Part 2: **Functional Groups with Technology Information Sheets**

Reading the Technology Information Sheets

For each Technology described in the System Templates, there is a Technology Information Sheet which includes a summary of the Technology, appropriate applications and limitations. The page is not intended to be a design manual or technical reference; rather it is a starting point for further detailed design. Moreover, the Technology descriptions are meant to serve as a source of inspiration and discussion amongst engineers and planners who may not have previously considered one or several of the feasible options.

Each Technology Information Sheet is colour coded according to the associated **Functional Group.** The letter code (e.g. U for User Interface) also indicates the Functional Group to which the Technology belongs. Figure 5 on the following page presents and explains an example of a Technology Information Sheet heading.

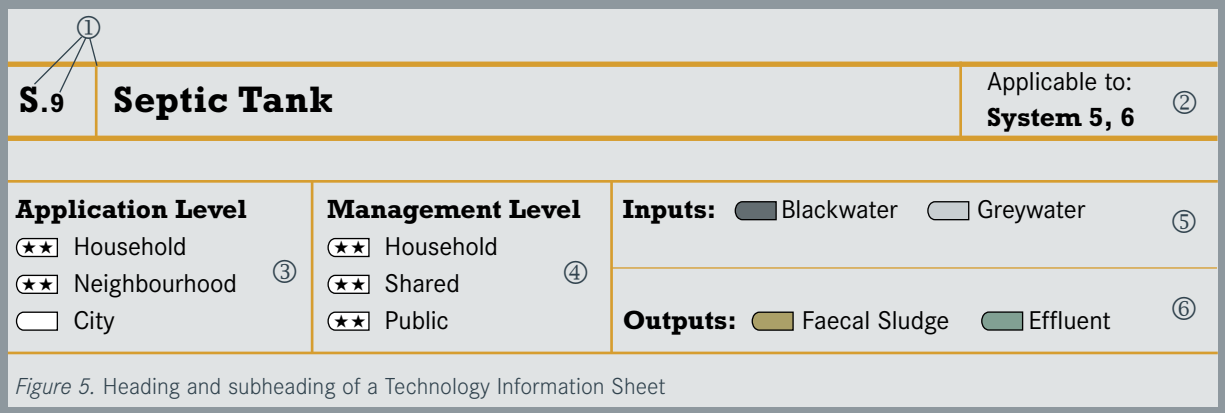


Figure 5. Heading and subheading of a Technology Information Sheet

1) The title with colour, letter and number code. The colour-code (orange) and the letter (S) indicate that the Technology belongs to the Functional Group 'Collection and Storage/Treatment (S). The number (9) indicates that it is the ninth (9th) technology within that Functional Group.
Each Technology description page has a similar colour, letter and number code for easy access and cross-referencing.

2) Applicable to System 5, 6. This indicates in which System Template the Technology can be found. In this case, the Septic Tank can be found (and only found) in System 5 and 6. Other Technologies may be found in only one or in several systems.

3) Application Level. Three spatial levels are defined under this heading:
- *Household* implies that the technology is appropriate for one or several households
- *Neighbourhood* implies that the technology is appropriate for several up to several hundred households
- *City* implies that the technology is appropriate at the city-wide level (either one unit for the whole city, or many units for each part of the city or household)

Stars are used to indicate how appropriate each level is for the given technology:
- *two stars* means suitable,
- *one star* means less suitable; and
- *no star* means not suitable.

It is up to the Compendium user to decide on the appropraite level for the specific situation that he/she is working on.
The 'Application Level' graphic is only meant as a rough guide to be used in the preliminary planning stage.
The technologies within the Functional Group 'User Interface' do not include an Application Level since they can only service a limited number of people.

4) Management Level describes the organizational style that is best used for the operation and maintenance (O&M) of the given Technology:
- *Household* implies that the household, e.g. the family, is responsible for all O&M
- *Shared* implies that a group of users (e.g. school, market vendors, community-based organization) assumes the O&M themselves either by ensuring that a person or committee is responsible on behalf of all the users. Shared facilites are defined by the fact that the community of users decides who is allowed to the use the facility and what their responsibilities are; it is a self-defined group of users.
- *Public* implies institutional or government run facilities. All O&M is assumed by the agency that operates the facility. Usually, only users who can pay for the service are permitted to use public facilities.

The Septic Tank in this example can be managed in all three styles.
The technologies within the Functional Group 'User Interface' do not include a Management Level since maintenance is dependent on the subsequent technologies, and not simply the User Interface.

