Chapter VIII

WATER CONSERVING TOILETS AND HOLDING TANKS

TABLES

INTRODUCTION

During the last several decades within the onsite wastewater industry, most of the emphasis has been on systems handling waste carried (or flushed) by water. However, non-water or very low water options are also available to handle human waste, but have not received as much attention. Non-water options include: vault privy toilet (modern outhouse), composting toilet, incinerating toilet, and portable toilet unit. These systems are only suitable for handling feces, urine, and toilet paper, plus organic kitchen wastes in some composting toilets. Yet sometimes a no- or low-water use system is not the most feasible option. In unusual circumstances or as a last resort, a holding tank may be a viable and a logical choice. This chapter summarizes information about options that involve little or no water flushing, holding tanks, and greywater systems.

Since the 1970s, a growing number of people are concerned that Kansas water resources are becoming over used. Irrigation of crops, power production, and to a lesser extent landscaping are the major consumers of water. Water used to carry wastes, though a small part of the Kansas total, can locally be an important part of high water use. Water used for the toilet can be reduced to less than a quart per flush. Composting, incinerating, and privy toilets work quite well without water. Greywater used for cleaning can easily be collected and treated by a separate wastewater system and, under the right conditions with an appropriate design, effluent can be used to water the landscape. The options discussed here are gaining in importance as water becomes more scarce and costly.

PRIVY OR OUTHOUSE

A “privy” is a small building separate but usually near a dwelling, often referred to as an “outhouse”, used for disposal of body wastes (feces and urine). It typically serves an individual home but may also serve a remote recreational area. The term “latrine” suggests communal use for groups such as for a camp, school, or military unit. A modern latrine may have flush toilets but in primitive locations it generally will not. The terms privy, outhouse, and latrine are often used interchangeably.

A privy can either be a “pit privy’ which is unlined or at least has an unlined bottom, or a “vault privy” which is set over a watertight tank. A pit privy is designed to allow the liquid wastes to seep into the soil (where most of the treatment occurs). The vault privy tank is often made of concrete similar to a septic tank, but plastic or fiberglass vaults are also used. Some county codes contain a section on privies. If there is no local code, the horizontal and vertical separation distances in KDHE Bulletin 4-2 should be used for guidance. In 1974, KDHE published official privy plans as Environmental Health Bulletin 4-3, *The Sanitary Privy*. Today pit privies are not considered suitable for legal use in Kansas because of unsanitary conditions so this bulletin is no longer current. Class V well regulations apply to all facilities with the capacity to be used by 20 or more persons per day and where the waste goes into the soil rather than into a central sewer system. All Class V wells should be registered with KDHE.

A vault toilet, as the name implies, has a water-tight container that retains wastes. Regular maintenance is essential to remove the accumulated waste. A well-designed and maintained vault toilet is legal, a suitable option, and much more sanitary than a pit privy. Septage from a vault toilet is much like septage from a septic tank and must be treated similarly. Because vault toilet septage has a much higher concentration of solids, handling will be different.

Odor-Free Toilet – The Modern Vault Privy

The United States Forest Service (USFS) is probably the world's foremost authority on the topic of sanitary privies. They supported a successful, multi-year project to develop a nicer vault toilet facility dubbed the Sweet Smelling Toilet (SST). The keys to success are location, design, and construction of the privy. Principles include: air flow moves down the toilet riser (seat) and up the vent stack at all times and materials used do not absorb odors and are easy to clean.

SST Design features include (Cook and Land, 1996):

1) 12 to 14 inch diameter black vent stack extending from vault to 3 or more feet above the highest part of the roof. The stack ideally located on the south side creates a strong upward air flow which lowers the pressure in the water tight vault and draws air in the riser. This air flow exhausts most of the odor into the atmosphere where it is dispersed.

2) The vent stack is uncapped and unscreened when possible.

3) A small (120 sq. in.) wall or door vent faces the prevailing winds (locate vent near the floor if wind is fluctuating).

4) The roof on the toilet portion of the structure is well insulated.

5) A manhole access to the vault is usually located near the vent stack and the vault floor slopes toward this access to make pumping the vault easier.

