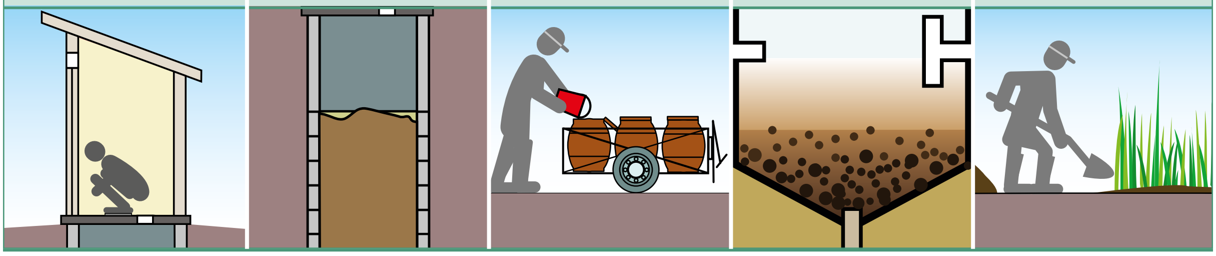
World Health Organization

Fact sheet 5

Dry or flush toilet with pit, effluent infiltration and offsite treatment of faecal sludge

Toilet	Containment	Conveyance	Treatment	End use / disposal
Dry or pour flush	Single pit or single VIP	Manual emptying and transport	Faecal sludge treatment plant for sludge and effluent	Soil conditioner; solid fuel; building materials; irrigation; surface water recharge*



* Sludge: treated and used as soil conditioner, solid fuel or building materials. Effluent: treated and used for irrigation or surface water recharge.

Summary

This system is similar to the system described in Fact sheet 1 with the use of a single pit technology to collect and store excreta. The system can be used with or without flushwater, depending on the toilet. Inputs to the system can include urine, faeces, cleansing water, flushwater and dry cleansing materials. The use of flushwater and/or cleansing water will depend on water availability and local habit.

The toilet for this system can either be a dry toilet or a pour flush toilet. A urinal could additionally be used. The toilet is directly connected to a single pit or a single ventilated improved pit (VIP). As the pit fills up, leachate permeates from the pit into the surrounding soil.

When the pit is full the faecal sludge needs to be emptied and transported for treatment. The treatment products can then be used (e.g. effluent used in irrigation), converted into end use products (e.g. faecal sludge converted to soil conditioner or solid fuels) or disposed of.

Applicability

Suitability: This system should be chosen only when there is an appropriate way to empty, transport, treat and use or dispose of the faecal sludge. For instance, in dense urban settlements, narrow roads may make it difficult for vehicles with emptying equipment to gain access to pits.

It is suited to areas where the soil is appropriate for digging pits and absorbing the leachate; where hard, rocky ground is found, or where groundwater level is high or the soil is saturated, conditions are not suitable. It is also not suited to areas that are prone to heavy rains or flooding, which may cause pits to overflow into users' houses or to the local community [2, 3].

When it is not possible to dig a deep pit or the groundwater level is too high, a raised pit can be a viable alternative: the shallow pit can be extended by building the pit upwards with the use of concrete rings or blocks. A raised pit can also be constructed in an area where flooding is frequent in order to keep water from flowing into the pit during heavy rain.

Cost: For the user, this system is one of the least expensive in terms of capital cost. However, the maintenance costs may be considerable, depending on the frequency and method of pit emptying [2, 3].

The capital cost of the treatment plant may also be considerable, while the treatment plant maintenance costs will depend on the technology chosen and the energy required to operate it.

Design considerations

Toilet: The toilet should be made from concrete, fibreglass, porcelain or stainless steel for ease of cleaning and designed to prevent stormwater from infiltrating or entering the pit [2, 3].

Containment: On average, solids accumulate at a rate of 40 to 60L per person/year and up to 90L per person/year if dry cleansing materials such as leaves or paper are used. In many emergency situations, toilets with infiltrating pits are subjected to heavy use, consequently excreta and anal-cleansing materials are added much faster than the decomposition rate, therefore the 'normal' accumulation rates can increase by 50 percent [9].

The volume of the pit should be designed to contain at least 1,000L. Typically, the pit is at least 3m deep and around 1m in diameter. If the pit diameter exceeds 1.5m, there is an increased risk of collapse. Depending on usage and how deep they are dug, some pits may last 20 or more years without emptying, but shallow pits that are used by many people every day may require emptying once or twice a year. As a general rule, a pit 3m deep and 1.5m wide that is used by a family of six, will require emptying after about 15 years [3].

As the pit will be reused, it should be lined. Pit lining materials can include brick, rot-resistant timber, concrete, stones, or mortar plastered onto the soil. If the soil is stable (i.e., no presence of sand or gravel deposits or loose organic materials), the whole pit need not be lined. The bottom of the pit should remain unlined to allow for the infiltration of liquids out of the pit.

