Water Treatment NOTES

College of Human Ecology, Cornell University

Household Chemicals and your septic system

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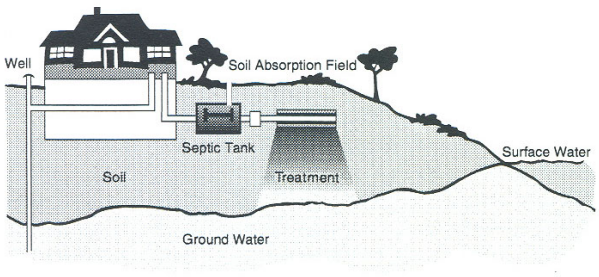
The average American household generates 55 to 75 gallons of waste water per person per day. Sources include toilets, showers, sinks, dishwashers, and washing machines. The diversity of sources means that household wastewater contains a variety of biological and chemical constituents found in sewage, food waste, and assorted household products that are washed or poured down the drain. For nearly one-quarter of American households, these constituents immediately enter a septic system when waste water leaves the home.

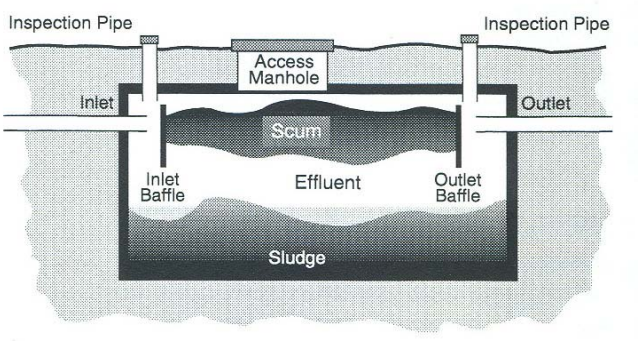
What is a septic system?

A septic system is a privately onwed on-site-water treatment system. A typical septic system consists of a **septic tank** and a **soil absorption system**. The latter is commonly referred to as the **leach field** or **tile drain field**. According to 1990 figures, approximately 1.5 million septic systems serve the rural residents of New York State.

The septic tank is a water tight receptacle comprised of a strong, corrosion-resistant material such as concrete, fiberglass, or plastic. Household waste water flows into the septic tank where it is stored for several days. This ensures that natural populations of bacteria living in septic tanks have sufficient time to break down organic solids and dissolved chemicals found in waste water.



Many septic tanks have multiple compartments to improve the settling and separation of waste water. Heavy solids such as food and sewage settle to the bottom of the tank and form the **sludge** layer. Lighter solids such as hair and grease float to the top of the tank and form the **scum** layer. The separated liquid left in the middle is called **effluent**.



Effluent flows from the septic tank in the soil absorption system when displaced by incoming wastewater. A typical soil absorption system consists of gravel-filled trenches that are 18 to 30 inches deep. Perforated pipes run the length of these trenches. Effluent that is discharged from the septic tank flows through the perforated pipes, empties into the gravel trenches, and ultimately percolates through the underlying soil..

Microorganisms living in the soil will further degrade the partially treated effluent, while remaining solids and other compounds adhere to soil particles. This combination of natural soil processes and interactions with soil microorganisms provides the final level of treatment for household wastewater in the septic system.

*When existing soil conditions are unsuitable for treating household waste water, alternative systems may be installed in place of leach fields. A **raised** or **mound system** may be used when the soil depth is too shallow to treat effluent directly from the septic tank.*

*Instead, effluent is pumped to the top of a mound where it percolates through the underlying soil. A **sand filter** (with downstream absorption system) may be used when the existing soil has a high clay content or similar characteristics that hinders the flow and treatment of waste water. Sand filters distribute effluent through layers of sand and gravel for filtration and treatment.*

Septic systems and groundwater pollution

If a septic system does not function properly, it may discharge a significant volume of untreated wastewater directly to soils overlying groundwater. The potential for groundwater contamination increases when the capacity of the septic tank to dilute or degrade incoming wastewater is exceeded, or when septic tank effluent flows directly through the soil without additional treatment. Potential contaminants found in untreated wastewater include **pathogens** (disease-causing organisms such as bacteria and viruses), nutrients (nitrogen and phosphorus) and household chemicals.

