



An Introduction to Small Flow Waste Treatment Systems

An Online Continuing Education Course for Engineers

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An Introduction to Small Flow Waste Treatment Systems

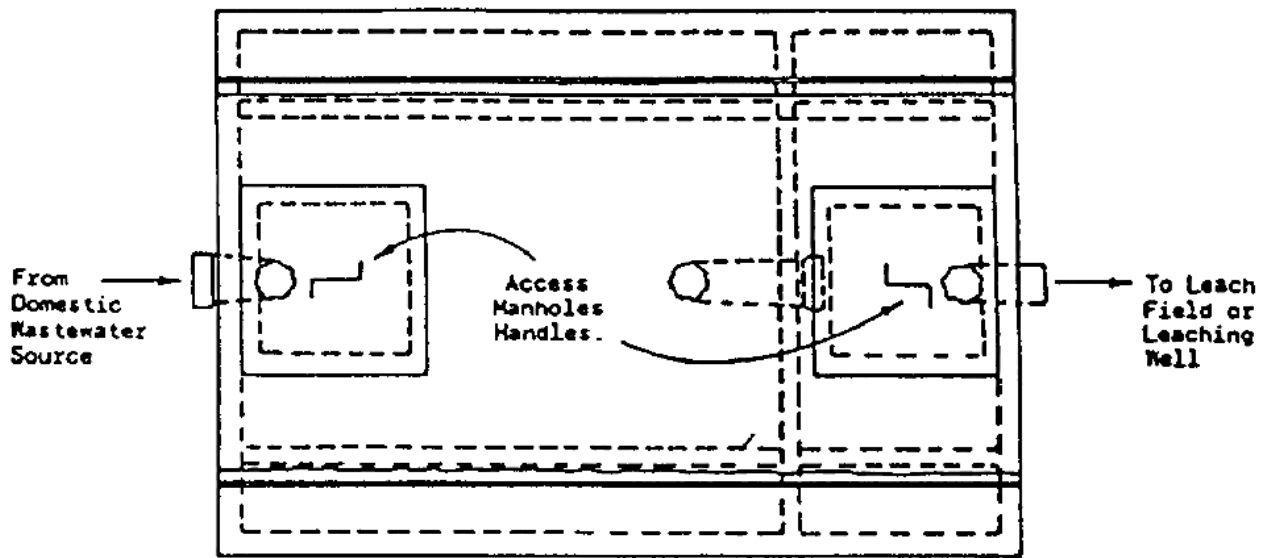
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1. GENERAL CONSIDERATIONS

Treatment systems handling less than 1.0 million gallons per day are generally considered small treatment systems. For some packaged treatment systems, the principles of design are no different but the choice of equipment will usually differ from that used in large plants. This is usually due to the effect of economies of scale, whereby certain operations are economically feasible only on a large scale. In other cases, certain treatment systems such as septic tanks, Imhoff tanks, waterless toilets, mounding systems and composting toilets are only applicable to very small flows. Small packaged plants must make larger safety factor allowances for flow variation and temperature effects relative to total wastewater flows. Smaller package plants inherently have less operational flexibility; however, they are capable of performing effectively and efficiently. These small packaged plants may consist of trickling filter plants, rotating biological discs, physical-chemical plants, extended aeration activated sludge plants, and septic tanks. (Barnes and Wilson, 1976.) Design criteria for septic tanks, Imhoff tanks, waterless toilets, mounding systems, composting toilets, and filtration/reuse systems are given below.

2. SEPTIC TANKS

Septic tanks, with appropriate effluent disposal systems, are acceptable as a treatment system for isolated buildings or for single-unit residential buildings when permitted by regulatory authority and when alternative treatment is not practical. When soil and drainage characteristics are well documented for a particular site, septic tank treatment may be permanently feasible. Septic tanks perform settling and digestion functions and are effective in treating from 1 to 300 population equivalents of waste, but will be used only for 1 to 25 population equivalents, except when septic tanks are the most economical solution for larger populations within the above range. Minimum size will be at least 500-gallons capacity. In designing tanks, the length-to-width ratio should be between 2:1 and 3:1, and the liquid depth should be between 4 and 6 feet (fig 2-1). Detention time depends largely on the method of effluent disposal. When effluent is disposed of in subsurface absorption fields or leaching pits, 24 hours detention time based on average flows is required.