6) In units with multiple risers, a separate tank and a vent stack are used for each riser.

7) Maintenance should include regular pumping; frequent disinfectant cleaning of the inside and outside of the riser, the riser lid, and the floor; and assuring that the vent stack is free of any material that would reduce air flow, including spider and insect webs.

PORTABLE TOILET UNIT (PTU)

A portable toilet unit (also known as (aka) porta-potty, portable sanitation unit, portable toilet, etc.) is a portable privy with small self-contained, watertight tank. These are supplied and maintained by private service companies. Common uses for these units are at construction sites, seasonal use areas, and events drawing many people to areas that are not adequately supplied with toilet facilities. These units are quite nice and pleasant to use, when regularly serviced and cleaned. Service providers use reference tables to determine the number of PTUs needed for an event based on the length of the event and the projected number of participants. PTU use has expanded greatly in the last two decades and is a 1.5 billion dollar per year industry utilizing 9,400 trucks to service 1.4 million toilets.

COMPOSTING AND DRYING TOILETS

Composting toilets use aerobic decomposition of organic matter by bacteria, fungi, molds, and other organisms to transform waste into a relatively dry, nutrient-rich humus material called compost. Composting toilets generally consist of a toilet unit with seat, a composting tank or tray, a vent with a fan, and an access port for compost removal. Dry, high carbon, organic material such as sawdust, leaves, bark, or straw clippings may need to be added to provide bulk and to aid compost organisms.

The composting process takes place in a holding chamber in the presence of oxygen, for rapid aerobic decomposition. A warm, well-ventilated container with a diverse community of microbes breaks down waste materials and produces an odorless nutrient-rich organic material. Waste materials can be excrement, urine, toilet paper, and readily decomposable vegetable by-products. A well-managed composting process reduces waste volume by 80-90 percent. With good care, these composts produce temperatures of 120-130 degrees F, high enough to destroy most pathogens. Nitrogen and phosphorous are conserved and concentrated in the compost product. Under limited conditions, compost can be applied to land as a nutrient-rich fertilizer.

Commercially made composting toilets, available from several manufacturers, come in two general types. Large, passive units have large compost tanks and few or no moving parts. They rely on size to hold waste materials for the long time periods necessary for natural composting. They do not use mechanical heaters or mixers. A basement, crawl space, or other excavation is required for a large compost tank. Small, active systems are self-contained units that fit easily into a typical bathroom. They rely on electrical heating with mechanical ventilation and mixing to speed up the compost process. The input of external heat and mechanical power can reduce the size and initial cost of the unit. However, maintenance costs are increased because of energy consumption.

INCINERATING OR EVAPORATING TOILET

Incinerating toilets use an energy source (electric, natural gas, or propane) to burn toilet wastes at 1400 degrees F, resulting in an ash residue that is disposed of as solid waste. A paper bowl liner is applied for each toilet use to protect the bowl and to reduce cleaning. The liner and waste are dropped into a holding container. The waste is incinerated after 2-4 “flushes”. The units require an external energy source, a vent pipe, and perhaps an odor control device. Because of the energy used, they have a significant operating cost and thus are typically not a good choice for long term continuous use.

HOLDING TANK

A holding tank is a watertight tank that holds discharged sewage. It must be pumped to remove sewage from the site to an approved treatment system. The high cost of frequently pumping the tank makes this an expensive and less desirable option. A holding tank is the least desirable solution for problem soil and site conditions but may be an option for a small lot with little or no suitable soil for a traditional absorption system.

Local codes typically allow holding tanks only for an existing residence or commercial establishment. Do not consider a holding tank as an option for a new business or year-around residence, except as a temporary solution when a central sewer system is approved for construction and will be completed in just a few years. If sewers are planned for the future but financing and construction are not already approved, another solution should be found.

A holding tank can be a suitable option for systems that are expected to have very small flows such as those at part-time, seasonal, or recreational facilities. Often, a holding tank is used as a low-cost repair to make a failing system code compliant. A holding tank might also be used where the lot shape or size is so restrictive that a properly designed and sized traditional or alternative soil absorption system cannot be installed. A holding tank can also be an excellent way to handle excess flows from a system that has marginal capacity, experiences seasonal

failure, or has temporary overloads.