A properly functioning septic system will trap most pathogens in the leach field, where soil conditions unfavorable to them will inhibit their survival. In the septic tank, beneficial bacteria chemically change phosphorus into phosphates and nitrogen into ammonia. When effluent is discharged into the leach field, phosphates frequently adhere to soil particles while ammonia is converted to nitrate by soil organisms. Although nitrate is utilized by growing plants, it is also water soluble and can easily percolate through the soil until reaching groundwater. High concentrations of nitrate in drinking water are considered a health threat to humans.

The fate of household chemicals in the septic system

A typical septic tank may contain more than 100 traceable chemical pollutants. Many chemicals found in a septic system originate from household products that are improperly disposed of down the drain or used in concentrations higher than those recommended on the product label. Some household products, such as ammonia, bleach , and laundry detergents, are intended to be poured down the drain. Under normal use conditions, the chemicals found in these cleaning products pose a minimal risk to the environment because they are diluted in the septic tank or degraded in the leach field.

Some household products, however, contain chemicals that may harm the septic system or contaminate groundwater. If these chemicals enter a septic tank in large doses or concentrated amounts, they may reach concentrations that are toxic to the beneficial bacteria that normally break down wastewater. If these chemicals flow unchanged from the septic tank, they may impact the soil microorganisms living in the leach field. Chemicals that pass through the leach field may become groundwater contaminants.

Septic systems are not designed to protect ground water from the chemicals found in certain household products, particularly those used for auto maintenance and home repair. These products are called **household hazardous products** and should not be disposed of in a manner that allows them to enter the septic system. The chemicals found in household hazardous products may pose a significant risk to human health and the environment if the products are not used or disposed of properly.

At any given time the average household contains an estimate 3 to 5 gallon of products that may be considered hazardous to human health and the environment. Examples of household hazardous chemicals include: fuels, motor oils, antifreeze, solvent-based lubricants, and lawn or garden chemicals such as pesticides. Household hazardous products should not be poured down the drain. They should be used up completely or taken to a household hazardous waste management facility.

Disinfectants

Household cleaning products called **disinfectants** contain antimicrobial ingredients to kill germs on contaminated surfaces. A products that is labeled as a disinfectant is required by law to carry a registration number from the U.S. environmental Protection Agency (EPA). The registration number indicates that the product has been tested thoroughly and meets federal criteria for disinfecting purposes.

Common household products containing disinfectants include pine cleaners. As their name implies, pine cleaners usually contain a disinfectant derived from pine oil. Bathroom and kitchen cleaners often contain a category of chemicals known as **quaternary ammonium compounds**, such as alkyl dimethyl; benzyl ammonium chloride. The key ingredient in most liquid bleaches is **sodium hypochlorite**, one of the most effective and fast-acting disinfectants available.

Disinfectants are considers safe for both septic systems and groundwater as long as they are used in concentrations listed on the product labels. For example, more than 2 gallons of hypochlorite bleach or 5 gallons of pine cleaner would be needed to kill most of the bacteria in a 1,000-gallon septic tank. It would then take 45-60 hours for the bacterial populations to recover from a lethal dose of hypochlorite bleach, and 30-65 hours to recover from a lethal dose of pine cleaner.

Additional concerns have been expressed regarding the fate of hypochlorite bleach in the septic tank. Under normal conditions of household use, the majority (97 percent to 99 percent) of sodium hypochlorite reacts with soils, stains, and organic solids in the wastewater to form salts and other harmful compounds. The remaining 1 percent to 3 percent of sodium hypochlorite entering a septic tank forms chlorinated compounds. Current research shows that the majority (87 percent to 94 percent) of these chlorinated compounds are degraded or removed by septic systems. As a result, the formation of chlorinated compounds from the normal use of hypochlorite bleach is not considered a threat to human health or the environment.

