Basic description of urine-diversion dehydration toilets (UDDTs)

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Preface and acknowledgements

Dear Reader,

This document is a revised version of the technical datasheets on "dehydration toilets" which were published on the GTZ website in 2005. Authors of those documents were Nathasith Chiarawatchai, Florian Klingel, Christine Werner and Patrick Bracken (in 2005 they were all working for the GTZ ecosan team).

The present document is the first part of a major revision and update. This revision has become necessary to include new findings obtained from research projects and practical experiences. The second part of the revision is due to be completed by June 2010. Information was, amongst other sources, taken from postings on the very useful EcosanRes Discussion forum in 2008 and 2009 (to join: http://www.ecosanres.org/discussion_group.htm).

The GTZ ecosan team hopes that you find this publication useful for your own ecosan projects and dissemination activities. If you spot omissions, errors or confusing text, please e-mail us your feedback at ecosan@gtz.de.

Kind regards,

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1. Introduction

1.1. Basic principles

In a UDDT, the excreta inside the processing vault are dried with the help of natural evaporation and ventilation. The toilet requires no water for flushing. UDDTs can be succesfully used in all climatic conditions and are most advatageous in arid climates where water is scarce and faeces can be effectively dried.

The faeces are collected in a chamber below the toilet pedestal (or squatting pan) and are dried. The ventilation also reduces odours due to air currents, which flow towards the vent pipe out of the chamber.

Absorbents such as lime, ash, or dry soil should be added to the chamber after each defecation to absorb excess moisture, make the pile less compact and make it less unsightly for the next user. The addition of absorbents also reduce flies and eliminates bad odours. Moreover, depending on the additive, the pH may also be increased due to this addition, and hence enhance bacterial pathogen die-off.

As breakdown of organic material in dehydrating conditions is slow, toilet paper or similar objects placed in the chamber will not disintegrate quickly. Toilet paper can therefore either be handled separately, or be screened out or composted in a secondary treatment process before reuse.

Once the chamber is almost full, the content may need to be removed. The contents are either further stored, used as a soil conditioner, buried or composted (in home composting or at a local composting centre).

The product from the dehydration process, a crumbly, powdery material, is not compost but rather a kind of powder which is rich in carbon and fibrous material, phosphorus and potassium. Nutrients are made available to plants directly or after further composting of the dried material.

UDDTs are often called "**ecosan toilets**" but this would wrongly label one particular toilet type as *the toilet* to be used in ecosan projects.

1.2. Available technologies

The main distinguishing features are listed in the following.

1.2.1. Urine diversion or non-urine diversion

Most dehydrating toilets require prior separation of urine to allow sufficient drying of faeces. Systems where urine and faeces are mixed only work properly in very dry climates. Some installations provide a drainage system for the chamber to improve dehydration of the solids. Urine diversion systems not only allow the separate collection of nutrient rich and virtually sterile urine (when "cross-contamination" of urine with faeces can be excluded), but also greatly reduce the odour problems associated with mixed systems.

A detailed description of the urine diversion concept is provided in the GTZ technology review on urine diversion, see:

http://www.gtz.de/en/themen/umwelt-infrastruktur/wasser/9397.htm

1.2.2. Use or disposal of urine

The use of separately collected urine as a fertiliser after appropriate storage is strongly recommended, due to its high nutrient concentration and the low associated health risks. However in certain circumstances urine use may not be acceptable or immediately possible and urine is infiltrated directly to the soil via a soakaway pit.

1.2.3. Single vault or double vault

UDDTs can be built with a single or a double chamber for collection of faeces. By using a double-vault, handling of fresh excreta can be avoided, as the vaults are used alternately, with sufficient time allowed for the faeces to sanitise. Single-vault systems may be less expensive to build, but need more labour to guarantee the same hygienic safety as double-vault systems.

