Recirculating Media Filter

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A recirculating media filter (RMF) pretreats septic tank effluent by filtering it through a medium of coarse sand gravel, peat, or textile before sending it to the soil treatment system. Sand is the most reliable and widely used medium. RMFs have been used since the 1970s in communities with flows of more than 5,000 gpd (gallons per day), but use for small flow application (less than 1200 gpd) has been growing. RMFs are an attractive alternative because they require less land and can handle higher strength waste.

A recirculation system has an advantage in areas where nitrogen contamination is a problem. As wastewater moves through the filter and becomes oxygenated, ammonia is transformed into nitrate. In the recirculation tank, conditions are anoxic (low in dissolved oxygen) and bacteria break down nitrates and releases N back to the atmosphere, a process called denitrification. Because of the large media size, RMFs do not remove fecal coliform as effectively as single-pass sand and peat filters.

Figure 1. Installation at a home near Brainerd, Minnesota

Recirculating Media Filters Application

Since wastewater leaving an RMF is a high-quality effluent, the soil in the trench or mound soil treatment system may be better able to accept it, and the system should last longer. Researchers are looking into whether soil treatment systems receiving pretreated wastewater could be downsized to reduce the total area required.

Because the wastewater flowing into the soil treatment system from an RMF is much cleaner than wastewater from a septic tank would be, RMFs are also useful for sites that have been compacted, cut or filled, and may be the best alternative in environmentally sensitive areas with shallow separation to bedrock or seasonally high water tables near lakes and rivers, groundwater recharge areas, and wellhead protection areas. RMFs can also help recover drainfields that have failed due to excessive organic loading. This is especially attractive for small lots with little room for replacement. Recently RMFs with gravel filters have been used to treat high strength waste from restaurants and other establishments.

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How Do Recirculating Media Filters Work?

Recirculation means cycling wastewater through the filter a number of times, allowing for continued filtering and increased bacterial decomposition. Wastewater moves from the house into a septic tank where solids settle out and some organic matter is decomposed (Figure 2). Liquid effluent moves, usually by gravity, to the *recirculation tank.* Here effluent that has been recirculated through the filter is mixed with septic tank effluent. Effluent is pumped repeatedly through a lined filter and then back (by gravity or pump) to the recirculation tank. In the filter, biological treatment occurs as the effluent passes the surfaces of the filter media. Treated effluent is collected at the bottom and returned to the recirculating tank where the cycle begins again. After the effluent has gone through the filter several times a controlling mechanism sends the effluent to the soil for final treatment. Depending on the site, final treatment could be trenches, a mound, at-grade, or drip distribution.

