Technical Overview

ALTERNATIVE TOILETS

Item Number SFBLTO04

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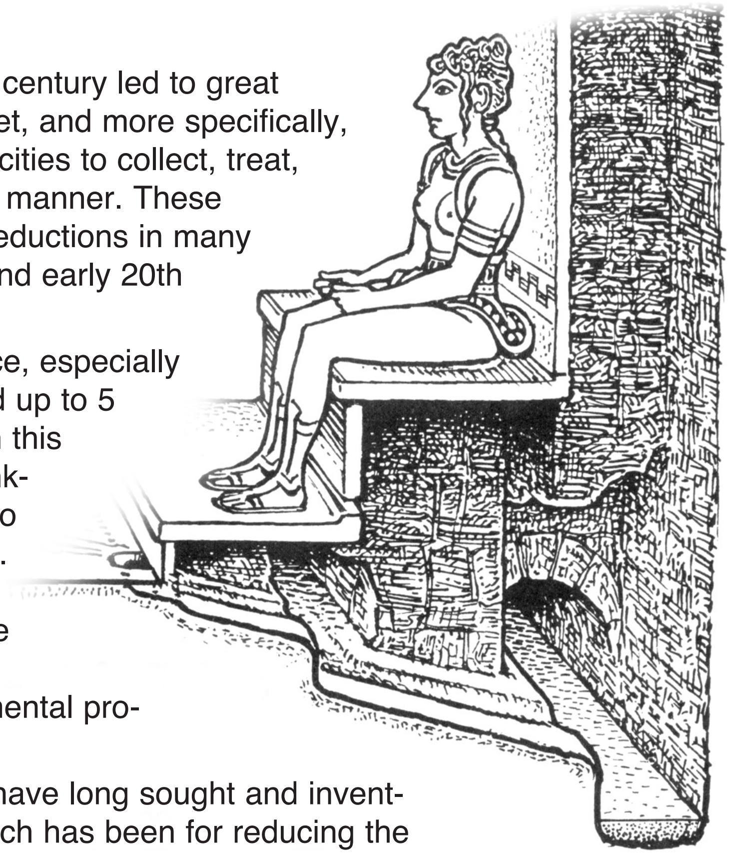
INTRODUCTION



The invention of the flush toilet in the 19th century led to great advances in public health and sanitation. The toilet, and more specifically, transport of sewage by water and pipes, allowed cities to collect, treat, and dispose of human wastes in a more hygienic manner. These improvements in urban sanitation led directly to reductions in many diseases that plagued city residents in the 19th and early 20th centuries.

However, water is not an unlimited resource, especially for cities in arid or desert areas. Early toilets used up to 5 gallons per flush (gpf) to transport sewage. When this water has been treated to make it potable for drinking, and then has to be retreated as wastewater to protect the environment, the costs quickly add up. Added to the financial aspect is the concern that contaminating water for the sole purpose of waste transport puts too much strain on the wastewater treatment end and unduly compromises environmental protection.

For these reasons, concerned individuals have long sought and invented "better" or alternative toilets. Much of this search has been for reducing the amount of water necessary to transport the waste. Conventional toilets today use around 3.5 gpf, with low-flow models and ultra low-flow models using 1.6 gpf and less than a gallon, respectively. Recent laws require new construction to use at most 1.6 gpf. These advances in toilet technology have had a positive effect on wastewater treatment, although some concern remains about reducing the effectiveness of the transport. One of the major complaints about low-flow toilets is that they do not sufficiently "wash" the bowl, requiring multiple flushes. Also, lower flush volumes have a reduced capacity to transport solids and may result in increased occurrences of blocked sewers and costly repairs.

Typical low-flow toilet.

Other alternative toilets focus on removing waste transportation, and thus water use, from the equation completely. These innovations include incinerating toilets, chemical toilets, and composting toilets. The concept here is to treat the waste in the toilet itself, thus removing the need for water transport. Incinerating toilets use heat to evaporate liquid wastes and turn solids to harmless ash. Chemical toilets store the waste and dose it with chemicals for safe holding until they can be emptied. Composting toilets mix the waste with a carbon source, such as old newspapers, and provide warmth and ventilation while bacterial processes render the waste into beneficial and inoffensive compost.

DESIGN

The trick to making low-flow and especially ultra low-flow toilets work is to increase the momentum of the water. This is usually done by reconfiguring the bowl so that a jet of water sweeps it clean or by using pressurized air to assist. One early model, dating from the early 20th century, used an elevated tank placed approximately at ceiling height. The extra elevation worked to increase the water's momentum and reduce the flush volume. Modern low-flow toilets rely on tighter seals, larger valves, and larger trapways. Some are even designed with two flush volumes, selected by pressing different buttons for flushing solids or just liquids.