1.2.4. Ventilated vault or not

Ventilation is generally recommended to prevent odour and flies and to enhance the drying process. In some cases it can be omitted (e.g. in extremely dry climates, or if the toilet is far from housing). In any case, if the toilet is constructed within the house, a vent pipe is strongly recommended in order to reduce odour and fly problems.

Ventilation through installed pipes can be natural or enforced by wind-propelled or electrical fans.

1.2.5. Squatting or sitting

There are numerous technologies that suit both defecation styles (squatting or sitting) with simple drop holes or specially designed urine diversion squatting pans for squatting cultures or urine diversion pedestals for sitting.

1.2.6. Dry or wet anal cleansing

Dry cleaning materials, such as toilet paper, can be discarded into UDDTs, however they will not decompose completely. UDDTs can also be used for wet cleaning cultures, water from anal cleaning then has to be drained in a separate pipe so that no liquid is led into the vault.

1.2.7. Self-built or prefabricated

Most systems can be totally or partially built by the users themselves using commercially available squatting pans or toilet seats. In some areas, complete systems including the toilet cabin and the substructure are available on the market.

1.3. Advantages compared to other toilet types

1.3.1. Advantages compared to pit latrines

Pit latrines and Ventilated Improved Pit latrines (VIP) cannot be used in many areas due to high water tables and groundwater pollution potential, seasonal flooding, a hard, rocky surface, lack of space, and potential for groundwater infiltration. This is not the case with UDDTs. If pit and VIP latrines are to be used for longer than the period it takes the pit to fill, regular, expensive, and often unhygienic emptying is required. Whereas the removal of the small, dehydrated volume of faeces from the UDDT is much easier and more hygienic.

If only used until the pit fills, the structure of pit and VIP latrines cannot be permanent and a new pit needs to be dug, comparing unfavourably to the permanent structure of UDDT. UDDTs are also more resource efficient due to the reuse potential of the product.

1.3.2. Advantages compared to composting toilets

UDDTs have advantages when compared to composting toilets, which is an alternate type of dry toilet suitable for ecosan concepts. The main advantage is that the dehydration process is less complex than the composting

process, resulting in lower maintenance needs. But in cool and humid climates, a composting process might be easier to maintain than dehydration.

1.4. Applicability

1.4.1. Countries where UDDTs are used

UDDTs are used in many sustainable sanitation projects worldwide, mainly in rural and peri-urban areas, and they have also been implemented in urban areas. They have been installed at households, schools, prisons, universities, hospitals, public toilets etc. (see for example, case studies of the Sustainable Sanitation Alliance (SuSanA) on http://www.susana.org/index.php/lang-en/case-studies).

In almost all the countries of the world, UDDTs have been installed. The **worldwide list of ecosan projects** maintained by GTZ shows example projects of UDDTs (and other ecosan-related technologies), see here:

http://www.gtz.de/en/themen/umwelt-infrastruktur/wasser/25699.htm

1.4.2. Climates

UDDTs are mainly suitable for regions with high average temperatures, long dry and short rainy seasons or arid climatic conditions with high evaporation rates. Nevertheless, with the right designs, they can also work in a more humid climate. And it is also possible to utilise a UDDT in regions with cold climate conditions.

UDDTs are waterless systems that are particularly suitable for conditions where water is scarce or expensive.

1.4.3. Rural and urban areas

UDDTs can be placed outside the house, attached or even inside to house. Therefore they are suitable both for rural and densely populated urban areas.

1.4.4. Different cultural settings

As already stated, UDDTs are suitable for various cultural settings: they can be designed to suit both sitting and squatting cultures and to cope with the use of water for wet anal cleaning cultures as well.

1.4.5. Careful handling required

An important condition for the success of UDDTs is that sufficient user commitment to the operation and maintenance can be provided.

Cleaning of a UDDT seat or squatting pan has to be done carefully with little water, to avoid introduction of water into the vault. The collection chamber has to be checked and emptied in regular intervals.

All those tasks require a certain level of responsibility and care from the users. Neglected maintenance can quickly lead to malfunctioning of the process and may severely impair the appearance and hygiene of the toilet.

