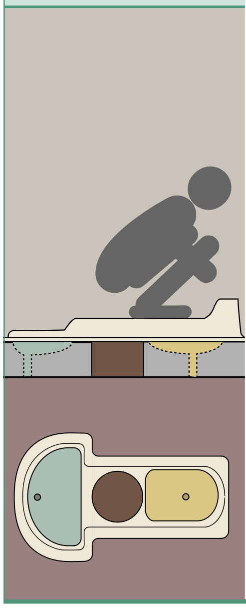
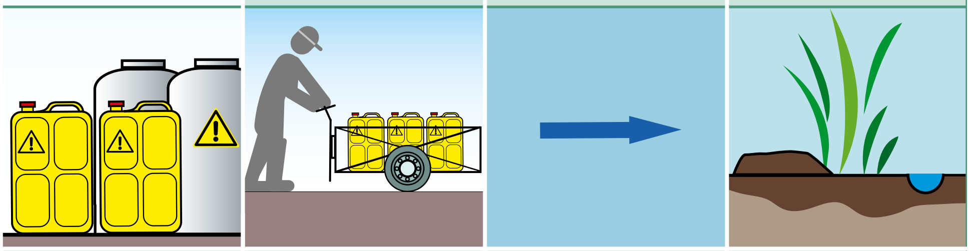
World Health Organization

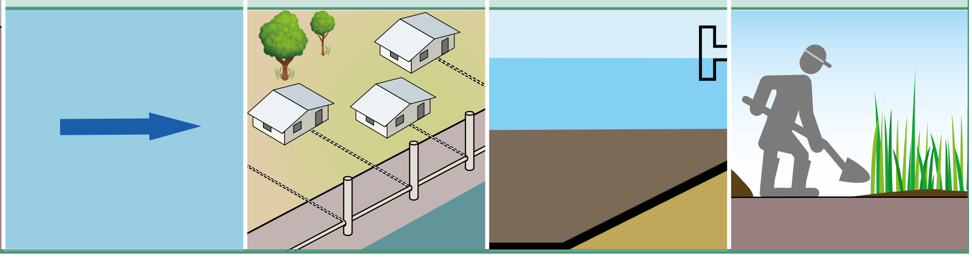
Fact sheet 11

Urine-diverting flush toilet with sewerage and offsite wastewater treatment

Toilet	Containment	Conveyance	Treatment	End use / disposal
Urine-diverting flush toilet	Urine: Jerry cans or tanks	Urine: Manual or motorized transport	None	Urine: used for irrigation
	N/A	Brownwater: simplified or conventional gravity sewer	Treatment plant for brownwater and wastewater sludge	Soil conditioner; solid fuel; building materials; irrigation; surface water recharge*







* Soil conditioner; solid fuel; building materials; irrigation; surface water recharge*

Summary

This is a water-based system that requires a urine-diverting flush toilet (UDFT) and a sewer. The UDFT is a special toilet that allows for the separate collection of urine without water, although it uses water to flush faeces.

Inputs to the system can include faeces, urine, flushwater, cleansing water, dry cleansing materials, greywater and possibly stormwater.

The main toilet technology for this system is the UDFT. A urinal could additionally be used. Brownwater and urine are separated at the toilet. Brownwater bypasses the urine storage tank and is conveyed to a treatment facility using a simplified or a conventional gravity sewer network.

Brownwater is treated at a treatment facility where a combination of technologies is used to produce treated effluent for end use and/or disposal, and wastewater sludge. This sludge must be further treated prior to end use and/or disposal.

Urine diverted at the toilet is collected in a storage tank. Stored urine can be handled easily and with little risk because it is nearly sterile. With its high nutrient content it can be used as a good liquid fertilizer. Stored urine can be transported using manual or motorized transport technologies. Alternatively, the urine can be diverted directly to the ground for infiltration through a soak pit.

Applicability

Suitability: This system is only appropriate when there is an end use and therefore a need for the separated urine, and/or when there is a desire to limit water consumption by using a low-flush UDFT (although the system still requires a constant source of water).

