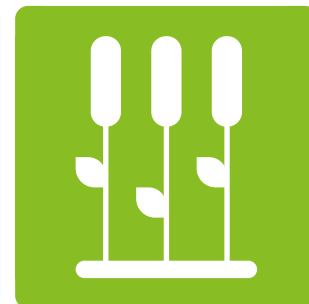


Urban pit waste management



Introduction

All pit latrines and septic tanks will eventually become full of accumulated sludge. Before construction starts, good designers will have made a decision as to whether or not the unit is to be emptied or moved. With septic tanks the decision is straightforward; they are designed to be emptied periodically. The decision for pit latrines is not so simple. It will depend on the latrine design, location and customs of the users. However, in urban areas it is likely that there is no land available to dig a new pit, so it will be necessary to arrange for a pit to be emptied as soon as it is full. The users need to be made aware of this requirement and to have formulated a workable method of emptying and disposing of pit wastes during the project planning stage.

This briefing paper looks at the options available for urban pit waste management, including various pit emptying methods and options for sludge disposal.

How it works

Emptying full single pit latrines can cause a serious health hazard, as the freshly deposited sludge at the top of the pit will contain many faecal organisms that may be pathogenic.

Twin pit latrines are designed to be emptied without the need to handle fresh excreta. Removal of dried sludge from a pit that has been left undisturbed and dry for two years should be relatively straightforward as the material will have decomposed

sufficiently and be relatively safe to handle (although care should still be taken to minimise contact).

The sludge and scum from septic tanks is relatively easy to remove because of its high liquid content. A septic tank serving a communal latrine will probably fill very quickly so it is very important that the emptying method is well designed and can be repeated at regular intervals.

Approaches

There are two parts to be considered in a pit waste management strategy: how to empty the pit and how to dispose of the material removed, including how to transport it.

Pit emptying

There are two choices for pit emptying: motorised emptying or human-powered emptying.

Motorised emptying

A vacuum truck or tanker is a motorised vehicle equipped with a pump and a storage tank. The pump is connected to a hose which is lowered down into a septic tank or pit, and the sludge is pumped up into the holding tank on the truck. Generally the storage capacity of a vacuum tanker is 3-10m³ so large septic tanks may require a truck to return more than once to fully empty the tank.

Although smaller more mobile pumps have been developed, large vacuum trucks are still the norm. Unfortunately, the large trucks often have difficulty accessing pits/septic tanks in areas with narrow or nondriveable roads. Depending on the collection or treatment technology, the material in the tank or pit can sometimes become so compacted that it can not easily be pumped.

In these situations it is necessary to thin the solids with water so that they can flow more easily, but this is inefficient and potentially costly. If water is not available, it may be necessary for the waste to be manually removed.

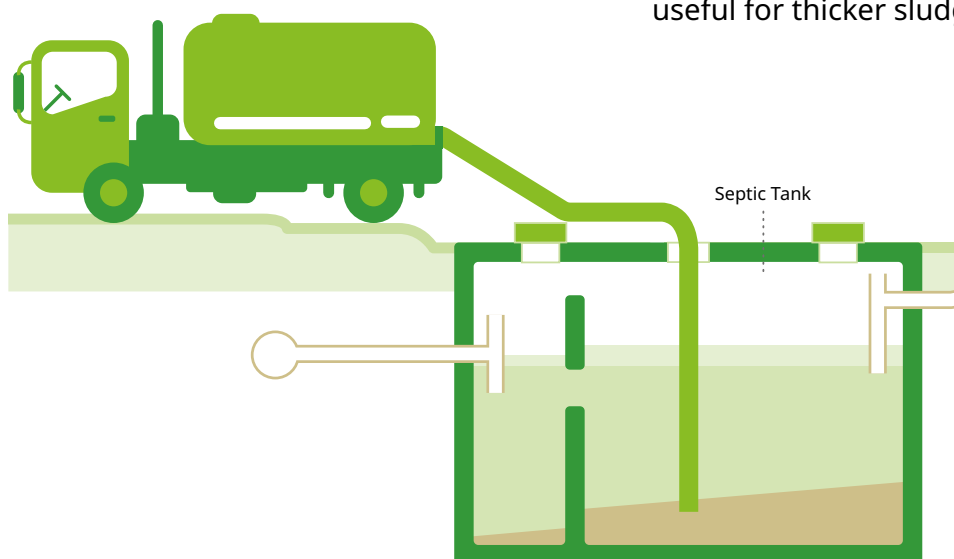
Human-powered emptying

Manual emptying of pits is done either by hand using buckets and shovels or using a portable, manually operated pump.

