

Performance of a Pilot-Scale Biofilters and Constructed Wetland with Ornamental Plants in Greywater Treatment

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Abstract: Partially treated black water from septic tanks and grey water from households in Kuching City were polluting the Sarawak River. A pilot scale ecological sanitation was implemented where blackwater was held in septic tanks and greywater was channeled to a grease trap, biofilters and a constructed wetland before discharge. The objectives of this study were to evaluate the efficiency of the biofilters and the constructed wetland with two species of terrestrial ornamental plants in greywater treatment. For the combined system, results indicated that the influent dissolved oxygen of below 1 mg/L improved to 3.4-4.6 mg/L. Removal of biochemical oxygen demand (BOD₅) and chemical oxygen demand (COD) were the highest (99 and 95%). Influent fecal coliform (FC) of 4.0×10^5 CFU/100mL dropped to 6.3×10^2 CFU/100mL at the effluent. More than 80% of ammonia-nitrogen (NH₄-N), total nitrogen (TN) and total suspended solids (TSS) were removed. Reactive phosphorus (RP) and total phosphorus (TP) removals were 64 and 61% respectively. The biofilters contributed most of the total removal of BOD₅, COD, FC and NH₄-N. However, the wetland and biofilters were equally efficient in TSS removal. The removal efficiency of the wetland in decreasing order was NO₃-N > FC > TSS > BOD₅ > TN > COD > NH₄-N > RP > TP and all removals exceeded 55% with the exception of P (38-39%). Both species of plants grown on the wetland contained significantly higher weight and P content than the control. Tissue P content of *F. microcarpa* was significantly higher than *S. campanulatum* indicating *F. microcarpa* as a better accumulator of P. This indicates that constructed wetland with *F. microcarpa* could be potentially implemented in urban housing areas to reduce river pollution.

Key words: Household wastewater • Constructed wetland • Biofilter • Grey water • Ornamental plants

INTRODUCTION

With 21% of the 2.2 million population of Sarawak State concentrated in Kuching City, treatment of wastewater from households is a challenge. Partially treated black water from septic tanks and grey water were discharged into storm water drains and subsequently into the rivers. It was reported that the main pollution source of the Sarawak River, running through the city, was the discharge from households [1].

Implementing a centralized wastewater treatment system in our cities would be expensive due to construction and maintenance. On the other hand, biological methods are regarded as economical in terms of construction and running and less polluting [2]. Therefore, the option of an urban ecological sanitation (EcoSan) was explored by the Sarawak State Government.

EcoSan is a cycle-a sustainable, closed-loop system, which closes the gap between sanitation and agriculture and thus it involves separating excreta at source and recycling of the nutrients [3]. A comparative life cycle assessment of an EcoSan was carried out for an office building by comparing it with conventional systems and it was reported to reduce contribution to ecosystem quality damage by more than 60% and also found to be a promising alternative small scale wastewater treatment system [4]. In this type of sanitation, human excreta are treated as a resource and are sanitized before being recycled as fertilizer. The grey water from kitchens, baths and laundries, though not mixed with the toilet water, has to be treated before being reused. Since most residential areas have a park area allocated for recreation, the treatment system could be constructed in the park. Thus, a pilot project of EcoSan was implemented at Hui