



## The effect of non-pathogenic bacteria on latrine sludge



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THIS PAPER PRESENTS the interim findings on the effects of spore forming non-pathogenic bacteria (bio-organic breakdown compound) in reducing sludge volume in pit latrines. This research project was undertaken in a rural set up 45 kilometres out of Harare, Zimbabwe's capital city. A considerable amount of work has been carried out in improving existing designs and developing appropriate technologies for proper sanitation disposal. However, very little consideration has been given so far to the problem of full pit latrines. Pit latrines were designed in such a way that, when they are full, the superstructure can be moved to a new site or a second pit will be used while the contents of the first pit are left to decompose into harmless and in offensive material. In some cases however, it may be necessary to empty a pit containing fresh excreta. This is likely to occur if the house holder can not afford to dismantle the superstructure and re-erect it elsewhere, Because of financial limitations or insufficient space on the plot to accommodate a second pit. These are some of the constraints common in rural areas. Pit emptying services have been tried for some time but most of these services have proved to be inefficient and unsatisfactory due to organisational and technical reasons. Some of these alternative devices consists of vacuum tankers, which were developed in industrialised countries for emptying septic tanks and flushing sewers. They are particularly suitable for removing water and very thin sludge, but not slurries containing materials commonly found in pit latrines. In addition they can not be properly maintained in developing countries where roads are bad and financial resources are limited. The volume of domestic sewage is steadily growing. Only this waste must be assimilated into the environment without impairing the health and well being of man. It is therefore necessary to assist the natural biological breakdown process by introducing a known bacteria to speed up the process. The bio-organic breakdown compound has been developed by Blair Research Laboratory and tried in Goromonzi Rusike village by the Institutes Communicable Disease Research Unit, as an alternative solution to mechanical and manual pit desludging.

### Objectives

The objectives of the field trials were to evaluate the effectiveness of the bio-organic breakdown compound in breaking down solids in the pits, and in reducing the sewage volume and to determine environmental conditions that promote efficient bio-degradation. At the same time without impairing the health and well being of man.

**Table 1.**

Toilet number	Number of users	Amount of bio-organic added
1	13	300g
2	5	300g
3	11	300g
4	10	300g

### Materials and methods

Four (4) Blair ventilated pit latrines were chosen depending on the volume of the pit contents, number of users and year constructed. All the selected sites had lined pits except at the bottom which allowed most of the effluent to seep underground. The selected sites served as family residential latrines with different number of users ranging from 5 to 13. The following bio-organic breakdown compound dosing programme was initiated at the selected sites.

After the initial dosage as indicated above, 300 grams of bio-organic compound was added to each of the sites ounce a week for a period of four weeks. A perforated pressure tube was used to inject the mixed breakdown compound into the pits by creating pressure from the micravac vehicle for mixing the breakdown compound and the pit contents. Dosing and sampling was done once a week for 4 weeks and sludge depth was recorded everyday from each of the four sites.

### Specimens analysis

The analyses of chemical oxygen demand (CODs), bio-oxygen demand (BODs), Phosphates, Sulphates, Ammonia, Suspended-Solids, Total-Solids, Organic and Inorganic were conducted in the laboratories of the City of Harare division of water and wastewater. Standard laboratory methods for the examination of water and wastewater were used ( APHA 1981).

### Cost analysis

The capping and rebuilding of new Blair ventilated pit latrines used to cost about US\$116.84 in 1995. During that period, the total cost would be about Z\$1005.00 at an exchange rate of US\$1.00: Z\$8.59. However, desludging of a 2m<sup>3</sup> pit latrine within an hour using a motorised vacuum tanker used to cost US\$1.17 during the same year. This motorised vacuum tanker method was thus much cheaper at that time. However, with the devaluation of the

