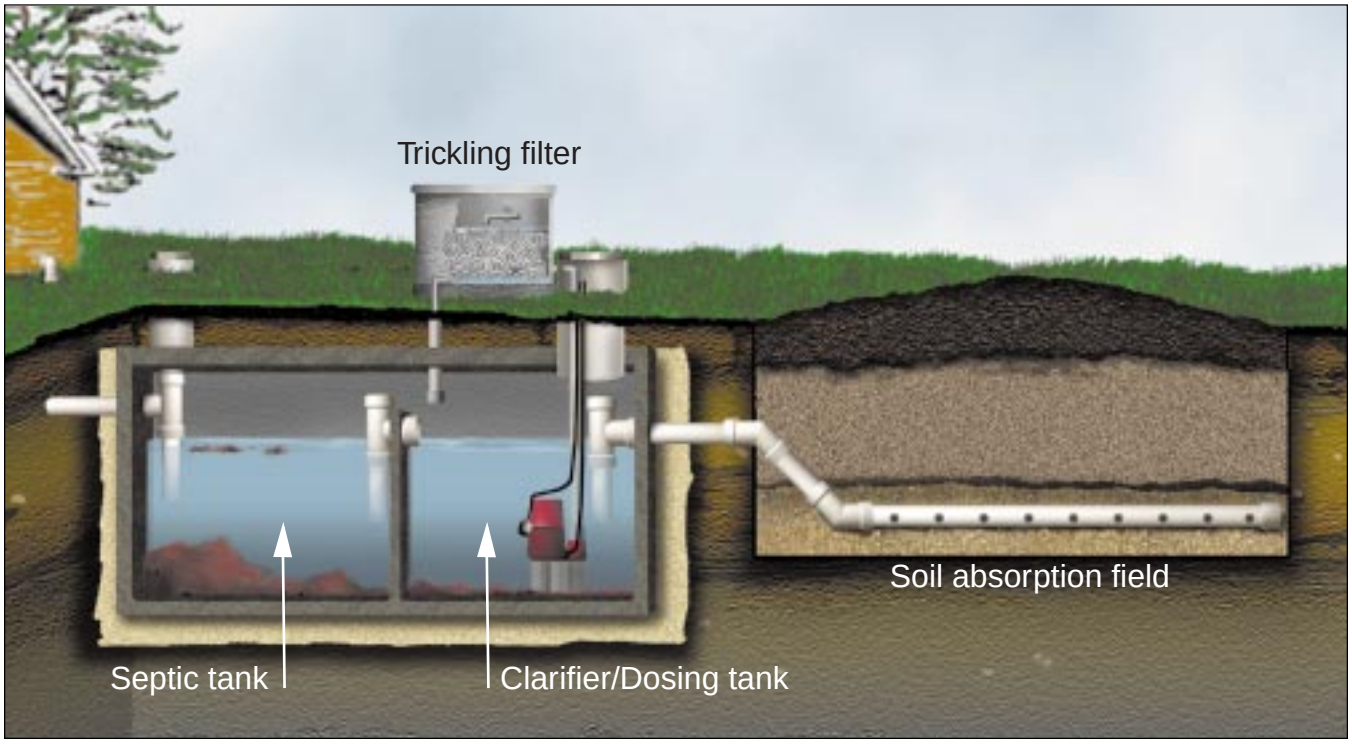

Figure 1: Trickling filters are a simple technology for treating wastewater.

Trickling filter

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A trickling filter is a bed of gravel or plastic media over which pretreated wastewater is sprayed. In trickling filter systems, microorganisms attach themselves to the media in the bed and form a biological film over it. As the wastewater trickles through the media, the microorganisms consume and remove contaminants from the water.

Trickling filters were a common technology for treating municipal wastewater before cities began using activated sludge aeration systems. Now, homes and businesses use trickling filters in on-site wastewater treatment systems.

Each trickling filter system has several components:

- ✓ A septic tank, which removes the settleable and floatable solids from the wastewater.
- ✓ A clarifier/dosing tank, which is a concrete or fiberglass tank that allows biological materials to settle out of the water. It also houses a pump to dose water over the top of the filter.
- ✓ A trickling filter, which is a tank of media such as gravel or plastic material. Wastewater is distributed over the top of the media and flows downward across the media surface in a thin film. It then exits the bottom of the tank and flows into the clarifier/dosing tank.