1.4.6. User acceptance

Like any technology, UDDTs are only an option if they are accepted by the users. The handling and use of dry faeces and separated urine may prove particularly difficult to accept by users in certain cultural or socio-economic settings.

User acceptance often depends on the perception of status connected to the new facility. Compared to situations with open defecation, public toilets or pit latrines, dehydrating toilets generally compare favourably. If flush toilets are already established, UDDTs are often connected with lower status. In such cases, education of and strongly stressing the advantages of UDDTs may lead to acceptance.

The fact that men need to sit for proper urine separation may lead to acceptance problems that generally can be overcome by providing simple urinals for men.

1.5. Reuse

The benefits of treated urine and faeces as a fertiliser and its application methods have been well documented in SuSanA (2008), PuVeP (2008), Morgan (2007), WHO (2006) and Jönsson et al. (2004).

Reuse of treated urine and dried faeces in agriculture is recommended for the sustainable operation of UDDTs. Reuse may even provide an incentive for proper operation and maintenance of the facility.

Therefore, UDDTs are most successful in rural and peri-urban areas, where the toilet users can directly use products from toilets in their gardens.

This direct reuse is often not possible in urban areas, where no space for cultivation exists in close vicinity of the toilets. In such situations, management systems for collection, marketing and use of products from toilets, are very important for sustainable operation of UDDTs.

2. Technical details of urine-diversion dehydration toilets (UDDTs)

2.1. Functional principles

2.1.1. The basics

UDDTs do not use water for flushing. They use a very simple system where the urine is captured in a bowl which is integrated in the front of the toilet pedestal or squatting pan. From here, the urine is drained off to a storage container.

For the faeces, a straight drop (or chute if toilets are on several levels in the house) is provided from the toilet pedestal or squatting pan to a collection vault or bin.

A vent pipe is provided to ventilate the faeces chamber, remove odour from the room and to speed up the drying process. UDDTs are not designed for composting to take place in the faeces vault but just for drying.

In regions where people practise anal cleansing with water, a third outlet hole and pipe is used to collect and treat the anal washwater separately from urine and faeces. It is best not to mix anal washwater with urine to keep pathogen levels in the urine at a minimum, if urine is to be used as a fertiliser. The anal washwater can be infiltrated in a gravel filter or treated together with greywater in a subsurface constructed wetland.

UDDTs are especially popular wherever there is water scarcity and a demand for cheap fertiliser. They can be built indoors or outdoors.

2.1.2. Two alternating vaults (double-vault UDDT)

In double-vault UDDTs, faeces are collected in two vaults beneath the toilet seat or squatting pan, where they are dried. A ventilation pipe connected to the vault helps reduce odours and enhances the drying process. The urine is diverted by a funnel or specially designed squatting pans or toilet seats. Anal cleansing water may be diverted through a separate funnel.

Vaults are used alternately with only one vault in use at any time, until it is almost full. Ash, lime or a bulking agent should be added after defecation to maintain high alkalinity and absorb humidity. When this first vault is filled, the defecation hole is sealed and the toilet bowl is transferred to the second vault.

The second vault is now active while the first is passive or "maturing". When the second vault fills, the dried material can be removed from the first. The product has a sandy appearance and is generally odour free.

2.1.3. Hygienisation through drying and time

Within the chamber, the moisture content is reduced to about 25% or less. This enhances the destruction of pathogens inside the chamber. Pathogen destruction is further enhanced by addition of alkaline material, such as lime or ash. Time itself also leads to pathogen kill

2.1.4. Storage time for pathogen removal

In warm environments (20°C - 35°C) storage times of less than 1 year - in ambient temperatures of 2°C - 20°C of 1.5 - 2 years - will be sufficient to eliminate most bacterial pathogens and substantially reduce viruses, protozoa and parasites. Some soil-borne ova (e.g. Ascaris lumbricoides) may persist. Alkaline treatment in warm environments, raising the pH to >9 reduces the required storage time to about 6 months (WHO, 2006).

