February 2014
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

Two new sanitation technology innovations from the WRC

The challenges of providing safe and acceptable sanitation to all households and schools in South Africa continues to be a priority of Government. It is believed that new pour flush and low flush sanitation technologies, developed and practically demonstrated through research funded by the Water Research Commission (WRC), could assist in addressing this challenge.

Background

While ventilated improved pit (VIP) latrines have been recommended as the minimum level of sanitation service and technology by the Government, this is often found unacceptable by communities who aspire to waterborne sewerage as the symbol of equality. Recent studies by the WRC have highlighted the challenges associated with emptying of VIPs, and the safe disposal of sludge. Many pits ultimately have to be manually emptied, a job that is not only messy and unpleasant, but also dangerous as sludge typically contains a range of infectious human pathogens.

On-site flush systems as an alternative

Pour flush system in Asia.

An on-site sanitation option is therefore needed which may address the aspirations of many South Africans for a flush toilet while overcoming the logistical challenges involved with standard sewerage systems, while working responsibly within the limits of South Africa's water resources. An on-site flush system using a low volume of water produces sludge with a higher moisture content and lower solid waste content than VIP sludge typically contains, enabling it to be removed with standard vacuum technologies. A sanitation system which meets these criteria could interface with a range of beneficial sludge disposal options that do not involve treatment at a standard wastewater treatment works.

Pour-flush and low-flush sanitation systems bridge the gap between on-site dry sanitation and full waterborne sanitation sustainably. Using a small amount of water or greywater (1- 2.5 ℓ) to flush, a pour system can terminate in a simple soak away or leach pit. It takes away the need for digging deep pits, and provides greater convenience to users in terms of smells and fly control.

From a gender and child sensitive perspective, this technology will encourage the latrines to be built closer to the house or building, making it safer and more accessible throughout the day.

Developing of pour flush technology in South Africa

The WRC funded a study into modified pour flush design, which is used widely in Asia, to meet the needs of the South

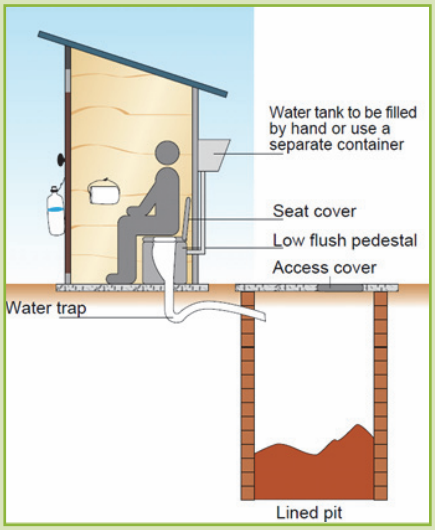
Advantages to pour flush and low flush sanitation systems

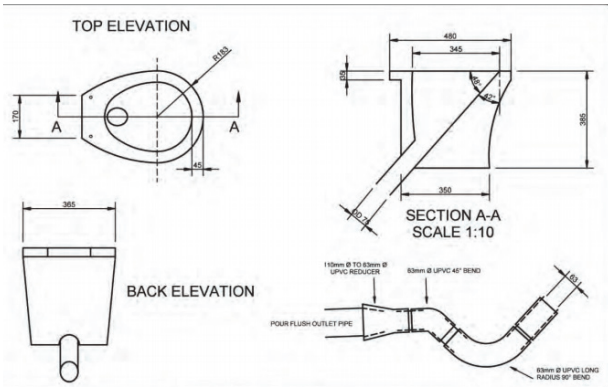
'Pour flush' refers to a system designed to be flushed by water poured into the pan by hand, pushing material through a water seal. In turn, the term 'low flush' refers to a system designed with a mechanical flush, which is designed to dispense water from the cistern around the pan, pulling material out of the pan.

These systems offer various advantages over conventional sanitation:

- Unlike a pit latrine pour flush toilets can be built onto a house
- Unlike conventional waterborne systems, pour and low flush sanitation use only a litre or two for flushing
- These technologies are cheaper to build than full flush toilets with septic tank and soak pit
- Because pour flush latrines are often flushed manually using a bucket, greywater can be used for flushing without the need for a piped recycling system
- Water seal prevents smells and flies, as well as trash and solid waste entering the pits
- Users cannot use the pit as a receptacle for domestic waste (unless they access the pit separately)
- Pits are smaller, so there is no need for deep excavations. This also allows for easier access and emptying.

Pour flush sanitation technology consists of the toilet block attached to two leach pits. When one leach pit becomes full, then the pit is switched. The full pit is allowed to dry out normally over a period of two years and then emptied, ready to be used again once the operational pit reaches its capacity.





Pour-flush pedestal design.

African context. In Asia people tend to squat, while the preference in South Africa is to sit.

A South Africa prototype was developed and subjected to stringent testing for its efficient operation. A pedestal was designed, which externally looks similar to a standard flush pedestal. Internally, the pedestal does not have a bowl associated with full flush toilets, but is more funnel shaped. This design was then piloted in 20 homes in KwaZulu-Natal where they were used for 18 months. The systems were monitored over the course of the project and performance and user experience assessed at the end of the project.

