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Pipeline

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Small Community Wastewater Issues Explained to the Public

Septic tank enhancements

This issue of *Pipeline* will investigate some of the options available to enhance the efficiency of your septic tank or to make maintenance practices more convenient. Note: It is not the National Small Flows Clearinghouse's intention to endorse one product over another, but to inform readers about options on the market.

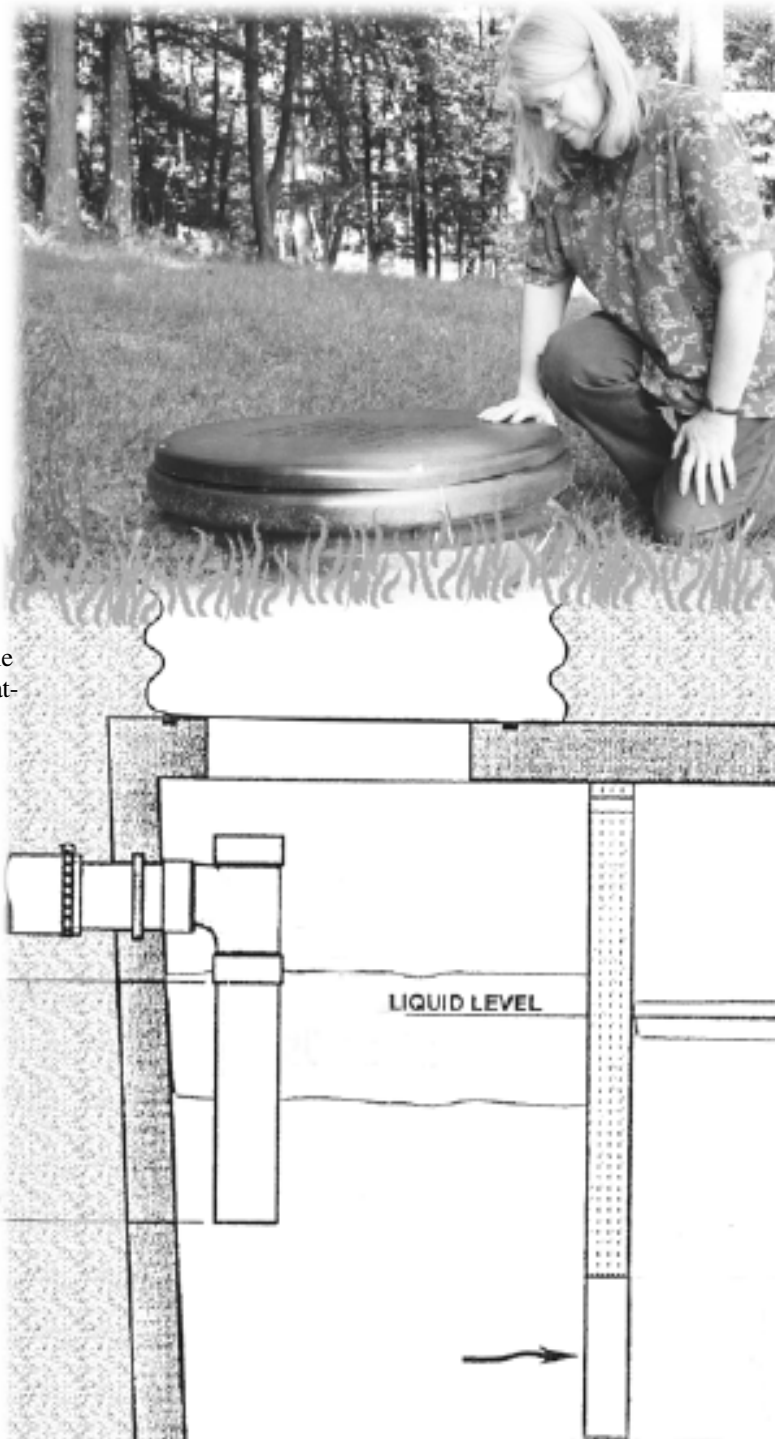
Historically, onsite septic systems were considered temporary measures, installed to fix an immediate problem until a more permanent solution could be arranged. Experience has shown us that if properly designed, installed, and maintained, onsite wastewater treatment systems are effective permanent solutions. But like any engineered device, an onsite system has a design life—a certain length of time after which performance begins to decline.