When used to contain excess field flows, the holding tank should be placed so only the flow that cannot be absorbed by the soil system will flow into it instead of discharging to the surface. This may be done with a drop box structure that allows overflow to run into the holding tank.

When used in this way, the soil absorption system handles most of the flow and the holding tank collects only the excess resulting from large wastewater flow or extended wet weather.

Holding Tank Installation

Locate the tank where it is easily accessible for a pump truck during all weather conditions.

Take steps to minimize the chances for nuisance spills from accidents during pumping. Placement of a holding tank will be similar to a septic tank and must be on firm soil capable of supporting the weight of a full tank. A holding tank must comply with the same setback regulations required for other onsite systems. The tank must not be placed below or into the water table, as the tank will float when empty and some can even float when nearly full. A tank should have a minimum two-week storage capacity and should have a reserve capacity of an additional week to allow for possible emergencies or delays in pumping the tank.

The holding tank should be equipped with an access manhole extended to the ground surface for easy access when pumping. The manhole lid should be watertight and be made of heavy cast iron material that can be locked or otherwise secured to prevent unauthorized access. It is also strongly recommended that the holding tank be equipped with an audible and/or illuminated high-water alarm that is activated when the tank is approaching its full capacity.

Holding Tank Operation

When a holding tank is used, carefully plan for and install water-conserving appliances and fixtures. Adjust water-use habits to minimize wastewater production and the cost of service. An additional water meter is recommended to separate water usage for domestic purposes from irrigation water. When domestic use is monitored, the user has better information for scheduling tank pumping and determining the amount hauled. For those who make a commitment to reduce water use, it is amazing how little water is really essential. Average water-use through the winter months can be used to estimate on average the frequency for pumping the holding tank.

SEPARATE GREYWATER SYSTEM

Questions are often asked about handling, treating, and use of greywater separate from blackwater. Blackwater is typically defined as the sewage that comes from the toilet and sometimes includes the kitchen sink. Greywater is all other wastewater from the home.

Wastewater systems of some older homes were designed to send the blackwater to a small septic system or cesspool and to surface discharge greywater. Surface discharge of any sewage including greywater has not been acceptable in Kansas since 1997.

Untreated greywater is still sewage and contains bacteria – including fecal coliform or E. coli especially in laundry and bath water. These bacteria are commonly found in the digestive system of warm-blooded animals and their presence indicates fecal contamination with a corresponding

high risk of pathogens being present. Greywater contains dirt, grease, soap, detergent, bleach, and other household chemicals depending on activities in the home. Greywater from the kitchen is often as high (or higher) in biochemical oxygen demand (BOD) compared to blackwater, and may contain pathogens. Because the wastes from the kitchen sink are more like toilet wastes this source is sometimes included with blackwater.

Dirty laundry, under normal circumstances, contains pathogens. The risk of harmful bacteria in laundry increases any time there is sickness. For these reasons it is a health risk (and in Kansas illegal) to have surface discharge of greywater. Bulletin 4-2 specifies greywater must be treated by an approved onsite wastewater system or be discharged to a permitted central sewer system.

In general, greywater is perceived as being relatively clean and low in nutrients or other pollutants. While it is true that greywater contains relatively little nitrogen (most of the nitrogen from a home is found in toilet wastes), greywater can contain significant amounts of BOD, phosphorus, and total suspended solids (see Table VIII-1).

Table VIII-1. Comparison of Some Greywater and Blackwater Characteristics

Parameter	Greywater	Blackwater
Source and flow	Wastewater from all sources except the toilet including: sinks, laundry, bath, shower, etc; usually about 70 percent or more of household total.	Wastewater flow from only the toilet; usually about 30 percent or less of household total.
BOD or organic load	Generally higher BOD concentrations; organics are easier to break down	Usually lower BOD concentrations; organics are more difficult to break down
Fecal bacteria	Greywater contains considerable fecal bacteria. It must be considered a potential disease source.	Blackwater contains higher fecal bacteria concentrations and is a serious disease source.
Nitrogen	Normally contains only about 10 percent of total nitrogen; has much lower concentration.	Typically contains about 90 percent of total nitrogen; has much higher concentration.
Phosphorus	Typically contains about half of the household phosphorous load; a lower concentration than blackwater.	Typically contains about half of the household phosphorous load; a higher concentration than greywater.
Treatment needs	Greywater must receive adequate treatment before reuse; cannot be surface applied or surface discharged.	Reuse of blackwater, except subsurface irrigation of windbreaks and grass, is strongly discouraged.