One of the installed pour-flush systems.

Key findings from this exercise indicated the following:

- **Design**: The pour-flush system developed in this study proved successful over the period of testing. Only one blockage was experienced in the 20 systems, and this was caused by a child flushing a plastic bag down the

toilet. The one-litre flush proved adequate for typical situations.

- **User satisfaction**: User satisfaction was high, and visitors to the homes where the technology was piloted expressed an interest in the pour-flush model. Responses indicate that the pour-flush system adequately addressed the wish of many dry sanitation users for a flush toilet, with the political, social and logistical considerations involved.
- **Lifespan**: Studies indicate that the pits have a lifespan of around five years before they need to be emptied.
- **Cost**: The technology is considerably less costly than installing a full flush toilet connected to a sewer or a standard septic tank. In addition, it is not dependent on piped water supply, and can be used even if the water supply is cut off occasionally, as a small amount of water is required and greywater can be used. It is also less complicated than a VIP in terms of installation and can possibly be lower in costs.

Successful application to date

Low flush sanitation for schools

The WRC developed pour flush system was modified and tested to a low flush system with a cistern. In consultation with eThekwini Water and Sanitation (EWS), two schools were then selected to participate in the trial. Sizimesele Primary School is located in rural Molweni in the Waterfall/ Hillcrest area and Thandaza High School is located between Hammarsdale and Mpumalanga. Three toilets were placed in each school: one in the boys' block and one in the girls' block.

The provision of new toilet blocks at schools also created an opportunity to educate teachers and learners about the transmission of disease, how it can be prevented through deworming and a change in personal habits, and, ideally, influence and motivate users to make a shift to new behaviours at the same time that they make a shift to a new sanitation system.

What were the results?

- **Dignity**. The provision of a flush toilet which performed well within the limitations existing in some communities which make full waterborne sanitation impractical provided a greater sense of cleanliness than does a pit latrine by removing the sight and smell of faecal material away from the user. The presence of the pan eliminated the concern of a child falling into the pit. While users may still experience an unpleasant smell from the system during hot weather due to the close proximity of the pit, issues of smell are far improved over a pit latrine, allowing the toilet to be installed inside the house if desired.
- **Environmental sustainability**. The low flush toilet performed well with a 2.5-litre flush, representing a 40% to 70% saving of water over standard toilets. It is possible this could be reduced further without any negative consequences. This represents a significant saving of water over a standard flush toilet and the development of low flush technology points a way forward for sanitation design which in its current form is unsustainable.
- **Versatility**. The low-flush system can be installed as an upgrade to a VIP latrine, a pour flush toilet or can replace a standard flush toilet linked to a septic tank if desired. The system can be installed indoors, providing greater convenience and safety to household members, but can also be installed in an existing VIP structure outside if there is not space for the toilet in the house. It is a practical option both in rural areas where sewering sparsely settled areas is too costly, and in informal settlements where sewering densely settled areas is not feasible.
- **Durability**. The low-flush system performed well when tests were done in which newspaper was flushed along with faecal samples. Users of the pour flush units which have been in use for 18 months to approximately 3 years have indicated that they have not experienced any difficulty when flushing newspaper. This meets an important criterion for basic sanitation in South Africa, where many users cannot afford toilet paper.

Pour flush application in high-density communities

Another WRC-funded pilot study was successfully undertaken in the Western Cape to investigate the sustainability of pour flush toilets in high-density urban and peri-urban settlements. Pour flush toilets were installed in three communities within the City of Cape Town, Stellenbosch and Theewaterskloof Municipalities. A total of 14 toilets were installed, and are working well.

Feedback from community members has been extremely positive, with all sites being receptive to the technology. Observations to date confirm that the pour flush design is working well without blockage. The success of the technology is further evidenced by the fact that some of the communities have expressed a willingness to contribute to the maintenance of their facilities. In townships such as Klein Begin, the communal pour flush toilets are working and being kept clean despite failure of previous flush toilets due to lack of household servicing. Furthermore, Stellenbosch

A happy recipient of a pour flush toilet.

Municipality is already considering incorporating pour flush sanitation into their standard specifications for informal settlements.

Recommendations

Pour flush and low flush technology is ready for piloting on a larger scale in both residential and institutional contexts. The particular advantages of these systems make it an appropriate option to be considered for the following contexts:

- Rural or urban schools
- Community or public ablution blocks
- Other institutional contexts
- Homes where householders are seeking an upgrade to an onsite flush system
- Communities where existing sanitation systems have failed or been rejected.

The only requirement for the effective functioning of the systems is access to small quantities of water. It is also essential that wherever low-flush systems are installed, pedestals and other parts are made available to local hardware shops and plumbers to ensure that systems can be repaired over time.

Further reading:
To obtain the reports, ***Piloting and testing the pour flush latrine technology for its applicability in South Africa*** (**Report No. 1887/1/12**); ***Developing a low-flush latrine for application in public schools*** (**Report No. 2198/1/13**) and/or ***Pour flush trials in the Western Cape*** (**Report No. KV 322/13**) contact Publications at Tel: (012) 330-0340; Fax: (012) 331-2565; Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.