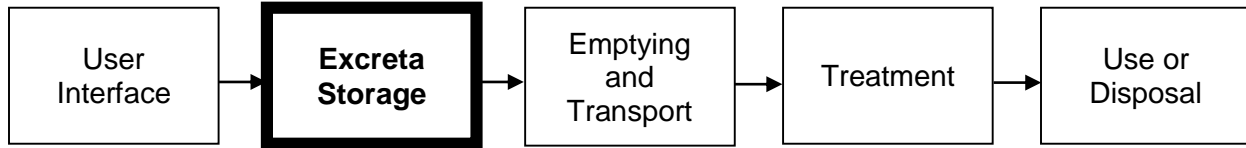


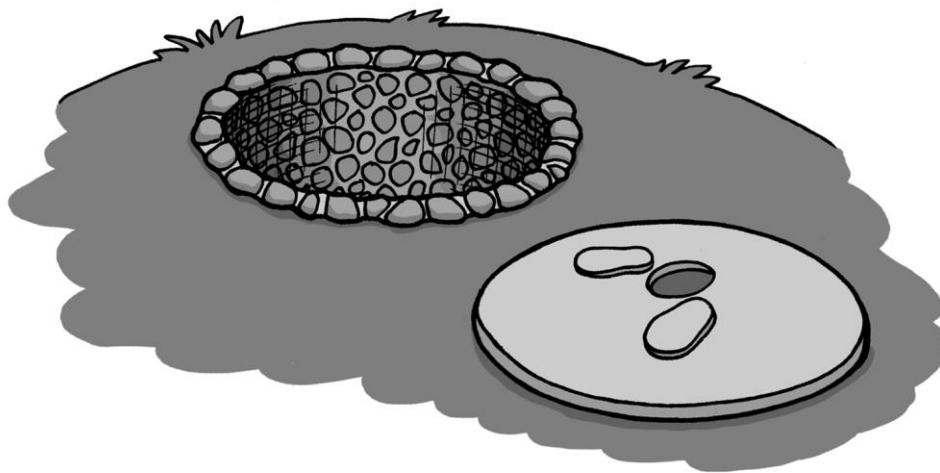
# Technical Brief: Sanitation System – Excreta Storage

## Sanitation System



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# Technical Brief: Sanitation System – Excreta Storage

## 1 Introduction

A sanitation system deals with human excreta from the time it is “captured” in a latrine until it is used or disposed of safely. Sanitation systems are built for people, are managed by people, and affect people’s daily lives. The latrine is the part of a sanitation system that people interact with the most. The latrine is made up of the:

- “Front-end” or the user interface: the parts that every user interacts with, including the toilet (seat or pan), slab and superstructure
- “Back-end” or excreta storage: the pit, tank or chamber used to store excreta

After the latrine user interface, the second component of any sanitation system is excreta storage. A latrine needs some way to safely store excreta and prevent the transmission of fecal pathogens and other contaminants (like nitrogen). The excreta storage method is also a key component to ensure that the latrine meets the users’ needs and preferences. It will influence whether there is any smell from the latrine, where the latrine can be placed, and what maintenance tasks the owner will have to do. How excreta is stored will also influence other components in the sanitation system, such as which type of toilet can be used, the method and frequency of latrine emptying, and treatment needed before using or disposing of the sludge.

There are several technology options for collecting and storing excreta, including the following:

- Pit
- Septic tank
- Aqua privy
- Biogas reactor
- Composting chamber
- Dehydrating chamber



This Technical Brief introduces the different types of pits, tanks and chambers that can be used for excreta storage. Further information on each technology is provided in CAWST’s Sanitation Fact Sheets, and in the Additional Resources section of this document. This Technical Brief also gives an overview of some user, environmental and technical factors to consider when selecting an excreta storage method.