- ✓ A land application system, which distributes the treated water under the ground surface.

Although trickling filters are a simple technology for improving wastewater quality, few manufacturers sell them already built. Most trickling filters are professionally designed and built by an installer.

According to Texas regulations, wastewater from trickling filter systems cannot be applied to the ground surface. Texas allows only systems certified as class I aerobic treatment units or sand filters to apply wastewater onto the ground surface, unless the system is specially designed by a professional engineer for surface application. Wastewater distributed by such systems must be tested periodically to make sure it meets the quality requirements for surface application.

Treatment

Wastewater dosed to a trickling filter must be pretreated, such as by a septic tank. Solids and greases must be removed before the wastewater is sprayed over the trickling filter. If these materials are not removed, they can cover the thin layer of microorganisms growing on the media and kill them.

A trickling filter can reduce:

- ✓ Biochemical oxygen demand (BOD_5), a measurement of the amount of the dissolved oxygen that microorganisms need to decompose organic matter. High BOD_5 normally indicates poor water quality; a low BOD_5 generally indicates good water quality. Removing dissolved solids from the wastewater lowers the BOD_5.
- ✓ Pathogens, or disease-causing organisms.
- ✓ Fecal coliforms, or bacteria from human or animal wastes.

The microorganisms remove nutrients and dissolved materials from the wastewater, storing them as food. As the biological material grows, it becomes too large to remain attached to the media and breaks away. It is carried with the water back into the clarifier/dosing tank, where it accumulates in the bottom of the tank, forming a sludge blanket. In some systems, a sludge pump sends this material to the septic tank, where it can decompose further.

Design

When choosing an appropriate trickling filter system for a site, you must consider several components: the area and volume of the filter surface; the type of media; the size of the pump; and the requirements for operating the trickling filter.

Trickling filters can handle from 25 to 100 gallons of wastewater per square foot of filter surface per day. They are usually designed to treat 50 gallons per square foot per day.

The amount of biological material that a treatment system can handle per day is called the organic loading rate. For trickling filters, it is measured in pounds of BOD_5 per day per cubic foot. The organic loading rate for a trickling filter is generally from 0.005 to 0.025 pounds of BOD_5 per day per cubic foot of media.

The depth of the bed of media for trickling filters can vary. The deeper a trickling filter's media, the more BOD_5 it can handle per day. Community-scale trickling filters range from 3 to 8 feet deep. A home-scale trickling filter can be 2 to 3 feet deep. The depth chosen depends on the amount and strength of wastewater the system is expected to handle per day.

The media in the trickling filter should be a porous material such as rock or plastic. It should have a large surface area with large openings to allow the biological material to have good aeration. The large openings also enable the biological material to flow to the bottom of the filter after it falls off the media so that it can exit into the clarifier/dosing tank.

The pump should be elevated above the bottom of the clarifier/dosing tank to ensure that clear water can circulate to the trickling filter. The pump requires little horsepower because it lifts the water only from the clarifier/dosing tank to the top of the trickling filter, about 10 feet.

The flow rate for the pump can be fairly low, about 3 gallons per minute, depending on the dosing rate and the surface area of the filter. A valve on the pipe entering the top of the trickling filter allows the pump flow to be adjusted.

The wastewater must be distributed evenly over the media so that it can flow in a thin film down through the media. The water can be sprayed over the top of the media or channeled through a pipe and dropped onto a splash plate, which is a plastic or fiberglass plate lying on top of the media.

Dosing to the trickling filter can be continuous, or controlled with a timer. If the flow is continuous, the rate should be fairly low, about 3 gallons per minute, to allow the biological material that falls off the media to settle in the clarifier/dosing tank. If the flow is timer-controlled, the system should be dosed often enough to prevent the biological material from drying out.

The pump should be connected to an on-off float in case the flow of water is interrupted. Without an on-off float, the pump will run with no water in the tank if flow is disrupted from the home (such as when the family goes on vacation) and the water evaporates from the trickling filter, thus reducing the volume of water in the clarifier/dosing tank.

