H2Oh No: Pharmaceuticals Contaminate Groundwater! Sulfamethazine Adsorption Isotherms and Kinetics with Hypercrosslinked Polymer MN250 in Acid and Alkaline Environments

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Four hundred tons of sulfamethazine are fed to livestock annually in North America to prevent disease and promote growth, but most of the drug is excreted unmetabolized into the environment. Due to slow degradation and high soil mobility, sulfamethazine contaminates groundwater supplies and causes aquatic ecosystem damage. Current water treatment methods to remove sulfamethazine are not universally effective and have considerable limitations, which necessitate newer remediation techniques. Hypercrosslinked polystyrene adsorbents show promise because of high surface areas, high mechanical strength, and regenerable properties. Using batch adsorption techniques, this study compared the capacity and rate of sulfamethazine adsorption onto Purolite hypercrosslinked adsorbent MN250 in simulated groundwater at pH 5, 7, and 9. The adsorption capacity of MN250 for sulfamethazine (Qe) generally increased with decreasing pH. Over the same range of equilibrium sulfamethazine concentrations, Qe values at pH 5 were 20 to 30% higher than pH 7 and 51 to 62% higher than Qe values at pH 9. At pH 5, the maximum Qe was 128.3 mg/g (Ce = 14.3 mg/L) whereas the maximum capacity at pH 9 was 80.33 mg/g (Ce = 16.7 mg/L). The adsorption kinetics displayed prolonged adsorption over 120 to 144 hours and were best described by Ho’s pseudo-second order model. Overall, MN250’s adsorption capacity for sulfamethazine is pH dependent because both the ionic distribution of sulfamethazine molecules and the zeta potential of MN250 vary as a function of solution pH. MN250’s high capacity for sulfamethazine adsorption across a wide pH range highlights its potential for groundwater remediation.

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