5) Inputs: refers to the Products that flow into the given Technology. The icons shown are those Products that can possibly go into the Technology, but not all of them MUST enter the technology. In this example, Blackwater and Greywater can be processed by the Septic Tank

6) Outputs: refers to the products that flow out of the given Technology. The icons show those Products that can be expected to flow out of the technology. In this example, the Septic Tank produces Faecal Sludge and Effluent.

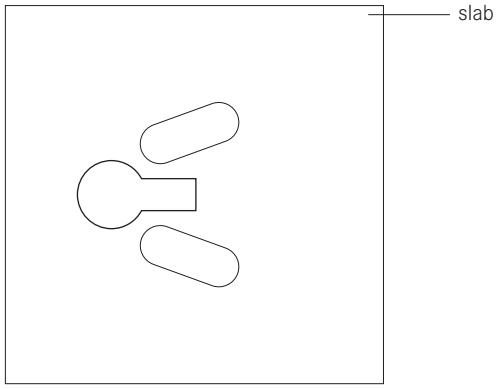
User Interface

U

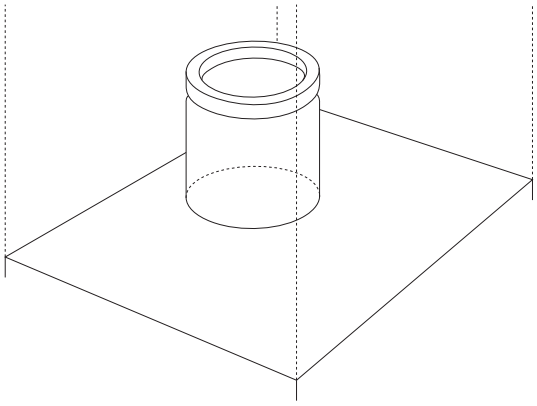
This section describes the technologies with which the user interacts.
The User Interface is the way in which the sanitation system is accessed.

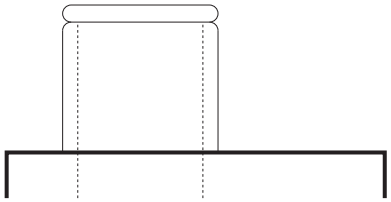
Inputs: Faeces Urine
Anal Cleansing Water

Outputs: Excreta



option 1




option 2

A Dry Toilet is a toilet that operates without water. The Dry Toilet may be a raised pedestal that the user can sit on, or a squat pan that the user squats over. In both cases, excreta (both urine and faeces) fall through a drop hole.

In this Compendium, a Dry Toilet refers specifically to the device that the user sits or squats over. In other literature, a Dry Toilet may refer to a variety of technologies, or combinations of technologies (especially pits).
The Dry Toilet is usually placed over a pit; if two pits are used, the pedestal or slab should be designed in such a way that it can be lifted and moved from one pit to another.
The slab or pedestal base should be well sized to the pit so that it is both safe for the user and prevents stormwater from infiltrating the pit (which may cause it to overflow).

Adequacy Dry Toilets are easy for almost everyone to use. Because there is no need to separate urine and faeces, they are often the most physically comfortable and natural option.

Pedestals and squatting slabs can be made locally with concrete (providing that sand and cement are available). Wooden or metal molds can be used to produce several units quickly and efficiently. When dry toilets are made locally, they can be specially designed to meet the needs of the target users (e.g. smaller ones for children). Fibreglass, porcelain and stainless steel versions may also be available. They are appropriate for almost every climate.

Health Aspects/Acceptance Squatting is a natural position for many people and so a well-kept squatting slab may be the most acceptable option.
Since Dry Toilets do not have a water seal, odours may be a problem depending on the Collection and Storage / Treatment technology to which it is connected.

Maintenance The sitting or standing surface should be kept clean and dry to prevent pathogen/disease transmission and to limit odours.
There are no mechanical parts and so the Dry Toilet should not need repairs except in the event that it cracks.

Pros & Cons:

+ Does not require a constant source of water
+ Can be built and repaired with locally available materials
+ Low capital and operating costs
+ Suitable for all types of users (sitters, squatters, washers, wipers)
- Odours are normally noticeable (even if the vault or pit used to collect excreta is equipped with a vent pipe).
- The excreta pile is visible, except where a deep pit is used

