Back to basics: Research looks down the pit

Lani van Vuuren

More than three million households in South Africa still lack access to basic sanitation.

South Africa could be chasing a perpetual sanitation backlog if not more thought is given to the rollout as well as operation and maintenance of basic sanitation services, a Water Research Commission (WRC) study has found. Lani van Vuuren reports.

Sanitation delivery in South Africa has increased sharply since the early 2000s, with about 17 000 units being delivered a year (excluding urban sanitation provided under the national housing programme). According to the Department of Water Affairs & Forestry, 2,8 million households have received at least basic sanitation services since 1994, with a further 3,3 million still to be served before government's deadline of 2014.

Single-pit ventilated improved pit (VIP) toilets continue to be considered the minimum level of sanitation of choice for many municipalities responsible for improving access to services in their rural and peri-urban communities, and over a million VIPs have been constructed around the country since 1994. While they remain and offer a good basic sanitation delivery option, their long-term sustainability pose a number of challenges to policymakers when the pits fill up. This is compounded by the fact that, generally, the contents of the pits or what happens to material in the pits are not well known or understood.

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"VIP planning and design dates from a time when government intervention was minimal and toilet construction was mostly owner driven," explains WRC Director Water Use & Waste Management Jay Bhagwan. "Therefore, not much thought was given on the required actions once the pits filled up. This is further compounded by the fact that current interventions put greater emphasis on the civil engineering and project management aspects of VIPs."

In principle, the rate at which the pit contents break down through biological activity should be similar to the rate of filling, thus providing a long service life for the pit. However, field experience has indicated that, in many areas, VIPs are filling up much faster than their design life, notes Bhagwan. This can occur either due to the size of the pit or because of undesirable solid waste and greywater being disposed of down the pit by the household.

Once an on-site sanitation system is full, it can no longer fulfil its function of providing safe, hygienic and dignified sanitation for its owners. Thus, despite being in possession of a VIP, the households do not have access to basic sanitation and therefore must be regarded as unserved.

"A shorter lifespan means an increase in maintenance costs should the desludging of pits be required. This is expensive (in some instances costing as much as installing a new pit) and becomes very difficult if the pits and superstructures are not designed to allow for desludging. Often pits have to be desludged manually, which carries a significant health and safety risk. On the other hand, if desludging proves difficult, then the other option is to build new VIPs, which contributes to the sanitation backlog," says Bhagwan.

WHAT HAPPENS DOWN THERE?

Historically, most research on VIPs has focused on elements above ground (the superstructure), with little data available on the degradation mechanisms or processes occurring in VIP toilets. For this reason, the WRC initiated a number of research studies to develop a more comprehensive scientific base to understand VIP technology and find ways to mitigate the current experiences and develop solutions.

The Pollution Research Group at the School of Chemical Engineering at the University of KwaZulu-Natal conducted field and laboratory investigations of VIPs and their contents in and around the eThekwini municipal area. The objective was to understand the conditions prevailing in the pits and to propose design and operating practices for extending the life of the pits.

A number of studies were undertaken within this project to characterise the material found in a VIP and to infer what processes have occurred in the pit from the time when material is added via the pedestal to the time when it is sampled from some depth within the pit. It was observed that the nature of pit latrine contents varied widely within a pit latrine and between pit latrines.

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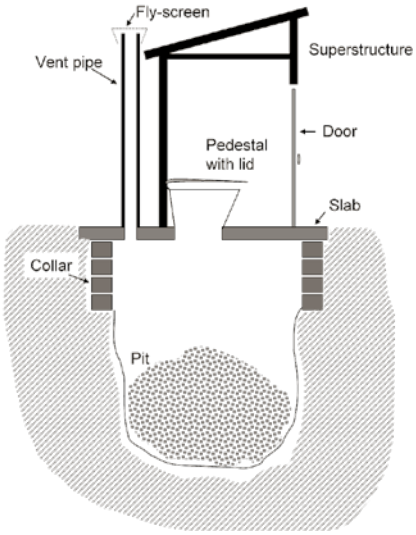
The project team observed that pit contents could look very different and have very different chemical and physical characteristics when comparing pits from different communities and even within communities. Many of the variations noted were due to differences in user practices, such as the type of cleansing material used, and the practice of using the pit as a solid waste disposal site in some communities.