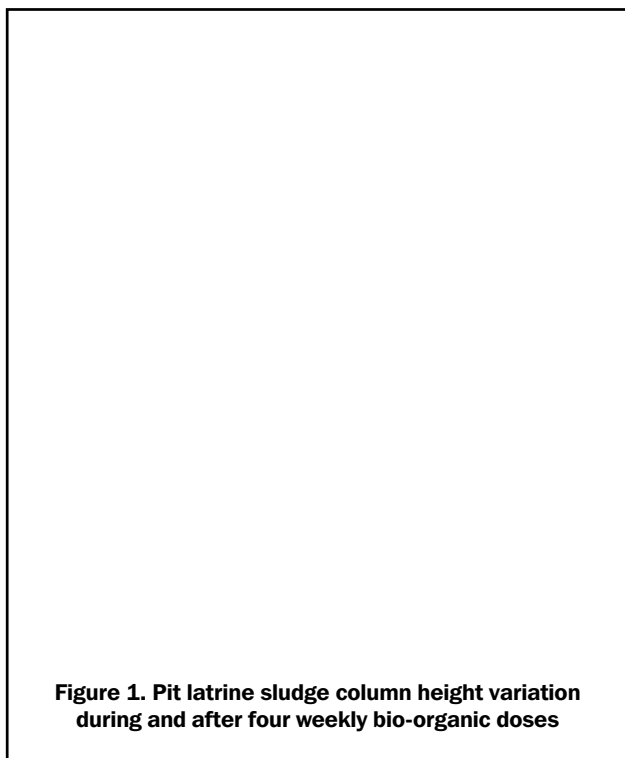


Figure 1 shows that pit latrine sludge volume decreased uniformly during and after treatment.

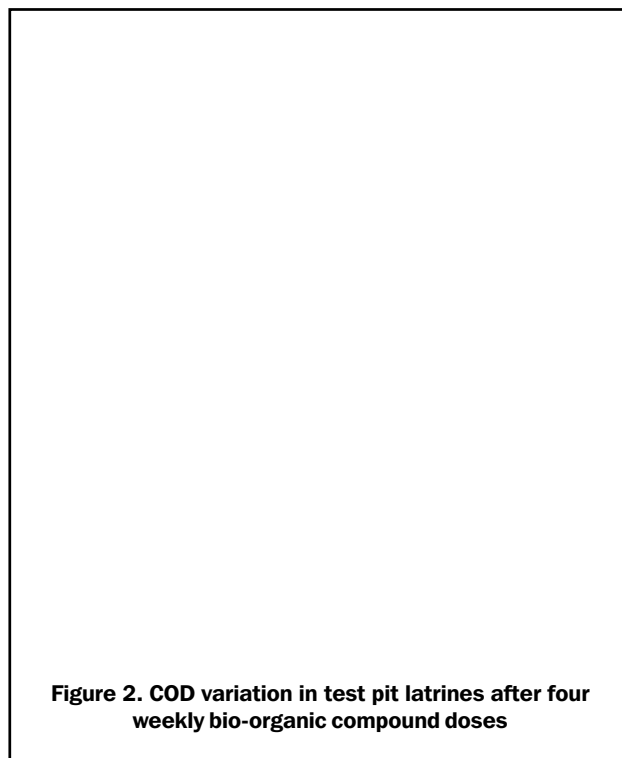


Figure 2 above shows that COD values decreased from the 2<sup>nd</sup> to the 8<sup>th</sup> week. Pit 2 values remained consistently low even after week 8. However, after the eight week, there was a slight increase in pits 1, 3, and 4.

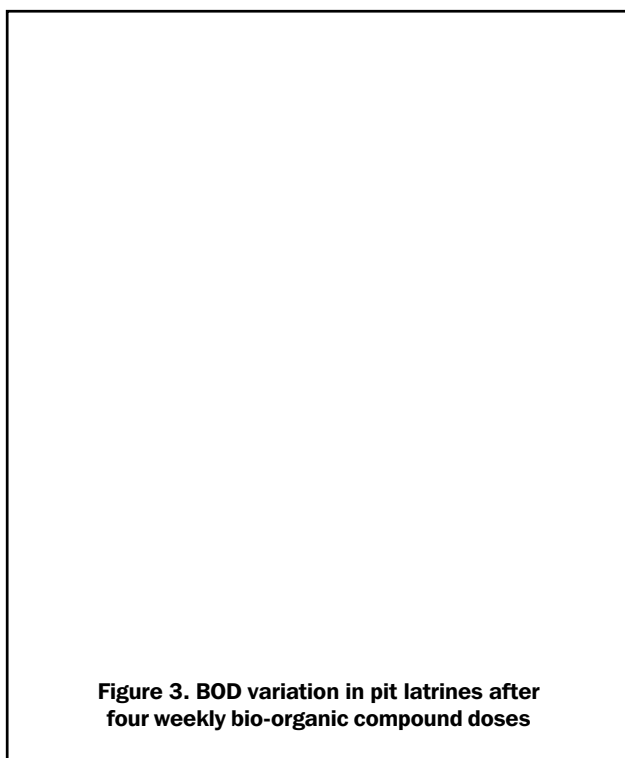


Figure 3 shows that the BOD decreased from the 1<sup>st</sup> to the 8<sup>th</sup> week in pit 2 and 3. Pit 1 and 4 show fluctuations from 1<sup>st</sup> to 4<sup>th</sup> week but however, increased thereafter in all pits.