References

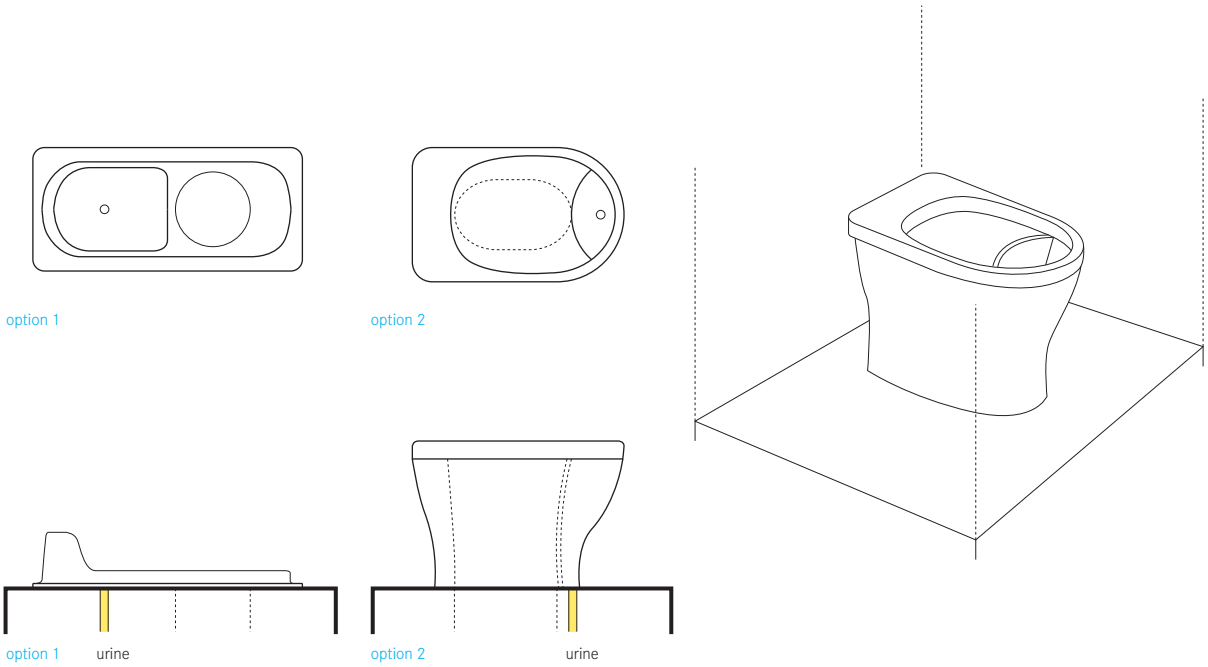
_ Brandberg, B. (1997). *Latrine Building. A Handbook for Implementation of the Sanplat System.* Intermediate Technology Publications, London. pp 55–77
(Describes how to build a squatting slab and the moulds for the frame, footrests, spacers, etc.)

_ Morgan, P. (2007). *Toilets That Make Compost: Low-cost, sanitary toilets that produce valuable compost for crops in an African context.* Stockholm Environment Institute, Sweden.
(Excellent description of how to make support rings and squatting slabs (pages 7–35) and pedestals (39–43) using only sand, cement, plastic sheeting and wire.)
Available: www.ecosanres.org

_ Netherlands Water Partnership (NWP) (2006). *Smart Sanitation Solutions. Examples of innovative, low-cost technologies for toilets, collection, transportation, treatment and use of sanitation products.* NWP, Netherlands.
(Provides country specific data and links for further information.)

Inputs: Faeces Urine Anal Cleansing Water

Outputs: Faeces Urine Anal Cleansing Water



A Urine Diverting Dry Toilet (UDDT) is a toilet that operates without water and has a divider so that the user, with little effort can divert the urine away from the faeces.

The UDDT toilet is built such that urine is collected and drained from the front area of the toilet, while faeces fall through a large chute (hole) in the back. Depending on the Collection and Storage/Treatment technology that follows, drying material such as lime, ash or earth should be added into the same hole after defecating.

It is important that the two sections of the toilet are well separated to ensure that a) faeces do not fall into, and clog the urine collection area in the front, and that b) urine does not splash down into the dry area of the toilet.

There are also 3-hole separating toilets that allow anal cleansing water to be separated from the urine and the faeces into a third, dedicated hole. It is important that the faeces remain separate and dry. When the toilet is cleaned with water, care should be taken to ensure that the faeces are not mixed with water.

Both a pedestal and a squat slab can be used to separate urine from faeces depending on user preference.

Adequacy The UDDT is simple to design and build using such materials as concrete and wire mesh or plastic. The UDDT design can be altered to suit the needs of specific populations (i.e. smaller for children, people who prefer to squat, etc.) They are appropriate for almost every climate.

Health Aspects/Acceptance The UDDT is not intuitive or immediately obvious to some users. At first, users may be hesitant about using it and mistakes (e.g. faeces in the urine bowl) may deter others from accepting this type of toilet as well. Education and demonstration projects are essential in achieving good acceptance with users.