The critical factor of any onsite system is the soil absorption system. Soil is the least uniform component and the most difficult to monitor. The majority of the enhancements discussed here are directed at protecting the drainfield. By including some of the optional enhancements reviewed in this newsletter, your onsite treatment system can achieve even more efficiency and longevity.

As onsite wastewater treatment technology has developed, and more systems are in use, various enhancements have been designed to improve treatment and to simplify maintenance. Some options can be added on to existing systems, while others must be incorporated into the initial design and installation.

Your local or state regulations may require some of these accessory items, while others are optional. Some types and models of these enhancements must be accepted under your local code before being installed. Check with your local health department when considering any modification to your onsite wastewater system.

What's Inside...



Let's start with the tank

Septic tanks were originally designed to serve as simple settling basins — to separate scum and solids from the liquid. We now know that biological processes partially digest the sewage. In fact, a good percent of ultimate treatment can be accomplished in the septic tank. (A well-functioning tank will reduce biochemical oxygen demand by 40 percent and total suspended solids by 70 percent—the two parameters used most often to measure the effectiveness of wastewater treatment.)

A septic tank is a watertight container constructed of a durable material resistant to corrosion or decay (commonly concrete, polyethylene plastic, or fiberglass). Septic tanks are usually buried underground near the house (usually 10 to 15 feet from the foundation), about 18 to 24 inches below the surface.

Septic tanks can be constructed out of various materials, but they must be completely watertight. Concrete tanks are very economical, but they can be difficult to install on small or remote sites due to their heavy weight. For ease of transportation, concrete tanks sometimes are cast in two or more pieces, to be joined on the site. In this case, all joints should be made watertight with a special approved sealant such as bitumen or butyl rubber. The sealant must remain pliable across a wide range of temperatures. All fittings and connections must be flexible to ensure watertightness in case the tank moves due to settling.

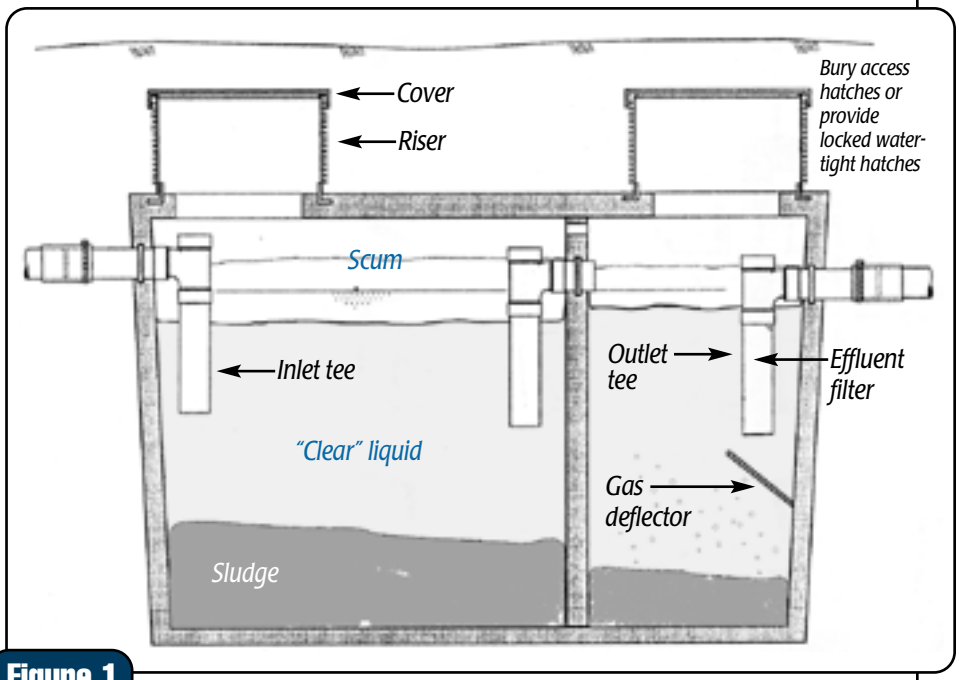


Figure 1 *Diagram of a typical dual compartment tank.*

Fiberglass tanks are lightweight, but can float out of the ground during periods of high groundwater unless securely anchored. Polyethylene tanks are also easy to transport and handle, but must be backfilled carefully to prevent crushing.

