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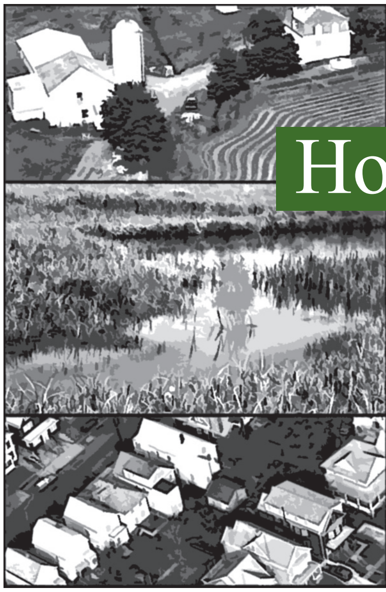

Home & Environment

Importance of Wastewater Biological Oxygen Demand in Septic Systems

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Household wastewater contains a mix of chemicals, impurities, and other materials. One of the most important of these materials is organic matter, which is composed of carbon (C), nitrogen (N), and oxygen (O). In septic systems, C comes from the digested and undigested food we eat, and the microorganisms that live in the system. The amount of biodegradable C found in septic systems is important, because by measuring it we can determine the waste stream's biochemical oxygen demand (BOD). BOD refers to the amount of oxygen microorganisms must consume to oxidize (that is, break down) all the organic compounds in a liter (about a quart) of wastewater. A high BOD value means potential septic system problems for homeowners; a low BOD means fewer problems for homeowners. This publication describes the environmental impacts of BOD, shows how BOD is distributed in septic systems, and describes remediation strategies for excess BOD.

Environmental Impacts of BOD

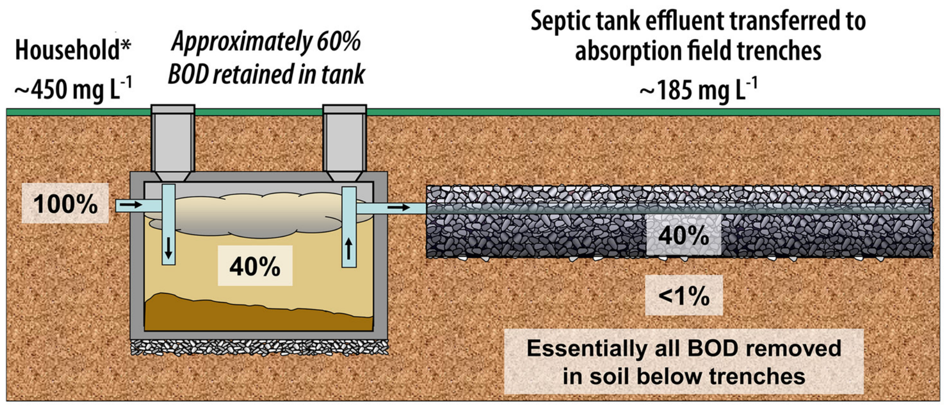
BOD tests measure the BOD over a five-day period instead of the total BOD. This five-day test, called a BOD_5, is typically about 70 percent of the waste stream's total BOD. We use BOD_5 out of convenience because it could take a very long time to determine the total BOD. The remainder of this publication will refer to the 5-day BOD.

The risk of groundwater contamination from excess BOD from a properly sited, designed, constructed, and maintained septic system is slight. Most of a waste stream's BOD is removed in the septic tank; BOD associated with suspended particles that make it to a septic system's soil treatment area is removed by the soil-trench infiltrative surface and biological mat (biomat). The dissolved BOD that makes it into the soil is quickly removed through aerobic biological processes in the soil. If excess biodegradable C finds its way to surface or groundwater it can result in low dissolved oxygen concentrations in water and create taste and odor problems in well water (see Figure 1).

Distribution of C in a Septic System

Under proper site and operating conditions, septic systems remove more than 95 percent of a waste

Figure 1. From the home 100 percent of the BOD enters the septic tank through the inlet baffle. Most (about 60 percent) household BOD in a properly functioning conventional trench septic system accumulates in the septic tank. The remaining 40 percent of the BOD reaches the soil treatment area trenches via the outlet baffle and pipe distribution network (not shown) where it is consumed by microbes. Less than 1 percent of the BOD moves to the soil below the absorption field.



*Value represents complete mixed waste in septic tank

In properly operating absorption fields, the biomat is in equilibrium—that is, about as many cells are growing as are dying.

stream's BOD. About 60 percent of the C that makes up the incoming BOD is removed in the septic tank during the settling processes. The remaining 40 percent of BOD enters the soil treatment area trenches. Much of the BOD in this effluent is composed of particulate matter, which is trapped at the gravel-soil interface in the soil trench (in traditional septic systems), in the sand (in elevated-sand mound septic systems), or on subsoil (in gravel-less systems). In either case, microorganisms break down and use the biodegradable C. At the trench-soil interface, microbial populations grow according to the amount of biodegradable organic matter that flows out of the septic tank. This growth results in a thick layer of cells, commonly called a biomat. This biomat is where most biological wastewater treatment occurs in a septic system soil treatment area (see Figure 2).