Maintenance A UDDT is slightly more difficult to keep clean compared to other toilets because of both the lack of water and the need to separate the solid faeces and liquid urine. For cleaning, a damp cloth may be used to wipe down the seat and the inner bowls. Some toilets are easily removable and can be cleaned more thoroughly. No design will work for everyone and therefore, some users may have difficulty separating both streams perfectly which may result in extra cleaning and maintenance.

Faeces can be accidentally deposited in the urine section, causing blockages and cleaning problems. As well, urine pipes/fittings can become blocked over time and may require occasional maintenance.
This is a waterless technology and water should not be poured down the toilet. As well, urine tends to rust most metals; therefore, metals should be avoided for the construction and piping of the UDDT.

Pros & Cons:

+ Does not require a constant source of water
+ No real problems with odours and vectors (flies) if used and maintained correctly (i.e. kept dry)
+ Can be built and repaired with locally available materials
+ Low capital and operation costs
+ Suitable for all types of users (sitters, squatters, washers, wipers)
- Requires education and acceptance to be used correctly
- Is prone to clogging with faeces and misuse

References

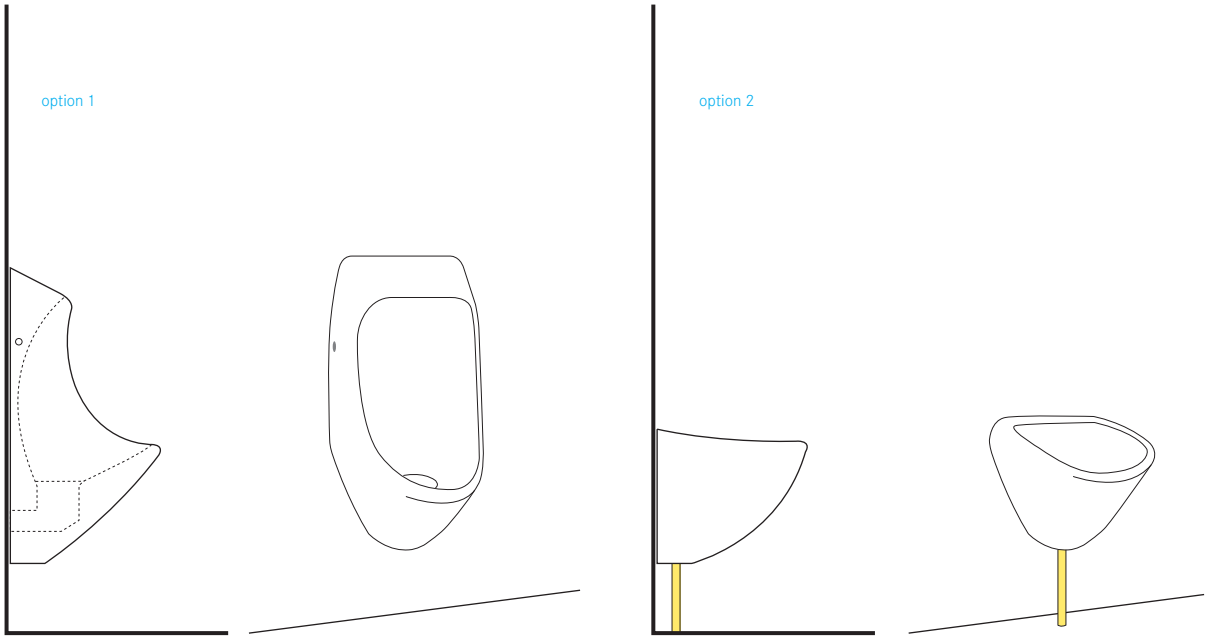
_ Morgan, P. (2007). *Toilets That Make Compost: Low-cost, sanitary toilets that produce valuable compost for crops in an African context.* Stockholm Environment Institute, Sweden. Available: www.ecosanres.org
(Provides step-by step instruction on how to build a UDDT using a plastic bucket and how to construct a urine diverting squat plate.)

_ Netherlands Water Partnership (NWP) (2006). *Smart Sanitation Solutions. Examples of innovative, low-cost technologies for toilets, collection, transportation, treatment and use of sanitation products.* NWP, Netherlands.
(Provides country specific data and links for further information.)

_ Winblad, U. and Simpson-Herbert, M. (2004). *Ecological Sanitation.* Stockholm Environment Institute, Sweden. Available: www.ecosanres.org
(Provides a good, general overview of different types of UDDTs – see especially page 59.)

Inputs: Urine Flushwater

Outputs: Urine Flushwater



A Urinal is only used for collecting urine. Urinals are generally for men, although Urinals for women have also been developed.

