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NebGuide

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Home Sewage Treatment Systems

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Homeowners in areas not served by municipal sewage treatment systems face a problem of providing safe and effective wastewater treatment systems for their homes.

There are several methods currently available for proper treatment of home sewage, including septic tank-absorption fields, mounds, lagoons, aerobic treatment units and others. These systems and their advantages and disadvantages are discussed in this NebGuide.

Treatment and disposal of domestic sewage is of concern because of the variety of pathogenic organisms contained in sewage. These include bacteria, viruses, and other microorganisms that come from the digestive tract, respiratory tract, and skin of man. Some of the illnesses caused by these include dysentery, infectious hepatitis and typhoid. It is important to keep these disease-causing organisms from entering underground water supplies or surface waters through improperly designed or installed sewage treatment systems.

Septic Tank-Absorption Field System

Conventionally, the septic tank-absorption field system has proven satisfactory for many areas when properly designed, installed, and maintained. However, conditions do exist where this system is not suitable. Areas of seasonal high groundwater tables, bedrock in close proximity to the soil surface, or soils having very fast or very slow percolation rates are not suited for the septic tank-absorption field system. Other limitations for this system include topography, small lot size and proximity to water supplies used for drinking or recreation.

The typical septic tank-absorption field home sewage treatment system consists of two major components—the septic tank and the absorption field *(Figure 1)*. In the septic tank, solids are separated from the liquid, undergo anaerobic digestion and are stored as sludge at the bottom of the tank. The liquid (septic tank effluent) flows to the absorption field where it percolates into the soil. The soil acts as a final treatment by removing bacteria, pathogens, fine particles, and some chemicals.

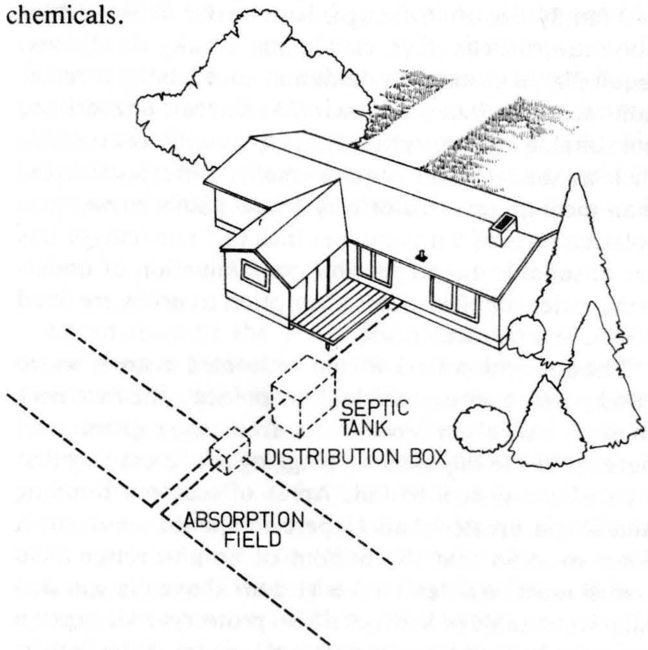


Figure 1. Typical septic tank-absorption field home sewage treatment system.

The minimum septic tank liquid capacity for any location is 1,000 gallons (3,800 l). For houses having more than three bedrooms, an additional 250 gallons (950 l) of tank capacity is added per bedroom. Septic tanks must be water tight and constructed from durable materials that resist excessive corrosion, frost damage and cracking or buckling due to settlement or backfilling. Common construction materials include concrete, fiberglass and bitumastic coated steel.

Location of the septic tank is usually determined by the placement of the home plumbing and the topography of the land. Septic tanks should be located at least 15 feet (4.5 m) from foundation walls and at least 50 feet (15 m) from private water supplies or surface waters. The location should be accessible for cleaning but should not be located beneath sidewalks, patios or driveways. Also, consider possible expansion of the house when selecting a site for septic tank placement.

The need for pumping septic tanks periodically to remove the sludge that accumulates in the bottom of the tank is often overlooked or neglected. If the sludge is not removed, the solids will eventually build up in the tank, wash out into the absorption field, and clog the soil pores to the point where a new field will be needed.

