

2012 Darcy Lecture Series in Ground Water Science

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Transport of Viruses in Partially Saturated Soil and Groundwater

Abstract. Surface water is often used for recharge of aquifers used in drinking water production. But it can be contaminated with pathogenic microorganisms and viruses from wastewater discharges or manure runoff. These pathogens have to be removed to produce safe drinking water such as passing surface water through soil. However, to assure production of safe drinking water from surface water, adequate travel times and travel distances are needed. In this regard, it is important to determine various factors that affect the rate of removal of pathogenic viruses during soil passage. These factors include hydraulic conditions (such as flow velocity and saturation) and geochemical conditions (pH, ionic strength, concentration of calcium). In this lecture, we will:

- Present the results of a large number of laboratory and field experiments involving bacteriophages (viruses affecting bacteria), which were carried out under a variety of conditions under steady-state flow settings.
- Show how the data from the experiments was used to derive (empirical) relationships between removal rate coefficients and geochemical conditions as well as saturation.
- Explain how in the case of unsaturated flow, the role of air/water interfaces in the removal of viruses was also investigated.
- Present findings from experiments performed under transient flow conditions where saturation has been changed significantly.
- Show how the experiments, as well as other researchers' results, have demonstrated that both drainage and imbibition fronts cause a remobilization of adsorbed viruses.
- Discuss the mechanisms behind this remobilization.

Provide evidence from pore-scale visualization experiments performed in a micromodel.

¹ <http://www.ngwa.org/Foundation/darcy/Pages/Current-Darcy-Lecturer.aspx>