Nitrogen Transformation in Horizontal Subsurface Flow Constructed Wetlands II: Effect of Biofilm

Author(s)
T. Bigambo, A.W. Mayo,

Abstract

In this paper the significance of the biofilm biomass present in horizontal subsurface flow constructed wetland in removal of nitrogen was demonstrated. The model was developed and optimised using data obtained in a horizontal subsurface flow constructed wetland planted with *Phragmites mauritianus* and filled with 6–25 mm diameter gravel pack. The effects of biofilm biomass activities were studied by removing the effects of plant and gravel bed biofilm in an already calibrated model and re-run the same.

Research results indicate that total nitrogen removal was largely influenced by growth of biofilm on plants than on aggregates. When plant biofilm and suspended biomasses were considered total nitrogen removal of 38.1% was observed compared with 25.1% when aggregate-biofilm and suspended biomasses were considered because plants have more surface areas, which are active sites for the effective biofilm activities than aggregates. However, in a natural wetland where the soil grain size is smaller, the effect of biofilm on plants may be smaller than biofilm on soil particles.

There was no significant difference in organic-nitrogen effluent concentrations when biofilm biomass was considered or rejected. The averages in organic-nitrogen effluent concentrations were 0.39, 0.41 and 0.53 gN/m^2 for suspended alone, aggregate-biofilm and suspended; and suspended and plant-biofilm, respectively. This indicates that the removal of organic-nitrogen in wastewater is not significantly influenced by biofilm activities. Sedimentation and mineralization processes are the major factors influencing the concentration of organic-nitrogen in the effluent.

On the other hand, biofilm activities had significant influence on ammonia–nitrogen and nitrate–nitrogen transformation. The developed model output indicates that the effluent ammonia concentration was 2 gN/m^2, but in absence of biofilm the effluent ammonia concentration increases to 3.5 gN/m^2. Statistical analysis indicates that the mean average nitrogen–nitrogen in the effluent was 0.71 gN/m^2 when aggregate-biofilm was considered, but increased to 0.83 gN/m^2 when it was not considered.

Keywords

Constructed wetlands biofilm;
Nitrogen transformation;
Nitrogen removal