

Treatment of Wastewater by Constructed Wetland Eco-Technology: Plant Species Alters the Performance and the Enrichment of Bacteria

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Abstract : Constructed wetland systems are eco-technology recognized as environmentally friendly and emerging innovative solutions remediation as these systems are cost-effective and sustainable wastewater treatment systems. The performance of these biological system is affected by various factors such as plant, substrate, wastewater type, hydraulic loading rate, hydraulic retention time, water depth, and operation mood. The objective of this study was to assess the alters of plant species on pollutants reduction and enrichment of anammox and nitrifying denitrifying bacteria in a modified vertical flow (VFCW) constructed wetland. This tests were carried out using three modified vertical constructed wetlands with a surface of 0.23 m² and depth 80 cm. It was a saturated vertical constructed wetland at the bottom. The saturation zone is maintained by the siphon structure at the outlet. The VFCW (1) system was unplanted, VFCW (2) planted with *Typha angustifolia*, and VFCW(3) planted with *Phragmites australis*. The experimental units were fed with domestic wastewater and were operated by batch mode during 8 months at an average hydraulic loading rate around 20 cm day⁻¹. The operation cycle was two days feeding and five days rest. Results indicated that plants presence improved the removal efficiency; the removal rates of organic matter (85.1-90.9%; COD and 81.8-88.9%; BOD₅), nitrogen (54.2-73%; NTK and 66-77%; NH₄ -N) were higher by 10.7-30.1% compared to the unplanted vertical constructed wetland. On the other hand, the plant species had no significant effect on removal efficiency of COD, The removal of COD was similar in VFCW (2) and VFCW (3) ($p > 0.05$), attaining average removal efficiencies of 88.7% and 85.2%, respectively. Whereas it had a significant effect on NTK removal ($p > 0.05$), with an average removal rate of 72% versus 51% for VFCW (2) and VFCW (3), respectively. Among the three sets of vertical flow constructed wetlands, the VFCW(2) removed the highest percent of total streptococcus, fecal streptococcus total coliforms, fecal coliforms, *E. coli* as 59, 62, 52, 63, and 58%, respectively. The presence and the plant species alters the community composition and abundance of the bacteria. The abundance of bacteria in the planted wetland was much higher than that in the unplanted one. VFCW(3) had the highest relative abundance of nitrifying bacteria such as *Nitrosospira* (18%), *Nitrosospira* (12%), and *Nitrobacter* (8%). Whereas the vertical constructed wetland planted with *typha* had larger number of denitrifying species, with relative abundances of *Aeromonas* (13%), *Paracoccus* (11%), *Thauera* (7%), and *Thiobacillus* (6%). However, the abundance of nitrifying bacteria was very lower in this system than VFCW(2). Interestingly, the presence of *Thypha angustifolia* species favored the enrichment of anammox bacteria compared to unplanted system and system planted with *phragmites australis*. The results showed that the middle layer had the most accumulation of anammox bacteria, which the anaerobic condition is better and the root system is moderate. Vegetation has several characteristics that make it an essential component of wetlands, but its exact effects are complex and debated.

Keywords : wastewater, constructed wetland, anammox, removal

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