Some pits can only be emptied manually, for example, material left to decompose and dry out in a twin pit system or Fossa Alterna. These technologies require manual emptying (with a shovel) because the material is solid and cannot be removed with a vacuum pump.

Technologies that are water-based, for example a septic tank can be emptied with mechanical pumps. Water-based technologies should generally not be emptied by hand because of the high risk of collapse, toxic fumes, and exposure to the hazardous sludge.

Several alternatives to vacuum tankers have been designed, such as: the Vacutug, a small vehicle where the same engine activates the pump and propels the tank to the treatment plant (see photo below); the MAPET (Manual Pit Emptying Technology), with mounted on a pushcart and a manual pump operated with a flywheel; and the Gulper, a manual direct-action pump, useful for thicker sludge.



Vacuum tanker emptying a septic tank

Many of these technologies are still not widespread due to cost, speed and institutional constraints that have prevented their widespread acceptance. It is critical then that locally-made, innovative solutions are found that can be owned and operated in the community. WaterAid experience of pit emptying in Maputo, Dhaka and Dar es Salaam with these technologies has identified the need for an alternative pit emptying technology with the following characteristics:

- Able to gain access without demolition of property.
- Able to handle waste without requiring direct contact by humans.
- Manufactured and maintained locally.
- Cost less than \$2000.
- Sufficiently light weight that it can be carried across the shoulder.
- Operable by one man.
- Sufficiently robust to allow for neglect and misuse.
- Capable of emptying at least the top metre of the pit.



Sludge disposal

Removal and disposal of sludge from pits and tanks is a complicated issue. It is regarded as unpleasant, dirty work and the people who do it carry with them a negative social stigma. To compound the problem they are often forced to work at night to avoid causing a disturbance to residents, in crowded, unlit neighbourhoods pushing barrows or manoeuvring vehicles through narrow lanes. Accessing suitable disposal sites nearby is also a major problem. Consequently the sludge is often neglected and illegal dumping of the waste is common. Alternatively the pits are not emptied at all; they fill up, overflow and become unusable. Giving the matter careful consideration at the system design stage and planning a safe, practical, affordable method of disposal will reduce the likelihood of this happening.

Sludge that has been left undisturbed for two years in a watertight pit or tank is not a hazard to the environment, and can safely be spread on a garden or on a refuse tip. Decomposed sludge can add humus and fibre to the soil which will promote plant growth. Sludge containing plastic bags, stones and other solids will be less useful as they will be environmentally intrusive if spread on open ground; this material should be buried.

Open disposal of fresh sludge into water or onto land is an environmental and health hazard. One solution is to bury the sludge in pits so that it cannot come into contact with humans or animals. Alternatives are to mix it with the influent at a nearby sewage works dry it on drying beds before reuse, or compost it with domestic refuse. Limiting the distance the sludge has to be transported to the disposal point will greatly reduce costs and will increase the likelihood of proper disposal being carried out.

The Vacutug. Credit: WaterAid/Eva-Lotta Jansson

For human-powered emptying a travel distance of no more than 0.5km is considered to be a practical guide.

Development of transfer stations can help improve sludge management. Transfer stations are discharge points for faecal sludge and septage into conventional sewers that are then connected to a centralised treatment plant. The transfer station can either be directly connected to a sewer main, or can be a large storage system that can be operated to release the waste into the sewer main at controlled intervals. This will improve treatment performance and reduce peak loads. Transfer stations are especially appropriate

for dense, urban areas where there is no alternative discharge point and may help to reduce the incidence of illegal sewage dumping. The location must be carefully chosen to maximize efficiency, while minimising smells and disturbances to nearby residents. Furthermore, if the utility provider responsible for sewers and sewage treatment can be persuaded to build transfer stations near to low-income communities and to offer incentives to increase their use, then it may be possible to significantly improve the health of a community by providing an inexpensive, local solution to faecal sludge and septage disposal.

