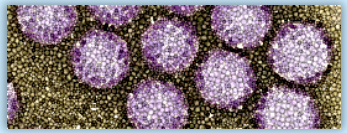
Transport of human adenoviruses in water saturated laboratory columns

Kokkinos Petros[1], Tselepi Maria[1], Syngouna Vasiliki[2], Chrysikopoulos Constantinos[2,3], Vantarakis Apostolos[1]

[1] Environmental Microbiology Unit, Department of Public Health, School of Medicine, University of Patras, 26504 Patras, Greece
[2] Department of Civil Engineering, Environmental Engineering Laboratory, University of Patras, 26504 Patras, Greece
[3] School of Environmental Engineering, Technical University of Crete, Chania 73100, Greece



4th International Conference on Food and Environmental Virology, 2-5 September, Corfu town, Greece

Introduction – Aim of the study

- Groundwater may be contaminated with infective human enteric viruses from human and animal sewage through wastewater discharges, sanitary landfills, septic tanks, and agricultural practices or by artificial groundwater recharge.
- Coliphages (e.g. MS2 and ΦX174) have been widely used under well-controlled environmental conditions as valuable models or surrogates for enteric viruses because they share many fundamental properties and features such as structure, composition, morphology and size.
- Although a large number of studies focusing on various factors (i.e. pore water solution chemistry, fluid velocity, moisture content, temperature and grain size) that affect biocolloid (bacteria, viruses) transport have been published over the past two decades, little attention has been shown toward human adenoviruses (hAdVs).
- **The main objective of this study was to evaluate the effect of pore water velocity on hAdVs transport in water saturated laboratory-scale columns packed with clean glass beads.**

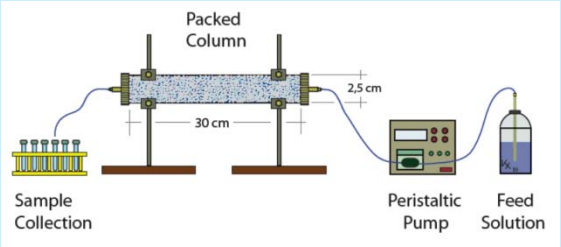


Fig. 1. Schematic illustration of the experimental apparatus.

Materials and Methods

- Glass beads were used for the packing of the columns in order to eliminate possible experimental difficulties associated with real soil, which may provide numerous uncertainties that can considerably complicate the analysis of the experimental data.
- All flow-through experiments were conducted using a 30 cm long glass column with 2.5 cm diameter, which was packed with 2 mm diameter glass beads. The porosity of the glass beads column was determined by standard gravimetric procedures.
- Prior to each experiment, the packed column was equilibrated by pumping 10 pore volumes of the background solution through the column at a constant volumetric discharge rate of Q=2.5, and 1.5 mL/min, corresponding to specific discharge or approach velocities of q=0.51, and 0.31 cm/min and pore water velocities of $U=q/\theta=1.21$ and 0.75 cm/min, respectively.
- A suspension of each hAdV of the same background solution was pumped for 3 pore volumes at the same Q followed by 3 pore volumes of hAdV-free solution. All experiments were carried out at room temperature (~25 ◦C).
- Adenovirus 35 was used for the transfer experiments. A qPCR assay using the primers and conditions described by Hernroth et al. (2002), and a carryover contamination prevention system utilising uracil N-glycosylase was used for AdV detection and quantification.

Fig. 2. Photographic illustration of the experimental setup.

Results

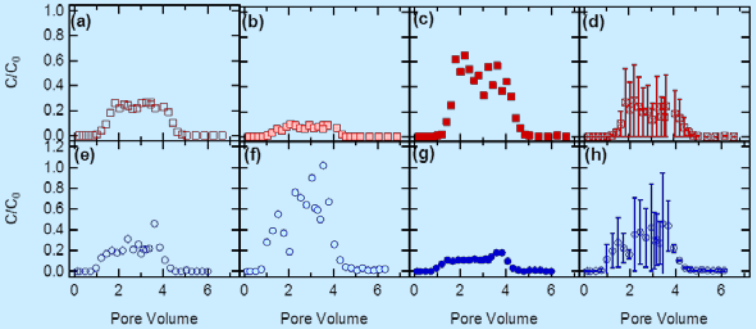


Fig. 3. Experimental hAdV breakthrough data for volumetric flow rates q of 0.51 cm/min (squares-a,b,c), and 0.31 cm/min (circles-e,f,g) in water-saturated columns packed with glass beads and average breakthrough concentration data (d, h) for q equal to 0.51 and 0.31 cm/min, respectively.

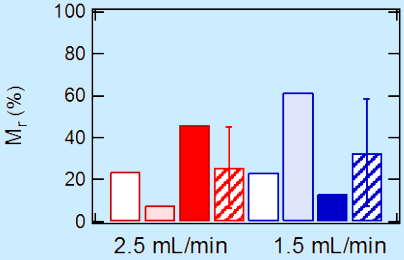


Fig. 4. Calculated mass recovery values, M_r (%) based on hAdV virus concentrations in the effluent, from the transport experiments with Q equal to: (a) 2.5 mL/min, (b) 1.5 mL/min. The cross shaded columns are the average M_r (%) values of three flow through experiments under identical conditions.

Conclusions

- The average mass recovery values of the hAdVs were 25.89±19.4 % and 32.82±25.56% for Q equal to 2.5 mL/min and 1.5 mL/min, respectively.
- No obvious relationships between mass recoveries of the hAdVs, calculated based on hAdV concentration in the effluent and water velocity could be established from the experimental results.
- The collision efficiencies were quantified using the classical colloid filtration theory.
- No significant effect of U on the collision efficiency was observed.

References

- Hernroth BE, Conden-Hansson AC, Rehnstam-Holm AS, Girones R, Allard AK (2002) Appl Environ Microbiol 68:4523
- Syngouna VI, Chrysikopoulos CV (2012) J Contam Hydrol 129-130:10
- Syngouna VI, Chrysikopoulos CV (2013) Colloid Surface Physicochem Eng Aspect 416 56-65

This research has been co-financed by the European Union (European Social Fund-ESF) and Greek National Funds through the Operational program "Education and Lifelong Learning" under the action Aristeia I (Code No. 1185). This work is a collaboration between members of the BioMet Network.