Interaction between human adenoviruses and clays in static and dynamic batch systems

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Viruses in natural water and wastewaters are frequently found attached onto sand, clays, bacterial cells, naturally occuring suspended colloids, sludge paticles, and estuarine silts and sediments suspended. Moreover, clays minerals have been reported to affect the growth and metabolic activity of viruses [1]. Among waterborne viruses, human adenoviruses (HAdV) are nowadays described emerging pathogens and are considered to be highly resistant in water. High quantities of adenovirus DNA were recently detected in polluted surface waters, and this genetic marker seems to be a very long-lasting indicator of fecal pollution in surface waters. Netherless, there is still a significant lack of data on the occurence and persistence of these viruses in grandwater [2]. Because of the potential public health risk caused by HAdV and the luck of understanding of ist transport behavior, the objective of this study was to investigate the survival of HAdV in clay particles.

The clays used as a model were crystalline aluminosilicates: kaolinite and bentonite. The survival of HAdVs onto these clays was characterized at two different controlled temperatures (4 and 25^{o} C) under static and dynamic batch conditions. Control tubes, in the absence of clay, were used to monitor virus inactivation due to factors other than adsorption to clays (e.g. inactivation or sorption onto the tubes walls). The batch equilibration method used consists of adding a virus stock solution into 2 ml centrifuge tube containing 0.02 gr of the clay at a concentration of 10 mg clay per ml. Controls containing only viruses and suspended clay particls were used to monitor virus inactivation, virus sorption to the centrifuge tube and PCR inhibition due to suspended clay particles. For both static and dynamic batch experiments, samples were collected every 24 hours for a period of seven days and centrifuged at 3000 xg for 5 minutes. This seven day time – period was determined to be sufficient for the virus-clay systems to reach equilibrium. To infer the presence of infectious HAdV particles, all samples (aquatic) were treated with Dnase and the extraction of viral nucleid acid was performed using a commercial viral RNA kit. All samples were analyzed by Real – Time PCR which was used to quantify viral particles in clays.

Exposure time intervals in the range of seven days (0.50-144 hours) resulted in a load reduction of 0.74 to 2.96 logs for kaolinite and a reduction of 0.89 to 2.92 for bentonite in dynamic batches, while a reduction of 1.66 to 2.75 logs for kaolonite and 3.57 to 4.29 for bentonite was recorded in static batches. Furthermore, virus survival was higher onto bentonite than kaolinite. The experimental results of this work indicate that viruses were systematically more persistent at 4^{o} C than at 25^{o} C onto both clays. For the most of the samples examined, the adsorption of HAdV onto both clays increase with increasing time and it is higher in dynamic experiments, because the number of accessible sites for attachment is higher. Agitation improves the contact of particles with the liquid and decreases the resistance to mass transfer.

Keywords: Human Adenovirus; clays; survival

References

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