Today's septic tank is designed to do three major tasks—clarify, treat, and store. Clarification takes place when solids settle out of the liquid based upon size and specific gravity. The lighter fats, oils, and greases (FOG) float to the surface (often along with soap suds) forming the scum layer. The solids settle to the bottom of the tank forming a layer called sludge. The liquid between the scum and sludge is called clarified sewage or effluent. It slowly flows to the drainfield for further treatment when displaced by new sewage coming into the tank.

A septic tank should be able to store the sludge and scum that accumulate over a period of two to four years or between pumpings. This can mean that up to one-half of the tank volume is reserved for sludge and scum accumulation. The rate of solids accumulation varies greatly from one household to another; actual storage time can only be determined by routine septic tank inspections.

A well-designed septic tank provides:

- liquid volume sufficient for a 24 hour fluid retention time at maximum sludge depth and scum accumulation,
- sufficient sludge storage space,
- outlet devices to prevent sludge or scum from discharging to the drainfield, and
- venting provisions to direct gases safely away.

Variable features of a septic tank are: the size, shape, and number of chambers, and the number and style of baffles and gas venting provisions. Check with your local health department about the current regulations for these variations.

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Size

A septic tank for a residence should have a liquid capacity of between 500 to 2000 gallons. The tank must be adequately sized so wastewater remains in the tank long enough for bacterial activity to take place (approximately 24 hours). Tank volume is usually based upon the building size, number of bedrooms, or other similar parameter.

Up to 50 percent of the solids retained in the tank decompose; the remainder accumulates in the tank. Your home's tank must be capable of storing the sludge and scum accumulated over a two to four year period. As solids build up, settling time decreases and suspended solids may pass through to the drainfield and damage it.

The material pumped is known as septage. The frequency of pumping depends on the capacity of the septic tank, the volume of wastewater (determined by the size of the household), and the amount of accumulated solids in the tank. Garbage grinders (disposals) increase the amount of solids and, thus, increase the frequency of pumping.

Configuration

An improperly configured tank will allow the wastewater to short-circuit through the tank to the outlet. The shape of the tank should allow the wastewater to spend the maximum detention time (the amount of time the wastewater spends in the tank before being sent on to the drainfield). Elongated tanks (with length to width ratio of 3:1) tend to be the most effective in improving suspended solids removal. The depth of the tank should be at least three feet below the outlet to prevent disturbance of the sludge layer.

Septic tanks can have one or multiple chambers. Although some engineers are convinced that two-compartment tanks do a better job of settling solids than single-chambered models, the single-chambered model continues to be an efficient and popular choice. Two-chambered models consist of two compartments created by an internal wall with an opening for flow from one compartment to the next. The compartments of a dual compartment tank should be unequal in size for

Figure 2 *Cutaway view of a dual compartment concrete tank.*

Installation considerations

The most important requirement of installation is to place the septic tank on a level grade and at a depth that provides adequate gravity flow from the home. The tank should be located where it can be easily accessed for pumping. Local codes must be consulted regarding minimum horizontal setback distances from buildings, property boundaries, wells, and water lines.

The tank should be placed on undisturbed soil so that settling does not occur that could loosen or break the lines. The underlying soils must be capable of bearing the weight of the tank and its contents. Soils with high organic content or containing large rocks are not suitable. If the excavation is dug too deep, it should be backfilled with sand to the proper elevation to provide a uniform bearing surface.

All joints must be sealed properly, including tank joints, inlets, outlets, manholes, and risers. Only high quality joint sealers should be used. After the sealant has been given the specific curing time, all joints must be tested for leaks before backfilling begins.