For more information on designing excreta storage as part of the entire sanitation system, CAWST’s Technical Briefs and Fact Sheets provide details on:

- How to select, site and construct latrines
- Latrine emptying
- Sludge treatment, use and disposal
- Approaches for sustainable latrine project implementation

## Technical Brief: Sanitation System – Excreta Storage

This document provides a technical overview and is not a design manual. An experienced professional should be consulted for the design of specific latrine technologies and structures.

Please see the Guide to CAWST Sanitation Resources for a complete glossary, list of abbreviations, unit conversions, and an overview of available resources.

CAWST focuses on the planning, design and implementation of on-site sanitation projects for low-income communities not connected to a sewer. For such communities, household or decentralized sanitation offers a hygienic and affordable solution.

CAWST's free, open content resources and schedule of international training workshops can be found at: [www.cawst.org/resources](http://www.cawst.org/resources) and [www.cawst.org/training](http://www.cawst.org/training).



### Definitions

**Chamber:** An impermeable vault structure built aboveground to store excreta. As the chamber fills with excreta, liquids cannot infiltrate through the walls into the surrounding soil. Composting and dehydrating latrines are the two main types of chamber latrines.

**Excreta:** Urine and feces that is not mixed with any flushwater. Excreta contains many nutrients and pathogens.

**Infiltrate:** To pass into or through something. Infiltration is the process by which liquid from a latrine pit enters the surrounding soil.

**Permeable:** Liquids can pass through. Latrine pit walls must be permeable for liquid to infiltrate into the surrounding soil. Impermeable means that liquids cannot pass through (also called watertight).

**Pit:** A hole dug into the ground to store excreta. A pit has permeable walls which allows liquid to infiltrate into the surrounding soil.

**Sludge:** Also called fecal sludge. Excreta removed from a latrine pit, septic tank, aqua privy, biogas reactor or holding tank. It may contain flush water, anal cleansing water, and other anal cleansing materials. It may be raw or partially treated.

**Tank:** An impermeable container built above or belowground to store excreta. As the tank fills with excreta, liquids cannot infiltrate through the walls into the surrounding soil. Some tanks have an outlet pipe to let the liquid (or effluent) flow out. Septic tanks, aqua privies and biogas reactors are all types of tank latrines.

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## 2 Storing Excreta

A latrine needs some type of pit, tank or chamber to safely store excreta. A goal of excreta storage is to prevent the transmission of fecal pathogens and other contaminants (like nitrogen). The technical design of the pit, tank or chamber usually depends on whether or not liquid from the latrine should infiltrate into the soil. Latrines that allow liquid to infiltrate into the soil have a higher risk of contaminating the groundwater than latrines with minimal or no liquid escaping.

Urine and feces may be collected and stored separately or together. Collecting urine separately makes it easy to use as a nutrient source (fertilizer) in fields and gardens. If urine is collected separately, a urine diversion toilet or a urinal must be used. The urine is stored in a container such as a small barrel or jerry can. The feces are collected and stored in a pit, tank or chamber. More information on urine diversion toilets is provided in CAWST's Technical Brief: Sanitation System – User Interface.



(Credit: AKVO, nd)

## 3 Pits

A pit latrine is the most basic type of latrine. A pit is dug into the ground and has permeable walls. This means that as the pit fills with excreta, liquid infiltrates through the pit wall into the surrounding soil. The bottom of the pit should be at least 2 metres above the highest annual groundwater level to minimize the risk of groundwater contamination (Franceys et al., 1992). Pit latrines are suitable in areas with permeable soil and a low groundwater table.

Even with infiltration, latrine pits will sooner or later fill up with sludge. Emptying latrines and transporting sludge is an essential service that is often neglected in the latrine design and implementation. When a pit latrine is full, there are generally two options:

1. The full pit is emptied and reused.
2. The full pit is covered and a new pit is dug.

More information about latrine emptying methods is provided in CAWST's Technical Brief: Sanitation System – Emptying Latrines and Transporting Sludge.

