Nitrogen and Phosphorus removal from waste water using vertical flow constructed wetlands

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Abstract

The cost for the modern waste water treatment plants are a challenge for developing countries like Sri Lanka. Currently, very low attention is paid on wastewater management in Sri Lanka. Therefore, it is essential to introduce low cost effective methods for wastewater treatment. Purification of water by using different types of plants is not a new technique in Sri Lanka. In ancient times, wetland plants were used for the purification of tank water in dry zone areas. But this system ceased due to modern technology. Hence, this study was initiated to investigate the efficiency of vertical flow wetland systems (a planted filter bed that is drained at the bottom) developed with locally available macrophytes and substrate materials in removing of nutrients from municipal wastewater. Four laboratory scale vertical flow constructed wetland (CW) units were employed and total bed media thickness for all the wetlands were maintained with dissimilar layer of different bed materials. Two sets of wetlands were set up using sand/charcoal/gravel filtration media with and without macrophytes (*Cyperus* spp. in Cyperaceae family) while the other two sets of wetland was set up using sand/gravel filtration media with and without *Cyperus* spp. Of these, two were treatments while the other two were replicates. Results showed high removal efficiency for total nitrogen (60%), nitrate (52%) and phosphate (95.6%) by the charcoal based wetland with *Cyperus* spp compared to unplanted charcoal based wetland, unplanted and planted sand gravel filtration media of wetlands. Higher biomass production and nutrient uptake contribution was seen in *Cyperus* planted charcoal based wetland than the wetland with sand gravel media. Total nitrogen (36.0 mgg^{-1}) and phosphorus (5.99 mgg^{-1}) removed from plant in charcoal based wetland was 20% higher than the plant in sand gravel media. Nitrogen uptake was high in plant root (90.2%) and phosphorus accumulation was high in shoot (90.4%) of the plant. Further, results indicated that the charcoal filtration media has high efficiency (48%) of removing nitrogen and phosphorus than the sand gravel filtration media (27.5%). Findings from this study demonstrated the capability of high phosphorus and nitrogen removal from inflow water by the vertical flow wetland and the importance of hydraulic regime to wetland performance.

Keywords: *Constructed wetland, Cyperus spp, Filtration, Nitrogen, Phosphorus*

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