The last step in the process is to apply the wastewater to the soil. For gravity-flow systems, the wastewater flows by gravity through an outlet from the clarifier/dosing tank and into trenches in the drain field.

If a pressurized land application system is needed, the wastewater flows from the clarifier/dosing tank into a pump tank, which collects the wastewater and then doses it to the drain field through a low-pressure dosing, subsurface drip or spray distribution system.

How to keep it working

To perform well, trickling filter systems require proper operation and maintenance. Please review the materials from the manufacturer or designer to make sure you comply with their guidelines.

Trickling filter systems contain several components—a septic tank, clarifier/dosing tank, trickling filter and land application field—working together to improve the quality of the effluent. For specific operation and maintenance guidance on septic tanks and land application fields, see Extension publications on those topics. They can be ordered from the Extension service and are available on the World Wide Web at *http://agpublications.tamu.edu.*

Here are some common problems with trickling filters, their possible causes and recommendations for remedies:

✓ **Standing water in the filter:** Could be caused by a plugged filter exit to the clarifier/dosing tank or by a buildup of biological material in the filter.

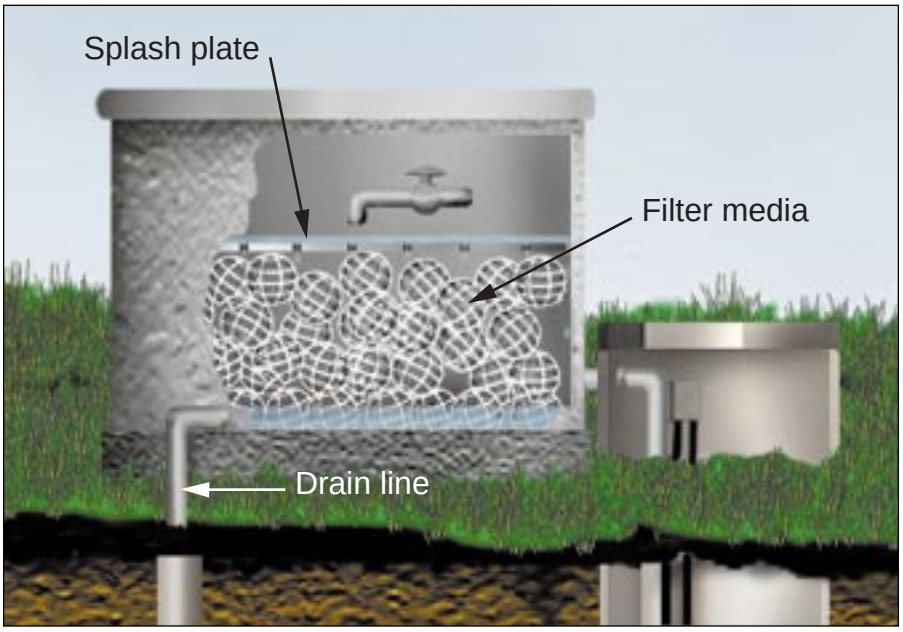

Figure 2: A trickling filter is a tank of media such as gravel or plastic material.

You may have to have the filter media removed and washed to reduce the amount of biological material on the media. Make sure the outlet is large enough so that the wastewater can exit the filter.

✓ **Water not being dosed to the trickling filter:** Could be caused by failure of the pump, the on-off float or the control panel, or disruption of electrical power.

Check these components to make sure they are functioning.

✓ **Effluent water containing a high BOD_5 concentration:** Could be caused by the dosing rate to the filter being too low; or, the incoming water could be too strong.

Raise the dosing rate by running the pump longer or adjusting the flow valve at the discharge to the filter surface. Lower the strength of incoming wastewater by managing the quantity of waste entering the system, such as by discontinuing use of a garbage disposal or sending less grease down the drain.

✓ **Biological growth being killed on the filter:** Could be caused by greases or solids entering the filter, coating the biological growth and killing it; or, the wastewater could contain high amounts of cleaners, disinfectants or pesticides.

Check the septic tank to make sure solids and grease are being retained. Evaluate your habits in the home to make sure you are not using too many cleaners or disinfectants, or continuous disinfectants in the toilet bowl. Also, make sure you are not disposing of solvents or pesticides in the toilet.

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