There are three types of pit latrines:

1. Simple pit latrine (usually just called a pit latrine)
2. Ventilated improved pit (VIP) latrine
3. Arborloo latrine




Pit latrines or VIP latrines can be built attached to a dry toilet or a water-flushed toilet. If a pour flush toilet is used, the latrine is often called a pour flush latrine.

Pit latrines or VIP latrines can also be built as twin (or double) pits. When the first pit fills up, it is closed and the second pit is used. When the second pit is full, the first pit is emptied. Because the sludge has sat in the pit for some time (2 years or more), it has reduced pathogen levels and is safer to handle.

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Each type of pit has different advantages, limitations and suitability for different situations. Common latrine pits are described briefly in the table below, and in more detail in CAWST's Sanitation Fact Sheets.

### Common Latrine Pit Technologies

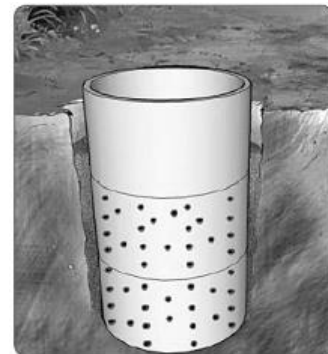
Latrine Pit	Description
	<b>Pit latrine:</b> A rectangular or circular pit dug into the ground and covered with a slab. One of the most common and low cost latrine options.
	<b>VIP latrine:</b> Modification of the pit latrine, with the addition of a vent pipe, open drop hole (do not use a lid!) and a vent or gap above the door. This design helps air to flow through the latrine which reduces odours. Because the inside of the latrine is kept dark (no interior light), any flies are attracted to the light at the top of the vent pipe where they are trapped by a screen.
	<b>Arborloo:</b> Modification of the pit latrine. Uses a shallow pit. When full, the pit is covered with soil and a tree planted in it. A new pit is dug, and the superstructure, toilet and slab are moved to the new pit.

(Illustrations Credit: AKVO, nd)

Pits can be shallow (less than 1.5 metres) or deep (up to 10 metres). The size and depth of a pit will depend on the number of users, the amount and type of anal cleansing material used, whether water is added to the pit, and how long the pit should take to fill up. For details on how to size a latrine pit, see CAWST's Technical Brief: Sizing Latrine Pits.

Pits can be lined to prevent the walls from collapsing. If pits will be emptied and reused, they must be lined. The lining can be made of wood, bamboo, bricks, blocks, stones, concrete or fired clay rings, or any other clean, durable material. Leaving gaps, or not sealing all the spaces between bricks, planks or rings will allow liquids from the pit to still infiltrate into the soil (called a permeable lining).

If the lining is made impermeable, or all the gaps and spaces are sealed so no liquid can infiltrate, the pit effectively becomes a holding tank. Holding tanks will fill up faster than a pit and must be emptied frequently. For more information about holding tanks, see Section 6 below.



Permeable Pit Lining  
(Credit: Cambodian Department of Rural Health Care, 2010)

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The top 0.5 metres of all pits should be lined with an impermeable material. This is also called a footing. The footing should stick up about 10-20 cm above the ground surface. This will stop surface water from entering the pit. The footing is often a ring of concrete, called a ring beam. It supports the slab and superstructure.

For more information on footings and pit lining, see CAWST's Latrine Construction Manual.



Pits can be lined with a permeable lining that will prevent the walls from collapsing, but still allow liquid to infiltrate into the soil.

When considering a pit latrine, some guiding questions to ask regarding technical and environmental conditions and the perspective of latrine users include:

- Is there enough space to dig a pit?
- Can a pit be dug with the soil and groundwater conditions?
- Will there be at least 2 metres between the bottom of the pit and the highest annual groundwater level?
- How many other pit latrines are located in the community?
- Can the pit operate properly in the local environmental conditions (e.g., floods)?
- Will the pit be emptied when it is full?
- How will the pit be emptied?
- How often will the pit need to be emptied?
- If the full pit will not be emptied, is there space to dig a new pit?

