Search Continues For Answers On Health Impact Of Ecosan

While the mass rollout of urine diversion (UD) toilets continues on the outskirts of Durban in the municipality's quest to provide all its constituents with decent sanitation by 2010, questions remain regarding the environmental impact of these systems and the possible reuse of the accumulating waste. A joint research effort between the Pollution Research Group of the University of KwaZulu-Natal and the Water and Sanitation Department of eThekwini Municipality is hoping to come up with some answers. Lani Holtzhausen reports.

A dwarf paw-paw tree grown on waste (front) compared with a tree grown in conventional soil (behind).

The eThekwini UD toilet is of a double vault design, with the toilet pedestal being relocated over the second, empty vault when the first vault has been filled.

The urine is disposed of in shallow soakaways. Sand or ash is added after each defecation to promote desiccation and limit odour and fly problems.

The contents of the first vault are allowed to stand for the period required for the second vault to fill (usually a year). Thereafter, it is recommended that the now dry waste


The research site at the University of KwaZulu-Natal.


Construction of the concrete columns


Filling the columns with waste material. This was reportedly a highly unpleasant task.


The waste material.


The plants grown above the waste showed enhanced growth and yield compared to those grown in the control columns.

- *Photographs courtesy of the Pollution Research Group*

is buried on site at a minimum depth of 250 mm below the soil surface and a tree planted to mark the burial site.

However, as more vaults start to fill up several questions have been raised such as how fast will the buried waste degrade and is there a threat of groundwater contamination by persistent pathogens? It is also not clear whether deep-rooted plants, planted above the burial site, will be able to penetrate and tolerate the anaerobic waste layer. Then there is the possibility of reusing the waste to grow food.

SEARCHING FOR ANSWERS

To answer some of these questions a study site was selected at the university grounds. The project, funded by National Research Foundation, started in August 2004. A total of 24 concrete columns were constructed from conventional manhole pipe rings with a diameter of 75 m and a height of 25 m. Mikey Guness, a research assistant at the Pollution Research Group, explains that 12 of the columns served as experimental treatments while 12 served as controls.

The columns were filled with combinations of soil and urine diversion solid waste collected from toilets nearing filling of the second toilet vault. Berea red soil, a relatively nutrient-poor soil typically found in the area, was used as covering soil and as substitute for the UD wastes

TABLE 1 Combinations of soil and urine diversion waste in treatment and control towers		
Depth	Treatment towers	Control towers
Ground level – 0,25 m	Umgeni river sand	Umgeni river sand
0,25 – 0,75 m	UD solid waste	Berea red soil
0,75 – 1 m	Berea red soil	Berea red soil

in the control columns. Umgeni sand was used as the bottom layer because it displays high leaching potential, providing a 'worst case scenario' for prediction of leaching of contaminations into groundwater.

A total of 20 columns were planted with dwarf paw-paw trees, while the rest were allocated to spinach plants.

Plant growth was monitored weekly. Parameters measured included plant height, stem diameter, number of leaves, and length and width of the three largest leaves present at the time. In addition, the spinach was harvested as necessary and the fresh weight of the harvested leaves recorded.

Leaching from the columns was determined by adding a constant volume of 45 ℓ of water to each column. Leachate was collected from each column and the volume recorded. The leachate samples were then sent to the eThekwini laboratory for microbiological analysis.

CAUSE FOR CONCERN

The results demonstrated that, far from being an inert mass, buried UD waste has a marked impact on the quality of soil above (and by inference below) the waste layer, and potentially of groundwater. This has positive and negative implications, notes Guness.

Analysis of topsoil from experimental and control columns three weeks after filling, immediately before planting, showed that there were significant differences in levels of exchange acidity, manganese, copper and total nitrogen. This demonstrates that UD waste constituents, particularly nutrients, can move upward in the soil column and, therefore, have the potential to affect even shallow-rooted plants which do not penetrate the waste layer. Furthermore, this suggests that microbial contaminants may move to the soil surface after burial and pose a potential health hazard.

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"Evidence of movement from matter from the waste layer to the soil surface is of particular concern with respect to ova of the *Ascaris lumbricoides* (a parasitic roundworm)," Guness tells *the Water Wheel.*

Ascariasis is endemic in the eThekwini municipal region, particularly in poorer communities which are likely to be served by on-site sanitation. One of the main purposes of any sanitation intervention is to provide a barrier between people and infectious agents present in their waste. If buried waste has the potential to release infective ova to the soil surface, it will increase – rather than decrease – the environmental load of this pathogen."

ENHANCED GROWTH

An extremely positive aspect of the project is that growth of the spinach plants was boosted markedly when growing above the buried UD waste. While the paw-paw trees took longer to show as marked a difference, the same trend was evident after eight weeks' growth and, particularly by ten weeks' growth. "Our research showed that even the UD sanitation-only approach adopted by eThekwini Municipality, which does not specifically provide for agricultural reuse, may boost food production from crops grown in a relatively small area immediately above the burial site," says Guness.

Analysis of the volume and quality of leachate from experimental and control columns showed that while the UD waste did not significantly alter the water retention characteristics, both chemical oxygen demand (COD) and microbial indicator organisms were significantly increased in leachate from the columns containing UD waste. This could have potentially damaging effects on groundwater quality.

As Guness notes: "The appearance of COD in the leachate from columns containing UD waste may indicate that degradation is occurring in the waste layer, releasing soluble organic carbon from the predominantly solid organic matter in the waste. Further analysis on soil layers is currently being conducted.

The jury is still out on whether the dry waste from UD toilets can safely be used to grow food. It is only with continued investment in research that all the answers will become known.