

# SEPTIC TANKS

CE 370

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## Septic Tanks

### ➤ Definition:

- A **septic tank** also known as a **septic system** is a small scale sewage treatment system common in areas with no connection to main sewerage pipes.
- Septic systems are a type of On-Site Sewage Facility. In North America approximately 25% of the population relies on septic tanks; this can include suburbs and small towns as well as rural areas. In Europe they are generally limited to rural areas only.
- The term "septic" refers to the anaerobic bacterial environment that develops in the tank and which decomposes or mineralises the waste discharged into the tank. Adding a supplemental bacterial agent to the tank will accelerate the digestion of solids in the tank.

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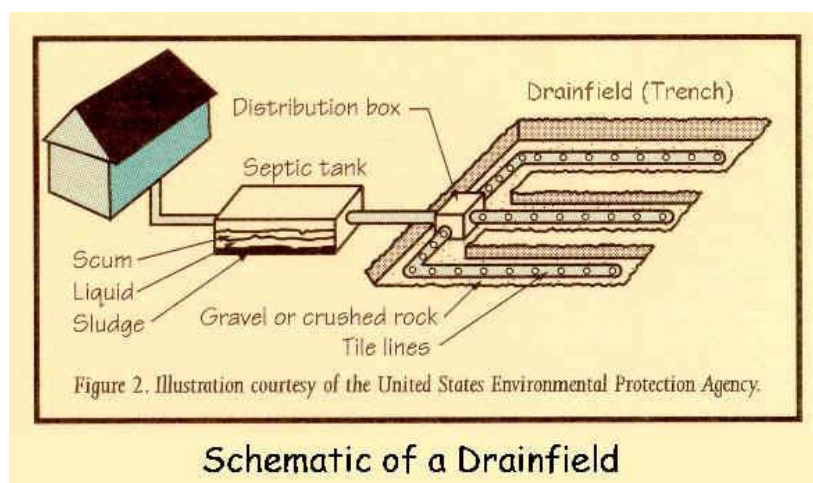
## Septic Tanks

### ➤ Description:

- A septic tank generally consists of a tank of between 1,000 and 1,500 gallons which is connected to an inlet wastewater pipe at one end and to a septic drain field at the other.
- Waste water flows from the house to the septic tank. The tank is designed to retain wastewater and allow heavy solids to settle to the bottom.
- These solids are partially decomposed by bacteria to form **sludge**.
- Grease and light particles float, forming a layer of **scum** on top of the wastewater.
- Baffles installed at the inlet and outlet of the tank to help prevent scum and solids from escaping.

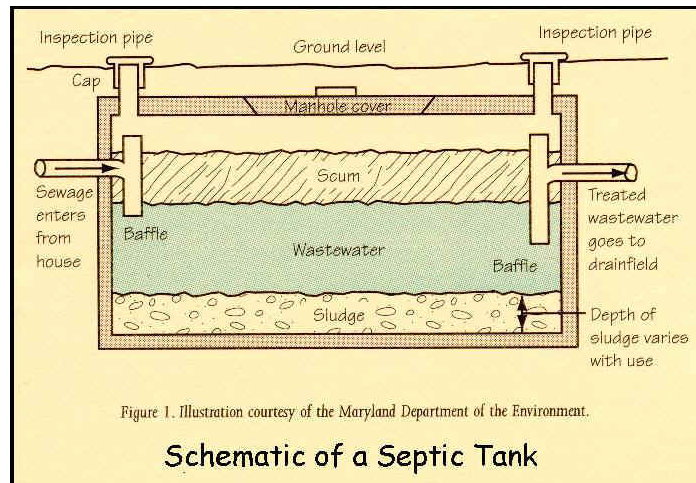
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## Septic Tanks