After setting the tank and leveling and joining the lines, the tank must be carefully backfilled. The backfill material must be added in stages, and compacted after each addition. Only fine-textured soils should be used. In areas where freeze and thaw cycles are common it is very important that granular material be used, especially when using plastic and fiberglass tanks. Tanks made of different materials may have specific bedding and backfilling requirements. The manufacturer should be consulted for these specifications.

If you must locate your tank in a saturated area (or that has the potential for periodic saturation), the tank must be secured to prevent flotation. Tank manufacturers can recommend the appropriate anchoring methods.

best performance; the first chamber should be approximately two-thirds of the total volume. Studies show that the first chamber is in almost constant turmoil due to the ongoing addition of new wastewater, while the second chamber is relatively tranquil, allowing the re-suspended particles to settle and digestion to occur.

Multi-chambered tanks, which are now required by law in several states, need a more frequent pumpout schedule than the older single chamber tanks.

Baffles & tees

There must be an inlet and outlet device at either end of the tank. Baffles are placed between these ports to regulate the flow of the wastewater or the gases produced. The inlet and outlet ports, often referred to as sanitary tees, are usually T-shaped pipe configurations. See Figure 1 and 3.

The inlet tee forces incoming wastewater down into the tank, preventing it from flowing directly across the top of the standing wastewater to the outlet.

Inlet baffles are designed to slow the incoming rush of water to prevent disturbance to the scum layer. These are also known as splash baffles.

The outlet tee is designed to draw effluent only from the clarified zone between the sludge and scum layers, therefore keeping the scum layer from moving into the soil absorption system. The soil absorption system is the least uniform component, and is the component most difficult to monitor for operational problems; it is vitally important to protect it from damage.

Baffles are available in various sizes and styles, ranging from a simple bend in the inlet pipe to complex plastic, fiberglass, or concrete partitions attached to the ceiling or walls of the tank. Outlet baffles are used to retain the scum layer within the tank. There is often a special baffle, the gas deflector device or baffle, located below the outlet tee to deflect the gas bubbles (to which solid particles often adhere) from leaving the tank.

SAFETY

It should never be necessary to enter a septic tank. Any work to replace the baffles or repair the tank should be done from the outside. Decomposing wastes in the tank produce toxic gases which can overcome a human in a matter of minutes. When working on a tank be sure the area is well ventilated and that someone is standing nearby.

Effluent filters

Excessive discharge of solids to the drainfield can cause it to plug and lose efficiency in treatment and dispersal of the normal liquid flow. Septic tank effluent filters are basket-like screens that provide a relatively inexpensive method of preventing solids from discharging to the drainfield. They are installed at the outlet of the septic tank, sliding right into the top of the sanitary tee at the tank's outlet, collecting solids that may be discharged from the tank. See Figure 3. Effluent filters can collect suspended solids to less than one-sixteenth of an inch in size. Effluent filters are even capable of straining out FOG, the most damaging component of the wastewater.

If the septic tank is maintained properly, including frequent inspection for solids accumulation and removal, an effluent filter may not be necessary.

If you are considering using such a product, check with your local public health authority to find out what requirements apply to the installation and use of septic tank effluent filters.