In properly operating absorption fields, the biomat is in equilibrium—that is, about as many cells are growing as are dying. But if organic matter is added to the system faster than it can be decomposed by the microorganisms, the biomat thickens and subsequently reduces the wastewater infiltration rate in the trench. This typically leads to a system-wide reduction in the rate at which wastewater is dispersed in the soil treatment area.

Other factors can affect biomat development, such as hydraulic loading rates, soil temperatures, and the maintenance performed on the system.

When the hydraulic loading rate (the rate at which wastewater enters a septic system) exceeds the soil infiltration rate, septic tank effluent begins to back up in the soil treatment area. If this process continues, the result is septic tank effluent backing up into the home or breaking out on the ground surface. Warm soil temperatures promote faster decomposition in the biomat than cold soil temperatures. For proper maintenance, routinely pump the septic tank, avoid in-sink garbage disposals (which add excess C), and prevent toxin disposal into the system, which can poison biological activity.

Remediation Strategies

The most common and best way to manage a septic system is to remove the solids from the septic tank. The benefits of this management are twofold:

- Because most of the C in a septic system is stored in the sludge at the bottom of the septic tank, pumping the tank at regular intervals helps to maintain a functioning soil treatment area.

- Removing the solids from the septic tank helps maintain the adequate separation distance between the sludge and scum layer to allow for proper settling time (24 to 48 hours), so that the solids can be removed from the effluent and remain in the septic tank.

We recommend pumping every three to five years for most homes. In addition to regularly pumping the solids from a septic tank, installing an effluent screen on a septic tank's outlet baffle is an excellent way to help keep the C-containing solids from leaving the septic tank and protect the soil treatment area.

If the biomat in your septic system is too thick, resting the soil treatment area for an extended period (such as six to twelve months) can renovate the system by cutting off the biomat's food source (C supply) and allowing microorganisms to consume the built up organic matter in the biomat. This essentially starves the microbial population and, over time, reduces the biomat's thickness and restores the soil's infiltration capacity.

Unless you can take an extended vacation from home, an alternative method of handling effluent must be found while resting the soil treatment area. One alternative is to construct and use an additional soil treatment area. Other alternatives include adding a secondary or "pretreatment" device to your septic system (such as an aerobic treatment unit, wetland, or sand filter) to remove much of the excess BOD. These devices require regular maintenance, often involve pumps and controls, and are commonly installed between the septic tank and the soil treatment area. Such treatment devices have been found to restore the original functioning of the soil absorption system in a matter of months. Contact your local health department for more information about adding treatment components to your system.

Summary

While the biomat in the gravel-soil interface of a septic system's soil treatment area is critical for wastewater treatment, biomats that become too thick due to excess BOD can reduce the system's effectiveness and result in system failure. Normally, there are three options for reducing the BOD load on the soil treatment area and correcting this problem:

- Construct an additional soil treatment area and rotate use every 6 to 12 months
- Rest the absorption field for an extended period
- Install a secondary treatment unit

For proper maintenance, routinely pump the septic tank, avoid in-sink garbage disposals (which add excess C), and prevent toxin disposal into the system, which can poison biological activity.

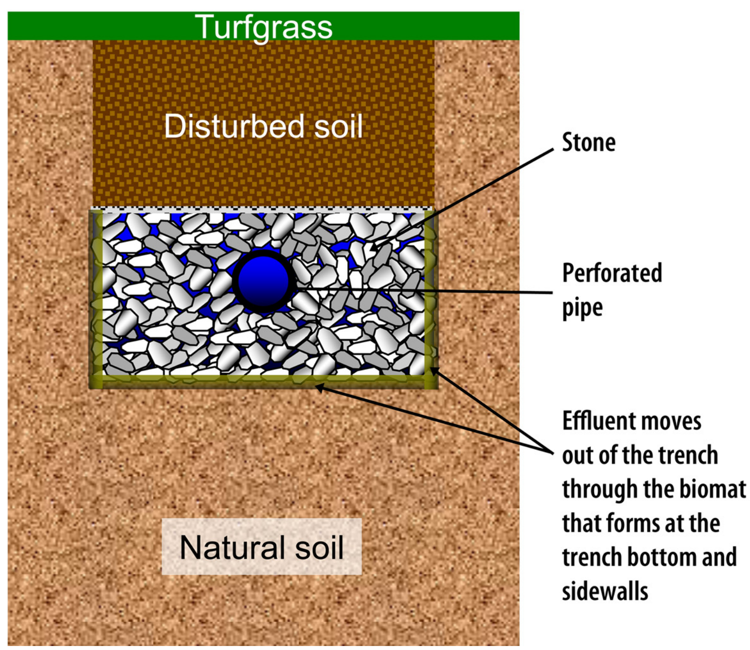


Figure 2. Cross-section view of a gravel soil treatment area trench. A perforated pipe delivers septic tank effluent via a distribution network to the gravel-filled trench. A thick layer of cells, commonly called a biomat, forms at the soil-trench interface to feed on the organic matter that flows out of the septic tank.

For more information

Visit the Home and Environment webpage at www.ca.uky.edu/enri/henv.

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