Performance of a constructed floating wetland in mesocosm scale: nutrient removal under shock load and water level oscillation

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Constructed Floating Wetland (CFW) has shown a high capacity to transform, recycle, retain and remove different types of pollutants, especially nutrients. A CFW was developed in mesocosms at the Institute of Hydraulic Research at the Federal University of Rio Grande do Sul, Brazil, in order to evaluate the functionality of the system on treating synthetic effluent with nutrient concentrations simulating urban surface runoff. Two species of emergent macrophytes, *Typha domingensis* Pers. and *Schoenoplectus californicus* were employed. The CFW was evaluated under changes in nutrient concentration and water level during two subsequent experiments, identified as “shock load” in order to simulate extreme rain events, accidental spills of pollutants or illegal discharges that are common in drainage systems and urban rivers worldwide. Comparative evaluations between species and the system responses were evaluated in different hydraulic retention time (HRT). The system was exposed to 24 h of HRT, with 20 cm of water level and 1.8 mg/L of TP, 4.9 mg/L of TN (mean concentration). After sampling, the tanks were filled to 40 cm, with 3.0 mg/L of TP and 13.8 mg/L of TN concentration. Samples were collected within 2 and 4 h to quantify the system’s response to shock-load. After sampling, the level was reduced to 20 cm, followed by exposure for the remaining 6 days, when final samples were collected. Temperature, conductivity, dissolved oxygen and redox potential were measured *in situ*. Turbidity, color and pH was measured immediately after collection in the laboratory. Total phosphorus (TP), orthophosphate (PO$_4^{3-}$), total nitrogen (TN), total organic carbon (TOC), chlorophyll-a and pheophytin were also quantified. Only orthophosphate presented significant differences between initial and final concentrations, after the first 24h (F = 6.106, df = 1, p = 0.024). The shock load demonstrated significant differences between initial and final concentrations for TN (F = 10.097, df = 1, p = 0.005), for TP (F = 9.392, df = 1, p = 0.0067) and for TOC (F = 9.817, df = 1, p = 0.005). As to final batch, significant differences between input shock load and output values were found for TN (F = 103.45, df = 1, p < 0.001), for TP (F = 7.584, df = 1, p = 0.0067), for PO$_4^{3-}$ (F = 6.864, df = 1, p = 0.017) and for TOC (F = 73.608, df = 1, p < 0.001). After 6 days, average removal rates for TN were about 28% for *S. californicus* and 87% for *T. domingensis*, for TP such removals were 29% and 55%, respectively. *T. domingensis* superior root development in association with the biofilm in the rhizosphere of the plants, were responsible for the best efficiency. The results show evidence of the benefits related to the ecosystem service associated with the CFW built in mesocosms. The understanding of the performance of compensatory techniques in controlled situations represents an indispensable tool for the knowledge of the
limitations and the consequent technical improvement necessary for the feasibility of implementing nature-based solutions as the CFW.