Plan

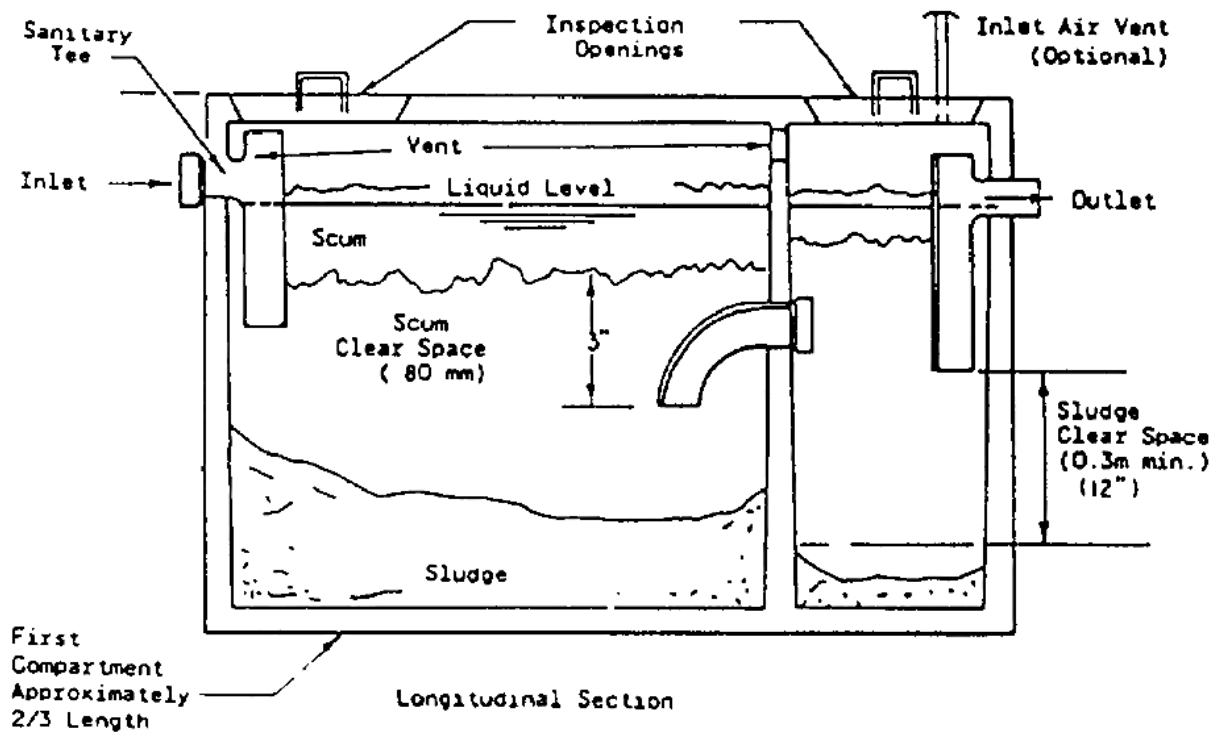


Figure 2-1: Typical two-compartment septic tank

The septic tank must be sized to provide the required detention (below the operating liquid level) for the design daily flow plus an additional 25 percent capacity for sludge storage. If secondary treatment such as a subsurface sand filter or an oxidation pond is provided, this can be reduced to 18 hours. Open sand filter treatment can further reduce detention time to 10 to 12 hours. Absorption field and leaching well disposal should normally be limited to small facilities (less than 50 population equivalents). If the total population is over 50, then more than one entirely separate field or well would be acceptable. For 10 or more population equivalents, discharge of effluent will be through dosing tanks which periodically discharge effluent quantities near 80 percent of the absorption system capacity.

2.1 Subsurface absorption. Subsurface absorption can be used in conjunction with septic tank treatment when soil conditions permit. Percolation tests must be performed as required by the U.S. Public Health Service, and the groundwater table at the highest known or anticipated level must not reach any higher than 2 feet below the invert of the lowest distribution line. Absorption fields normally consist of open-joint or perforated distribution pipe laid in trenches 1 to 5 feet deep and 1 to 3 feet wide. The bottoms of the trenches are filled with a minimum of 6 inches of $\frac{3}{4}$ to $2\frac{1}{2}$ -inch rock or gravel (fig 2-2). The perforated distribution pipe is laid on top of this rock, and the open joints between pipe lengths are covered to prevent clogging. More rock is placed carefully over the pipe network, and then a semipermeable membrane is used over the rock layer to prevent fine-grained backfill from clogging the drainage zone. Distribution pipe may be spaced as close as 2 feet if the rock beneath is deep, the subsoil porous, and distance to bedrock greater than 4 feet. Generally, distribution pipelines are 3 to 6 feet apart laterally and are no longer than 100 feet. Consult EPA 625/1-80-012 for complete details and leach field special design information. Minimum depth of trench will be 18 inches, with 12 inches of backfill. Invert slopes will be 0.3 percent when dosing tanks are used and 0.5 percent when not used. Soil absorption systems will be 100 feet from water supply wells, 50 feet from streams, 10 feet from any dwelling or property lines. Soil testing is a mandatory prerequisite for and subsurface disposal of waste. Local and State regulations must be consulted for additional mandatory requirements.