Advantages and disadvantages

| | Advantages | Disadvantages |
|------------------------|--|--|
| Human-powered emptying | <ul style="list-style-type: none"> • Useful for serving sections of the population which would otherwise go unserved. • Potential for local job creation and income generation. | <ul style="list-style-type: none"> • Time consuming: can take several days depending on the size of the pit. • Hard, unpleasant work. • MAPET requires some specialised repair (welding). • Requires a disposal point or discharge area; sludge transport over 0.5km is impractical. • Sludge must be carried/pushed offsite which is difficult and time consuming. • Spillage and bad odours are likely. |
| Motorized-emptying | <ul style="list-style-type: none"> • Fast, and generally efficient. • Minimizes risk of contact with unhygienic material. • Depending on the political/ economic structure, vacuum truck enterprises can benefit a community and be a source of sustainable income. | <ul style="list-style-type: none"> • Expensive operating and maintenance costs that are passed onto the customer; not all customers can afford the service. • Cannot pump thick, dried sludge (this must be manually removed). • Very high capital costs. • Because of access, location, or economics, not all trucks discharge to a suitable facility. • Pumps can usually only suck down to a depth of 2-3m and the pump must be located within 30m of the pit. |

Capital and operational costs

A new Vacutug can cost anywhere from \$20,000 to \$100,000, although new trucks are rarely purchased. Used or self-modified trucks are more common and cost in the region of \$8,000 to \$10,000. A MAPET will cost around \$3,000 and a Gulper around \$300. Both can be can be fabricated locally. A shovel, drum and cart for hand-emptying will cost about \$150.

Operation costs of the Vacutug are very high compared to the MAPET, Gulper and hand tools. These will will be mainly vehicle maintenance, fuel and oil, but bribing/ paying local authorities to obtain licenses and permission to discharge contents will incur large expense too.

Useful resources

Eawag and Sandec (2008) *Compendium of sanitation systems and technologies*.

Available at:

<http://ecompendium.sswm.info/>

Fecal sludge management on Wikipedia

https://en.wikipedia.org/wiki/Fecal_sludge_management

Stone Family Foundation, Experiences of developing pit emptying businesses in East Africa

http://www.thesff.com/resources/SFF_Experiences-of-developing-pit-emptying-businesses-in-East-Africa-FINAL.pdf

Case study

Gulper



WaterAid/ Eliza Deacon

Julius Chisengo, Group Operator UMAWA, 48 years old (right) and Cleophas Shinga, Group Operator UMAWA, 49-years old (left, empty the contents of a pit latrine, Dar es Salaam City, Tanzania

Since 2010, WaterAid Tanzania has worked with entrepreneurs in Temeke, one of the municipalities of Dar es Salaam. These entrepreneurs (often family-owned businesses) have ventured in waste management and especially pit emptying: they have used the Gulper manual pump to extract the sludge from full pits, discharging it into barrels which are transported on motorised tricycles until reaching small treatment plants. The small size of the tricycles means they are adept at winding through the narrow lanes of unplanned settlements which do not have a sewer network.

WaterAid teamed up with BORDA, a German organisation that has promoted decentralised treatment of human waste in many countries. This had to be done in a manner that was safe, environmentally sound and also offered a commercial return for those running the collection business. The plan was boost returns by experimenting with production of manure and biogas for sale.

For the business to be viable, it needed to have the potential for scaling up. This meant identifying an operational area with a reasonable density of population. Household and business rates were fixed and management systems put in place to ensure a service that responded to the needs of their customers with a technically appropriate solution that complied with local regulations.

Several years after, several businesses are still thriving and one of them has established an “excellence centre” to train new entrants. The businesses have more than 4,000 customers, in addition to hotels and restaurants. They have proven that pit emptying is a viable operation, to the point that the neighbouring municipality has included such pit emptiers in its regular tenders

Part of a series of WaterAid
technology briefs available at
www.wateraid.org/uk/technology



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everyone, everywhere within a generation.**

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