Other variations may have been due to the geographical location of the VIP, such as moisture content due to the presence of groundwater.

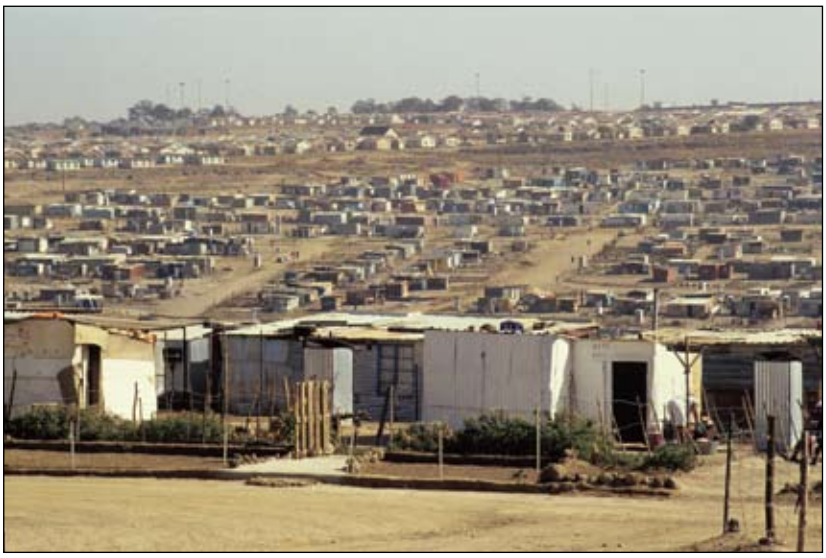


Basic structure of a VIP

WHAT IS A VIP?

For a pit latrine to qualify as a ventilated improved pit, it must comply with certain requirements, it must:

- Provide hygienic separation of human waste from contact with people;
- Have a vent pipe fitted with a fly-screen to minimise odour and flies;
- Be built on a secure slab that will resist collapse of the superstructure; and
- Provide privacy and dignity for the user.



Millions of VIPs are being rolled out to rural communities in efforts to meet government's sanitation target.

A poorly maintained, overflowing pit latrine, filled with non-biodegradable material.

Contents of pit latrines extracted during pit emptying near Tongaat, KwaZulu-Natal.

Pit latrine contents were sampled from several areas and studied.

Differences were also observed between samples taken from the top of the pit, and samples buried within the pit. The differences in the nature of pit contents affect the type and extent of biological processes that may occur. Equally, the processes occurring affect the nature of the pit contents, particularly of the pit contents located well below the surface of the pit latrine.

Why are these observations important? They emphasise the fact that management of pit latrine sludge is not a one-dimensional problem, but may require different approaches that are dependent on the nature of the pit contents.

MAN OR MACHINE

The project team emphasises that the future emptying of VIPs should be taken into account right from the start when the pits are designed. Absolutely unacceptable is a heavy permanent structure single-pit VIP with access only through the pedestal.

If manual emptying is the only method that is practically and economically possible, then the pits should be provided with removable slabs, preferably at least two. Furthermore, the required pit volumes should be achieved by increasing pit area rather than pit depth, as it is very difficult to manually empty a pit which is deeper than 1,5 m without the worker having to get into the pit, and this should be avoided for health and safety reasons.

Removal of pit contents is extremely hazardous to the health (and safety) of workers and members of the community who have access to the area around the pit latrine during and after pit emptying operations. Examination of face masks worn by workers engaged in emptying pit latrines and screening the exhumed contents indicate that viable ova of a number of helminth species, including ***Ascaris***, ***Trichuris*** and ***Taenia*** spp (roundworm, whipworm and tape worm) may be present in pit latrine contents.