Source: Adapted from handout by J. Howard Duncan, 26 March 1992.

Separating greywater from blackwater after a house is constructed is usually difficult and expensive. However, houses that are already plumbed this way or houses just being or to be built are candidates for a separate greywater collection system. Using composting or incinerating toilets is more feasible if greywater is already handled separately or can easily be separated from blackwater. The Ruck System® uses a septic tank and an aerobic filter for blackwater which is then blended with greywater that has passed through a separate septic tank. The Ruck System can reduce nitrogen and phosphorous going to the soil absorption field.

Biochemical oxygen demand (BOD) in greywater may equal or exceed the BOD content of blackwater. This is primarily because of food waste and grease from kitchen drains. Total suspended solids (TSS), also from kitchen flows, may equal those found in toilet wastes and can far exceed toilet flows when a garbage disposal is used.

In a typical residence, greywater contains about half of the phosphorus (P) from a typical home. However, because of greywater's greater volume, the phosphorous concentration is less than in blackwater. Concentration and total P load in greywater directly relates to the use of detergents containing phosphate. Although some states prohibit the sale of phosphate detergents, Kansas does not. However, today most detergents contain less phosphorous than they did just a couple of decades ago.

CHOOSING WATER CONSERVATION / MANAGEMENT OPTIONS

Several options with very different characteristics for water conservation and management are presented and discussed in this chapter. Because the options are so different and information comes from different sources, choosing between them can be especially challenging. Table VIII-2 summarizes some parameters of interest and characteristics that might be important to the decision maker. Additional information is available through internet searches, dealers, and installers for each of the water conservation and management options identified in this chapter.

Additionally, new options will likely become available in the future. The user is encouraged to search out information about the parameters most important to him or her.

In addition to differences in types of equipment, there are also differences in the knowledge, experience, and skills of suppliers and installers. Complications can arise when the equipment dealer has had no previous experience with the equipment or because of location is not able to install the equipment they sell. It is therefore advisable to obtain customer referrals for the unit you are considering. A buyer should confirm that the chosen dealer and/or installer will do quality work by talking to a few previous customers. Be sure to ask about problems and how those problems were resolved.

Table VIII-2. Comparison of Selection Parameters for Different Water Conserving Options

Parameter	Vault Toilet (Privy)	Composting Toilet	Incinerating Toilet	Holding Tank	Greywater System
Best Use	Short term (camp, cabin, recreation); where no water or power are available	Must save water; very strong desire to save water; reuse nutrients; more sustainable; protects environment	Short term or limited use; no water but power available	Very small lot; temporary need; little use	Dry area and limited water; reuse for subsurface landscape watering
Initial installation cost	Low for regular unit; moderate for odor-free unit	Moderate to high; may require special construction	Low to moderate	Low	Moderate for new construction; typically high for existing home
Annual operating cost	Low	Low	High energy: cost is proportional to use	Very high: cost is proportional to use	Low to moderate
Labor	Very low	High; daily or weekly action	Moderate or high	Low to moderate	Low to moderate
Strengths	Very simple; no water needed; no wastewater produced; reliable	No or little water used; inside; save & reuse nutrients; environmentally sensitive	No water needed; inside	Normal bathroom plumbing; low initial cost; limited or temporary use	Possible beneficial reuse of water; normal home plumbing appearance
Limitations	Outside separate from house; must be pumped occasionally; primitive	Management is essential; requires a greywater system	Management is essential; requires a greywater system; high energy use	Must limit water use; tank must be pumped regularly; septage must be properly disposed	Requires same treatment as blackwater; yard reuse must be subsurface

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