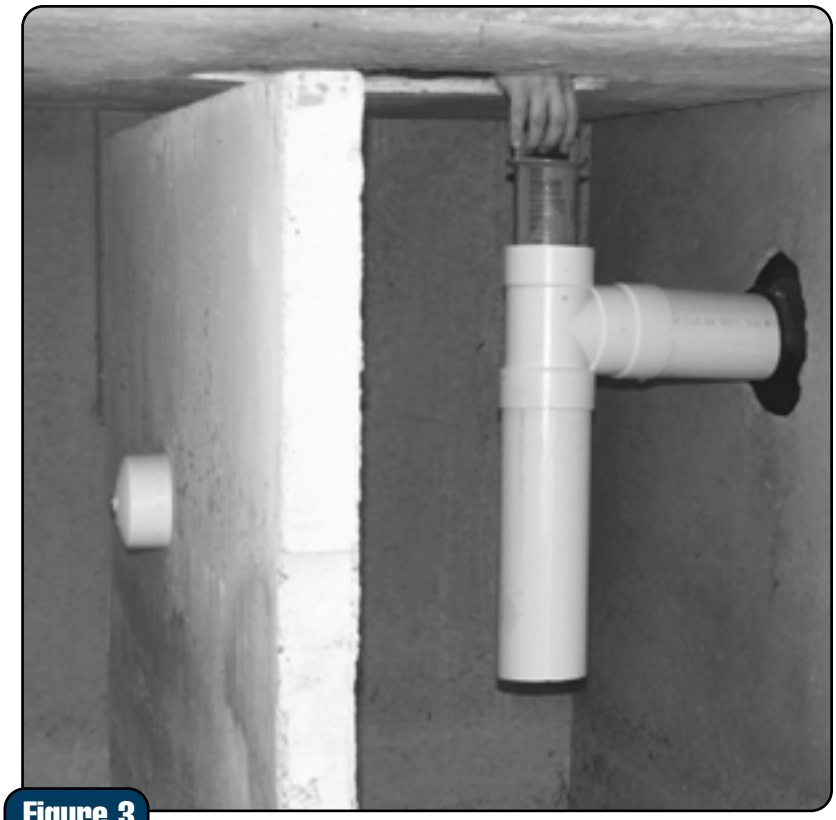


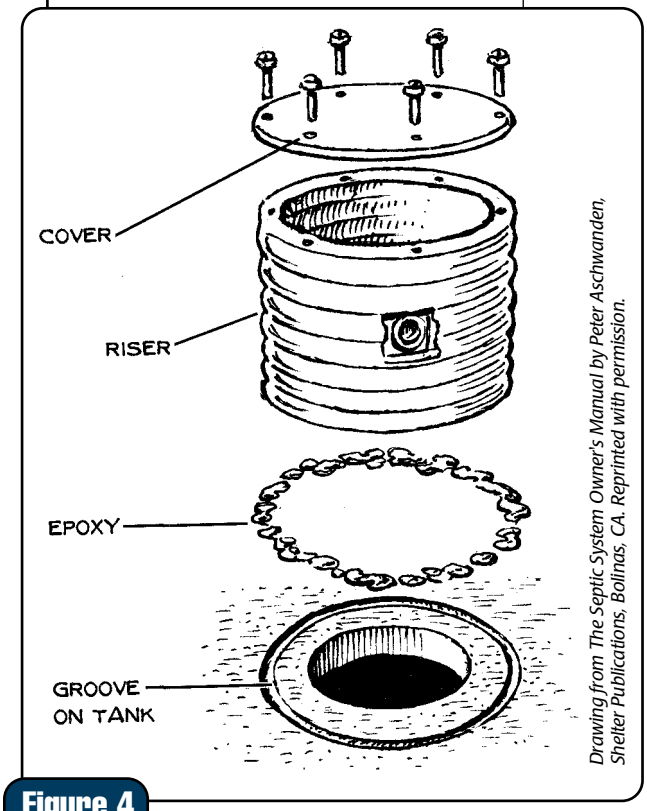
Figure 3 *Outlet tee with effluent filter exposed. Please note that this photo is of a demonstration tank, not actually in use. You should wear protective gloves when handling a filter in a working tank.*

Access ports

There are two types of access points into the tank itself: larger ones for maintenance and smaller ones for visual inspection. In some situations, especially with dual-compartment tanks, they are combined – each compartment has one large port, placed so inspection of baffles can occur and pumping can be done without damaging the baffles or inlet or outlet devices.

The large maintenance ports are usually called manholes and are large holes (24 or more inches wide) in each tank or compartment for pumping. Inspection ports are small openings (between four and six inches wide) used to inspect the scum and sludge levels, or the condition of baffles, etc. Be aware that pumping a tank through the baffle inspection port can damage the baffles. Also remember the dangers of entering the tank. See the Safety Tip on Page 4.