Further storage, sun drying, alkaline treatment or high temperature composting may be used to further decrease health risks in utlisation of the dehydrated faeces (WHO, 2006).

2.1.5. Functional principles of single vault dehydration toilet

The design of the single-vault UDDT is very similar to a double-vault toilet, except that there is only one collection chamber. The primary functioning principles are similar: faeces are collected in the chamber and dried, aided by heat, ventilation and the addition of bulking agents. However unlike double vault toilets, single vault systems do not offer the possibilty of prolonged storage of excreta for hygienisation within the sealed vault.

In the single-vault system, care must be taken to ensure that fresh faeces do not directly contact dry material that is ready to be removed (see 3.2).

2.2. Comparison of single-vault to double-vault UDDTs

2.2.1. Advantages of single-vault UDDTs compared to double-vault UDDTs

Construction costs are lower compared to double-vault UDDTs.

2.2.2. Disadvantages of single-vault UDDTs compared to double-vault UDDTs

Health risks from single-vault toilets might be higher than from double-vault toilets, because handling of fresh faeces and contact of already dried and stored faeces with fresh material cannot be completely avoided.

Maintenance of single-vault systems must be continuous with weekly or monthly intervention, whereas in double-vault systems, removal of the faeces is necessary only once per year or even every two years. This may lead to lower user acceptance of single vault toilets.

2.3. Operation and maintenance

2.3.1. Operational requirements

The main operational requirement when using UDDTs is that the faeces vault is kept as dry as possible (no addition of urine or water)

Covering material should be added to the faeces vault after each defecation. Covering material can be ash, sand, soil, lime, leaves or compost and should be as dry as possible. The purpose of adding covering material is to:

- reduce odour,
- assist in drying of the faeces (soak up excess moisture),
- prevent access for flies to faeces,
- improve aesthetics of the faeces pile (for next user), and
- increase pH value (achieved when lime or ash is used).

2.3.2. To-do list for operation and maintenance

The operation and maintenance of urine diverting UDDTs is very simple. The most important "do's" for UDDTs are:

- Before the first use, cover the vault floor with a 3 cm thick layer of dry powdered earth to absorb moisture from the faeces and to prevent faeces from sticking to the floor.
- Preferably keep two containers on the latrine platform, one full with dry absorbents (sawdust, peat moss, dry soil, ash, etc.) and a shovel or a small bowl, and the other for storing used toilet paper after anal cleaning with a small stick to compress it in the container (you can throw toilet paper in the excreta hole but it may retard the drying process of the faeces by covering them).
- After each use (of defecation), sprinkle two bowls or shovelfuls of dry absorbents over the faeces and return the cover attached to the pan. Their application absorbs moisture, increases pH, controls bad odours, prevents fly breeding and makes faeces less unsightly to the next user.
- Paper used for anal cleaning stored in a container should be burnt regularly outside the house.
- Keep a brush or small piece of cloth for cleaning the pan at regular intervals without pouring water in the excreta-hole.
- Wash hands with soap after defecation, handling urine container and cleaning the squatting pan. Always wear gloves while emptying the faeces vault and wash hands with soap afterwards.
- Always keep two small urine containers and two large urine containers. The large urine containers with tight lids should be placed in a shed for storing the urine from the small containers. Two small containers (with a small inlet for inserting urine pipe) should be used alternately to collect urine. Urine containers should be closed at all times to prevent odour and loss of ammonia into the air. When the first large urine container is full seal it properly for at least 30 days before using as a liquid fertiliser.
- In kitchen gardens, urine may be applied directly but the time gap between urine applications and harvesting should be in any case one month. Urine contains salt so plain watering would be beneficial after urine application for better plant growth.
- Apply undiluted urine to open soil. For plants in growth urine can be used diluted or undiluted. If urine is diluted then use one part urine with three parts of water. For crops with smaller roots apply urine in smaller doses. For fertilising nearly 670 m² of land, approximately 850 litres

of urine would be required i.e. roughly the total urine discharge of two adults in a year.

