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**WATER, SANITATION AND HYGIENE SERVICES BEYOND 2015:
IMPROVING ACCESS AND SUSTAINABILITY**

**Testing decentralised treatment solutions for portable
home toilet waste – Kumasi, Ghana**

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Water and Sanitation for the Urban Poor (WSUP) and Unilever have developed Clean Team, a business providing portable home toilets that are attractive and branded. Customers pay for their waste to be collected two to four times per week. Three “off-the-shelf” technologies are being tested to treat this waste and allow Clean Team to scale up to other cities. The three technologies are Sistema Biobolsa, which uses flexible tubes as anaerobic digesters, and aerobic planted gravel filter; Biorock, where an anaerobic pre-treatment tank is followed by an aerobic tank containing synthetic filtration media, pretreated with enzymes that stimulate the growth of aerobic bacteria and ventilation executed by natural draft; and Biofil, which will receive the sludge from the Biorock system, and digest it using macrofauna. The paper will present the initial trial results.

Introduction

Water and Sanitation for the Urban Poor (WSUP) and Unilever have developed the Clean Team, a business providing portable home toilets that are attractive and branded. Customers pay for their waste to be collected two to four times per week, after which it is taken directly to the centralised sewage treatment plant. As of February 2015, Clean Team are serving 810 households in Kumasi in Ghana.

In Kumasi, the city sewage works at Dompouse can accept the Clean Team waste. But not every city where Clean Team may work in the future will have facilities that accept this waste. Hence there is a need to find a treatment solution that can be replicated into as many contexts as possible.

Technology selection

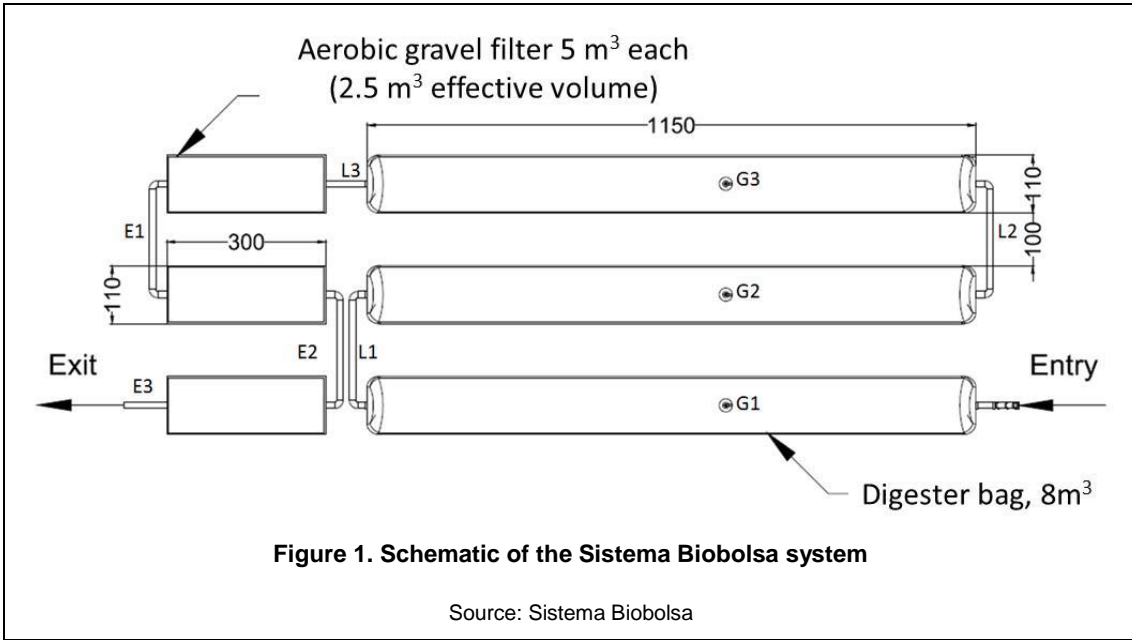
This solution needs to be found rapidly to support Clean Team’s planned scale-up, so WSUP commissioned Cranfield University to test three existing “off-the shelf” technologies. The following criteria were developed to select the technologies:

1. ability to treat the liquid effluent for discharge into the environment, as specified by the Ghanaian guidelines;
2. low energy requirements;
3. easy to transport and install;
4. track record of extended operation in off-grid situations;
5. small footprint so it can fit on current and future Clean Team sites;
6. low capital costs;
7. ability to be operated by well-trained competent staff without tertiary training; and

Despite an extensive technology search only one technology was found that came close to meeting all the criteria, however, by combining two other technologies a further system was identified. All three are currently being trialled in Kumasi, Ghana. The three technologies are:

Sistema Biobolsa

This system was initially developed in Mexico for generation of biogas from animal manure, and was then replicated in Haiti to treat human waste and Nigeria for animal waste. It consists of a modular multi-stage treatment system that uses flexible tubes as anaerobic digesters. These are quick to set up and easy to transport. Following anaerobic digestion, aerobic planted gravel filters provide further treatment. It can have a higher residence time than other anaerobic systems as the capital cost per cubic metre is significantly lower. This increases hydraulic and solids retention time.



Photograph 1. The anaerobic digesters during installation

Biorock

Although the Biorock system was developed in Luxembourg for the treatment of household wastewater, it was appealing as the ventilation is executed by natural draft, so no external energy is required, and the modular combination of aerobic and anaerobic technologies will be easily replicable throughout the world. It will be the first application of this system for treatment of non-waterborne sewage. It is a modular two-stage treatment system, where raw sewage first enters a primary tank to provide pre-separation and initial breakdown of organic solids in an anaerobic environment. The liquid effluent then passes through an effluent (bristle) filter before discharging into an aerobic tank containing synthetic filtration media, pretreated with enzymes that stimulate the growth of aerobic bacteria. It has a much shorter solids retention time, and the first stage which is effectively a conventional septic tank is not designed to work with high solids waste so will require regular desludging.



**Photograph 2. The Biorock tanks during installation
(anaerobic on the left, aerobic on the right)**

Modified drying bedsThe sludge that is regularly emptied from the Biorock system will be put onto a modified drying bed developed at Cranfield University. (Rose et al; this conference). The drying bed consists of a down-flow fixed media filter bed, with a layer of clinoptilite. This layer adsorbs ammonium-nitrogen, which can subsequently be dug out of the bed and used as a soil amendment. This will be the first field trial of the drying beds.

Technology trials

Trials of the three different technologies will start in March 2015. Biorock will be fed with 50 L per day of Clean Team waste initially, working steadily upwards in small steps until performance is compromised or the standard hydraulic loading rate for a septic tank is reached, which is usually a retention time of 2 days. Sistema Biobolsa will begin at 100 L per day of Clean Team waste, ramping up to 1000 L per day over the course of a few weeks.

The testing regime will be as follows: Liquids and solids will be collected daily from each technology including all intermediate steps. They will be analysed for pH, alkalinity, ammonia concentration, Chemical Oxygen Demand, temperature, turbidity, presence of blue dye in final effluents using the spectrophotometer. Odour levels and characteristics will also be collected daily. On a weekly basis the samples will be analysed for Total Solids, Volatile Solids and E. Coli. Every 6 weeks phytotoxicity trials will be carried out on the final sludge from the Biofil and Sistema Biobolsa systems to check if the chemical biocide persists.

This paper will share the preliminary results on the performance of these systems, and comment on their performance against the original seven criteria.



Photograph 3: Column scale experiments in the laboratory at Cranfield University to determine drying bed design parameters (credit: C. Rose)

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