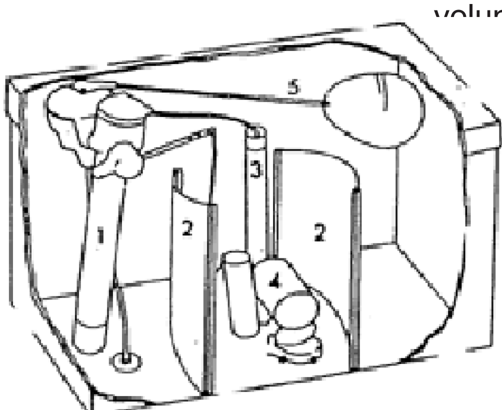
The most important choice in selecting a low-flow toilet is gravity versus pressure-assisted models. Pressure-assisted models perform much better in removing solids from the bowl, preventing soiling, and car- rying the wastes through the drains. They are, however, noisi- er and more expensive than gravity toilets. With more working parts, they are also a bit more susceptible to breaking down and require more specialized repair than a normal toilet. The gravity low-flow toilets rely on redesigning the bowl and pipes to increase the efficiency of he flush.

Pressure assisted unit

Inside a pressure assisted toilet

Some homeowners may want to r old toilets without the expense of replacement. The "tried and true" method was to add bricks to the toilet tank. This displaced a certain amount of water in the tank, resulting in less water admitted and thus smaller flush volumes. The major problem with this method is that the bricks tend to deteriorate in the tank and the crumbled masonry could damage the toilet as it got sucked through the valves.

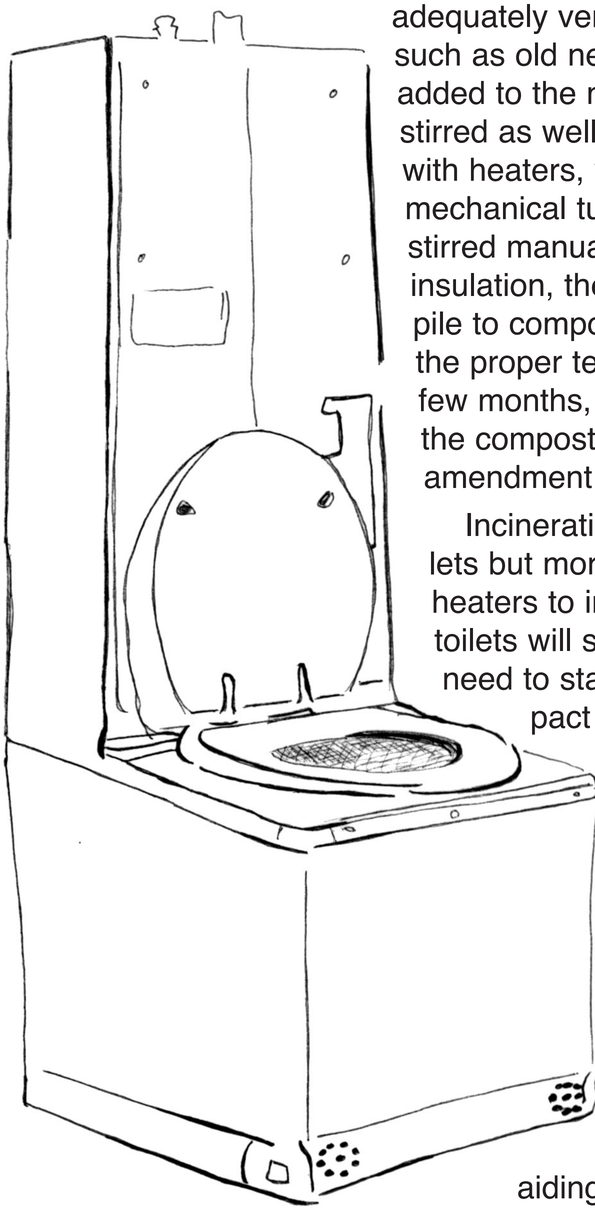
A safer method, for the toilet at least, is to use a gallon milk jug filled with water. This will displace water in the tank without corroding away and damaging the toilet. While displacement methods do reduce flush volumes, they may not provide enough water to sufficiently acuate the bowl, which leads to double flushing (and more water wastage) as well as dirtier toilet bowls.



Toilet dam

To do away with water entirely, there are composting, incinerating, and chemical toilets. The composting toilet usually requires a large compost container on a lower floor (in the basement, for instance). Wastes from the toilet drop directly into the compost vat. If planned properly, several toilets can be connected directly to the compost container.