For more information, see CAWST's Technical Brief: Siting Latrines and Technical Brief: Sanitation System – Emptying Latrines and Transporting Sludge.



Digging a pit may not be possible if the groundwater level is very high




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## 4 Tanks

A latrine tank is an impermeable container built above or belowground. It may be bought commercially or made from local materials. As the tank fills with excreta, liquids cannot infiltrate through the walls into the surrounding soil. Some tanks have an outlet pipe to let the liquid (or effluent) flow out, which is usually infiltrated into the surrounding soil. The sludge that builds up in the tank can be accessed through an access hatch. The sludge must be periodically removed – usually by a vacuum truck. Septic tanks, aqua privies and biogas reactors are all types of tank latrines.

Each tank technology has different advantages, limitations and suitability for different situations. Common latrine tanks are described briefly in the table below, and in more detail in CAWST’s Sanitation Fact Sheets.

### Common Latrine Tank Technologies

Latrine Tanks	Description
	<p><b>Septic tank:</b> A two or three compartment tank built belowground. The excreta and flush water is partially treated before it is infiltrated into the soil or discharged to a sewer system. Sludge settles to the bottom, and has to be emptied periodically. Any water-flushed toilet can be connected to a septic tank.</p>
	<p><b>Aqua privy:</b> Modification of the septic tank. A latrine is built directly above an impermeable tank filled with water. Excreta drops or is flushed down into the tank through a pipe. The end of the pipe is below water – this creates a water seal that controls smells and flies. In the tank, sludge settles to the bottom, and has to be emptied periodically. The liquid effluent drains out through the outlet pipe (placed at the level of the water in the tank). The effluent is infiltrated into the soil or discharged to a sewer system.</p>
	<p><b>Biogas reactor:</b> Also called an anaerobic digester. A tank built above or belowground to decompose excreta. The reactor produces biogas, which can be used in the home for cooking, lighting or heat. It also produces a slurry, which can be treated and used as a soil amendment. Any water-flushed toilet can be connected to a biogas reactor. Connection to a latrine is not sufficient to produce biogas – the addition of animal manure, kitchen/garden waste or excreta from many latrines is required.</p>

(Illustrations Credit: AKVO, nd)

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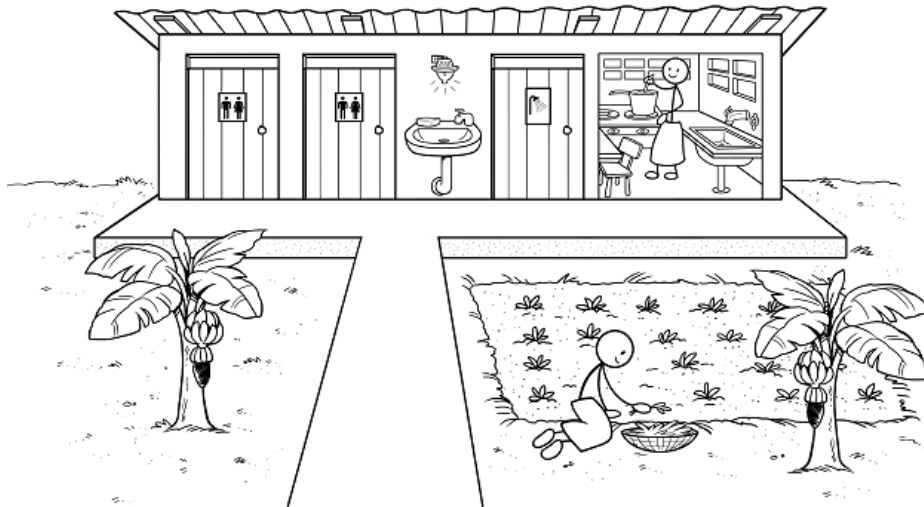
Effluent can be discharged to a soak pit or infiltration trench so that it can be infiltrated into the surrounding soil. There should be at least 2 metres below the soak pit or infiltration trench to the highest annual groundwater level, to minimize the risk of groundwater contamination.