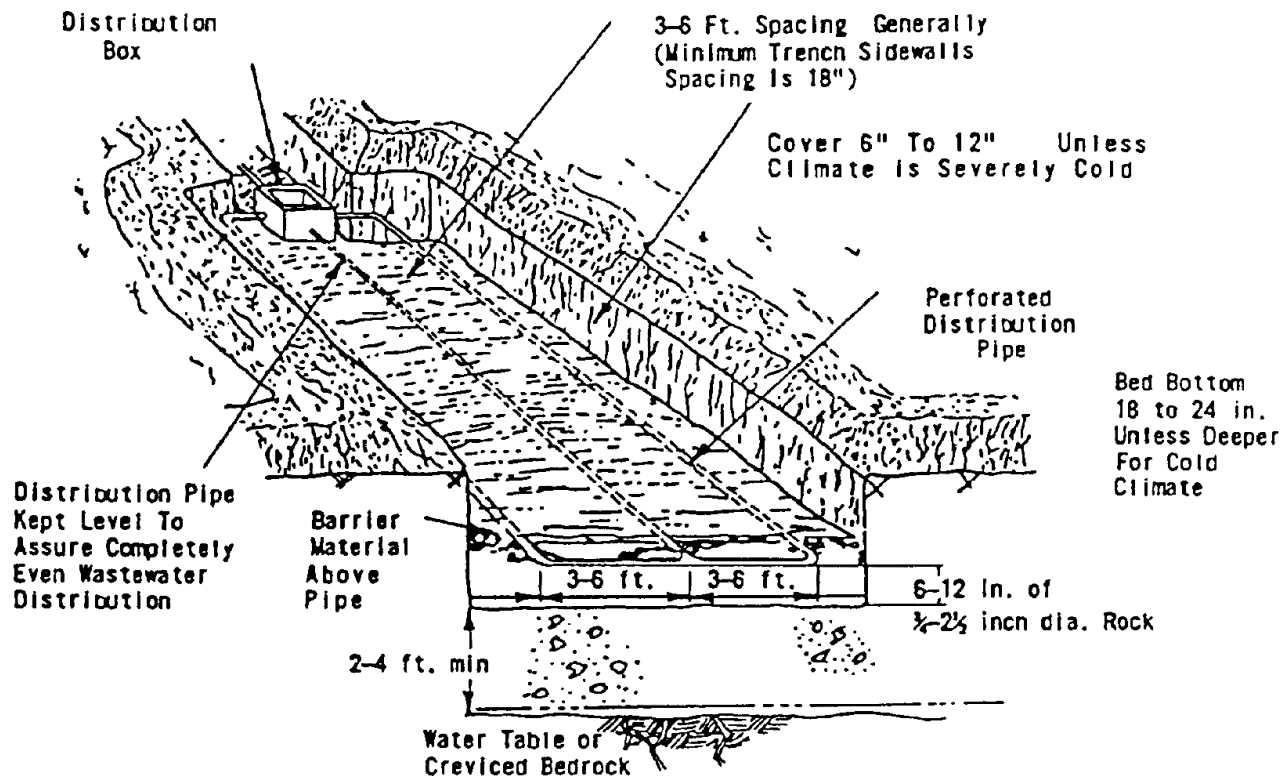
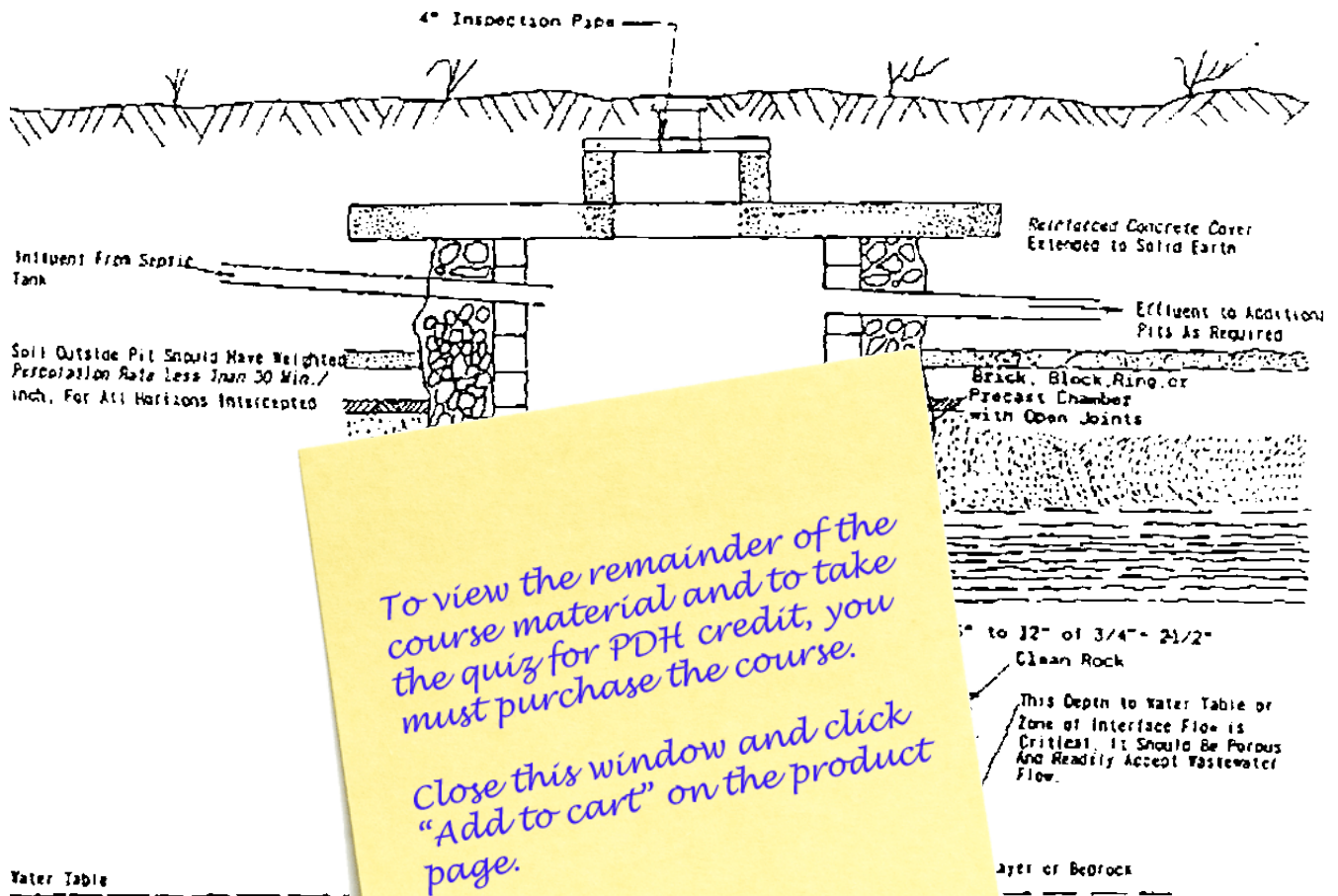


Figure 2-2: Sub-surface absorption system



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2.2 Leaching wells. Leaching wells can be used for septic tank effluent disposal where subsoil is porous. Although absorption beds are generally preferred, site characteristics and cost considerations may encourage the use of a leaching well. Wells are constructed with masonry blocks or stone with lateral openings, and gravel outside to prevent sand from entering the well. If more than one well is required, they should be spaced at intervals with at least twice the diameter of a well as distance between well hole sides. Percolation area is that area on the side and bottom of the hole for the leaching well. The bottom of a leaching well should be 4 feet above seasonal high water. See figure 2-3 and EPA Manual No.625/1-80-012.

2.3 Subsurface sand filters. Septic tank effluent can also be applied to subsurface sand filters. Subsurface explorations are always necessary. Clogging and installation costs are significant disadvantages. Where recirculatory sand filters are used dose rate may range between 3-5 gallons per day per square foot, Consult EPA Manual No.625/1-80-012, Harris et al., 1977, and Ronaye et al., 1982, for appropriate procedures for site evaluation and design parameters.