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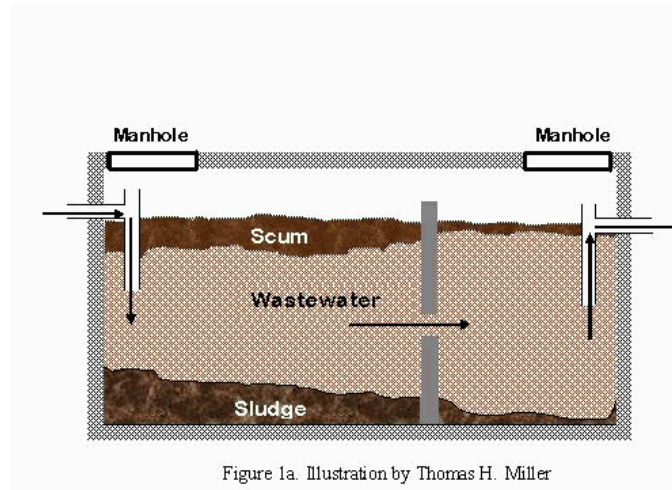
## Septic Tanks

### ➤ Description:

- Today the design of the tank usually incorporates two chambers (each of which is equipped with a manhole cover) which are separated by means of a dividing wall which has openings located about midway between the floor and roof of the tank.
- Wastewater enters the first chamber of the tank, allowing solids to settle and scum to float. The settled solids are anaerobically digested reducing the volume of solids.
- The liquid component flows through the dividing wall into the second chamber where further settlement takes place with the excess liquid then draining in a relatively clear condition from the outlet into the leach field, also referred to as a drain field, or seepage field, depending upon locality.

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## Septic Tanks



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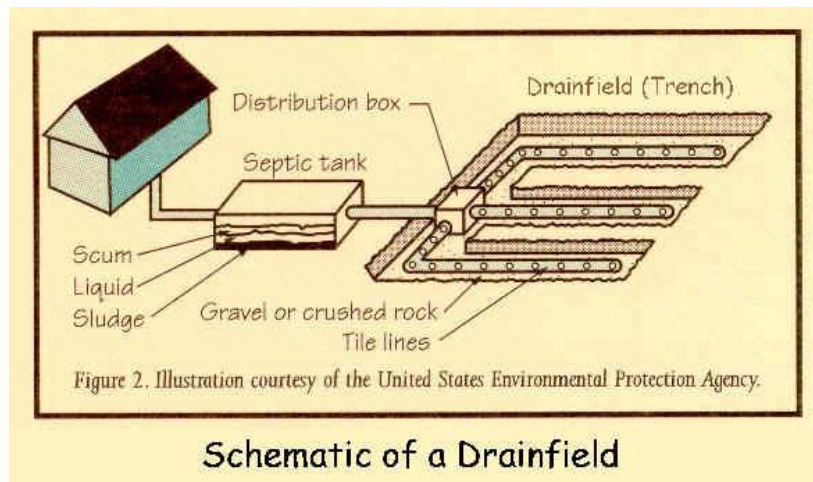
## Septic Tanks

### ➤ Drainfield (Trench):

- A solid pipe leads from the septic tank to a distribution box where the wastewater is channeled into one or more perforated pipes set in trenches of gravel.
- The water slowly infiltrates (seeps) into the underlying soil.
- Dissolved wastes and bacteria in the water are trapped or adsorbed to soil particles or decomposed by microorganisms.
- This process removes disease-causing organisms, organic matter, and most nutrients (except nitrogen and some salts).
- The purified wastewater then either moves to the groundwater or evaporates from the soil.
- Trench systems are the most common type of system used in new home construction.

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## Septic Tanks

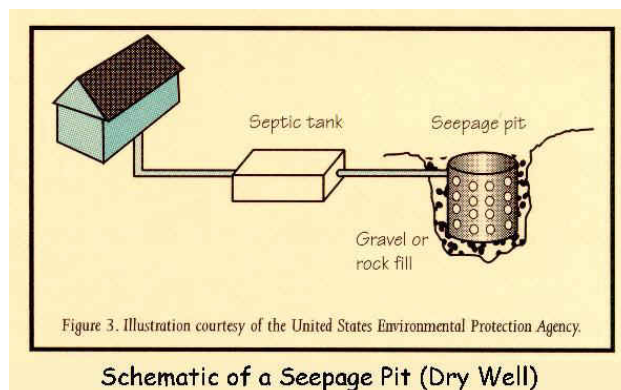


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## Septic Tanks

### ➤ Seepage pit:

- An alternative to the common drain field is the Seepage Pit (Dry Well). In this type, liquid flows to a pre-cast tank with sidewall holes, surrounded by gravel. Liquid seeps through the holes or joints to the surrounding soil.