- The first vault can be used for at least 6 months, depending on the vault's volume. When it is full the vault is sealed. All openings are tightly closed, e.g. with lime mortar or clay. The other vault now comes into use instead. When the second vault is nearly full, the first vault has to be emptied.
- The dehydrated faeces, now odourless, can be reused as a soil conditioner. Further storage or co-composting with other organic materials is recommended to increase hygienic safety.
- The use of the compost should be planned in advance (400 - 500 kg humus per family per year can be formed).
- Wash the urine pipe at regular intervals by passing small quantities of water through it from the squatting pan, where it is attached.

2.3.3. Particular operation and maintenance issues for single-vault UDDTs

Every 1 or 2 weeks the pile of fresh faeces accumulated below the toilet seat is shifted to the rear of the vault with a hoe or rake. This tool can be stored inside the vault. The shifting can be done from outside with a specially installed pusher tool. Every 3 to 6 months, depending on vault size, the dry pile at the rear of the vault is shovelled into a sack and stored outside the toilet or brought for further treatment. Special care has to be taken not to mix fresh faeces with mature dry material that is due to be removed, as well as to avoid any direct contact with fresh faeces.

2.4. Extent of application

Examples for the use of UDDTs in sustainable sanitation projects have been document in the SuSanA case studies[1].

The urine-diversion double-vault toilet originated from the model of the Vietnamese dry toilet, consisting of two chambers built above the ground with a drop hole for squatting while defecating. This type of toilet was developed in the 1960s to increase hygienic safety of the traditional use of excreta in agriculture.

Modifications of this design have been adapted in several countries, such as vent pipes to reduce odour and facilitate dry conditions, or toilet seats within the house.

A modified version of the Vietnamese double-vault dry toilet with toilet seats instead of squatting pans is promoted by the Mexican NGO, Espacio de Salud AC (ESAC). Furthermore, the design has also been adapted for use within houses. It has been reported from ESAC that this toilet has been successfully built in communities in a variety of climates from humid and temperate to dry and tropical.

Another adaptation of the Vietnamese model was found in Guatemala, in which the design is similar to the one in Mexico. The so called double vault dry alkaline fertiliser family (DAFF) latrine was introduced by the Centro Mesoamericano de Estudios sobre Tecnologia Apropiada (CEMAT) in Guatemala.

In China, prefabricated squatting pans for dry toilet systems with urine diversion have been developed and are produced at a very low price. These pans replace the drop holes normally used in squatting slabs. The squatting pan will increase the durability of the system since it can prevent a collapse of the structure. It also enhances prestige status of the system. The design in China is also applied within houses.

In Kerala, India, water used for anal cleaning is diverted into an evapotranspiration bed next to the toilet. The bed requires little maintenance, only cutting the excessive growth of planta. Urine is diverted separately.

2.5. Strengths and weaknesses

2.5.1. Health and environmental impact

A double-vault UDDT can transform infectious faeces into a safe product, if storage times are respected and the UDDT is operated correctly (dry faeces vault).

Of particular hygienic importance is the alternating system of the double vault toilet, as it avoids any direct contact between users and fresh faeces and provides at least a 6 month period, during which the effects of time, temperature and pH can act on pathogens.

Due to the urine diversion, drainage of liquids can be avoided and pathogens and nutrients be confined to the chambers. Systems where urine or washing water is mixed with faeces always produce contaminated liquids that are difficult to treat.

The main health and environmental risks from a double vault UDDT with urine diversion results from poor maintenance. If the alternating rhythm of chamber use and necessary storage time is not respected, safety of content cannot be guaranteed and people may handle infectious matter. If liquids enter the chamber, the drying process will be impaired and germs may be spread through leakage of liquids. Poor design and neglect of adding dry and alkaline adsorbents also decreases safety.

