Treatment Technology for Leachate from Faecal Sludge Drying Beds

The use of planted drying beds for faecal sludge treatment is effective for solid-liquid separation, but the leachate produced requires further treatment prior to discharge or reuse. This study investigates the potential of a new and low-cost solution for leachate treatment. E. Soh Kengne[1], K. Ives Magloire[1], W. Arsenne Letah[1], A. Akoa[1], H. Nguyen-Viet[2,3,4], L. Strande[2]

Introduction

The use of planted drying beds for the treatment of faecal sludge in Sub-Saharan Africa is a recent development [1]. The beds achieve solid-liquid separation, stabilize sludge that can be used for agriculture, and produce plants that can be used as animal fodder. However, the leachate from drying beds is still high in nutrients, organic matter, and pathogens. Therefore, it requires further treatment prior to discharge into the environment or reuse. This research focused on the use of planted drying beds in series for the treatment of faecal sludge and the subsequent leachate, resulting in the leachate treatment effectively being achieved through the same principles as vertical flow constructed wetlands (VFCW).

Methodology

The experimental setup is illustrated in Figure 1. Physical-chemical (i.e. COD, BOD5, TKN, NH_4^+, NO_3^-, PO_4^{3-}, conductivity, TDS, and salinity) and bacteriological analyses (i.e. faecal coliform and faecal streptococci densities) were performed on the faecal sludge, leachate and effluent following standard methods [2]. The density of rhizospheric bacteria was determined using the Germida method [3].

Findings

Planted drying beds batch fed with leachate from faecal sludge dewatering beds at 50, 100 and 150 L/d were effective in removing on average more than 80 % of monitored pollutants (COD, BOD, NH_4^+, NO_3^-, PO_4^{3-}, faecal coliforms and faecal streptococci) at all three hydraulic loads. Peak loadings were associated with increased effluent concentrations. The treatment performance met the WHO guidelines for effluent discharge for most parameters (i.e., COD < 100, BOD_5 < 20, Conductivity < 2000 mg/L; Salinity < 500 mg/L and PO_4^{3-} < 10 mg/L). However, nitrates and faecal coliforms exceeded the limits of the WHO guidelines (i.e., NO_3^- > 30 mg/L; FC > 1000 UFC/100 mL). Degradation by bacteria, plant uptake, and adsorption on the filter medium are the most likely mechanisms for the observed removal [4]. The density of plants and bacteria increased with respect to hydraulic load. However, the increased bacteria and plant growth did not correlate to an increase in treatment performance.

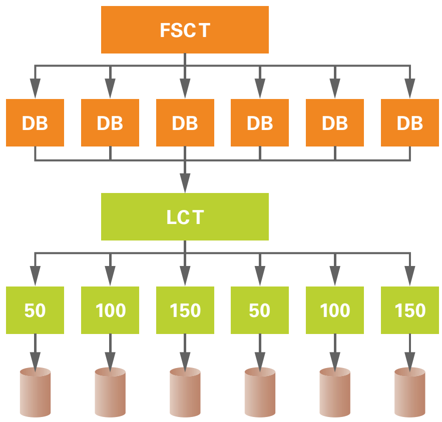

Figure 1: Experimental setup and operation.

1. Raw faecal sludge (FS) from Yaounde (typically 90% septic tanks, 4% pit latrines, 3% public toilets, 3% others)
2. Planted drying beds (DB) with *Echinochloa pyramidalis*, batch fed with raw FS at 200 kg TS/m^2/yr.
3. Leachate collection tank (LCT)
4. Planted beds (VFCW) with *Echinochloa pyramidalis*, batch fed with leachate at three different hydraulic loads: 50, 100 and 150 L/day
5. Barrels for collection of effluent from leachate treatment

Conclusion

Planted drying beds in series appear to be a very promising technology for the solid-liquid separation of faecal sludge, and the subsequent treatment of leachate. This treatment scheme is low-cost, relatively easy to operate, and produces plants that can be sold as fodder. However, the receiving environment of the effluent needs to be carefully evaluated due to the nitrate and coliform concentrations. The next phase of this research will evaluate the use of stabilization ponds for the treatment of leachate from planted drying beds.

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Photo 1: View of the experimental setup.

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