Composting Toilet Systems

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Fact Sheet

What is a composting toilet system?

A composting (or biological) toilet system contains and processes excrement, toilet paper, carbon additive, and sometimes, food wastes. Unlike a septic system, a composting toilet system relies on unsaturated conditions (material cannot be fully immersed in water) where aerobic, or air-requiring, bacteria and fungi break down wastes, just as they do in a yard waste composter.

If sized and maintained properly, a composting toilet breaks down waste to 10 to 30% of its original volume. The resulting soil-like material, called "humus," legally must be either buried or removed by a licensed septage hauler in accordance with state and local regulations.

Because they require little to no water and produce a usable end-product, composting toilet systems have traditionally been used by public facilities, parks, cottages, and remote homes. However, tightening wastewater regulations, growing awareness of pollution sources, and compatible graywater systems and micro-flush toilets are making them a viable alternative to septic systems and central sewage treatment plants in many areas, particularly those with poor soil drainage and proximity to surface water and groundwater.

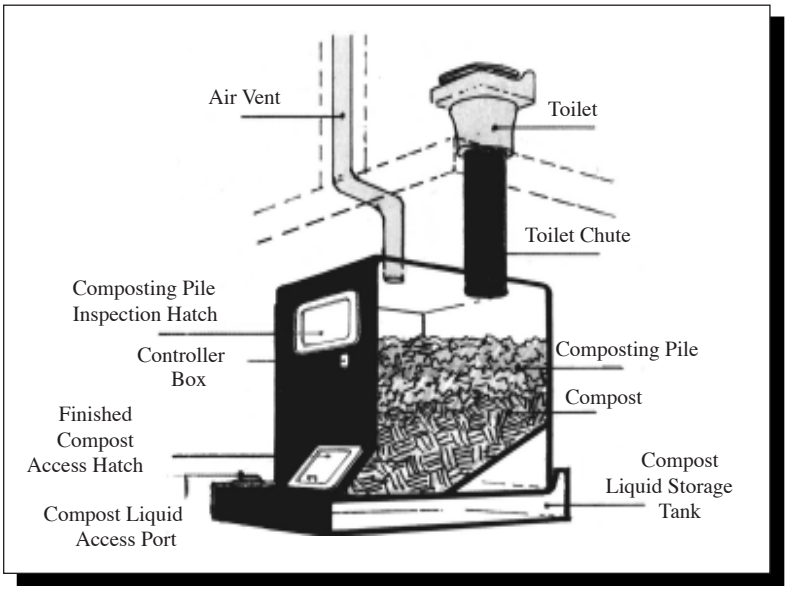

Figure 1: Composting Toilet

Adapted from: Clivus Multrum, Inc. (1994) with permission

The main components of a composting toilet system (see Figure 1) are:

- a composting reactor connected to a dry or micro-flush toilet(s);
- a screened air inlet and an exhaust system;
- a means of ventilation to support the aerobic organisms in the composter;
- a means of draining and managing excess liquid and leachate (optional);
- process controls to optimize and facilitate management of the processes; and
- an access door for removal of the end-product.

In the composting process, organic matter is transformed by naturally occurring bacteria and fungi that break down the waste into an oxidized, humus-like end-product, without the need for water or chemicals.

Composting toilets are mainly classified as either continuous composting or batch composting. Continuous composters (including such brands as CTS, Clivus Multrum, Phoenix, Biolet, SunMar, etc.) are single chambers where excrement is added to the top, and the end-product is removed from the bottom. Batch composters (such as Carousel, Vera, and nearly all of the site-built composters worldwide) are actually two or more composters that are filled and then allowed to cure while another reactor fills.

What are the advantages and disadvantages of using composting toilet systems?

Advantages

- Composting toilet systems do not require water for flushing, and thus, reduce domestic water consumption.
- These systems reduce the quantity and strength of wastewater to be disposed of onsite.
- They are especially suited for new construction at remote sites where conventional onsite systems are not feasible.
- Composting toilet systems have low power consumption.

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A General Overview

- Self-contained systems eliminate the need for transportation of wastes for treatment/disposal.
- Composting human waste and burying it around tree roots and nonedible plants keeps organic wastes productively cycling in the environment.
- Composting toilet systems can accept kitchen wastes, thus reducing household garbage.
- In many states, installing a composting toilet system allows the property owner to install a reduced-size leachfield, minimizing costs and disruption of landscapes.
- Composting toilet systems divert nutrient- and pathogen-containing effluent from soil, surface water, and groundwater.

