

# Keeping the Trash Out: Improvements in Pit Emptying Technology

Removing the vast quantities of trash from pit latrines is time consuming and dirty work that raises prices to consumers because of the extra work involved. Researchers at North Carolina State University have developed a technology that reduces this burden and tested it in Malawi. Elizabeth Tilley<sup>1</sup>, Tate Rogers<sup>2</sup>, Francis de los Reyes<sup>3</sup>

## Introduction

In recent years, much emphasis has been placed on not just building toilets, but on using them, both consistently and correctly [1]. Unfortunately, there is much evidence that points to the other, more popular uses of toilets: grain storage, animal housing and garbage bins [2]. Given the lack of solid waste collection in most urban settlements, residents often use their pit latrines as a convenient way to dispose of solid waste. In many ways, this is an easy solution that protects the local environment and makes use of an existing resource. The challenge, of course, comes when it is time to empty the pit.

## The struggle with trash

Although sucking faecal sludge out of pits can be challenging, it can be done with the right mechanical pump. What makes pit-emptying difficult are the conditions around, between, and inside the pits: poor, steep roads limit the size and type of vehicles that can reach the household; small holes for defecation and low roofs make bulky equipment hard to manipulate; and trash, such as plastic bags, diapers, rocks and bottles, quickly clog, if not destroy hoses and pumps, leaving the operator with a repair bill and the customer with a full pit.

Because of the risk to their equipment, most emptiers will first take the time to “fish” out the garbage with a hooked, steel rod. Fishing is time consuming and messy, and someone has to haul the sludge-soaked trash away (Photo 1). Extra time is also necessary, meaning that the cost often increases accordingly. Fishing is not a guaranteed method: the self-made tools are best suited for rags and bags, but do not work for bottles or other hard objects, which require other methods and more time, resulting in even higher prices for the service.

## Flex-X

Of course, keeping trash out of the pit would be the easiest solution, but city-wide solid waste management strategies and behaviour change take time to implement. In the meantime, there is a need to empty thou-



Photo 1: Sludge-soaked trash that has been fished out of a pit.

sands of pits with significant levels of trash. One possible solution was developed at North Carolina State University: the Flex-X, which actively excludes the trash during desludging.

The Flex-X is a modular attachment that can be fitted onto the hose of any conventional vacuum truck. It consists of two parts: a shaftless, flexible screw that rotates inside a flexible vacuum hose, and a power/control unit. The screw inside the hose rotates in a reverse manner to push material away, thus preventing the trash from entering the hose. At the same time, the free-flowing sludge is sucked up through the centre of the screw by the existing vacuum system. External power for the screw rotation comes from a generator, while the vacuum to lift out the sludge is provided by the vacuum truck, as in normal operations. The vacuum tank fills with sludge while the trash remains in the pit.

This has several advantages: no clogging, no extra time needed to fish, and no contact with the sludge-covered trash. If the user insists on having the trash removed, it can be done at an additional cost after the emptying has been completed. Because the sludge has been removed, the trash is not “swimming” in faecal material, and can be more easily taken out using long rods with hooks, or modified trash collection tools [3].

## Results

Extensive lab-testing (at NC State) and field testing (in Hyderabad, India) were carried out before bringing the Flex-X to Malawi in December 2016 to test it under different operating conditions. Harold Chirwa and his experienced pit emptying team were enlisted to test the equipment and determine its ease of use from the perspective of operators (Photo 2). The Flex-X was connected to the vacuum tanker used by Mr. Chirwa’s



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Photo 2: The pit-emptying and research team examine the equipment before testing.

team and tested on six pits. It showed promising results as the equipment demonstrated its ability to reject large pieces of trash, while removing sludge from every pit tested. The compact size and flexibility of the hose made it easy to access the pits and for operating inside the superstructure. Some areas for improvement were also identified: (1) preventing small, stringy trash from causing blockages inside the hose and (2) making a rigid end piece for the hose similar to current equipment that allows the operator to remove “slugs” of waste in more viscous pits.

Based on this data, the Flex-X was improved and tested again on another six pits in February 2017. The modifications proved successful as only one blockage was observed during testing and the rigid end made manoeuvring within the pit easier on the operator. This testing also showed that as the sludge became more viscous, the flow rates with the Flex-X dropped in comparison to the existing vacuum equipment. Final modifications are currently underway to

improve the trash rejection efficiency and to increase the flow rates through the system with more viscous sludge. These modifications will be tested in Malawi and other African countries beginning in July 2017.

### Conclusion

The Flex-X does not solve the pit-emptying challenges of inaccessible toilets or slabs. It does, however, represent a significant time saving to the operator who can then pass the savings onto the customer, by being able to service more pits in a day. More importantly, keeping the trash in the pits means that the operators (during fishing) do not come into contact with the highly pathogenic waste. Future work will quantify the time savings and health risk reductions associated with using the Flex-X. Even still, this equipment is not meant to replace much needed solid waste collection and disposal options, two often over-looked elements of effective faecal sludge management that will, hopefully, put the Flex-X out of a job one day soon.

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<sup>1</sup> Eawag/Sandec, Switzerland

<sup>2</sup> Triangle Environmental Health Initiative, USA

<sup>3</sup> North Carolina State University, USA

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Contact: elizabeth.tilley@eawag.ch