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Porous media augmented with biochar for the retention of E. coli

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A significant number of epidemic outbreaks has been attributed to waterborne fecal-borne pathogenic microorganisms from contaminated ground water. The transport of pathogenic microorganisms in groundwater is controlled by physical and chemical soil properties like soil structure, texture, percent water saturation, soil ionic strength, pore-size distribution, soil and solution pH, soil surface charge, and concentration of organic carbon in solution. Biochar can increase soil productivity by improving both chemical and physical soil properties. The mixing of biochar into soils may stimulate microbial population and activate dormant soil microorganisms. Furthermore, the application of biochar into soil affects the mobility of microorganisms by altering the physical and chemical properties of the soil, and by retaining the microorganisms on the biochar surface.

The aim of this study was to investigate the effect of biochar mixing into soil on the transport of Escherichia coli in saturated porous media. Initially, batch experiments were conducted at two different ionic strengths (1 and 150 mM KCl) and at varying E. coli concentrations in order to evaluate the retention of E. coli on biochar in aqueous solutions. Kinetic analysis was conducted, and three isotherm models were employed to analyze the experimental data. Column experiments were also conducted in saturated sand columns augmented with different biochar contents, in order to examine the effect of biochar on the retention of E. coli. The Langmuir model fitted better the retention experimental data, compared to Freundlich and Tempkin models. The retention of E. coli was enhanced at lower ionic strength. Finally, biochar-augmented sand columns were more capable in retaining E. coli than pure sand columns.