Final treatment of the septic tank effluent occurs in the absorption field. The conventional absorption field consists of two or more flat-bottom trenches not more than 100 feet (30 m) long. Each trench generally contains a line of perforated plastic or sewer pipe laid in a gravel bed. This permits the effluent to spread uniformly over the entire length of the trench and percolate into the soil. The amount of absorption area needed depends on the number of bedrooms in your home and the percolation rate of the soil. The absorption area is based on the number of bedrooms rather than the number of individuals currently living there because home ownership and family size often change. Soils having slow percolation rates, such as clays, clay loams, or silty clay loams, require large absorption fields and soils having percolation rates 60 minutes per inch (24 min/cm) or more are not suitable for absorption fields. Similarly, coarse soils such as sandy loams require smaller absorption areas than medium textured or clayey soils. Soils having percolation rates of 5 minutes per inch (2.5 min/cm) or less are unsuitable due to possible contamination of underlying water supplies unless absorption trenches are lined with a less permeable soil.

The absorption field should be located in areas where good grass cover is possible. Do not locate the field near trees or shrubbery since roots from these plants will develop inside the tile line, plugging it and causing that part of the system to fail. Areas of seasonal flooding and slopes greater than 15 percent should be avoided. Keep in mind that the bottom of an absorption field trench must be at least 4 feet (1.2 m) above the seasonal high water table or bedrock. Also protect the absorption area against surface runoff and water from roofs, patios, driveways or other paved areas. Never discharge the water from footing drains or other sources into the absorption field area.

Mound Systems

Mound systems were developed to allow home sewage treatment in areas where the conventional septic tank-absorption field has limited usage due to high groundwater tables, bedrock layers close to the soil surface, or soils with either very low or high percolation rates. The mound system includes a septic tank for primary sewage treatment and a constructed absorption field or mound for final waste treatment *(Figure 2)*. The mound is used in place of existing soil and consists of fill material having suitable absorption capacities. Rather than having a continuous or gravity flow of septic tank effluent to the mound, a dosing pump or siphon is often used. The use of a dosing pump allows the use of mounds which are constructed at higher elevations than the septic tanks.

Mounds are often constructed on roughened soil surfaces so a "bond" between the fill material and soil surface is formed. This allows some seepage from the mound into the existing soil while providing sufficient separation between septic tank effluent and high groundwater tables or bedrock. Care must be taken during construction of the mound to ensure that compaction of the fill material and underlying soil does not occur.

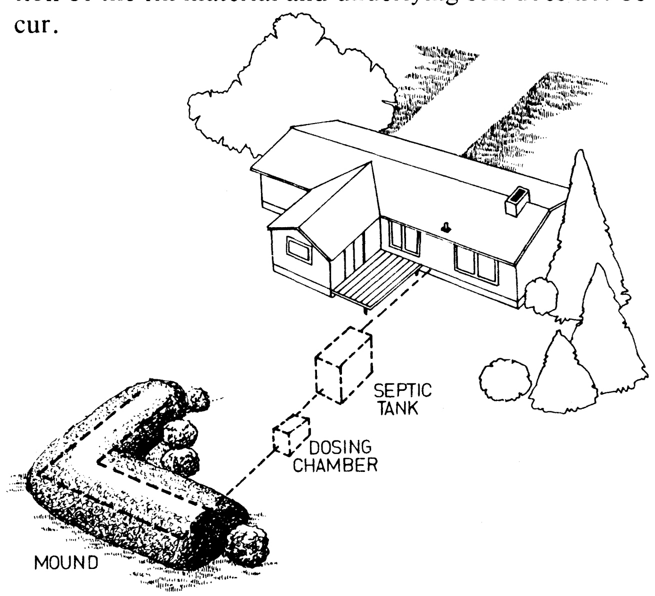


Figure 2. Mound system used for home sewage treatment.

Mound size is dependent on the existing soil percolation rate, fill material and dosing rate. A typical 3-bedroom home would require a total mound area of approximately 1300 sq. ft. (120 m^2). A mound has a larger total absorptive surface area than an absorption field and also has increased evapotranspiration from its surface, thus its size may be somewhat smaller than a properly sized absorption field.

