

Cotransport of clay colloids and viruses through both horizontal and vertical water-saturated columns: Downward and Upward flows

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Abstract

The cotransport of clay colloids and viruses in laboratory packed columns, in both horizontal (H) and vertical (V) orientations, was investigated. Bacteriophages MS2 and Φ X174 were used as model viruses, kaolinite (KGa-1b) and montmorillonite (STx-1b) as model clay colloids. A steady flow rate of $Q=1.5$ mL/min was applied in horizontal, vertical upward (VU) and downward (VD) directions. For the most cases examined, estimated mass recovery values were higher in VD than VU flows suggesting that flow direction has a significant influence on the particle deposition. For all transport experiments, slight enhancement was observed for both viruses and clay colloids except the case of the VU and VD flows of Φ X174 and STx-1b. Mass recovery values for both viruses, calculated based on total virus concentration in the effluent, were reduced compared to those in the absence of clays. In the presence of KGa-1b, at H and VD flow directions, clay colloids hindered the transport of Φ X174 while in the presence of STx-1b at all flows (H, VU, VD), the presence of clay colloids facilitated the transport of Φ X174. Moreover, both clays hinder MS2 in all cases examined except VU and VD flow directions in the presence of STx-1b.

Keywords: viruses, Φ X174, MS2, clay minerals, KGa-1b, STx-1b, cotransport, flow direction