Disadvantages

- Maintenance of composting toilet systems requires more responsibility and commitment by users and owners than conventional wastewater systems.
- Removing the finished end-product is an unpleasant job if the composting toilet is not properly installed or maintained.
- Composting toilet systems must be used in conjunction with a graywater system in most circumstances.
- Smaller units may have limited capacity for accepting peak loads.
- Improper maintenance makes cleaning difficult and may lead to health hazards and odor problems.
- Using an inadequately treated end-product as a soil amendment may have possible health consequences.
- There may be aesthetic issues because the excrement in some systems may be in sight.
- Too much liquid residual (leachate) in the composter can disrupt the process if it is not drained and properly managed.
- Most composting toilet systems require a power source.
- Improperly installed or maintained systems can produce odors and unprocessed material.

What determines the performance of a composting toilet system?

There are several factors that affect the rate of composting. The predominant factors are the microorganisms, temperature, moisture, pH, carbon to nitrogen ratio, and aeration.

The two main parameters in the composting process that account for the destruction of pathogens are:

- *Antibiosis:* During the decomposition process, bacterial reactions in the compost pile produce substances that are toxic to most pathogens.
- *Time:* When exposed to an unfavorable environment for an extended period of time, most pathogenic microorganisms will not survive.

As with all wastewater treatment systems, management is critical to the efficiency of the system.

Are composting toilet systems easy to operate and maintain?

In general, operation and maintenance (O&M) for composting toilets does not require trained technicians or treatment plant operators. However, regular O&M is critical since all wastewater systems depend on responsible administration. In cold climates, all composting toilet systems should be heated to levels specified by the manufacturer or designer.

Composting toilet systems may require bulking agents to be added, such as grass clippings, leaves, sawdust, or finely chopped straw. They assist composting by providing a source of carbon for the bacteria, as well as keeping the pile porous for proper air distribution. Periodic mixing or raking is suggested. In addition, the finished end-product must be removed periodically (anywhere from every 3 months for a cottage system to every 2 years for a large central system).

What is the cost of a composting toilet system?

The cost of manufactured composting toilet systems vary. For the year-round home of two adults and two children, the cost of a composting toilet system could range anywhere between $1,200 and $6,000, depending on the system. Cottage systems designed for seasonal use range from $700 to $1,500.

How do I stay informed about composting technology?

For more information on composting toilet systems or a list of other fact sheets, contact the National Small Flows Clearinghouse (NSFC) at West Virginia University, P.O. Box 6064, Morgantown, WV 26506-6064. Phone: (800) 624-8301 or (304) 293-4191. Fax: (304) 293-3161. World Wide Web site: *http://www.nsfc.wvu.edu*.

The NSFC provides free and low-cost informational services and products to help homeowners and small communities address their wastewater needs. Also, information about manufacturers, consultants, regulations, and facilities can be obtained from the NSFC's databases.

References

Clivus Multrum, Inc. 1994. "When nature calls... it calls Clivus®." Clivus Multrum, Inc. Lawrence, Massachusetts.

Cook, B. 1981. "Field Evaluation of Compost Toilets." Individual Onsite Wastewater Systems: Proceedings of the Seventh National Conference. pp. 83–98.

Del Porto, D. A. and C. J. Steinfeld. 1998. *The Composting Toilet Book*. Chelsea Green Publishing, Inc. Whiteriver Junction, Vermont.

Felton, D. (editor). 1981. "State-Of-The Art Assessment of Compost Toilets and Greywater Treatment Systems." The Winthrop Rockefeller Foundation. Little Rock, Arkansas.

Scholze, R. J. September 1985. "Innovation in Remote Site Waste Treatment." *BioCycle*. pp. 37–38.

Scholze, R. J.; J. E. Alleman; S. R. Struss; and E. D. Smith. December 1986. "Technology for Waste Treatment at Remote Army Sites." USA-CERL Technical Report N-86/20. USA-CERL. Champaign, Illinois.

Seabloom, R. W. and J. Engeset. March 1 & 2, 1978. "An Appraisal of Composting Toilets." Proceedings of the Second Northwest On-Site Wastewater Disposal Short Course. University of Washington. Seattle, Washington.

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