The water table level and groundwater use should be taken into consideration in order to avoid contaminating drinking water. If groundwater is not used for drinking or alternative cost effective sources can be used, then these options should be explored before assuming that groundwater contamination by pit latrines is a problem.

Where groundwater is used for drinking and to prevent its contamination, the bottom of the pit should be at least 1.5m above the water table [3]. In addition, the pit should be installed in areas located down gradient of drinking water sources, and at a minimum horizontal distance of 15m [4].

Excreta, cleansing water, flushwater and dry cleansing materials should be the only inputs to this system; other inputs such as menstrual hygiene products and other solid wastes are common and may contribute significantly to pit contents. As this will result in pits filling up more rapidly and make it more difficult to empty, an appropriate container for disposal of these wastes should be provided in the toilet cubicle. (Some greywater in the pit may help degradation, but excessive amounts of greywater may lead to quick filling of the pit and/or excessive leaching.)

Conveyance: As the untreated faecal sludge is full of pathogens, human contact and direct agricultural application should be avoided. Instead, the emptied sludge should be transported to a faecal sludge treatment facility.

The conveyance technologies that can be used include manual emptying and transport or motorized emptying and transport. However, a vacuum truck cannot be used as it can only empty liquid faecal sludge.

In the event that a treatment facility is not easily accessible, the faecal sludge can be discharged to a transfer station. From there, it can be transported to the treatment facility by a motorized transport technology.

Treatment: Treatment technologies produce both effluent and sludge, which may require further treatment prior to end use and/or disposal. For example, effluent from a faecal sludge treatment facility could be co-treated with wastewater in waste stabilization ponds or in constructed wetlands, and then used for irrigation water, fish ponds, floating plant ponds or discharged to a surface water body or to groundwater.

End use/disposal: Options for the end use of the treated sludge include use in agriculture as a soil conditioner or as a solid fuel or as an additive to construction materials [6].

Operation and maintenance considerations

Toilet and containment: The user is commonly responsible for the construction of the toilet and pit, although they may pay a mason to carry out the work. The user will be responsible for cleaning and repairs to the toilet, including the slab, seat/squat hole, drop-hole, cover/lid and superstructure. In rural areas, the user may undertake emptying but in urban locations this is more likely to be done by a service provider who charges the household for the service [2].

At shared facilities, a person (or persons) needs to be identified to clean and carry out maintenance tasks on behalf of all users.

Conveyance and treatment: The conveyance and treatment technologies are typically operated and maintained by a combination of private and public service providers working together; for example, where emptying and transport is done by private and/or public service providers who deliver faecal sludge to treatment plants operated by public service providers. All plant, tools and equipment used in the conveyance and treatment steps will require regular maintenance by the relevant service providers.

End use/disposal: Farmers and the general public will be the main users of the treatment products and will be responsible for maintenance of all tools and equipment they use [5].

Mechanisms for protecting public health

Toilet and containment: The toilet separates users from excreta while the pit isolates the excreta and pathogens within from physical human contact.

During rains, the toilet and the pit contain the fresh excreta and prevent it from being washed away into surface water bodies, while squat-hole covers or lids can reduce disease transmission by preventing disease carrying vectors from entering and leaving the pit [2, 3].

Any leachate permeates from the pit into the surrounding soil and pathogens contained in the liquid are filtered out, adsorbed onto particles, or die off during their slow travel through soil [2, 3].

Conveyance: The conveyance step removes the pathogen hazard from the neighbourhood or local community. To do this safely, emptying and transport workers require personal protective equipment as well as standard operating procedures. For instance, the wearing of boots, gloves, masks and clothing that cover the whole body is essential, as well as washing facilities and good hygiene practices. The emptiers should not enter a pit but use long handled shovels to remove sludge at the bottom of a pit [5].

Any non-degradable solid waste removed from the pit, needs to be disposed of properly, for example through a regulated solid waste management service or, where this is not available, through burial.

Treatment: In order to reduce the risk of exposure of the local community, all treatment plants must be securely fenced to prevent people entering the site. To safeguard workers' health when operating the plant and carrying out maintenance to tools and equipment, all treatment plant workers must wear appropriate protective equipment and follow standard operating procedures [5].

End use/disposal: If correctly designed, constructed and operated, treatment technologies can be combined to reduce the pathogen hazard within the effluent or sludge by removal, reduction or inactivation to a level appropriate for the intended end use and/or disposal practice [8]. For example, sludges require dewatering and drying followed by co-composting with organics before use as a compost-type soil conditioner, but for use as a solid fuel or building material additive, they only require dewatering and drying. While effluent will require stabilization and pathogen inactivation in a series of ponds or wetlands before use as crop irrigation water [6, 7].

To protect the health of themselves, colleagues and the general public, end users must wear appropriate protective equipment and follow standard operating procedures in accordance with the actual level of treatment and end use [5].

References

The text for this fact sheet is based on Tilley, et al. [1] unless otherwise stated.

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