Urinals for women consist of raised foot-steps and a sloped channel or catchment area for conducting the urine to a collection technology. For men, Urinals can either be wall-mounted units that are vertical, or squat slabs that the user squats over.
Most Urinals use water for flushing, but waterless Urinals are becoming increasingly popular.

Adequacy The Urinal can be used with or without water and the plumbing can be developed accordingly. If water is used, it is mainly used for cleaning and limiting odours (with a water-seal). Water-based Urinals use 8 to 12 litres of flushwater, whereas low-flush models use less than 4 litres of flushwater. Because the Urinal is exclusively for urine it is important to also provide another toilet to be used for faeces.
Waterless Urinals are available in a range of styles and complexities. Some Urinals come equipped with an odour seal that may have a mechanical closure, a membrane, or a sealing liquid. To minimize odours in simple Urinal designs, each Urinal should be equipped with a dedicated pipe that is submerged in the collected urine (or tank) to provide a basic water-seal.
Portable waterless Urinals have been developed for use at large festivals, concerts and other gatherings, to improve the on-site sanitation facilities and reduce the point load of wastewater discharged at the site. In this way, a large volume of urine can be collected (and either used or discharged at a more appropriate location or time) and the remaining urine/faeces toilets can be reduced or used more efficiently. Urinals can be used in homes as well as within public facilities.
By putting a small target, or painted fly near the drain, the amount of spraying or splashing can be reduced; this type of user-guidance can help improve the cleanliness of the facility.
Urinals are appropriate for every climate.

Health Aspects/Acceptance The Urinal is a comfortable and easily accepted User Interface. In some cases, the provision of a Urinal is useful to prevent the misuse of dry systems (e.g. UDDT). Urinals, although simple in construction and design, can have a large impact on the well-being of a community. When men

have access to a Urinal, they may be encouraged to refrain from urinating in public, which reduces unwanted odours and allows women to feel more comfortable.
Men have generally accepted waterless Urinals, as they do not call for any change of behaviour.

Maintenance Maintenance is simple, but should be done frequently. Minerals and salts may build up in pipes and on surfaces where urine is constantly present. To prevent scaling, slightly acidic water and/or hot water can be used to dissolve any minerals that form. All of the surfaces should be cleaned regularly (bowl, slab and steps) to prevent odours and to minimize solids formation.

Pros & Cons:

+ Does not require a constant source of water
+ Can be built and repaired with locally available materials
+ Low capital and operating costs
- No real problems with odours if used and maintained correctly

References

_ Austin, A. and Duncker, L. (2002). *Urine-diversion. Ecological Sanitation Systems in South Africa.* CSIR, Pretoria, South Africa.
(Directions for making a simple Urinal using a 5L plastic container.)

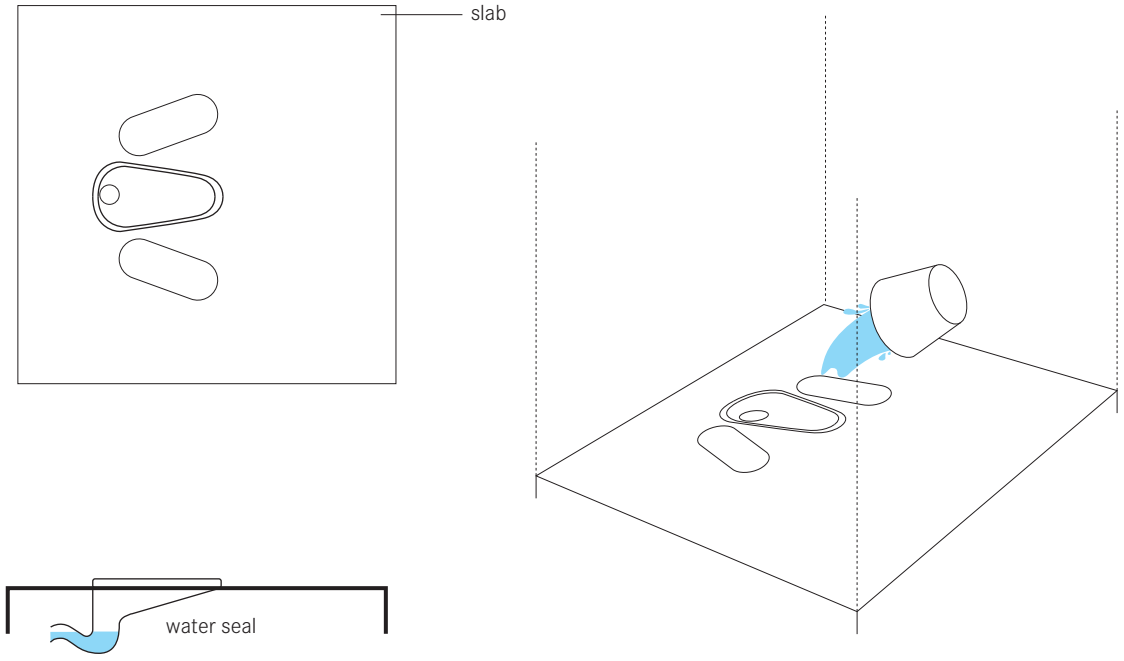
_ CREPA (2008). *Promotion de latrines ECOSAN à la 20è édition du FESPACO: Ecosan Info No. 8.* Centre Régional pour l'Eau Potable et l'Assainissement à faible coût (CREPA), Burkina Faso.
Available: www.reseaucrepa.org

