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The WRC operates in terms of the Water Research Act (Act 34 of 1971) and its mandate is to support water research and development as well as the building of a sustainable water research capacity in South Africa.

TECHNICAL BRIEF

Sanitation

Tackling the challenges of full pit latrines

A completed WRC study has increased understanding of sludge accumulation in ventilated improved pit (VIP) latrines while providing strategies for emptying full pits.

Background

When South Africa's first democratically elected government came to power in 1994, half of South Africa's people did not have decent toilets. Access to basic water and sanitation for all became one of the priorities of the new government.

Over the past 17 years a framework of legislation, policies and guidelines have evolved to support the achievement of this goal. Responsibility for provision, operation and maintenance of basic sanitation rests with local or district municipalities designated as water services authorities (WSAs).

Over two million VIPs and other on-site sanitation systems have been built since 1994. But with a remaining three million households still without basic sanitation, many WSAs in South Africa are still focused on addressing backlogs and have not given serious thought to the maintenance of the systems they have already built.

Many of the toilets that were first provided in the push to provide basic sanitation for all are expected to reach capacity in the next few years, which will result in an overwhelming demand for pits to be emptied. Without funds, policies, tools or procedures in place to manage the emptying of pits and disposal of sludge when this happens, many WSAs around the country may soon be facing a crisis.

Project scope

The goal of this project was to investigate existing management practices with regard to VIP toilets, identify challenges and lacks and develop strategies and tools for more effective management. Existing literature and current practice was explored to consolidate knowledge on pit filling, strategies and methodologies for pit emptying and the economic aspects of successful on-site sanitation management.

New technologies and methods were developed for pit emptying and sustainable alternatives for the beneficial use of sludge were explored. The findings of this research have been published in three volumes as the series, ***Tackling the challenges of full pits.***

Challenges in on-site sanitation

Data provided by WSAs in the course of this research indicated that most pits were filling in five to nine years. This suggests that of the more than a million VIPs that have been built in the past decade many will soon reach capacity. Studies of pit filling rates across a number of communities indicated that pits generally filled at a rate of 40 litres per capita per annum, with 60 litres per capita per annum providing a safe margin for planning pit design and emptying programmes. The use of pits for solid waste disposal dramatically decreased the lifespan of a pit.

Some WSAs did not intend to assist householders with full pits at all. Some had invested in pit additives with the hope that it would prevent pits from filling up altogether, or increase their lifespan, although the effectiveness of these products has not been proven. And those that did not plan to empty pits often assumed that they would be able to service VIP pits using the same methods they employed for septic tanks: removing the sludge with a vacuum tanker and disposing of it at the municipal wastewater works.

These methods, however, are proving inadequate for the special challenges of pit sludge. The dry consistency of VIP sludge and the high rubbish content that is found in many pits can present obstacles to vacuum removal. In addition,

Manual pit emptying in eThekwini.

there are many households across South Africa with access only by footpaths; in these cases too it will prove impossible to empty pits with a vacuum tanker.

eThekwini Municipality, which has the largest pit emptying programme in South Africa, has found manual pit emptying with long-handled tools to be the most effective method to service its 35 000 pit latrines. Clearly more appropriate technologies are needed for pit emptying.

In addition, WSAs frequently assumed that they would treat VIP sludge at their wastewater treatment works. VIP sludge, however, is highly concentrated, and it has been found that the sludge from a small number of pits can quickly disable a treatment works entirely. Plans for managing the sludge after it had been removed frequently dealt with sludge as a waste requiring disposal. This is problematic both because waste disposal options for sludge are running out and because discarding the valuable nutrients in faeces and sludge is ultimately not a sustainable practice.

Pit filling

The rate at which sludge accumulates in a pit is determined by the amount of material entering the pit, the rate and extent to which it degrades and the conditions in and around the pit allowing liquids and degraded material to exit the pit. Degradation of biodegradable material happens through both aerobic and anaerobic processes. Volume two of this series, ***How fast do pits fill up? A scientific understanding of sludge build up and accumulation in pit latrines***, explores this in detail.