In addition to providing home sewage treatment, a mound can improve the existing landscape features of a lot. It can be located and landscaped to enclose space, block winds and improve appearances and views. With side slopes of three units horizontally to one unit vertically, a grass vegetative cover can be easily mowed. Species of small trees or shrubs placed around the mound can screen unsightly views, create interest on a flat lot, and enhance privacy. Although the location of a mound is somewhat dependent on soil characteristics, its shape and orientation can be changed to benefit the lot's appearance.

Management of the mound system is similar to that of a septic tank-absorption field system. The mound system uses a septic tank which is sized, located and maintained just the same as for the septic tank-absorption field system. Like the absorption field, the mound should not be located in areas subject to flooding or on slopes greater than 12 percent, and the area should not be subject to excessive compaction.

Lagoons

The lagoon system *(Figure 3)* is an effective method of home sewage treatment and is well suited for larger lot areas having very slow soil percolation rates. This system generally discharges home sewage directly into the lagoon. Properly designed and sized lagoons use evaporation for dewatering. Both aerobic and anaerobic decomposition occur in lagoon treatment of home sewage. Anaerobic treatment generally occurs at and near the bottom of lagoons where settled solids and sludges accumulate. This treatment is similar to the anaerobic treatment that occurs in septic tanks. Aerobic treatment occurs in the presence of oxygen and usually occurs near the lagoon surface. Aerobic treatment aids in reducing the odors released during anaerobic treatment and also provides additional treatment of home sewage. Wind movement aids in mixing oxygen into the lagoon surface and helps to increase evaporation.

Proper lagoon sizing and construction is essential for holding and treating home sewage. The surface area of a lagoon must be at least 900 square feet (83.6 m^2). When more than 5 people live in a house, an additional 175 square feet (16.3 m^2) of lagoon surface area is required for each person. Lagoon length should not exceed three times its width and the liquid depth is about 3 feet (0.9 m). For ease of mowing, the lagoon should have side slopes of three units horizontal to one unit vertical. It may also be necessary to place a diversion terrace around part of the lagoon to keep surface water from entering into it.

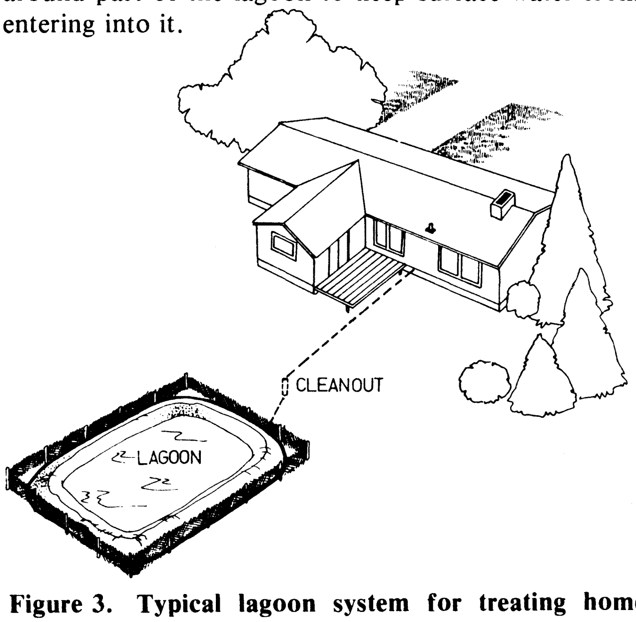


Figure 3. Typical lagoon system for treating home sewage.

Lagoons must be at least 50 feet (15 m) from any property line and 200 feet (60 m) from neighboring residences. Therefore, the minimum size lot area for lagoon construction is 3 acres (1.2 ha). Lagoons must be enclosed with a 4 foot (1.2 m) high fence having a locking gate, and signs stating: NO TRESPASSING—WASTE LAGOON.

In areas where the soil is not conducive to compaction, additional materials such as soda ash, bentonite, or plastic liners may be required to completely retain seepage of effluent. Open water during the summer months provides a nesting ground for mosquitos, which requires mowing of the lagoon banks to reduce possible mosquito breeding area.