_ GTZ (1999). *Technical data sheets for ecosan components: Waterless Urinals.* GTZ, Germany.
Available: www.gtz.de
(Information about specialized urinals, which include stench traps and other specialized features.)

_ Netherlands Water Partnership (NWP) (2006). *Smart Sanitation Solutions. Examples of innovative, low-cost technologies for toilets, collection, transportation, treatment and use of sanitation products.* NWP, Netherlands.
(Provides country specific data and links for further information.)

Inputs: Urine Faeces Flushwater Anal Cleansing Water

Outputs: Blackwater



A Pour Flush Toilet is like a regular Flush Toilet except that instead of the water coming from the cistern above, it is poured in by the user. When the water supply is not continuous, any cistern Flush Toilet can become a Pour Flush Toilet.

Just like a traditional Flush Toilet, there is a water seal that prevents odours and flies from coming back up the pipe.
Water is poured into the bowl to flush the toilet of excreta; approximately 2 to 3 L is usually sufficient. The quantity of water and the force of the water (pouring from a height often helps) must be sufficient to move the excreta up and over the curved water seal.
Both pedestals and squatting pans can be used in the pour flush mode. Due to demand, local manufacturers have become increasingly efficient at mass-producing affordable, Pour Flush Toilets and pans.
The S-shape of the water seal determines how much water is needed for flushing. To reduce water requirements, it is advisable to collect toilet paper or other dry cleansing materials separately.
The waterseal at the bottom of the Pour Flush Toilet or pan should have a slope of 25 to 30°. Water seals should be made out of plastic or ceramic to prevent clogs and to make cleaning easier (concrete may clog more easily if it is rough or textured). The optimal depth of the water seal is approximately 2 cm to minimize the water required to flush the excreta. The trap should be approximately 7 cm in diameter.

Adequacy The water seal is effective at preventing odours and it is appropriate for those who sit or squat (pedestal or slab) as well as those who cleanse with water. It is only appropriate when there is a constant supply of water available. The Pour Flush Toilet requires (much) less water than a traditional cistern Flush Toilet. However, because a smaller amount of water is used, the Pour Flush Toilet may clog more easily and thus, require more maintenance.
If water is available, this type of toilet is appropriate for both public and private applications.
Pour Flush Toilets are adequate for almost all climates.

Health Aspects/Acceptance The Pour Flush Toilet (or squatting pan) prevents users from seeing or smelling the excreta of previous users. Thus, it is generally well accepted. Provided that the water seal is working

well, there should be no odours and the toilet should be clean and comfortable to use.

Maintenance Because there are no mechanical parts, Pour Flush Toilets are quite robust and rarely require repair.
Despite the fact that water is used continuously in the toilet, it should be cleaned regularly to prevent the build up of organics and or/stains.
To prevent clogging of the Pour Flush Toilet, it is recommended that dry cleansing materials be collected separately and not flushed down the toilet.

Pros & Cons:

+ The water seal effectively prevents odours
+ The excreta of one user are flushed away before the next user arrives
+ Suitable for all types of users (sitters, squatters, wipers and washers)
+ Low capital costs; operating costs depend on the price of water
- Requires a constant source of water (can be recycled water and/or collected rain water)
- Cannot be built and/or repaired locally with available materials
- Requires some education to be used correctly