To facilitate accessing the various inspection ports and manholes, it is a common practice to add risers—vertical extensions from the actual opening in the tank to ground level. These ribbed plastic tubes allow easy access to the mechanics of the tank and simplifies lawn maintenance. Risers must be fitted with an airtight and watertight lid that prevents children or animals from entering. See Figure 4.



Drawing from The Septic System Owner's Manual by Peter Aschwanden, Shelter Publications, Bolinas, CA. Reprinted with permission.

Figure 4 *Detail for retrofitting a riser on an existing tank.*

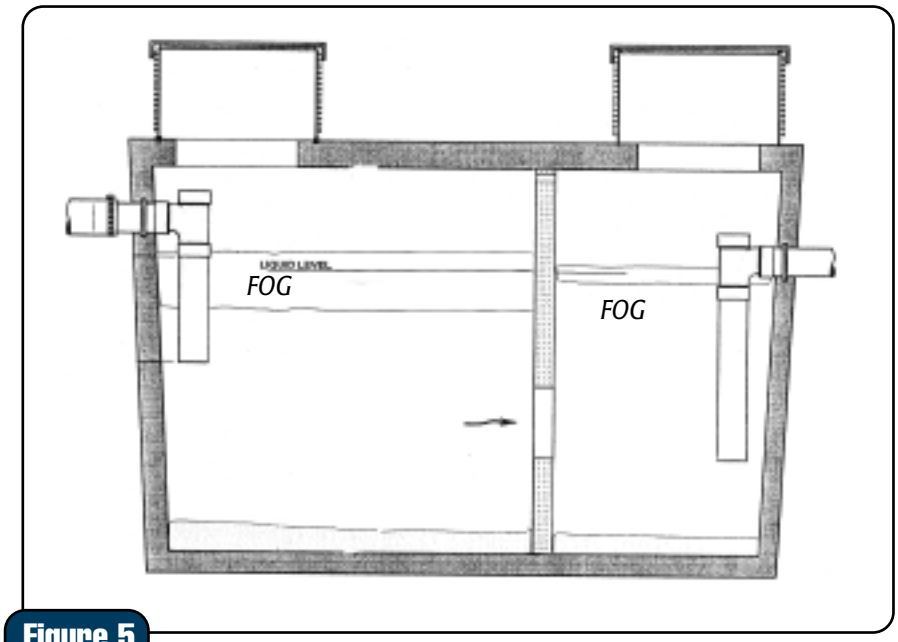


Figure 5 *Diagram of a typical grease trap.*

Gas vents

The natural digestion of the sludge at the bottom of the tank produce gases. These gases are hydrogen sulfide, methane and others—all of which are foul-smelling, possibly lethal, and explosive, and so must be vented out of the system. This venting is handled in several different ways.

Some inlet and outlet pipes are open at the top allowing the gas to collect at the top of the tank. From there the gases are piped back through the house's plumbing and released out the stack vent on the roof.

Vents inside the tank are placed above the scum layer between the inlet and outlet and through any compartment walls. Gas deflection devices or baffles are placed below the outlet tee to prevent rising gas bubbles from inadvertently carrying solids out to the drainfield.

Greasetraps

It is sometimes necessary to use several tanks in a series, the first a grease trap, designed to cool and capture all of the FOG. A grease trap prevents grease and other fatty substances from entering the septic tank and from being carried over to the drainfield, potentially causing clogging and system failures. Used mostly for effluent produced by commercial establishments, grease traps are essentially floatation chambers. They are either small units located directly at the kitchen drain, or large in-ground single or double chambered units. The outdoor type units will be discussed here.

The main application for grease traps is in treating kitchen wastewater for cafeterias, restaurants, hospitals, schools, and other institutions with large volumes of kitchen wastewater.