When considering a tank latrine, some questions to ask regarding technical and environmental conditions and the perspective of the latrine users include:

- Is there enough space to place the tank belowground?
- Can a tank be built belowground with the soil and groundwater conditions?
- Where will the effluent from the outlet pipe go?
- Will there be at least 2 metres between the bottom of the soak pit or infiltration trench and the highest annual groundwater level?
- Can the tank operate properly in the local environmental conditions (e.g., floods)?
- How often must the tank be emptied?
- Is there a vacuum truck available to remove sludge periodically?
- Can a vacuum truck physically access the latrine?
- Are people interested in using biogas or treated slurry?
- Does the household keep livestock whose excreta can be added to a biogas reactor?



Vacuum truck emptying a septic tank  
(Credit: AKVO, nd)



A community WASH Centre where a biogas reactor (belowground) produces gas for lighting and cooking, and the treated slurry is used as a soil amendment in the garden

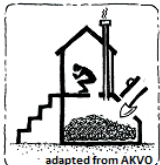



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### 5 Chambers

A latrine chamber is an impermeable structure built aboveground. As the chamber fills with excreta, liquids cannot infiltrate through the walls into the surrounding soil. Composting latrines and dehydrating latrines are the two main types of chamber latrines. Each of these technologies has different advantages, limitation and suitability for different situations. They are described briefly in the table below, and in more detail in CAWST’s Sanitation Fact Sheets.

#### Common Latrine Chamber Technologies

Latrine Chambers	Description
 <p>adapted from AKVO</p>	<p><b>Composting latrine:</b> Uses two chambers to store excreta. An organic cover material (e.g., sawdust, soil, ash, leaves) is added to the chamber after defecation to help degrade the excreta, reduce smells and control flies. One chamber is used for up to two years and then covered and left while the other chamber is used. During this time, microbes decompose the excreta, reduce the pathogens, and create compost – a soft, dark, earthy material. Because optimal composting conditions are difficult to achieve in latrine chambers, the compost usually requires secondary treatment before it is safe to use. The final compost product can be used in gardens or fields to improve soil structure and provide nutrients for plant growth.</p>
	<p><b>Dehydrating latrine:</b> Also called a dehydration vault or urine diversion dry toilet. Uses two chambers where the urine and feces are collected and stored separately. A special urine diverting toilet is required. A cover material (e.g., sawdust, ash) is added to the chamber after defecation to help dry the excreta, reduce smells and control flies. One chamber is used for up to two years and then covered and left while the other chamber is used. Pathogens are reduced through dehydration. Both urine and dried feces can be used in agriculture as soil amendments, or safely disposed of elsewhere.</p>

(Illustrations Credit: AKVO, nd)

Composting and dehydrating latrines can be built anywhere, including areas where:

- It is difficult to dig a pit
- There is a high groundwater table
- Flooding is frequent
- Homes are built over or on water

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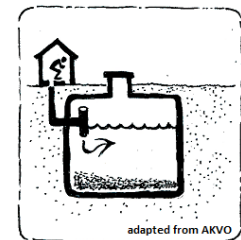
When considering a composting or dehydrating latrine, some guiding questions to ask regarding technical and environmental conditions and the perspective of the latrine users include:

- Are people willing to use a urine diversion toilet?
- Are people willing to add cover material to the toilet after each defecation?
- How often must the chamber be emptied?
- What is the level of treatment to reduce the pathogens to safe levels?
- Are people willing to handle and use treated excreta?
- Is there a local use or market for treated excreta?
- Can the chamber operate properly in the local environmental conditions (e.g., cold climate)?

### 6 Other Excreta Storage Options

Removable containers and holding tanks are less common excreta storage options that are sometimes used in challenging environments. For instance, areas with high groundwater, with frequent flooding, where it is difficult to dig into the ground, or environmentally sensitive.