Table 1. Suggested alternative recommendations for primary treatment of dry faeces before use at household level. No addition of new material (WHO, 2006).

Treatment	Criteria	Comment
Storage only at ambient temperature 2°- 20°C	1.5 - 2 years	Will eliminate most bacterial pathogens, substantially reduce viruses, protozoa and parasites, some soil ova may persist
Storage only at 20°- 35°C	>1 year	As above
Storage and alkaline treatment	pH >9 during >6 months	Temperature <35°, moisture content >25° or lower pH will prolong the time for absolute elimination

2.5.2. Costs and benefits

Construction of a UDDT in most cases can be done with locally available materials and labour. Prefabricated parts may include toilet seats or squatting pans. If those parts do not need to be imported from abroad, they are usually cheap and can be even cheaper than self constructed squatting pans made from cement. Squatting pans made of ceramics are also available which are not very costly and easy to maintain.

The costs of the construction of a double-vault UDDT is slightly higher to the cost of constructing a VIP or pit latrine.

[1] See: http://www.susana.org/lang-en/case-studies/technology/uddt

Economic benefits for the user arise mainly from increased yields of garden and field crops, when products from the UDDTs are regularly applied as fertiliser. In a denser settlement where direct use is not possible, the direct economic benefits come from the fact that households have a permanent toilet system that can be emptied quickly and cheaply, without the aid of vacuum trucks. In the long-run this can be represented as a significant savings for households over the use of pit or VIP latrines, or even over conventional flush toilets.

Benefits to the community arise from improved health and environmental protection through clean sanitation facilities and the elimination of groundwater pollution. The burden of disease in a community can therefore be reduced. Additionally, increased food production in poor communities through better availability of fertilisers improves food security and nutrition.

2.5.3. Socio-cultural suitability

The regular maintenance needed may lead to acceptance problems. The handling of dried faeces and urine may prove problematic in some circumstances.

Experience shows that acceptance is highest where there is a strong interest in the use of the nutrients from excreta and in saving water.

In situations where flush toilets connected to septic tanks or sewers are technically and economically feasibly, UDDTs may be more difficult for users to accept, as they are often perceived as inferior in status, comfort and hygiene. In such situations, information on the beneficial aspects of dry systems and reuse is extremely important to change common perceptions.

As the long-term success of UDDTs depends much on proper operation and maintenance, intensive and long lasting information and awareness campaigns are essential when introducing UDDTs as a new sanitation technology.

2.6. Economic data

Investment costs for a UDDT with urine separation varies largely, depending on the location and materials used. Cost breakdowns for construction and maintenance can be found in SuSanA case studies dealing with UDDTs:

http://www.susana.org/lang-en/case-studies/technology/uddt

A functioning and comfortable toilet unit can be built at a low cost, if local labour and materials can be used.

Maintenance costs are very low. Additives, such as ash or sawdust, should be available for free. Some labour time is necessary throughout the year for toilet cleaning, inspecting chambers and emptying the urine containers. The required labour will not exceed a few hours per month. At most twice a year, a collection faeces chamber may need to be emptied, requiring another few hours of work.

The UDDTs can ideally even provide economic benefits through reuse of faeces and urine, replacing costly mineral fertilisers.

2.7. Design information

The chamber volume should be large enough to store faeces for at the very least 6 months. The volume will consequently depend on the number of users.

The toilet should be built entirely above ground to allow easy access to the collection chambers. Those should be placed on a solid floor of concrete, bricks or clay, elevated around 10 cm above ground level, so as to avoid flooding in rain.

The chambers have to be individually accessible through access hatches or doors. To increase the solar heating effect, these lids can be of metal, inclined and facing the sun, optionally painted black.

The processing chambers are covered with a slab (for squatting or with a toilet pedestal) that has two drop holes. For squatters, prefabricated elements with holes for separate outlets for urine and faeces may be more convenient. These elements can be produced from plastics, porcelain or concrete.