Drain Cleaners

Drain cleaners contain some of the most corrosive chemicals found in the home. A key ingredient in some household drain cleaners is a caustic compound that dissolves grease and breaks through clogged pipes. A common ingredient in both liquid and crystal drain cleaners is **sodium hydroxide**, or **lye**. Some liquid drain cleaners contain corrosive chemicals such as concentrated **sulfuric acid** or **hydrochloric acid**.

When used according to label instructions, most liquid drain cleaners will react with the clogged material and then become diluted before entering the septic tank. If large quantities are used or a build-up occurs in the plumbing, the caustic chemicals may corrode metals in pipes or destroy beneficial bacteria living in the septic tank. Research shows that 1.3 ounces of crystal drain cleaner poured directly into a 1,000-gallon septic tank is enough to kill most of its bacteria. It would then take more than 48 hours for the natural population of bacteria to recover from this lethal dose. Crystal drain cleaners should be used only when necessary and always according to label directions.

Maximum daily dosage of selected household Chemicals for a 1,000-gallon septic tank (Gross, 1987)

Product	Amount
Liquid hypochlorite bleach	1.3 gallons
Pine cleaner	2.5 gallons
Crystal drain cleaner	0.65 ounces

Surfactant-based Cleaning Products

Laundry detergents and other household cleaning products contain surfactants. These compounds help loosen the soil and stains from clothing and keep it suspended in the wash water. Surfactants are made from either petrochemicals or oleo chemicals. Petrochemicals are derived from crude oil; oleo chemicals are derived from natural fats and oils. Both types of surfactants are intended to be used with water and disposed of down the drain.

Surfactants commonly found in laundry detergents include linear alkylbenzene sulfonate and alkyl dimethyl ammonium chloride. These compounds may be removed in the septic tank if they settle to the bottom or naturally degrade. Typically, however, surfactants are absorbed by the soil surrounding the leach field. This reduces their mobility below the leach field, which in turn provides more time for other treatment processes such as biodegradation. As a result, most laundry detergents and surfactant-based cleaning products are considered safe for both septic systems and groundwater.

Products containing Heavy metals

Household plumbing provides the major source of heavy metals found in wastewater, particularly copper from pipes and lead from solder. Other metals, including cadmium, chromium, silver, and zinc, may be found in personal care products such as cosmetics and shampoos. In addition, some types of paints and household cleaners may contain heavy metals. Lead-based paints and cleaning products containing metals should be used up completely or taken to a household hazardous waste management facility.

When personal care products containing heavy metals are washed down the drain, the metals usually become incorporated in the sludge at the bottom of the septic tank. If these metal flow into the leach field along with the effluent, they are usually absorbed by the surrounding soil. However, incidents of groundwater contamination have been reported when a failing septic system is located in the proximity to shallow groundwater.

Solvents and Solvent-based products

A solvent is a substance that dissolves other materials. Many solvents are derived from petroleum, usually crude oil. These solvents tend to be flammable as well as volatile, which means they readily vaporize in the open air. Common household products that contain solvents include gasoline and other fuels, paint thinners, nail polish removers, degreasers, spot removers, and craft or hobby glues such as rubber cement.

Disposal down the drain of solvents or products containing solvents may contaminate groundwater via septic tanks. Many solvents do not mix with water and do not break down easily, even after several days of retention in the septic tank. As a result, those chemicals may flow unchanged through a septic system or percolate through a leach field to underlying groundwater. Solvents entering groundwater may persist for a long time.

