Abstract

Lack of access to basic sanitation and water by rural and dense peri-urban communities in South Africa has necessitated the introduction of ventilated improved pit latrines (VIPs). However improper use and inadequate maintenance of these facilities could lead into system failure or to pits filling up faster than they are designed to do. VIPs present a problem once they are full. Pit emptying is an enormous challenge, particularly in communities where there is no space to dispose of pit contents on site. Pit latrine contents poses environmental and health risks since sludge may contain organic pollutant compounds and pathogenic micro-organisms. Contamination of surrounding ground- and surface water is also highly likely. Increased understanding of the biodegradative processes occurring in VIP pits will facilitate better management of pits during their lifespan and better handling of the pit contents upon emptying. These were the needs which drove the present study into the potential biodegradability of the contents of VIPs and the physico-chemical characterization of VIP contents and fresh faeces.

It was expected that user practices such as use of the pit for disposal of wastes other than faeces, and addition of chemicals alleged to reduce malodour from the pit would strongly affect the physical properties of contents from pit latrine. Therefore user practices related to pit functioning were investigated at the outset of the study, through an informal questionnaire survey.

The informal questionnaire survey provided a qualitative insight into VIP use. The different practices surveyed included dumping of household wastes, throwing grey water and also tap water into the pit, and the addition of chemical or commercial additives into the pit. These practices are considered as significant factors contributing to the variation in the studied properties of pit latrines contents, and to the overall function of VIPs.

In the laboratory-based component of the study, fresh faeces and samples of pit latrines contents from a number of locations within eThekwini Municipality were analysed for anaerobic biodegradability using a modified serum bottle test. All samples were also analysed for physico-chemical characteristics, including total and soluble COD, moisture, total solids, and organic solids.

Serum bottle test results for fresh faeces showed an average anaerobic biodegradability of COD of 70 % (n=5) at 95 % confidence. On the other hand, biodegradability tests on pit latrine contents produced less methane, relative to total COD and organic solids content of samples, which was understood to indicate an inhibition of anaerobic digestion. The biodegradability results for pit latrine material at showed that there was no significant difference ($p<0.05$) in anaerobic biodegradability at different depths, and that overall gas production was very low. This was unexpected and it was concluded that the serum bottle test was inappropriate for evaluating the biodegradability of VIP sludge samples. It is recommended that future studies use an aerobic biodegradability test to test the biodegradability of samples.

Despite the limitation of the poor results for biodegradability, it was possible to use results from physico-chemical analyses to develop a theoretical model of biological activity in the different layers in a pit latrine. In accordance with with model, faecal sludge in a pit can be divided into four layers, showing decreasing biological acticvity with decreasing depth. Biological activity in the top layer is considered to be aerobic, while that in lower layers is considered to be anaerobic This information can be used as a background to assess the feasibility of different management options for filling pits and different disposal possibilities for pit latrine contents. This is because feasibility of treatment depends on the inherent ability of the treatment processes to accept the load of solids and organic material in the VIP sludge, the residual biodegradability of the VIP sludge, and the health risks associated with handling the sludge.