The superstructure can be built from any material, depending on the users preference and local availability.

Important for the function and comfort of a UDDT is the ventilation system. This consists basically of a pipe that leads from the collection chamber to the outside and ends well above the toilet roof. The wind can then draw moist air and odours from the chamber through the pipe. The pipe outlet should be sealed with a mesh to trap flies. The ventilation effect can be caused by using a T-shaped attachment at the top of the pipe or by a wind-propelled or electric fan.

For the water from anal cleansing, a third outlet may be necessary. Anal cleansing water should be handled very carefully. A good way of treatment and use of this water is to divert it into a small constructed wetland just attached to the toilet. The water should be applied under the surface to a soil-sand filter. The filter can be planted with grass or crops.

3. Urine-diversion dehydration toilets with movable containers

3.1. Functional principles

In UDDTs, faeces can also be collected in movable containers instead of fixed vaults. The structure of such a toilet is similar to other UDDTs: the toilet seat or squatting pan, usually with urine diversion, is located above a ventilated and accessible chamber. Faeces do not drop directly into the chamber below, but into a bucket or container placed under the toilet seat. When the container is nearly full, it is replaced by an empty one.

If the chamber is designed large enough, the full container can be left next to the empty one in the chamber for storage and drying of faeces, similar to the process in a double-vault system. If space is limited, the full container with partly fresh faeces has to be taken out and the faeces must be further stored or treated. Another possibility is to place a carousel of empty containers which is simply rotated when one of the containers is full. After completing one rotation (and thus having spent a certain period within the chamber below the toilet), the container can be removed.

If urine diversion is not applied, drying of faeces will hardly be possible, unless an effective drainage of the container is provided.

Containers can be of plastic, metal or any other impervious material and of variable size. The volume is generally 100 l or less, to allow easy removal of the full container. Compared to fixed chamber systems, emptying or changing frequency is higher due to the reduced collection volume.

3.2. Bucket toilets versus dehydration toilets with movable containers

Movable container systems resemble, to a certain extent, the traditional bucket toilets that have been widely used in large parts of Asia.

Actually the Vietnamese double-vault UDDT was initially developed to improve the rather unhygienic practice of collecting and using fresh faeces from bucket toilets.

Movable container systems are more hygienic than traditional bucket toilets, because the main feature of UDDTs is preserved: faeces are dried inside the toilet facility and handling of fresh material is minimised. Comfort is higher and odours are minimised because of the sealed and ventilated chamber.

3.3. Strengths and weaknesses

Health risks from movable container systems may be slightly higher than in fixed chamber systems, as the containers have to be moved when there is still partially fresh material inside. Systems with larger chambers, allowing the full container to be stored within the chamber itself are safer than systems where the full container with fresh material has to be taken away immediately. Because of the generally shorter storage time, compared to fix chamber systems, dried faeces have to be further stored or treated before safe reuse (see Table 1).

Movable container systems are particularly interesting in sanitation schemes where a collection service for dried faeces is in place. Emptying time and hassle is reduced to a minimum, even if the toilet is located in-house and the chamber is only accessible from inside. The movable container system may therefore prove advantageous in urban settings.

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4.2. Further information

The GTZ ecosan team and partners have uploaded a large number of UDDT **photos** to the photo sharing website Flickr.com:

- Urine diversion toilet seats and squatting pans: http://www.flickr.com/photos/gtzecosan/sets/72157612793192986/
- Put either UDDT or “ecosan toilet” in the search field of www.flickr.com, and you will find many photos of UDDTs.

Videos on UDDTs can be found by entering “ecosan toilet” in the search field of www.youtube.com.

A **list of suppliers** for pedestals and squatting pans which can be used in UDDTs is provided in the appendix of the technology review on urine diversion (Appendix A: Worldwide listing of suppliers for waterless urinals, UD pedestals and squatting pans, see: http://www.gtz.de/en/themen/umwelt-infrastruktur/wasser/9397.htm)