Aerobic Treatment Process

Aerobic treatment tanks are sometimes used to treat home sewage. Aerobic tanks are similar to septic tanks, but the treatment process is quite different. In aerobic units, air is mixed into the sewage which promotes growth of oxygen-using aerobic bacteria. A stirring agitator or an air compressor is used to supply the oxygen to the aerobic bacteria.

The biological activity and digestive process in an aerobic tank are much more efficient than in an anaerobic septic tank, but energy is required to provide aeration. If the aerobic tank is properly functioning, the effluent discharge is cleaner and less odorous. However, it is still sewage and must be discharged to an absorption field for final filtration and purification. If the aerobic tank agitator or air compressor fails, the quality of effluent discharged from an aerobic tank will not be as good as that from an adequately sized and maintained septic tank. Because aerobic units require considerable maintenance, a continuous service agreement should be maintained with a dealer or installer.

Other Alternatives

Alternatives to the flush toilet, and thus to other home sewage treatment methods are also available. These include the chemical toilet, incinerating toilet, composting toilet, and low water use toilet. Chemical toilets are available in many models. In most of them, a charge of chemical is added to a small amount of water. After use, the liquid is recirculated by an electric or hand-operated pump to "flush" the wastes into the holding chamber. When the holding chamber is full, a valve can be opened to discharge the wastes into a septic tank or other holding tank for later disposal at a sewage treatment plant. On some chemical toilets the holding chamber can be removed for waste disposal.

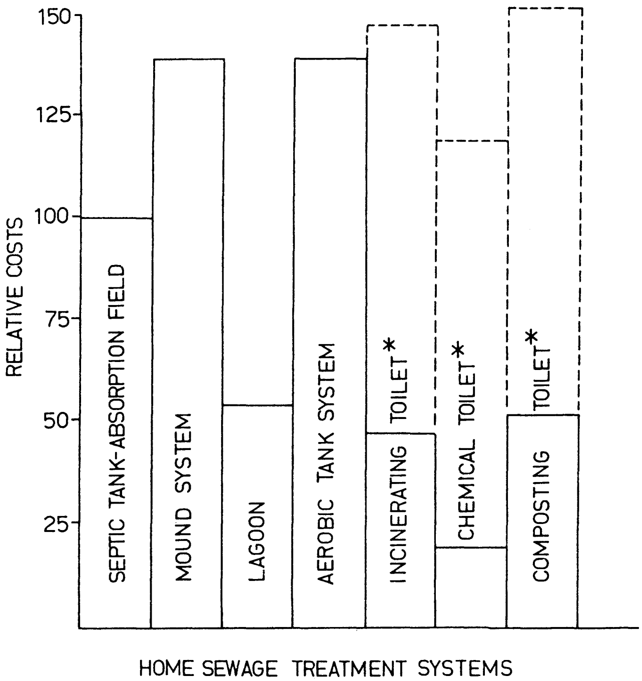
Incinerating toilets can completely eliminate liquid wastes from the toilet and are available both in electric and gas models. The wastes are collected in a firing chamber and incinerated into sterile ash which must be removed periodically and applied to the land.

The composting system collects wastes in a chamber where decomposition occurs through bacterial action and the heat produced from this action. Organic wastes from the kitchen can also be composted in some models. Some require a ventilation fan to minimize odors, while others use electricity for heat to aid the composting process. The composted wastes must be removed periodically and disposed of by land application or another sanitary manner.

Water used for laundering, dishwashing and bathing is not usually treated by incinerating or composting toilets. Thus, these alternative toilets also require a second home sewage system, such as a septic tank-absorption field or mound, to properly treat water used in places other than the toilet. However, when toilet wastes are not discharged to the septic system, the size of the system can be reduced by approximately 35 percent.

Summary

Several home sewage treatment alternatives are currently available. All systems have some disadvantages, and some will work better than others for specific situations. Relative cost comparison among the systems is shown in *Figure 4.* Remember—the cheapest system may not be the most advantageous or acceptable to your neighbors.



***These systems generally require a second home sewage system to properly treat water used for bathing, laundering, and other non-toilet water uses.**

Figure 4. Relative costs of home sewage treatment systems as compared to the septic tank-absorption field system (assumed to be $2,500 in spring, 1980).

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