A number of products now exist on the market claiming to enhance biological degradation, thereby reducing or eliminating pit filling. A number of these products were tested during this study and none demonstrated any ability to reduce sludge volume. It is clear that investing in these when they have no demonstrated effectiveness represents a loss of municipal funds which could be spent ensuring that effective strategies are in place for emptying pits.

Pit emptying technologies

A review was conducted of the manual, semi-mechanised and mechanised technologies that have been developed to attempt to address the challenge of pit emptying in various contexts along with extensive discussion with engineers who have been involved in their development. The Vacutug, a pit emptying technology developed by UN Habitat, was trialled during this project with some success on low flush pits.

For VIP pits, issues of access, sludge that is too dry for vacuuming and the presence of rubbish continued to present obstacles. A number of different extraction principles were explored during the course of this research with the goal of producing a technologies suited to emptying pit latrines.

Chains, augers, belts, pumps and vacuums were investigated. The most successful prototypes developed to date have been the motorised pit screw auger, which uses a soil auger to lift sludge from the pit, and the Nano Vac and eVac, which use piston pumps and vane pumps to suck relatively wet sludge from pits. In addition, a pressure vessel has been developed which can be used for collecting sludge or for pumping water or air into a pit to aid removal.

These technologies overcome the issue of access and proved viable when trialled on pig slurry, however, in some cases the widely ranging conditions found across different pit latrines proved too challenging for effective evacuation. Prototype development and design specifications of these technologies have been published in Volume 3 of the series, *The development of pit emptying technologies*.

As some pathogens found in pit sludge may survive for very long periods of time inside the pit, it is of utmost importance that workers, householders and household surfaces are protected from contact with sludge at all times throughout the cycle of on-site sanitation maintenance.

Disposal

If sludge is not to be buried on site after removal from a pit, it must be transported to another point for storage, disposal and processing. Disposal of pit latrine sludge has become a massive problem for some municipalities and, with a large number of pits in South Africa anticipated to reach capacity soon, is going to become an even greater difficulty.

Disposal of dense pit sludge at wastewater treatment works has been found to quickly overload the works in addition to being counterproductive in a number of respects. The policy of the South African government stresses the value of human excreta as a resource although utilisation must be undertaken within strict parameters due to the hazards of contamination.

Volume 1 consolidates knowledge about a number of possibilities which exist for utilising faecal sludge beneficially. Composting allows nutrients to be recovered safely if done correctly, while biogas generation accesses the energy potential of sludge – though this process produces sludge as well. eThekwini Municipality has pioneered a method for pasteurising and pelletising sludge for use as a fertiliser. Another WRC project has investigated the impact of burial of sludge for use in agroforestry.

Conclusions

The task of providing adequate sanitation does not end with building toilets. On-site syste,s will eventually reach capacity, and if a long-term plan for their maintenance, supported by a budget, is not in place, full toilets will become unusable and households will be effectively without basic sanitation once again. WSAs need urgently to assess the real requirements of the basic sanitation systems they have delivered, and put plans, policies and budgets in place to maintain these systems if they are to avoid a sanitation crisis in the near future.

To date, additives currently being marketed to reduce pit filling have proven ineffective. While the potential for significantly enhancing processes already occurring in the pit seems limited, there is a need for standard methods to be established in order to investigate the effectiveness of new products. In the absence of this, municipal funds are better invested in proven methods of sludge removal.

The experience of municipalities, such as eThekwini, which have led the way in pit emptying has demonstrated that vacuum tankers are not always effective for maintaining VIP systems. The development of more appropriate technologies shows promise and prototypes designed during this research provides a strong basis for further development.

The presence of waste in the pits of toilets represents an enormous obstacle for effective pit emptying. Placing a high priority on instituting and maintaining reliable solid waste collection programmes will go a long way to solving this problem.

Further reading:
To order the reports, *Tackling the challenges of full pit latrines, Volume 1: Understanding sludge accumulation in VIPs and strategies for emptying full pits* (**Report No. 1745/1/12**), *Volume 2: How fast do pits fill up? A scientific understanding of sludge build up and accumulation in pit latrines* (**Report No. 1745/2/12**) and *Volume 3: The development of pit emptying technologies* (**Report No. 1745/3/12**) contact Publications at Tel: (012) 330-0340, Email: orders@wrc.org.za, or Visit: www.wrc.org.za to download a free copy.