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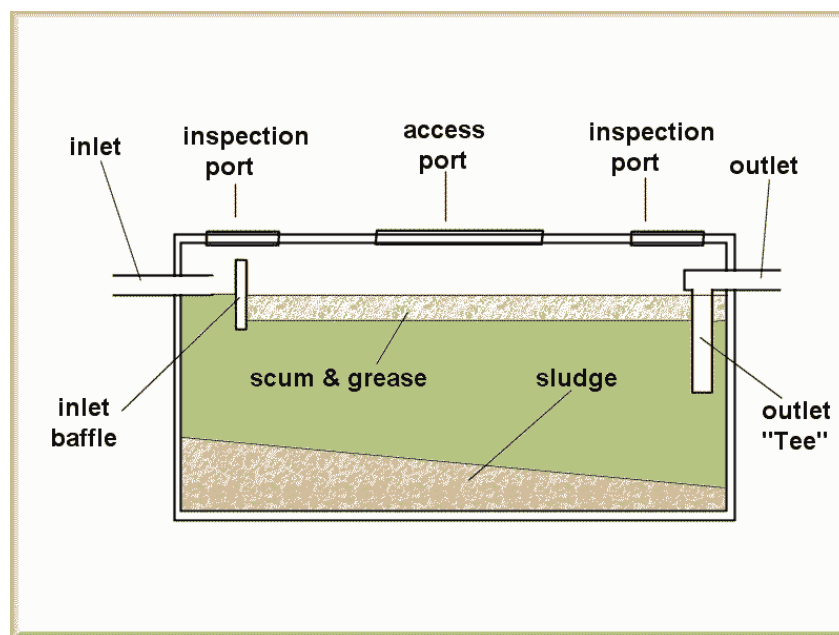
## Septic Tanks

### ➤ How long liquids must remain in tank:

- **Effective volume:** The floating scum layer on top and the sludge layer on the bottom take up a certain amount of the total volume in the tank. The effective volume is the liquid volume in the clear space between the scum and sludge layers. This is where the active solids separation occurs as the wastewater sits in the tank.
- **Retention time:** In order for adequate separation of solids to occur, the wastewater needs to sit long enough in the quiescent conditions of the tank. The time the water spends in the tank, on its way from inlet to outlet, is known as the retention time. The retention time is a function of the effective volume and the daily household wastewater flow rate:

Retention Time (days) = Effective Volume (gallons)/Flow Rate (gallons per day)  
A common design rule is for a tank to provide a minimum retention time of at least 24 hours, during which one-half to two-thirds of the tank volume is taken up by sludge and scum storage.

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## Septic Tanks

### ➤ How long liquids must remain in tank:

- Note that this is a minimum retention time, under conditions with a lot of accumulated solids in the tank. Under ordinary conditions (i.e., with routine maintenance pumping) a tank should be able to provide two to three days of retention time.
- As sludge and scum accumulate and take up more volume in the tank, the effective volume is gradually reduced, which results in a reduced retention time. If this process continues unchecked-if the accumulated solids are not cleaned out (pumped) often enough-wastewater will not spend enough time in the tank for adequate separation of solids, and solids may flow out of the tank with the effluent into the drain field. This can result in clogged pipes and gravel in the drain field, one of the most common causes of septic system failure.

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## Septic Tanks

### ➤ Solids storage:

- In order to avoid frequent removal of accumulated solids, the septic tank is designed with ample volume so that sludge and scum can be stored in the tank for an extended period of time.
- A general design rule is that one-half to two-thirds of the tank volume is reserved for sludge and scum accumulation.
- A properly designed and used septic system should have the capacity to store solids for about five years or more.
- However, the rate of solids accumulation varies greatly from one household to another, and actual storage time can only be determined by routine septic tank inspections.