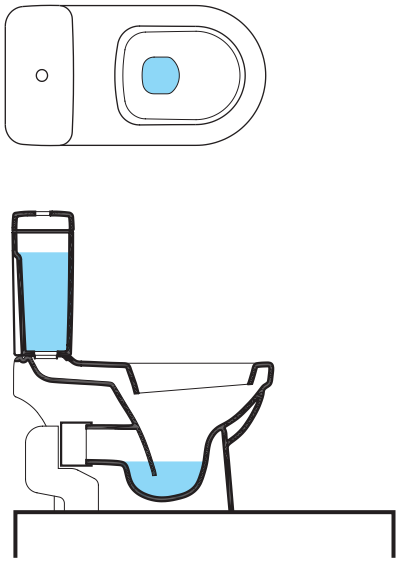
References

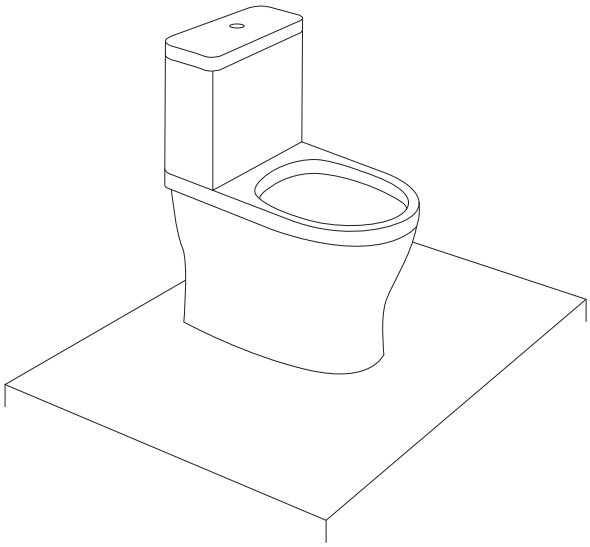
– Mara, DD. (1996). *Low-Cost Urban Sanitation.* Wiley, Chichester, UK.
(Provides detailed drawings of Indian glass-fibre squat pan and trap with dimensions and critical design criteria. A description of how to modify a Pour Flush Toilet to a cistern Flush Toilet is included.)

– Roy, AK., et al. (1984). *Manual on the Design, Construction and Maintenance of Low-Cost Pour Flush Waterseal Latrines in India (UNDP Interreg. Project INT/81/047).* The World Bank + UNDP, Washington.
(Provides specifications for Pour Flush Toilets and connections.)

Inputs: Urine, Faeces, Flushwater, Anal Cleansing Water

Outputs: Blackwater





The Cistern Flush Toilet is usually porcelain and is a mass-produced, factory made User Interface. The Flush Toilet consists of a water tank that supplies the water for flushing the excreta and a bowl into which the excreta are deposited.

The attractive feature of the Flush Toilet is that it incorporates a sophisticated water seal to prevent odours from coming back up through the plumbing. Depending on the age and design of the toilet, approximately 3 to 20 L of water may be used per flush.
Water that is stored in the cistern above the toilet bowl is released by pushing or pulling a lever. This allows the water to run into the bowl, mix with the excreta and carrying them away.

There are different low-volume Flush Toilets currently available that use as little as 3 L of water per flush. In some cases, the volume of water used per flush is not sufficient to empty the bowl and consequently the user is forced to use two or more flushes to adequately clean the bowl, which negates the intended water saving.

A good plumber is required to install a Flush Toilet. The plumber will ensure that all valves are connected and sealed properly, therefore minimizing leakage.

Adequacy A Cistern Flush Toilet should not be considered unless all of the connections and hardware accessories are available locally.
The Cistern Flush Toilet must be connected to both a constant source of water for flushing and a Collection and Storage/Treatment or Conveyance technology to receive the blackwater.
The Cistern Flush Toilet is suitable for both public and private applications and can be used in every climate.

Health Aspects/Acceptance It is a safe and comfortable toilet to use provided it is kept clean.

Maintenance Although flushwater continuously rinses the bowl, the toilet should be scrubbed clean regularly. Maintenance is required for the replacement or repair of some mechanical parts or fittings.

Pros & Cons:

+ The excreta of one user are flushed away before the next user arrives
+ No real problems with odours if used correctly
+ Suitable for all types of users (sitters, squatters, wipers and washers)
- High capital costs; operating costs depend on the price of water
- Requires a constant source of water
- Cannot be built and/or repaired locally with available materials

