Modelling Nitrogen Transformation in Horizontal Subsurface Flow Constructed Wetlands Planted with Phragmites Mauritianus

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Abstract

A mathematical model was developed to permit dynamic simulation of nitrogen interaction in a pilot horizontal subsurface flow constructed wetland receiving effluents from primary facultative pond. The system was planted with Phragmites mauritianus, which was provided with root zone depth of 75 cm. The root zone was packed with gravel of 6 to 25 mm diameter in uniform proportions. Stella II software was used to simulate nitrogen transformation processes. The results show that the most influential nitrogen transformation processes were nitrification, denitrification, plant uptake, decomposition and accretion of organic nitrogen. Volatilisation played a negligible role in reducing nitrogen at the typically neutral pH levels found in subsurface wetland systems. Denitrification process, which ensures the permanent removal of nitrogen, accounted for 0.219 $g/m^2.d$, which was only 15.0% of incoming nitrogen load (1.458 $gN/m^2.d$). Harvesting of plants removed 0.195 gN/m2.d (13.4%) from the system. Accretion of organic nitrogen was a major pathway accounting for 0.279 $g/m^2.d$, which is 19.2% of all the influent nitrogen. The accumulation of ammonia nitrogen was found to be high compared to other water phase state variables (organic nitrogen and nitrate nitrogen).