United States Environmental Protection Agency | Office of Water Washington, D.C. | EPA 832-F-00-048 September 2000

Water Efficiency Technology Fact Sheet
Oil Recirculating Toilets

DESCRIPTION

Oil recirculating toilets are "non-water carriage" toilets, meaning that they do not require water to operate. Instead, human wastes are deposited into mineral oil, or another similarly non-aqueous medium. The water-based urine and the solid waste products are separated from the oil medium, which is then filtered and reused in the toilet. The waste is separated and contained in a holding tank until it can be disposed of at an approved facility.

APPLICABILITY

Oil recirculating toilets are not widely used in the United States. Nevertheless, they are an option for numerous situations, including:

- Rural areas where no municipal sewage system exists, especially where installation of septic systems is impractical or prohibitively expensive due to shallow soils, deep slopes, high groundwater levels or extremely cold weather conditions.
- Remotely located roadside rest areas, where connection to a piped sanitary system is impractical and the cost prohibitive.
- Large marine vessels, which are faced with a prohibition against discharging untreated waste into bodies of water and must either hold accumulated wastes in tanks or must treat before discharge.
- Areas where water is scarce, either due to drought or to other environmental conditions, and the need to conserve water motivates consideration of alternative, water-free toilet systems.
- Where community, environmental, and health organizations have concerns regarding existing sewage disposal practices, especially seepage of contaminants into local water supplies from improperly functioning septic or other treatment systems, or exposure of residents to improperly dumped waste products from rudimentary collection pails, or "honey buckets."

ADVANTAGES AND DISADVANTAGES

Advantages

- Requires no water.
- Coast Guard-approved for marine use.

Disadvantages

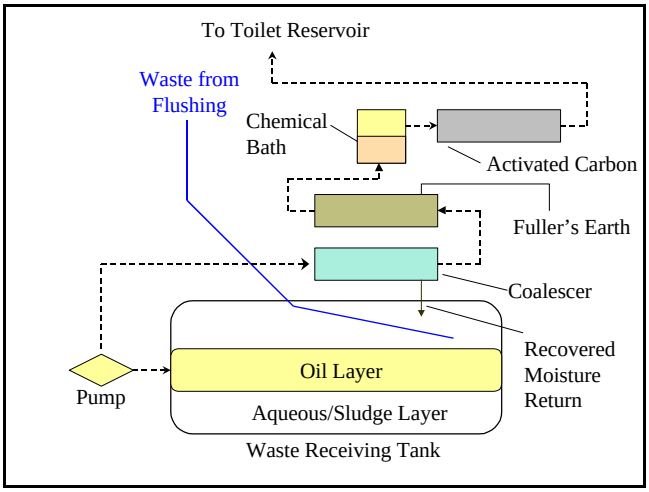
- Emulsion formation between oil and urine can cause an incomplete separation.
- Recycled flushing media can become discolored and unpleasant smelling with use.
- Flushing media eventually deteriorate and must be replaced.
- System requires a relatively large space for the holding tank and equipment for separation/purification.
- Disposal of separated waste products may be problematic due to oil content.

DESIGN CRITERIA

An oil recirculating toilet consists of a commode-type receptacle, a storage tank typically 53 cubic feet in size, and a recycling system (see Bishton *et. al*. for the following discussion). The flushing bowl is coated with Teflon or a similar coating product to minimize adherence of the waste products to the bowl. A closet reservoir with a float-controlled refilling mechanism is often attached to the toilet bowl for flushing, akin to conventional water-flushing systems. The simplest separation device simply relies on waste products settling to the bottom of the holding tank while the oil-based flushing medium floats to the top. The flushing medium can then be drawn from the top of the mixture for reuse, and waste products can be removed from the bottom periodically. In this way, waste products are stored in the same tank used for separation.

When the flushing medium is drawn from the reservoir for reuse, it is first directed to a coalescer, which is designed to remove suspended particulate matter and water droplets. Water and particulate matter thus removed are drained to the holding tank via a return line. The pump used to transfer liquid from the holding tank to the coalescer should be a reciprocating piston pump or other pump that will minimize break-up of aqueous droplets in the non-aqueous medium. From the coalescer, the flushing medium then passes through a filtering medium (such as Fuller's earth) to remove any residual water not caught by the coalescer. The fluid then passes through a disinfecting chemical bath, typically a hypochlorite solution, to treat odorous and pathogenic contaminants present. Following disinfection, the fluid is finally directed through another adsorbent medium (usually activated carbon) to remove non-water-borne dissolved contaminants.