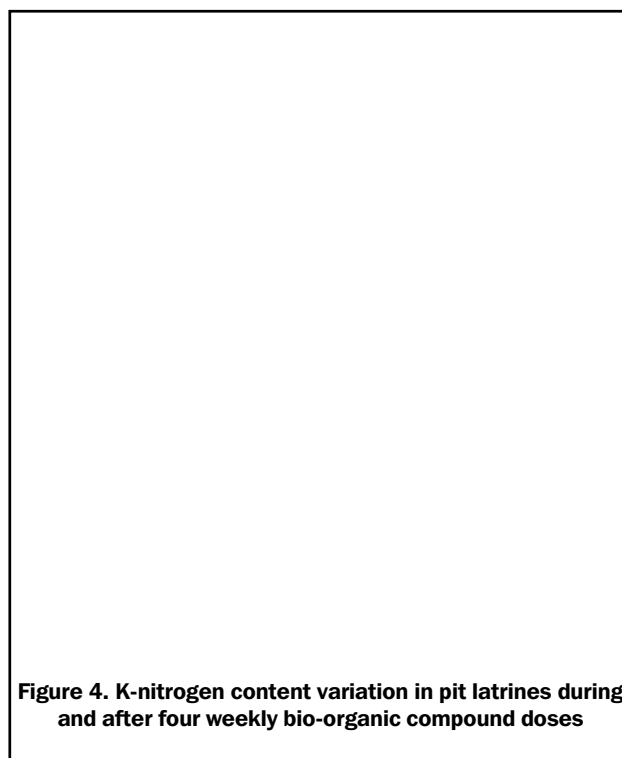


Figure 4: K-Nitrogen content decreased drastically from the 1<sup>st</sup> week to the 2<sup>nd</sup> week and maintained at very low concentration throughout the study period.

Zimbabwean dollar, US\$1.00: 8.59 in 1995 to US\$ 1.00: \$17.9148, the cost of capping and rebuilding ventilated pit latrines has gone beyond the reach of the majority populace in the rural areas. Prices of building materials, diesel, spare parts and proper gear for the micravac operators has gone up to unaffordable limits. This leaves the bio-organic breakdown compound as the only affordable option for reducing the pit contents. A 50kg of bio-organic breakdown compound costs US\$4.50, no extensive labour is needed and overall the compound is environmentally friendly. The compound can be mixed with warm water to a fluid and allowed to stand for 2 to 4 hours to pre-activate it before it is applied into the pit latrine.

## Results and discussions

On inspection, the four (4) pit latrines were 100% full. Pit latrines are considered full when the sludge level is between 30 and 50 cm below the level of the latrine floor. The pit contents decreased tremendously during the study period (Figure 1). The observed And those of COD, BOD, K-Nitrogen (Figures 2, 3 and 4 respectively varied in all the (4) pit latrines selected for the study. During the study period observations were carried out especially on the behaviour of sludge, when fresh waste was introduced in the pits, the natural process of bio-degradation took place, but when the breakdown compound was introduced the process of degradation increased its pace of digestion. In the fourth week most of the solids were digested to liquid which to a blackish effluent. This blackish effluent seeped into the ground rapidly. Total solids contents increased after the first dose, and decreased after the second dose and maintained a stable equilibrium to the fourth week or after the last dose, unstable conditions after terminal dosing. Inorganic solids were very unstable during the four week dosing period but maintained stable conditions rise after eight weeks. Organic solids decreased during dosing period and four weeks after. Phosphates decreased during the dosing and four weeks after, four weeks after the terminal dosing there was a sharp increase in phosphates. All the determinants tested (i.e.) BODs, CODs, Phosphates, Inorganic solids and organic solids follow the same trend. This was probably due to other things thrown into the pits since there was no control in what should or should not be put into the pits.

## Conclusions

Desludging not only provides an increased life span for pit latrines, but also markedly reduces the environmental

impact of building new latrines, and digging spare pits for desludging. Since additional ground space will thus not be required, neither are additional bricks, which would have to be fired using the increasing scarce fuel wood. The bio-organic breakdown compound proved to be efficient in reducing the pit contents. The user communities should be educated not to use pit latrines as refuse pits so as to avoid addition of non bio-degradable materials.

The above findings remain preliminary pending further monitoring and evaluation of the breakdown compound, in the following factors:

- The incidence of acute diarrhoea diseases: the die-off rate of the diarrhoea diseases causing bacteria will be evaluated.
- The presence of sanitation related nuisance (e.g.) foul smell and flies: the die-off rate of offensive or foul smell and flies before and after applying the breakdown compound will be evaluated and monitored.
- A questionnaire will be administered to evaluate the acceptability of the breakdown compound by the user community.

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