Taking care of your septic system

- Always conserve water to reduce the amount of wastewater that must be treated and disposed of.
- Stagger your laundry wash loads throughout the week rather than doing it all on one day.
- Keep accurate records of all maintenance including pumping and repairs.
- Repair all leaking faucets and toilets.
- Discharge only biological wastes into the system: no panty liners, cigarette filters, q-tips, tampons, condoms, disposable diapers, dental floss, or other non-biodegradable products.
- NEVER flush chemicals that could contaminate surface and groundwater, such as paints, varnishes, thinners, waste oils, photographic solutions, or pesticides
- Divert all down spouts and all other surface water away from the tank and drainfields.
- Have your septic tank pumped on a regular schedule and check for leaks and cracks.
- Keep all septic tank covers accessible for tank inspections and pumping.
- Do not use a garbage disposal. Compost your garbage or put it in your trash instead. (A garbage disposal can be used if your septic system was designed for it; however, you should have your tank pumped more frequently.)
- Don't dig in your drainfield or build anything over the entire septic system including the tank.
- Don't plant anything over the drainfield except grass.
- Don't drive over the drainfield or compact it in any way as to prevent flow to the drainfields.

Taken from *"Septic System Maintenance,"* at *www.nesc.wvu.edu/nsfc/nsfc_septicnews.htm*

Grease traps operate by cooling the wastewater to separate out the FOG. The FOG floats to the surface of the trap, and is prevented from leaving by baffles and effluent discharge tees that extend below the depth of the oil and grease. See Figure 5. To make it more effective, a grease trap should be placed close to the kitchen where it can receive the still-hot wastewater. The separation process occurs while the liquid cools.

Maintenance practices are important as failure to properly clean the trap and remove the grease and solids can result in excessive grease buildup. This buildup could lead to the possible discharge of grease into the effluent, causing clogging of the drainfield.

Sources

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Burks, Bennette Day, Mary M. Minnis. *Onsite Wastewater Treatment Systems*, 1994. Hogarth House, LTD., Madison, Wisconsin

The following articles can be ordered from the National Small Flows Clearinghouse at (800) 624-8301, or by email at *nsfc_orders@mail.nesc.wvu.edu.* Cost is $.15 per page plus shipping and handling or they can be found online at *www.nesc.wvu.edu/nsfc/nsfc_archive.htm*.

Robillard, P. and K. Martin. "Septic Tank Pumping," Penn State College of Agricultural Sciences: Cooperative Extension: Agricultural and Biological Engineering Fact Sheet, 1990. #L003893.

Rock, Chet A. and James A. Boyer. "Influence of Design on Septic Tank Effluent Quality," *Proceedings* 8th Northwest On-Site Wastewater Treatment Short Course and Equipment Exhibition, Seattle, WA. September 18-19, 1995. #L004575.

Sherman, Kevin M. "Septic Tank Designs for High Effluent Quality," *Florida Journal of Environmental Health*, November 1995. #L004587.

Making it more attractive

Decorative fake rocks are being manufactured that are specially designed to hide septic tank risers, manholes, vent pipes, and other potentially offensive parts of the wastewater treatment system that need to be at or above ground level.

The replicated boulders come in a variety of colors and are lightweight for easy moving. These 'rocks' help reduce motor noise, and have hidden air holes to keep constant air supply to vent pipes and motors.

There are also birdhouses and other lawn ornaments that are specifically manufactured to provide easily accessible, highly visible, yet esthetically pleasing solutions to the aboveground devices of a septic system.

For more helpful information about your septic system…

These issues of *Pipeline* are recommended for further reading. Hard copies may be ordered by calling the National Small Flows Clearinghouse at (800) 624-8301 or by email at *nsfc-orders@mail.nesc.wvu.edu.* A shipping and handling charge will apply. You can also find these newsletters online at *www.nesc.wvu.edu/nsfc/plarchiveframe.html.*

Septic Systems–A Practical Alternative for Small Communities Summer 1995, SFPLNL02

This issue of *Pipeline* explains when septic systems are a good idea, how they work, and their advantages and disadvantages. Brief descriptions and sketches of various alternative designs and distribution systems are included.

Maintaining Your Septic System– A Guide for Homeowners Fall 1995, SFPLNL03

This issue of *Pipeline* explains how to care for septic systems, when to pump, what to flush and not to flush, and what to expect during an inspection visit. Included also with this issue is a list of system do's and don'ts and information about failing systems, system additives, and the effect of cleaners and detergents.