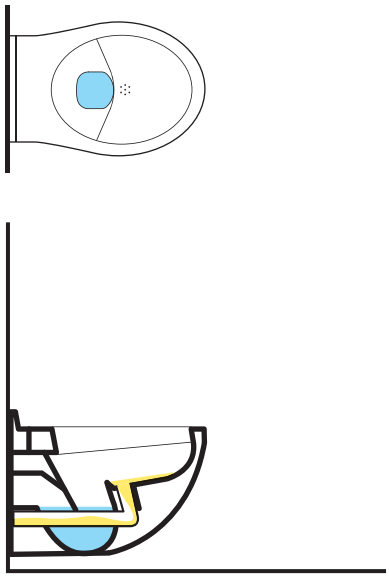
References

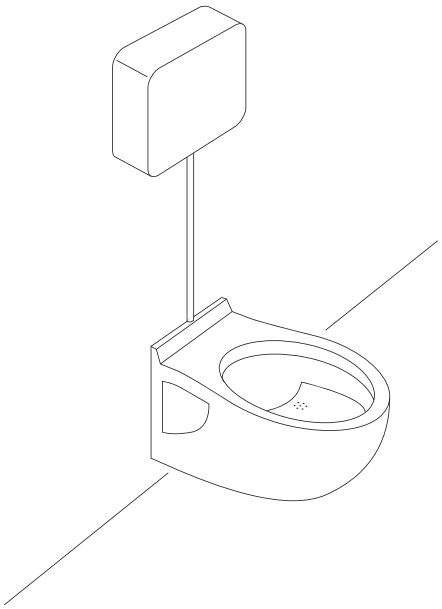
_ Maki, B. (2005). *Assembling and Installing a New Toilet.* Available: www.hammerzone.com
(Describes how to install a toilet with full colour photos and step-by-step instructions.)

_ Vandervort, D. (2007). *Toilets: Installation and Repair.* HomeTips.com.
Available: http://hometips.com/content/toilets_intro.html
(Describes each part of the toilet in detail as well as providing links to other tools such as how to install a toilet, how to fix a leaking toilet and other toilet essentials.)

Inputs: Urine, Faeces, Flushwater, Dry Cleansing Material, Anal Cleansing Water

Outputs: Urine, Brownwater





The Urine Diverting Flush Toilet (UDFT) is similar in appearance to a Cistern Flush Toilet except for the diversion in the bowl. The toilet bowl has two sections so that the urine can be separated from the faeces.

When the user sits on the toilet, urine is collected in a drain in the front (where there is no water) and faeces are collected in the back (where there is water). The urine is collected without water, but a small amount of water is used to rinse the urine-collection bowl after the user stands up. The urine flows into a storage tank for further use or processing, while the faeces are flushed with water to be treated. The system requires dual plumbing (i.e. plumbing for the urine and for the brownwater).

Adequacy The toilet should be installed carefully with an understanding of how and where clogs may occur so that they can be easily removed.
A UDFT is adequate when there is a limited supply of water for flushing, a treatment technology for the brownwater (i.e. faeces, dry cleansing material and flushing water) and a use for the collected urine.

To improve diversion efficiency, Urinals for men are recommended.
UDFTs are suitable for public and private applications although significant education and awareness is required in public settings to ensure proper use and to minimize clogging.
This technology requires dual plumbing (separate for urine and brownwater), which is more complicated than plumbing for Cistern Flush Toilets.

Health Aspects/Acceptance Information cards and/or diagrams are essential for ensuring proper use and for promoting acceptance; if users understand why the urine is being separated they will be more willing to use the UDFT properly. Proper plumbing will ensure that there are no odours.

Maintenance As with any toilet, proper cleaning is important to keep the bowl(s) clean and prevent organic residues and stains from forming.
Because urine is collected separately, calcium- and magnesium-based minerals can precipitate out and build up in the fittings and pipes. Washing the bowl with a mild acid and/or hot water can prevent the build-up

of mineral deposits; stronger (>24 % acetic) acid or a caustic soda solution (2 parts water to 1 part soda) can be used for removing blockages however, some manual removal may be required periodically.
To limit scaling, all connections (pipes) to storage tanks should be kept as short as possible; whenever they exist, pipes should be installed with at least a 1 % slope and sharp (90°) angles should be avoided. Larger diameter pipes (75 mm for low maintenance and 50 mm for higher maintenance) should be used.

Pros & Cons:

+ Requires less water than a traditional Flush Toilet
+ No real problems with odours if used correctly
+ Looks like, and can be used almost like, a Cistern Flush Toilet
- Limited availability; can not be built or repaired locally
- High capital and low to moderate operating costs (depending on parts and maintenance)
- Labour-intensive maintenance
- The toilet is not intuitive; requires education and acceptance to be used correctly
- Is prone to clogging and misuse
- Requires a constant source of water
- Men usually require a separate Urinal for optimum collection of urine.

References

_ GTZ (1999). *Technical data sheets for ecosan components: Urine diversion Toilets.* GTZ, Germany.
Available: www.gtz.de
(Provides a thorough comparison of the Flush Toilets with Urine diversion currently on the market. Information includes contact information and pricing as well as a description of the installation and maintenance requirements.)

_ Kvarnström, E., et al. (2006). *Urine Diversion – One step towards sustainable sanitation. Report 2006-1.*
Ecosan Res: Ecosan Publication Series, Stockholm.
Available: www.ecosanres.org