Several scientific studies have monitored solvents in household wastewater, septic tank effluent, and groundwater. In virtually every study, solvents that were present in the wastewater were observed frequently in the effluent leaving the septic tank, even if detected only in small quantities. For example, one researcher in Ontario, Canada, studied the fate and transport of a solvent-based commercial plumbing-cleaner through a septic system. Although more than 99 percent of the active ingredient (dichlorobenzene0 volatized or degraded, the concentration reaching the groundwater still exceeded Canadian standards for drinking water.

Solvents or solvent-containing products that are not intended to be used with water should not be poured down the drain. Those products should be used up completely or taken to a household hazardous waste management facility.

Septic tank additives

Numerous products called **septic tank additives** are available to consumers. One type of additives contains bacterial “starters” or enzymes that are intended to rejuvenate bacterial populations in both the septic tank and the leach field. Manufacturers of bacterial starter products claim that household chemicals destroy the natural population of bacteria living in a septic system.

A second type of additives contains solvents that are intended to reduce the grease or fat in a septic tank, thereby minimizing the need for pumping.

Under most circumstances additives are not needed to enhance the normal function of a septic system because a new supply of bacteria is provided every day from incoming household wastewater. These bacteria thrive under the natural growth conditions of a septic tank and will quickly restore the conditions necessary for a properly functioning wastewater treatment system.

The use of solvent-based septic tank additives is not recommended. They have no proven benefit and may actually harm the septic system. Some additives cause the sludge in a septic tank to accumulate, resulting in solids being flushed into a leach field, where they clog the soil. Other additives, particularly degreasers, contain carcinogens (cancer-causing chemicals0 that may flow directly through the septic tank into soils overlying groundwater.

Homeowner care and maintenance of the septic system

Septic systems provide an effective means of treating a wide variety of wastewater constituents. Current research indicates, however, that septic systems cannot treat some household chemicals adequately, particularly solvents and solvent-containing products. For that reason, some household products are considered safe for septic systems, but others are considered a potential source of groundwater contamination.

It is important that homeowners maintain the proper functioning of their septic systems by minimizing the disposal of household hazardous products down the drain and always following directions listed on the product label. Proper use, storage, and disposal of household products will extend the life of septic systems and help protect groundwater from chemical contamination.

Guidelines for maintaining a properly functioning septic system

- Reduce sludge build-up in your septic system by having it pumped regularly (every 3-5 years)
- Reduce wastewater inputs to the septic system by installing low-flow water fixtures in your home and conserving water (unless flushing household products down the drain)
- Avoiding pouring large amounts of household products and other chemicals down your drain at the same time. When disposal down the drain is necessary, always flush with plenty of water and do not mix products together (toxic gases might be formed)
- Do not use solvent-based septic tank additives or other products to enhance the normal function of your septic tank
- Always read the label carefully for all household products. Note the active ingredient(s) and follow the manu-

Selected household products that are intended to be rinsed down the drain during normal use

Laundry products
- Bleaches
- Detergents
- Fabric Softeners (not dry sheets)
- Water softeners

Dishwashing products
- Detergents
- Film and spot removers
- Rinse agents

Cleaning products
- All-purpose cleaners
- Ammonia or ammonia-based products
- Aluminum cleaners
- Baking Soda
- Borax
- Carpet cleaners (water based)
- Disinfectants
- Drain cleaners (liquid only)
- Floor or furniture cleaners (water based)
- Glass and multi-surface cleaners
- Toilet bowl cleaners
- Tub/tile/sink cleaners

Personal care products
- Alcohol-based lotions
- Hair relaxers and removers
- Hand/body soaps (liquid or gel)
- Medicines (expired)

Hobby and other products
- Lye-based paint strippers
- Water-based glues

Note: Most household products that are water soluble may be disposed of safely down the drain. Other products, such as oven cleaners, crystal drain cleaners, furniture polishes, and solvent-based cleaners, should not enter the septic system. For proper disposal guidelines, call the manufacturer's toll-free number that is listed on the product label or contact your household hazardous waste or solid waste management facility.

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