Enzyme activities in pilot-scale constructed wetlands for treating urban runoff in China: temporal and spatial variations

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Received 13 January 2014; Accepted 7 September 2014

\textbf{ABSTRACT}

Two pilot-scale integrated constructed wetland (ICW) systems were constructed to assess the feasibility of treating urban runoff in Hefei, P.R. China. Each ICW consisted of a down-flow chamber (50 m\textsuperscript{2}, planted with \textit{Canna indica}), an up-flow chamber (50 m\textsuperscript{2}, planted with \textit{Iris pseudacorus}), and a horizontal subsurface-flow chamber (50 m\textsuperscript{2}, planted with \textit{Acorus calamus}) in series. Substrate enzyme activities, growth of vegetation, and contaminant removal efficiencies were monitored during a one-year period. These two systems, achieved an average efficiency of 64.8\% for total phosphorus (TP), 59.6\% for total nitrogen (TN), 52.7\% for ammonium (NH\textsubscript{4}\textsuperscript{+}-N), and 72.7\% for chemical oxygen demand (COD). There were significant correlations between the phosphatase (PP) activity and the removal efficiencies of TP and COD, as well as between the urease (UR) activity and TN removal. The activities of both nitrate reductase (NR) and PP were the highest in down-flow chamber (DFC), and then in up-flow chamber (UFC) and horizontal subsurface-flow chamber (HFC), successively. Meanwhile, the maximum enzyme activities of DFC and UFC occurred in summer or autumn when plants were in the vigorous growing stage. Furthermore, the enzyme activities of both PP and UR were significantly correlated with all growth parameters of \textit{C. indica} in DFC. Significant correlations existed between the root number of \textit{I. pseudacorus}, and PP and UR activities in UFC. In HFC, there were no significant correlations between the enzyme activities (PP, UR, and NR) and all growth parameters of \textit{A. calamus}.

\textbf{Keywords:} Pilot-scale constructed wetland; Plant growth; Removal efficiency; Substrate enzyme activity; Urban runoff

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