A permanent holding tank (also called cesspit, sealed pit, tank or chamber) can be used to store excreta. It is a watertight tank that is usually built belowground. Because there is no infiltration of liquid into the soil, a holding tank must be emptied more frequently than a septic tank or pit. It should be emptied by a trained service team. There must be safe treatment, use or disposal, so that sludge is not disposed of unsafely in the environment. Due to the cost of frequent emptying, holding tanks may not be suitable for family or communal latrines. Note that a pit that is fully lined with an impermeable lining is a holding tank.



(Credit: Adapted from AKVO, nd)

Removable containers can also be used to collect and store excreta. The removable containers must be hygienically collected, emptied and cleaned frequently – ideally by a trained service team. A safe sanitation system including sludge treatment and safe use or disposal is essential if this option is to have minimal negative impacts on public health and the environment.



(Credit: AKVO, nd)

For more information, see CAWST's Sanitation Fact Sheet: Holding Tanks, Sanitation Fact Sheet: Removable Containers, and Technical Brief: Latrines in Challenging Environments.

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## 7 Additional Resources

**CAWST Sanitation Resources.** Available at: [www.cawst.org/resources](http://www.cawst.org/resources)

- CAWST’s education and training resources are available on a variety of sanitation topics including latrine design, siting and construction; latrine parts and technologies; latrine emptying and transporting sludge; sludge treatment, use and disposal; and latrine project implementation.

**Compendium of Sanitation Systems and Technologies.** Tilley, E., Ulrich, L., Lüthi, C., Reymond, P. and C. Zurbrügg (2014). 2nd Revised Edition. Eawag: Swiss Federal Institute of Aquatic Science and Technology, Dübendorf, Switzerland. Available at: [www.eawag.ch/forschung/sandec/publikationen/compendium\\_e/index\\_EN](http://www.eawag.ch/forschung/sandec/publikationen/compendium_e/index_EN)

- The Compendium presents the concept of sanitation systems together with detailed information about sanitation technologies for each component of sanitation systems. The document targets engineers, planners and other professionals who are familiar with sanitation technologies and processes. However, it is also a useful document for non-experts to learn about the main advantages and limitations of different technologies and the appropriateness of different systems.
- The e-Compendium, is an online, interactive version of the Compendium, complete with a tool for combining technologies into a complete sanitation system. Available at: <http://ecompendium.sswm.info/>

**Household Latrine Construction Manual.** Cambodian Department of Rural Health Care (2010). Ministry of Rural Development. Available at: [www.hesperian.info/wp-content/uploads/pdf/en\\_hmx/en\\_hmx\\_2010\\_latrineconstruct.pdf](http://www.hesperian.info/wp-content/uploads/pdf/en_hmx/en_hmx_2010_latrineconstruct.pdf)

- This illustrated manual, prepared by the World Bank Water and Sanitation Program with the Cambodian Ministry of Rural Development, describes how to select latrine technologies, construct latrine superstructures, build and install slabs, and excavate and line pits.

**WEDC Guides Series.** WEDC, University of Loughborough, UK. Available at: <http://wedc.lboro.ac.uk/knowledge/know.html>.

- Series includes guides containing practical information and recommendations on designing latrine pits and tanks, excavating and lining pits, building slabs and superstructures.

# Technical Brief: Sanitation System – Excreta Storage

## 8 References

AKVO Illustrations (no date). Retrieved from: [http://akvopedia.org/wiki/Sanitation\\_Portal](http://akvopedia.org/wiki/Sanitation_Portal)

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Franceys, R., Pickford, J. and R. Reed (1992). A Guide to the Development of On-site Sanitation. World Health Organization, Geneva, Switzerland. Retrieved from: [http://whqlibdoc.who.int/publications/1992/9241544430\\_eng.pdf](http://whqlibdoc.who.int/publications/1992/9241544430_eng.pdf)

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