To properly compost the waste, the container must be



adequately ventilated and warmed. Further, a carbon source, such as old newspapers, bark chippings, or sawdust must be added to the mix periodically. Finally, the mix must be turned or stirred as well. Several manufactured composting toilets come with heaters, ventilation fans, and mechanical turners. Without mechanical turners, the vat must be opened and the contents stirred manually, using a pitchfork. Depending on climate and insulation, the contents may provide enough warmth for the pile to compost; otherwise, a heater is required to achieve the proper temperatures, warm but not necessarily hot. Every few months, depending on the size of the compost container, the compost should be removed and can be used as a soil amendment, fertilizer, or can be buried in the yard.

Incinerating toilets are much smaller than composting toilets but more expensive to maintain and run. They rely on heaters to incinerate the stored waste. Some incinerating toilets will store around 40 "uses" and then the operator will need to start an incineration cycle. Others are more compact and need to incinerate after each use, by the press of a button, much like flushing. They can be fueled using natural gas or electricity, so the units are suitable for remote uses such as cabins or construction sites. The end product is a harmless ash that drops into a bin or bag and can be thrown away with the normal household garbage.

An incenerating toilet

In most chemical toilets, a chemical is added to a small amount of water. The chemical has several purposes, including masking odors, disinfecting the waste, and aiding in the breakdown or digestion of solids. It usually also contains a deep blue dye for aesthetic purposes. Upon flushing, some of the liquid being held is recirculated by an electric- or hand-operated pump to flush the wastes into the holding chamber. The initial charge of chemical is adequate for 40 to 160 uses, depending upon the model. Some chemical toilets are equipped with a valve to empty the holding chamber to discharge wastes into the septic tank or to be pumped by a septic tank pumper. On most chemical toilets, especially small units for remote uses, the holding chamber can be removed for disposal of wastes into a manhole or specially provided waste dumping facility. The chemical treatment reduces the waste to a small fraction of a conventional flush toilet. Maintenance costs should be minor, including the cost of the chemical additive. Most chemical toilets are used in remote sites where the waste would be removed physically after use, such as campgrounds or rustic cabins.

ADVANTAGES AND DISADVANTAGES

Several types of alternative toilets are ideal for remote sites without running water. Composting, incinerating, and chemical toilets are all methods that do not require indoor plumbing. Further, chemical toilets do not require electricity or gas, while incinerating toilets do. Composting toilets work better when provided with electric fans for ventilation and some heat source, but can be designed to use natural heat and ventilation for remote sites.

These toilets can be used in almost any situation. They are suitable for remote sites, for segregated systems where the homeowner wishes to only treat the greywater in a septic system, or for reducing the organic load on an overworked onsite system. Low-flow toilets, on the other hand, are used to replace older flush toilets and require indoor plumbing. They are useful in saving water, and thus money for the homeowner, as well as reducing the hydraulic load for an onsite system.

Image courtesy of Sun-Mar corporation.

Compost collection unit

OPERATION AND MAINTENANCE

Gravity low-flow toilets present the same maintenance needs as conventional toilets. Pressure-assisted low-flow toilets have more moving parts and will thus be somewhat harder and more costly to repair.

Incinerating toilets require the extra step of incineration. In addition, there is the heating element that requires fuel and servicing. The ash needs to be removed periodically. Chemical toilets require the occasional addition of a chemical, as well as the removal of the waste. Most come with a waste tray that can be removed from the unit and dumped in an appropriate place.

Composting toilets require the most operation and maintenance. Sawdust, newspaper, or hay must be included with approximately every other use, the compost pile must be aerated, warmed, and turned, and the compost must be physically removed. This represents a serious commitment on the part of the homeowner, and composting toilets should only be used by those people willing and excited to make such an environmental effort.

COSTS

Costs for low-flow toilets vary by model. Typical gravity low-flow toilets will cost around $80 to $300, and pressure-assisted models around $200 to $800 per toilet. Of course, there are water savings to consider as well. Going from 3.5 gpf to 1.6 gpf saves 2 gallons per flush, or for a family of four around 16 to 20 gallons per day or 7,500 gallons per year. The monetary value of savings will be based on local water rates.

Chemical toilets, depending on size, can be as cheap as $60 or as much as $400. The chemical additive is relatively cheap, around $5 for around 100 "flushes." Incinerating toilets represent a substantial investment, running around $1,500 per unit. Power or gas costs are not excessive but they are a factor. Composting toilets can also be expensive, with large compost containers, heating, and ventilation, and can cost as much as $2,000. There are some electric costs, but the major maintenance expense is the labor involved in turning and removing the compost pile.

If you would like more information on alternative toilets, the National Environmental Services Center maintains a Bibliographic Database with articles about toilets and a Manufacturers Database with company listings of firms that market alternative toilets. Both databases are searchable online at the Web site www.nesc.wvu.edu/. Or you can call the toll-free hotline at (800) 624-8301, option 2, and request a database search from the technical assistance unit.

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