



# Entrenchment of faecal and sewage sludge and possible benefits for the timber industry

We picked up on a fascinating report issued by the Water Research Commission (WRC) on the potential benefits of entrenching faecal and sewage sludge for the timber industry. The key findings have been extracted with permission from the authors, but the full report is definitely worth a read.

The study arose when the need for cost effective disposal mechanisms for faecal sludge became apparent after the Ethekwini Municipality began its pit emptying programme.

Given that sludge entrenchment lends itself to labour intensive methods, there is opportunity for employment creation in the loading, offloading and haulage of drums.

## BACKGROUND

Investigation into the entrenchment of sludge started in the United States in the 1970s. This research was initiated by several co-operating agencies as a result of high volumes (200-300 tonnes per day) produced by the Blue Plains wastewater treatment facility which served two million people.

The entrenchment or burial of sludge in rows was investigated as a potential disposal method and as a means of beneficiation for the forestry industry and wildlife habitat rehabilitation. Three decades of research identified the following benefits:

- more sludge could be applied than surface application;
- it improved the structure and organic content of soil;
- nutrients were released at a slow rate, reducing the frequency of application; and
- it reduced vector disease transmission and sludge contact with humans and animals.

## THE SOUTH AFRICAN CONTEXT

These findings spurred on similar trials in South Africa, involving sludge from pit latrines, the country's most basic form of sanitation, and wastewater treatment works (WWTW).

Partners in Development (a research consultancy specialising in water and sanitation) was commissioned by the WRC to investigate entrenchment as a potential disposal and beneficiation mechanism. The study comprised five experiments, ranging from household to large-scale application.

### Experiment one

This involved the use of pit latrine sludge to fertilise and condition the soil around new citrus and peach trees at two homesteads in Pietermaritzburg. The citrus trees planted with sludge were notably larger and produced greater yields. While the experiment was too small to be of much scientific significance, the most important finding was that the planting of trees over faecal sludge and the consumption of the fruit that grew on those trees was not considered taboo.

### Experiment two

The second experiment involved the planting of eucalyptus and wattle trees in tree towers at the University of KwaZulu-Natal (UKZN).

For each species, 12 trees were planted in one metre-high concrete towers. Six experimental trees were grown with a layer of river sand above a core of pit latrine sludge while six control trees were grown without sludge but with a liquid fertiliser solution. The experimental trees were given only water.

The growth response of the experimental eucalyptus trees was strikingly better, while in the case of the wattle trees, this was less so. Not only were the roots denser in the experimental trees but they also grew into the sludge core.



FAR LEFT: Root development of eucalyptus around sludge core.

LEFT: Growing tips of *E. grandis* from trees of experimental (left) and control (right) groups at approximately five and a half months after planting.

### Experiment three

In the third experiment, more than 1,000m<sup>3</sup> of pit latrine sludge was buried on the site of an old oxidation pond in Umlazi, south of Durban, onto which eucalyptus and wattle trees were planted. Five monitoring boreholes were drilled between the site and the nearby Umlazi river. No significant changes were detected in the groundwater over a two-year monitoring period.

Samples of the sludge were taken from time to time and assessed for physical properties and pathogen content. After three years, the sludge was hard to distinguish from the surrounding soil, the organic matter had virtually decomposed and the pathogens (using *Ascaris*\* as a marker) had all died.

### Experiment four

Near Howick in the KwaZulu-Natal midlands, a two hectare experimental area was provided by Sappi where around 360m<sup>3</sup> of WWTW-activated sludge was entrenched. The test site was divided into 30 plots of 900m<sup>2</sup>. In 18 of these, sludge was buried in a 400m<sup>2</sup> section in the centre of each plot.

Five treatments were compared: Treatment 1 (T1) comprised a 10m<sup>3</sup> load of sludge; T2 two loads; T3 three loads; trenches but no sludge for T4; and for T5 no sludge or trenches (negative control).

The growth of 900 trees (30 at the centre of each plot) was observed over a period of 52 months, from planting in January 2010 until May 2014. The plots with sludge showed a 50% increase in timber volume compared with those without. The site was also closely monitored for groundwater impact, using a number of piezometers for near-surface flow and two 60m-deep boreholes at the bottom of the site for groundwater monitoring.

In the first year after planting, a small difference (2mg/ℓ) in nitrate levels was detected in the downstream borehole compared with the upstream borehole. After four years there was no difference in nitrate content

\* *Ascaris* infestation (parasitic roundworm) is rife in Durban and faecal sludge removed from pit latrines typically has average egg counts of several hundred ova per gram of sludge. The presence of *Ascaris* has been monitored in buried sludge over a period of 48 months. The results show a complete die-off over a period of three to four years.

above or below the site and in fact the nitrate content in the water sampled from the site rain gauge was significantly higher than that sampled from the boreholes or the piezometers.

The final experiment, which is ongoing, is looking more closely at leachate emanating from buried WWTW sludge in a set of 15-one metre square plots, 12 of which have a layer of either 250mm or 500mm of sludge.

### COUNTING THE COSTS

Although the Umlazi and Sappi trials have not detected any negative environmental impacts, it may make sense to apply smaller amounts of sludge more often if one is to maximise the nutrient uptake in crops intended to benefit from the process.

Entrenchment can be expected to cost approximately R60,000 per hectare, assuming an entrenchment rate of 300m<sup>3</sup> of wet sludge per hectare and a haulage distance of 30km. That is R200/m<sup>3</sup>. At approximately R3.20/m<sup>3</sup> km, transport quickly becomes the dominant factor in the cost calculation.

The results of these trials indicate that timber tonnages would increase by up to 50% for plots with entrenchment which, over a 10-year growing cycle would translate into increased revenue of R25,000 at current prices. This is less than the cost of entrenching sludge, but it does nevertheless offset the cost of sludge disposal.

Further costs include establishing leachate and groundwater monitoring well points, which might amount to several hundred thousand rands. A monitoring establishment cost of R10,000 per hectare is a reasonable budget figure assuming that one monitoring well will cover at least 10 hectares.

Other methods of sludge disposal, including landfills, incineration, pelletising and composting can be considerably more expensive. ■

SOURCE: Sanitation Matters; Issue 6 - 2014

#### REFERENCES:

Still, D, Lorentz, S and Adhanom G. (2014) Entrenchment of Pit Latrine and Waste Water Sludges – An Investigation of Costs, Benefits, Risks and Rewards. WRC Research Report K5/2097, Pretoria, South Africa.

A copy of Sanitation Matters can be downloaded from [www.wrc.org.za/Pages/KnowledgeHub.aspx](http://www.wrc.org.za/Pages/KnowledgeHub.aspx)

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