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## Septic Tanks

### ➤ Cleaning of septic tank

- Septic tank should be periodically cleaned to avoid the build-up of sludge and eventual escape with the effluent into the drainage field. If this happens, it may clog the leach field piping requiring expensive repairs.
- How often the septic tank has to be emptied depends on the volume of the tank relative to the input of solids, the amount of indigestible solids and the ambient temperature (as anaerobic digestion occurs more efficiently at higher temperatures).
- In general it is rare for a septic tank system to require emptying more than once a year, and by careful management many users can reduce emptying to every 3 to 5 years.

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## Septic Tanks

### ➤ Cleaning of septic tank: (continue)

- When emptying a tank, only a small residue of sludge should be left in the tank. Anaerobic decomposition is rapidly re-started when the tank re-fills.
- A properly designed and normally operating septic system is odor free and besides periodic inspection and pumping of the septic tank should last for decades with no maintenance.
- A well designed and maintained concrete, fiberglass or plastic tank should last about 50 years.

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## Septic Tanks

### ➤ Potential problems:

- Excessive dumping of cooking oils and grease can fill up the upper portion of the septic tank and can cause the inlet drains to block. Oils and grease are often difficult to degrade and can cause odor problems and difficulties with the periodic emptying.
- Flushing non-biodegradable hygiene products such as sanitary towels, cotton buds etc. will rapidly fill or clog a septic tank and these materials should not be disposed of in this way.
- The use of waste grinders for disposal of waste food will cause a rapid overload of the system and early failure.
- Certain chemicals may damage the working of a septic tank, especially pesticides, herbicides, materials with high concentrations of bleach or caustic soda or any other inorganic materials such as paints, solvents etc. Such materials inhibit bacterial function.

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## Septic Tanks

### ➤ Potential problems: (continue)

- Roots from trees and shrubbery growing above the tank or the drain field may clog and or rupture them.
- Playgrounds and storage buildings may cause damage to a tank and the drainage field. In addition, covering the drainage field with an impervious surface, such as a driveway or parking area, will seriously affect its efficiency and possibly damage the tank and absorption system.
- Excessive water entering the system will overload it and cause it to fail. Checking for plumbing leaks and practicing water conservation will help the system's operation.
- If the system is damaged or malfunctions, Proper professional help is required to avoid potential health hazards.

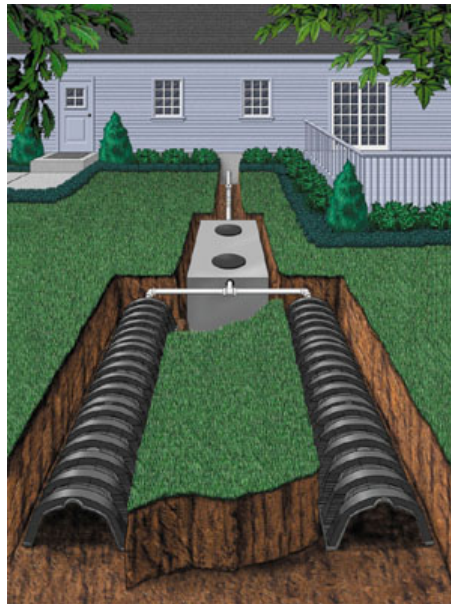
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## Septic Tanks

### ➤ Environmental issues:

- Some pollutants, especially sulfates, under the anaerobic conditions of septic tanks, are reduced to hydrogen sulfide, a pungent and toxic gas.
- Likewise, nitrates and organic nitrogen compounds are reduced to ammonia.
- Because of the anaerobic conditions, fermentation processes take place, which ultimately generate carbon dioxide and methane, both of which are known greenhouse gases.
- Phosphate is kept in a soluble form in a septic tank. Because phosphate can be the limiting nutrient for plant growth in many eco-systems, the discharge from a septic tank into the environment can trigger prolific plant growth including algal blooms.

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