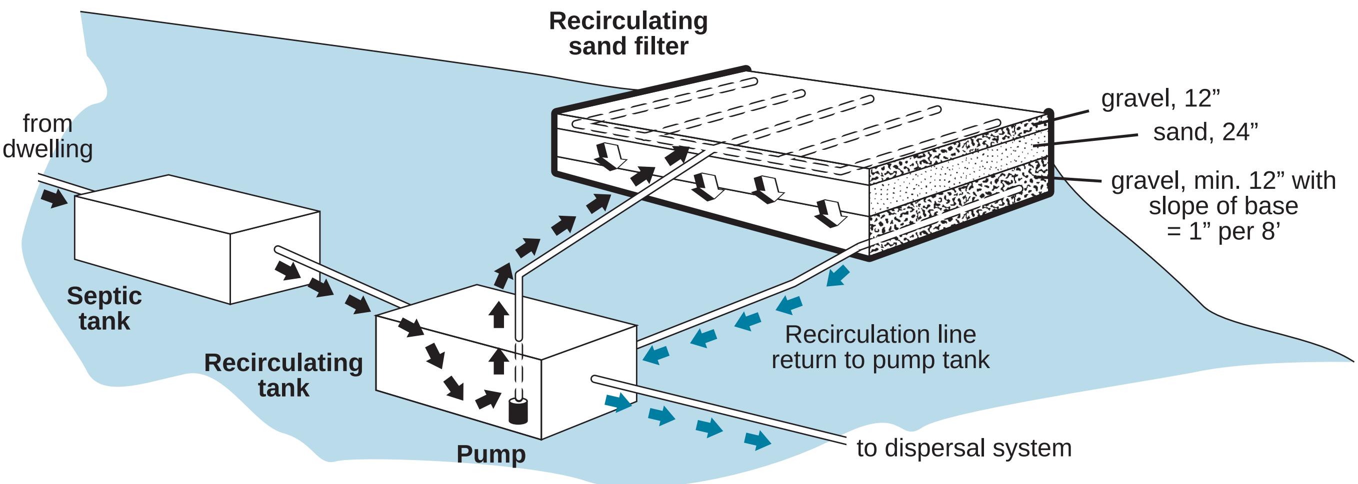

Figure 2. Recirculating media filter

The filter is in a watertight liner or container. Although the liner can be made from a number of materials, 30 mil polyvinyl chloride (PVC) is the most common and the most reliable material. The filter is composed of twelve inches of drainage media. Outflow from the filter is provided by a four-inch pipe surrounded by drainfield rock. Depth of the outflow should be from one foot to eighteen inches below the bottom of the treatment media. Effluent must drain freely out of the media since saturation reduces the filter’s effectiveness. The layer above the outflow drain is the treatment media (usually two feet of coarse sand, 0.05-2.0 mm in diameter). The top layer is the distribution media (usually drainfield rock), where the pressure distribution system is located.

Designing Recirculating Media Filter

A properly designed, installed, and managed RMF can achieve the treatment levels shown in Table 1. These results are typical for RMF using sand as the treatment media. The major considerations when designing an RMF are loading rate and recirculation rate.

	BOD (mg/l)	TSS (mg/l)	Fecal Coliform (MPN/100mL)	Nitrogen % removal	Phosphorus % removal
Septic tank effluent	175	65	1 million–1 billion	0	0
RMF effluent	20	20	5,000–100,000	30-70	10-30

Table 1. Septic tank and recirculating filter effluent

The *loading rate* describes how much wastewater is applied per square foot. In an RMF, the loading rate can range from 1–20 gallons per day per square foot. The most widely used and researched loading rate is 4–5 gallons per day per square foot.

The *recirculation rate* describes how many times the effluent goes through the filter before being released to the soil treatment system. This rate is generally in the range of 2–10 times. To achieve acceptable treatment levels a minimum recirculation rate is 4 times. Coarse media is needed for the higher loading rates to accomplish the recirculation without plugging problems.

A vertical-flow system (popular in northern Europe and now used in Minnesota) is simply small, planted gravel beds that are dosed intermittently with wastewater across their entire surface. The intermittent application of wastewater allows oxygen from the atmosphere to be more efficiently drawn through the gravel medium and its attached microbial community. The difference between this system and other RMFs is the addition of wetland plants on the surface.

Placement

Site flexibility is a major advantage of filter systems. Because the filter is watertight and uses a medium for treatment, the soil where it is constructed is not as important as the ability of the system to transfer oxygen. Without adequate oxygen, bacterial action will be compromised. Landscape rock is recommended for the filter surface to maximize gas exchange. The location is mounded in the center to avoid excessive surface runoff into the system. Landscaping should divert surface water around the filter to minimize surface water additions. RMFs are much smaller than single-pass sand filters; therefore, they are a better option for small lots.

Final Disposal of Wastewater

Effluent from the RMF will be very clean, but must still be applied to the soil for final treatment. Because effluent is so clean, a biomat layer does not form the way it does with effluent from septic tanks. A pressure distribution network is needed to apply effluent evenly throughout the system.

There are many options for the soil treatment system including trenches, mounds, and drip distribution. Figure 3 shows a recirculating filter system with pressurized trenches.