Wastewater Treatment Protects Small Community Life, Health Summer 1996, SFPLNL06

This issue of *Pipeline* explains the importance of wastewater treatment for protecting the health of small communities. Some of the potential health risks posed by inadequate treatment are also described.

A Homeowner's Guide to Onsite System Regulations Winter 1998, SFPLNL12

This issue of *Pipeline* examines some common onsite wastewater system regulations as they affect property transfers, professional qualifications, operation and maintenance, and system changes and repairs. Their importance is discussed, as are the steps that others typically must take to have systems approved. The different roles and responsibilities of health officials are also discussed. This issue highlights a health inspector in rural Kentucky who aids in the installation of onsite wastewater systems.

Inspection Equals Preventative Care for Onsite Septic Systems Spring 1998, SFPLNL13

This issue of *Pipeline* focuses on the advantages of having onsite wastewater systems regularly inspected. An overview of what occurs during an inspection visit is provided for homeowners, as well as information about when and how often systems should be inspected and how to locate a qualified inspector. The issue also includes a list of questions homeowners may be asked about their systems and a discussion of the homeowner's role in the process.

How to Keep Your Water "Well" Summer, 2002, SFPLNL30

The Summer 2002 issue is titled "How To Keep Your Water 'Well" and presents the possible effects and special considerations that are mandatory to prevent the contamination of drinking water wells in areas where onsite treatment is employed. Included are tips from the EPA on protecting groundwater supplies and signs that suggest you should test your well.

Alternative Dispersal Options Fall, 2002, SFPLNL31

The Fall 2002 issue is titled "Alternative Dispersal Options" and provides clear descriptions and diagrams of the various approved subsurface dispersal methods, including trenches, contour systems, drip irrigation, gravelless and chamber systems, mound systems, evapotranspiration systems, and pressure/low pressure pipe systems. A case study is presented which demonstrates the process for determining the most appropriate wastewater technology for a rocky, mountaintop observatory in California.

Reprint Info

Readers are encouraged to reprint *Pipeline* articles in local newspapers or include them in flyers, newsletters, or educational presentations. Please include the name and phone of the National Small Flows Clearinghouse (NSFC) on the reprinted information and send us a copy for our files. If you have any questions about reprinting articles or about any of the topics discussed in this newsletter, please contact the NSFC at (800) 624-8301.

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What is NESC?

The National Environmental Services Center (NESC)—pronounced "nessie"—specializes in providing technical assistance and information about drinking water, wastewater, and environmental training to communities with fewer than 10,000 residents. You may be familiar with our individual programs, each well established as a national leader in its areas of expertise.

Located in Morgantown, West Virginia, NESC is based at one of the nation's major doctoral-granting research institutions, West Virginia University.

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National Small Flows Clearinghouse (NSFC) is a national information and assistance program that helps identify appropriate wastewater technologies. NSFC offers more than 400 free or low-cost products, *Small Flows Quarterly* magazine, and *Pipeline,* a newsletter. NSFC maintains five databases with bibliographic, manufacturers and consultants, state regulations, health department, and facilities information. Visit their Web site at *www.nsfc.wvu.edu.*

National Drinking Water Clearinghouse (NDWC) services include a toll-free technical assistance hotline; *On Tap*, a quarterly magazine on current drinking water issues; more than 300 free products; a literature database, and RESULTS [Registry of Equipment Suppliers of Treatment Technologies for Small Systems] database. The Web address is *www.ndwc.wvu.edu.*

National Environmental Training Center for Small Communities (NETCSC) services include *E-Train*, a quarterly newsletter on environmental training; providing information about environmental training activities; and many free and low-cost products, including the *Environmental Training Resources Catalog*. Find them at *www.netc.wvu.edu.*

National Onsite Demonstration Program, (NODP) encourages the use of alternative, decentralized wastewater treatment technologies in small and rural communities. NODP helps communities fund, install, monitor, and manage model wastewater treatment systems as cost-leffective alternatives to centralized sewage systems. Visit their Web site at *www.nodp.wvu.edu.*

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