Effect of Diffusional Mass Transfer on the Performance of Horizontal Subsurface Flow Constructed Wetlands in Tropical Climate Conditions.

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Abstract

The effect of mass transfer on the removal rate constants of BOD₅, NH₃, NO₃ and TKN has been investigated in a Horizontal Subsurface Flow Constructed Wetland (HSSFCW) planted with Phragmites mauritianus. The plug flow model was assumed and the inlet and outlet concentrations were used to determine the observed removal rate constants. Mass transfer effects were studied by assessing the influence of interstitial velocity on pollutant removal rates in CW cells of different widths. The flow velocities varied between 3-46 m/d. Results indicate that the observed removal rate constants are highly influenced by the flow velocity. Correlation of dimensionless groups namely Reynolds Number (Re), Sherwood Number (Sh) and Schmidt Number (Sc) were applied and log-log plots of rate constants against velocity yielded straight lines with values β = 0.87 for BOD₅, 1.88 for NH₃, 1.20 for NO₃ and 0.94 for TKN. The correlation matched the expected for packed beds although the constant β was higher than expected for low Reynolds numbers. These results indicate that the design values of rate constants used to size wetlands are influenced by flow velocity. This paper suggests the incorporation of mass transfer into CW design procedures in order to improve the performance of CW systems and reduce land requirements.