Column experiments for nitrate attenuation in groundwater using reed and bamboo chips in phosphorus restrictions environment

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Nitrate pollution of groundwater is one of the environmental issues in the world. Wetland and riparian zone play a very important role on removing nitrate from groundwater through denitrification where denitrifying bacteria reduce nitrate to nitrogen gas. In past decades, such natural attenuation has been enhanced in a low cost by using wood chips as the carbon sources available for denitrifying bacteria. However, its performance depends on largely on phosphorous that is an indispensable element of organisms and plays an important role in biological metabolism. Phosphorous concentration is often limited in groundwater even those polluted by nitrate under the natural condition.
In order to study the effect of phosphorous on denitrification efficiency, column experiments have been conducted by using reed or bamboo chips as denitrification materials. It was found that the NO_3-N removal efficiencies decreased from 86.1% to 61.6% for reed and from 73.6% to 37.0% for bamboo when the phosphate-P concentration of influents declined from 0.4 mg/L to 0.04 mg/L. In addition, NO_2-N concentration was detected high in the effluent from the column filled with bamboo chips when the phosphate-P concentration was low. NO_3-N removal rate was estimated by the Michaelis-Menten equation. The half-saturation constant for phosphate-P concentration was 0.03 mg/L for reed and 0.09 mg/L for bamboo, indicating that phosphorous is the key to control NO_3-N removal rate. Therefore, the NO_3-N removal rate in groundwater with plant chips can be expected high when N/P ratio is around 100.

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