INDEX

LANDFILL LEACHATE TREATMENT BY CONSTRUCTED WETLAND FOCUSING ON ORGANIC MATTER AND NITROGEN REMOVAL

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The waste management scenario in Brazil has been in transformation during last 6 years, mainly due to the National Policy on Solid Waste (NPSW) implemented on August 2, 2010. The NPSW prioritizes no generation, reduction, reuse and recycling, and creates directives such as the closure of existing open dumps, implementation of sanitary landfills and system integration with recycling and composting and/or incineration. Those directives incorporate the world trend concerning reduction of municipal solid waste (MSW) generation and landfilling (Deus et al., 2016). However, yet Brazil needs to improve the MSW management, eliminating environmental liabilities historically caused by landfilling, such as landfill leachate (Feijó, 2015).

To evaluate the feasibility of low-cost landfill leachate treatment by constructed wetland, a lab-scale subsurface horizontal flow system (HF-CW) consisting of two units operated in series was examined. The HF-CWs consisted of polypropylene tanks (length 0.73 m, width 0.30 m and depth 0.14 m) filled with calcareous gravel (5 mm and porosity of 49%). HF-CW planted with the tropical plant species *Heliconia psittacorum* (HP) and HF-CW unplanted (control) were monitored. The two systems were continuously fed with a hydraulic loading rate of 0.012 ± 0.004 $m^3.m^{-2}.d^{-1}$ and hydraulic retention time of 4.62 ± 1.5 d for each unit of the series (total system: of 9.25 ± 3 d).

Mean chemical oxygen demand (COD) removal for HP and control were less than 20%, due to the recalcitrance of organic matter, which was reported as an important limitation for COD removal in other studies with constructed wetlands treating landfill leachate (Vymazal, 2009). For ammonium nitrogen (NH_4^+-N), the mean global removal efficiencies with and without influent pH adjustment were, respectively, 74% and 54% for HP and 56% and 43% for control, resulting in mean concentrations between 36 and 93 $mg.L^{-1}$. NH_4^+-N removal in the aerobic surface layer creates a gradient of ammonia concentration and promotes the upward transport by diffusion of the NH_4^+-N from the lower layers (anaerobic) to aerobic zone (Wu et al. 2001). Negative exponential correlation between influent C:TKN and NH_4^+-N removal rate were observed. Thus, nitrification is hampered when wastewater presents high organic matter content in relation to nitrogen, due to bacteria competition for oxygen (Zhu et al. 2014).

In our study, the biodegradability of organic matter was pointed out as an important factor controlling the system efficiency. Directives proposed in the NPSW may change the new landfills waste composition, resulting in leachate with different biodegradability and C:N ratio, which must be considered for efficient treatment. In addition, further studies as pre-treatment for enhancement biodegradability of recalcitrant compounds should be taken into consideration for the better performance of organic matter and total nitrogen removal in HF-CW treating leachate from old landfills.

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ABSTRACT

Irrigation in Cameroon causes health and environmental problems and has economic/financial impacts for the market gardeners using treated wastewater from wetlands as a source of nutrients for agriculture. Conventional water treatment is expensive, requires advanced technology and frequent breaks down in less developed countries, hence low cost interventions are needed. In this light, the treatment of wastewater through natural products that has ecological and environmental importance is adapted because its technology is simple and accessible for the population in low-income countries compared to conventional water treatment. With the aim to implement a sustainable wastewater management approach in my urban area and regarding its population and level of economic development, field and laboratory based trials were carried out in order to investigate the effect of the natural coagulant *Moringa oleifera* seed extracts in reducing faecal indicators from faecal sludge leachate. The raw faecal sludge produced from onsite sanitation technologies like cesspools, pit latrines and septic tanks were contained, removed and transported to the study site where they were initially treated by two stage of vertical flow constructed wetlands planted with *Echinochloa pyramidalis* and each post leachate was collected for investigations. The measurement of bacteriological and some physico-chemical parameters, after three different settling times and concentrations, were used to determine the optimum conditions and assess treatment efficacy. Settling times between 60 min and 120 min with a concentration of *Moringa oleifera* seed extracts between 200 mg/L and 267 mg/L appeared sufficient to reduce faecal coliforms in the range of 78.49 – 86.39% and between 120 min and 180 min with a concentration of 200 mg/L for a removal in the range of 72.87 – 88.1% and 75.60 – 81.33% respectively for *Escherichia coli* and faecal streptococci during faecal sludge leachate post treatment. These results indicate that post-treatment of leachate from faecal sludge with *Moringa oleifera* seed extracts is in function of the

initial quality of the wastewater and also a proof that during the recycling of wastewater, *Moringa oleifera* seed extracts can aid in reducing health risks and therefore improve it although does not meet all Cameroon and WHO guidelines for safe reuse in agriculture.
Keywords: Developing countries, *Moringa oleifera*, VFCW, faecal sludge, wastewater treatment, water reuse.