To prolong the life of the adsorbent and filtering medium, it is desirable for the fluid drawn from the holding tank to be as water- and particle-free as possible before recycling begins. For this reason, commode-and-tank design should be configured so as to prevent mixing of the holding tank contents to the greatest extent possible. Ramping systems are often used to reduce the velocity of waste products entering the tank from the commode and to create an oblique angle of entry. Moreover, waste products from the commode should be deposited on the opposite side of the tank from the intake for fluid recycling and the intake point should be situated at the top-most liquid layer of the tank. Finally, the size of the holding tank relative to that of the commode, closet reservoir, and filtration system should be designed so that at least eight minutes of settling time is allowed in the holding tank between uses. For a five gallon toilet/closet reservoir capacity, and a filtration unit capacity of five gallons, the holding tank should have a capacity of twenty gallons. Figure 1 illustrates the primary components of a typical mineral oil recirculating toilet system.



Source: Parsons Engineering Science, 1999.

FIGURE 1 PRIMARY COMPONENTS OF A TYPICAL MINERAL OIL RECIRCULATING TOILET SYSTEM

PERFORMANCE

The Commonwealth of Virginia Department of Transporation (VDOT) installed oil recirculating toilets at four rest areas on the interstate highway I-64 in the late 1970s, all of which have been operative to date. According to VDOT's Director of Special Operations, complaints of odors and of discolored flushing medium have been common. A representative of the property management company responsible for maintaining the toilet systems, DTH Contract Services, stated that the oil recirculating systems require constant maintenance. Transport of the oil, which has a higher viscosity than water,

causes pipe vibration with each flush leading to development of leaks on a regular basis. Moreover, the multi-component assembly of filters and cleansing solutions requires frequent checking and changing. During the high-traffic season, from April through October, a full-time operator needs to be on hand to repair leaks and tend to maintenance, taking approximately 5 hours per day. Pump-out of the holding tank must be performed approximately two to three times a week. In the off season, maintenance consumes approximately 2.5 hours per day. According to both the Commonwealth's Director of Special Operations and the property manager, plans are underway to remove the oil recirculating toilet systems and replace them with traditional, water-flushed toilets.

OPERATION AND MAINTENANCE

Removal of waste products from the tank bottom must be performed on a routine basis. For proper system functioning, the filtration and adsorbent media and chemical disinfection solution must be replaced when exhausted. Mineral oil flushing media lost through waste disposal must be replenished and the total volume of oil used must be replaced periodically because of breakdown.

COSTS

The cost of purchase and installation varies widely depending on the capacity of the system and application (shipboard versus land). Maintenance costs will include replacement of filters and sanitizing solutions, replacement of flushing medium lost through tank pump-out, and routine holding tank pump-out. Operation cost will include electricity to run the pumping system. The State of Virginia experienced additional maintenance costs associated with fixing leaks and other malfunctions.

Most or possibly all of the U.S. companies that once made recirculating toilets have since discontinued production of these systems. As a result, cost estimates for package systems are currently not available.

REFERENCES

Other Related Fact Sheets

Incinerating Toilets
EPA 832-F-99-072
September 1999

Composting Toilets
EPA 832-F-99-066
September 1999

High-Efficiency Toilets
EPA 832-F-00-047
September 2000

Other EPA Fact Sheets can be found at the following web address:
http://www.epa.gov/owmitnet/mtbfact.htm

1. Bishton, N.J., Jr.; Rod, R.L.; Wagenhals, B; Woltanski, T.M.; and Blink, J.S., III, 1974. *Recirculating Toilet and Human Waste Storage System.* U.S. Patent No. 4,070,714.

2. Director of Special Operations, Commonwealth of Virginia, Department of Transportation, Richmond, Virginia. Personal communication with Donna Messner, Parsons Engineering Science, Inc., 1999.

3. Kollmar, Ray. DTH Contract Services, Dunn, North Carolina. Personal Communication with Donna Messner, Parsons Engineering Science, Inc., 1999.

4. Ward, Cindy. Commonwealth of Virginia, Department of Transportation, Richmond, Virginia. Personal Communication with Keith Kornegay, 1998.

ADDITIONAL INFORMATION

Director of Special Operations
Commonwealth of Virginia
Department of Transportation
1401 East Broad Street
Richmond, Virginia 23219

The mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Environmental Protection Agency.

For more information contact:

Municipal Technology Branch
U.S. EPA
Mail Code 4204
1200 Pennsylvania Avenue, NW
Washington, D.C. 20460

OWM MTB
Excellence in compliance through optimal technical solutions
MUNICIPAL TECHNOLOGY BRANCH