Table 1: Factors that may affect performance of a pit latrine

Construction and location	Operation	Maintenance
Construction of walls and base of the pit	Age of the pit	Frequency/history of emptying
Permeability of the walls and base of the pit	Addition of other material (e.g. household waste)	Amount of seed material left after emptying
Construction of slab, collar and superstructure of the latrine	Ingress of (non-urine) liquid via the top of the pit	Additives used to enhance digestion
Height of water table (low/high)	Rate of filling/number of users	Ownership: communal or private
Type of soil	Anal cleansing material	
Presence of bedrock or sandy aquifer		
Proximity of other pits		

Furthermore, the disposal of pit sludge to wastewater treatment works has been found to be unacceptable and uneconomical, both from a transport and a waste handling point of view. A simpler, more economical and probably more beneficial option appears to be the burial of pit sludge as near as possible to the VIP.

TO ADD OR NOT TO ADD

One approach being proposed to extend the life of a filling or full pit is the application of commercial pit latrine additives. These may be chemical, microbiological or enzymatic in nature. The additives are promoted as being able to reduce (or even reverse) the sludge accumulation rate in the VIPs, and also to reduce potential problems of flies and odours.

While anecdotal evidence suggests that they may well be effective, independent scientific evidence of their efficacy is scarce. Equally, a number of informal studies have suggested that these additives do not perform significantly better than the addition of plain water or inert additives. The research has found through controlled experimental conditions, that these VIP additives add no benefit to accelerate the rate of degradation of pit latrine contents under either aerobic or anaerobic conditions. Twelve locally available products were tested and none have been found to be effective.

FOUR FACTORS FOR SUCCESS

The WRC project found that a VIPs ability to safely accumulate and biodegrade human faecal waste was dependent on four important factors:

STEPS TO SUCCESSFUL VIP IMPLEMENTATION

- The VIP substructure and superstructure must be properly constructed to prevent collapse, control flies and odours, and to facilitate emptying if this will be required.
- Educate users on the use and maintenance of VIP toilets.
- Ensure the presence of an effective solid waste removal programme.
- Budget for maintenance and emptying or rebuilding.
- Train members of the community to conduct simple maintenance work.

- **User education** – poor user practice cause unhygienic conditions to exist in and around the latrine.
- **Solid waste management** – It was found that where there was an efficient solid waste removal programme there tended to be a lower fraction of solid waste in the pit contents. The presence of non-degradable solid waste accelerates pit filling rates and makes emptying the pit more difficult.
- **Emptying** – Large-scale projects have been undertaken to build VIPs for unsewered communities without adequate planning and budgeting in place to deal with the emptying, rebuilding or maintenance of full or damaged pit latrines. It is vital that the provision of sanitation by national government and municipalities is accompanied by a detailed, sustainable and appropriately budgeted and financed plan for dealing with maintenance and emptying issues that will arise in the expected lifetime of the pit.
- **Maintenance** – For latrines with missing or damaged features, including doors, pedestals and lids, backplates, flyscreens and vent pipes, users not only did not understand the importance of repairing or replacing these parts, but also did not know how to access new parts or the expertise to perform simple maintenance. This suggests that there should be a supplementary programme that ensures a supply of spare parts and the training of maintenance contractors to undertake simple maintenance work.

"These experiences and the research findings are of international relevance," report Bhagwan. "There is a risk that the large-scale rollout of low cost, on-site systems that are poorly designed and poorly understood will not assist in achieving the Millennium Development Goal and national target, but rather prove unsustainable, fail to improve quality of life and create new problems for policymakers and service providers when they fill up or fail."

The WRC is funding ongoing research to deal with this looming challenge.

To access the report, ***Scientific Support for the Design and Operation of Ventilated Improve Pit Latrines and the Efficacy of Pit Latrine Additives*** (**WRC Report No**: **TT 357/08)**, contact Publications at Tel: (012) 330-0340; Fax: (012) 331-2565; E-mail: orders@wrc.org.za