EFFECT OF COLLOIDS ON CONTAMINANT TRANSPORT IN RIVERBANK FILTRATION

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Abstract

Riverbank filtration is a natural process, using alluvial aquifers to remove contaminants and pathogens in river water for the production of drinking water. In Korea, most of the drinking water is supplied by surface water in-take. However, maintaining the quality of the drinking water becomes more difficult due to the increase of contamination sources. Central and local governments are considering riverbank filtration as an alternative. In riverbank filtration, the understanding of contaminant transport is an important task for the production of high quality drinking water.

In this study, the transport behavior of hydrophobic organic contaminants is investigated in riverbank filtration where contaminants are present simultaneously with dissolved organic matter (DOM) and bacteria. A mathematical model for the transport of hydrophobic organic contaminants based on mass balance is developed to describe the fate of biodegradable contaminant. In the developed model, the aquifer is thought of as a four phase system: two mobile colloidal phases, an aqueous phase, and a stationary solid matrix phase. An equilibrium approach is used to represent the mass transfer mechanism of contaminant with DOM, bacteria, and solid matrix. The model equations are solved numerically for various situations.

Results show that in the riverbank filtration the presence of DOM and bacteria can enhance the mobility of contaminant significantly (see Fig.1). It means that the colloidal materials in riverbank filtration behave as a carrier and induce the phenomenon of pollutant acceleration by reducing the retardation factor. Sensitivity analysis indicates that the distribution of the total aqueous phase contaminants is significantly affected by distribution coefficients accounting for affinity of solid or colloidal phase to contaminant. Especially, the equilibrium partitioning coefficients K_1^+, K_2^+, K_3^+, affinity to soil, colloids, and bacteria respectively, turn out to be crucial to the transport of hydrophobic organic contaminants (Fig. 2).

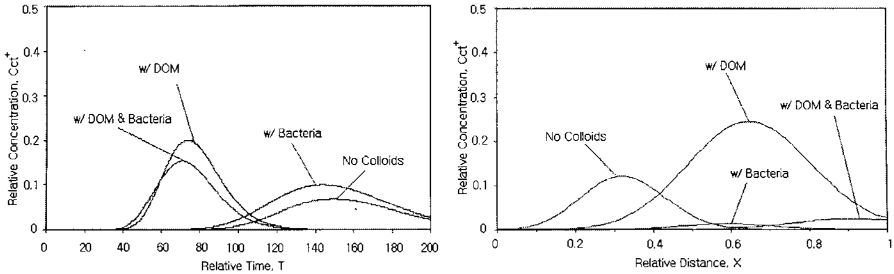

Fig. 1 Exit concentration and spatial distribution of pollutant.

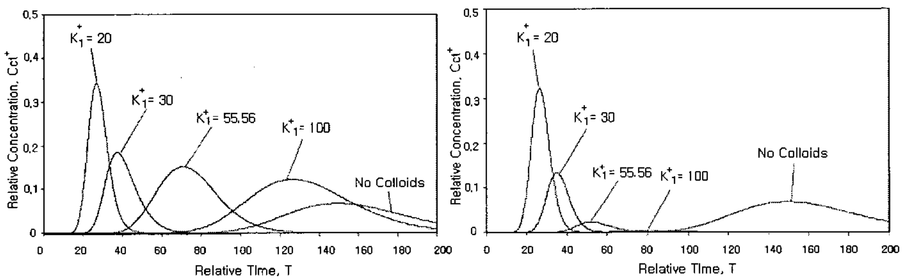

Fig. 2 The influence of partitioning between water and solid-state (K_1^+): Temporary and continuous inflow of bacteria.