



INNOVATIVE ON-SITE SOIL DISPOSAL SYSTEMS FOR SEPTIC TANK EFFLUENT

by PURUSH K TERKONDA

There are many areas where the conventional septic tank-soil absorption field is not a suitable system of wastewater disposal. Sites with very slowly permeable soils, excessively permeable soils, or soils over shallow bedrock or high groundwater, for example, are simply not suited for the conventional system. However, alternate systems can be used which still utilize the capabilities of soil to absorb and purify wastewater.

Slowly Permeable Soils

Slowly permeable soils constitute a major group of problem soils. Soils with percolation rates faster than 120 min/in often have seasonal perched water tables within 2 feet of the ground surface, especially during the spring and fall. Infiltrating surface water during these wet periods is unable to percolate through the subsoil fast enough and flooding occurs from lateral movement of water through the topsoil from higher elevations. Such conditions are not suitable for conventional soil absorption systems.

To overcome these conditions, one alternative is to raise the absorption field above the natural soil by building the seepage system in a mound of medium sand. This raises the seepage system above the wet slowly permeable subsoil and places it in a dry permeable sand (see Figure 1). There are several advantages to this. First, the percolating liquid enters the more permeable natural topsoil over a large area and can safely move out laterally until absorbed by the less permeable subsoil. Second, the clogging zone that eventually develops at the bottom of the gravel trench within the mound will not clog the sandy fill to the degree it would in the natural soil. Finally, smearing and compaction of the wet subsoil is avoided, since excavation in the natural soil is not necessary.

The design of the mound is based upon the expected daily wastewater volume it will receive and the natural soil characteristics. It must be sized such that it can accept the daily wastewater flow without surface seepage when perched water exists in the natural soil in the spring and fall, as well as when the water table is lower during the summer and winter. Size and spacing of the seepage trenches is important to avoid liquid from rising into the fill below the trenches when the water table is high. In addition, the total effective basal area of the mound must be sufficiently large to conduct the effluent into the underlying soil.

A clean, medium sand is used as the fill material in construction of the mound and the gravel trenches constructed within consist of 1 - 1-1/2 inch stone. As in any seepage trench, a clogging mat will develop at its bottom. The ultimate infiltration rate through this zone has been shown to be 5 cm/day. Therefore, one consideration must be to insure that sufficient trench bottom area is available for the design flow.

If more than one trench is included, another consideration is the spacing between trenches. The area between trenches must be long enough for the underlying natural soil to absorb all the liquid contributed by the upslope trench. Infiltration rates into the natural soil is based on the hydraulic conductivity characteristics of the least permeable soil horizon below the proposed site. The basal area required for the mound is based on this as well.

To distribute the wastewater to each of the trenches a pressure distribution network is used. This provides uniform application which is necessary to prevent local overloading and eventual surface seepage.