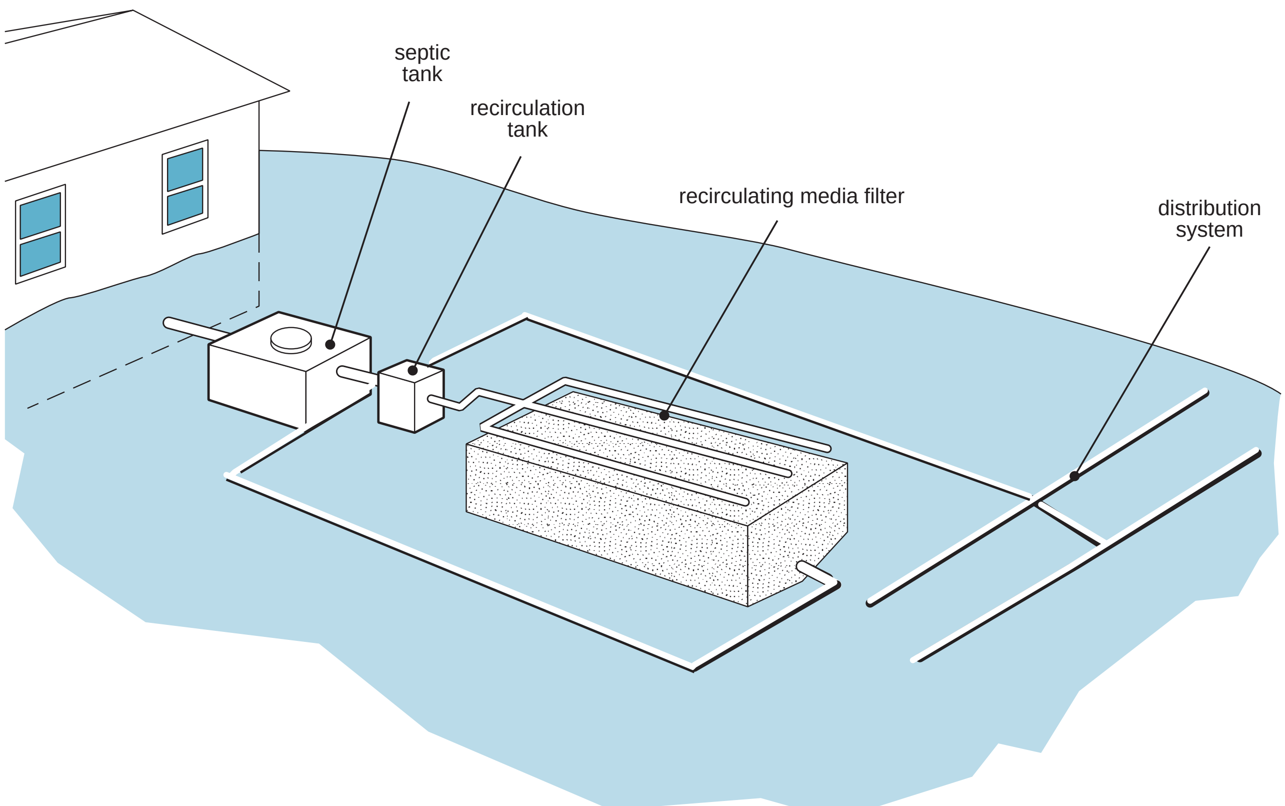

Figure 3. Recirculating filter system with pressurized trenches

Operation and Maintenance

All the routine operation and maintenance practices suggested for any onsite treatment system apply to RMFs. (See *Septic System Owner's Guide*, PC-06583, for details.)

RMFs require more maintenance than conventional septic-tank-drainfield systems. A maintenance contract is strongly recommended. Depending on the local governmental unit and the recommendations of the manufacturer, the system may require quarterly to annual maintenance. Maintenance includes inspecting flow meters, pump, recirculation tank, recirculation pump, distribution systems, media and effluent quality; and cleaning and repairing when needed. In particular, the flow meter should be read to make sure the application rates are within the design limits. Spray heights on the pressure distribution system should be inspected to ensure even distribution over time. A visual inspection of the effluent is required and often a lab analysis is necessary.

Over time the upper layer of the RMF may become plugged with solids or a build-up of organic matter. If this happens, the upper layer should be removed and replaced with new media. Adding air to the system may minimize this problem.

The running costs for an RMF are based on the operation of a small submersible pump, and average less than five dollars per month for an individual home. Overall operational costs of $200–$500 per year includes pumping, repairs, maintenance, and electricity.

Figure 4. Installation at a research site near Mankato, Minnesota

Summary

Recirculating media filter systems are a viable onsite sewage treatment option. The small land requirement makes them attractive for small lots. The increased ability to remove nitrogen is an advantage in areas with nitrogen contamination. Because of the large media size, RMFs do not remove fecal coliform as effectively as single-pass sand and peat filters.

Visit our Web site at www.bae.umn.edu/septic/ for additional information.

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