Depending on the type of sewers used, this system can be adapted for both dense urban and peri-urban areas. It is not well-suited to rural areas with low housing densities. Since the sewer network is (ideally) watertight, it is also applicable for areas with high groundwater tables.

Cost: UDFTs are not common and the capital cost for this system can be very high. This is partly due to the fact that there is limited competition in the toilet market and also because high quality workmanship is required for the dual plumbing system. Conventional gravity sewers require extensive excavation and installation, which is expensive, whereas simplified sewers are generally less expensive if the site conditions permit a condominial design.

Users may be required to pay a connection fee and regular user fees for system maintenance; this will depend on the operation and maintenance arrangement.

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.

Overall, this system is most appropriate when there is a high willingness and ability to pay for the capital investment and maintenance costs and where there is an appropriate treatment facility.

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 sewer.

This water-based system is suitable for cleansing water inputs, and easily degradable dry cleansing materials can be used. However, rigid or non-degradable materials (e.g., leaves, rags) could clog the system and cause problems and should not be used. In cases when dry cleansing materials are separately collected from the flush toilets, they should be collected with solid waste and safely disposed of, for example through burial or incineration.

Conveyance: The gravity sewer network can transport greywater to treatment, where the combined flows are treated together. Stormwater could also be put into the gravity sewer network, although this would dilute the wastewater and require stormwater overflows. Local retention and infiltration of stormwater, or a separate drainage system for rain and stormwater are therefore preferred approaches.

End use/disposal: Options for the end use and/or disposal of the treated effluent include irrigation, fish ponds, floating plant ponds or discharge to a surface water body or to groundwater [2].

Treated sludge can be used in agriculture as soil conditioner, as a solid fuel, or as an additive to construction materials [3].

Operation and maintenance considerations

Toilet: The user is responsible for the construction, maintenance and cleaning of the UDFT.

At shared toilet facilities, a person (or persons) to clean and carry out other maintenance tasks (e.g. repairs to superstructure) on behalf of all users needs to be identified, as well as a urine transport service provider.

Conveyance: Depending on the sewer type and management structure (simplified vs. conventional, city-managed vs. community-operated) there will be varying degrees of operation or maintenance responsibilities for the user [4].

Treatment and end use/disposal: Functioning, properly maintained wastewater and sludge treatment technologies are a key requirement. In most situations these are managed at the municipal or regional level. In the case of more local, small-scale systems, operation and maintenance of the urine transport service, the sewer network and the treatment plant are managed and organized at the community level [4].

Importantly, for this system, all plants, tools and equipment used in the containment, conveyance, treatment and end use/disposal steps will require regular maintenance by the service providers.

Mechanisms for protecting public health

Toilet and containment: The toilet separates the excreta from direct human contact, and the water seal reduces smells, nuisance and disease transmission by preventing disease carrying vectors from entering and leaving the sewer.

The urine poses little health risk as it is nearly sterile, and storage before use in sealed containers will protect public health [3]. In areas in which schistosomiasis is endemic, urine should not be used in water-based agriculture, such as rice paddies

Conveyance: The conveyance step removes the pathogen-laden brownwater from the neighbourhood or local community to a treatment plant. The (ideally) watertight sewer network isolates the brownwater from physical human contact and ensures groundwater is not contaminated.

When clearing blockages or repairing sewers, all 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 [5].

Treatment and 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. For example, effluent requires stabilization and pathogen inactivation in a series of ponds or wetlands before use as crop irrigation water. 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 [2,3,6].

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, and 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.

References

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

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4. Brikké F, and Bredero M (2003). *Linking Technology Choice with Operation and Maintenance in the Context of Community Water Supply and Sanitation. A reference document for planners and project staff.* Geneva, Switzerland.

5. World Health Organization (2015). *Sanitation Safety Planning – Manual for safe use and disposal of wastewater, greywater and excreta.* Geneva, Switzerland.

6. World Health Organization (2006). WHO G*uidelines for the safe use of wastewater, excreta and greywater. Volumes I to IV.* Geneva, Switzerland. 2006.