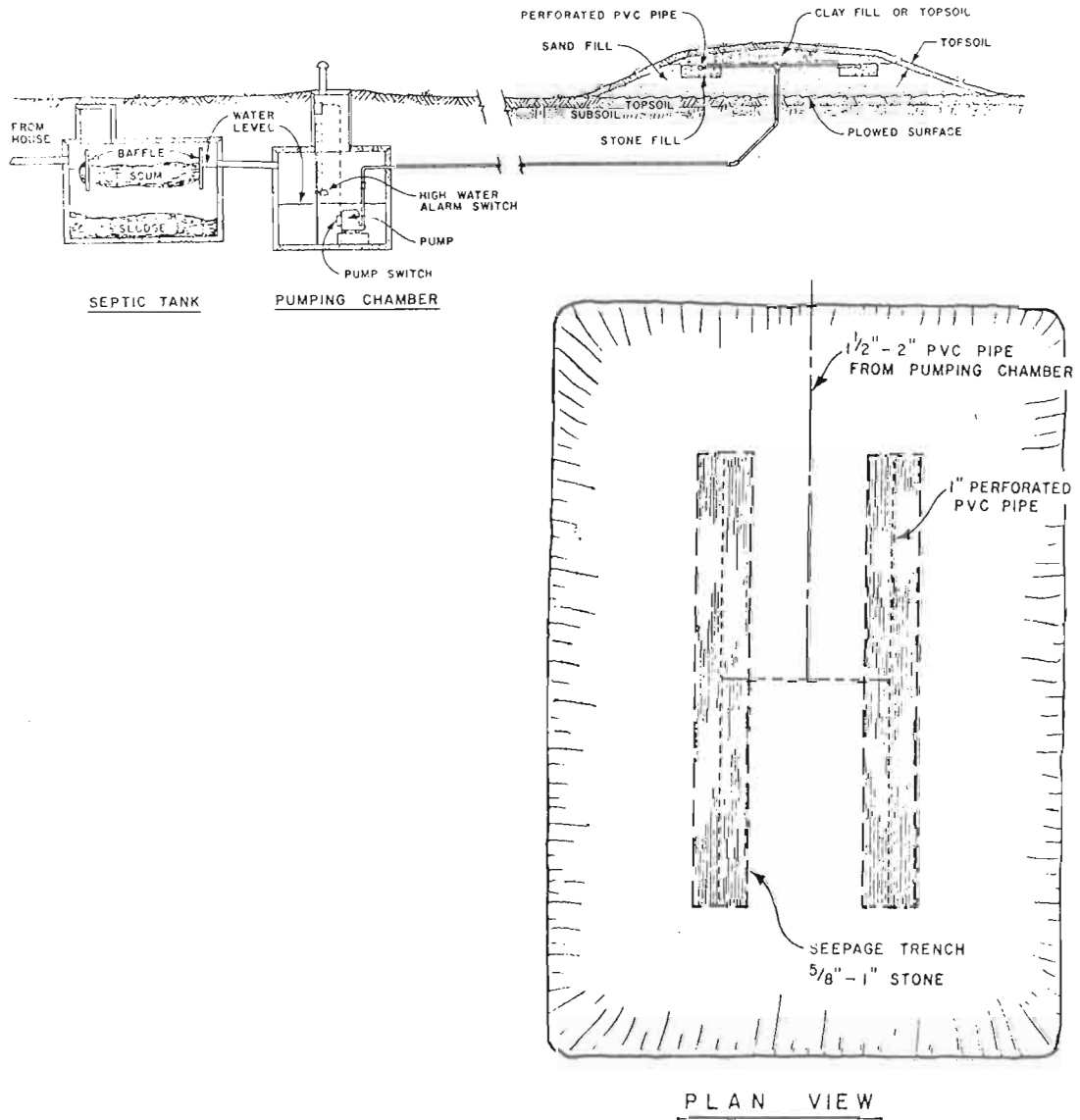


Figure 1 A plan view and cross-section of a mound system for problem soils (After Otis, et al.)

Shallow, Permeable Soils Over Creviced or Porous Bedrock

Shallow, permeable soils over creviced or porous bedrock constitute a major group of problem soils because inadequate soil is available to purify the percolating waste before it reaches the porous bedrock which leads directly to the groundwater. To overcome these limitations, the absorption field can be raised above the natural soil by using the mound system (see Figure 1). This increases the amount of soil available for percolation and with uniform application of effluent, purification will be adequate by the time the percolating effluent reaches groundwater.

The design of the mound follows the same procedures as described for the mound in slowly permeable soils. However, the seepage system within the fill may have nearly any shape desired, since the permeability of the natural soil is not a limiting factor. A bed is usually more suitable than trenches.

Permeable Soils With Seasonally High Groundwater

Mound systems

Homes should not be built in areas with a permanently high groundwater table. However, in some areas, homes are built where the water table is high only occasionally during the year. During high water table periods, a conventional septic tank-soil absorption system cannot function properly due to flooding of the system and improper purification.

A properly designed and constructed mound system provides sufficient unsaturated distance for purification before the effluent reaches the groundwater (Figure 1). The design of the mound follows the same procedures as described for the mound in slowly permeable soils but the seepage system within the mound is usually a rectangular bed. Normally the permeability of the natural soil is not a limiting factor but the mound must be designed to prevent the intrusion of the perched water table to the base of the mound.

Curtain or underdrain systems

Conventional subsurface trenches can be constructed where periodic high water tables are a problem if the natural soil is drained. Agricultural drain tile is used to lower the water table and to discharge the water to the ground surface. Careful placement of the drain is necessary to insure a sufficient depth of unsaturated soil is maintained for purifying the wastewater to avoid short circuiting.

There are disadvantages to these alternate systems. Construction of mound systems depends upon a source of suitable fill material and relatively large lots. Mounds cost \$2500 to \$3500 or more to construct depending on hauling costs. Underdrain systems may be cheaper but systems not dependent on soil for disposal sometimes may be more desirable.