H2Oh No: Pharmaceuticals Contaminate Groundwater! Sulfamethazine Adsorption onto Hypercrosslinked Polymer MN250 with Dissolved Humic Acid

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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 and causes aquatic ecosystem damage. Current treatment methods are not universally effective, necessitating 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 investigated the capacity (Qe) and rate of sulfamethazine adsorption at pH 7 onto Purolite hypercrosslinked adsorbent MN250 in the presence of 4.04 mg C/L of dissolved humic acid and compared it to Qe in deionized water and with common groundwater ions. MN250 had a maximum Qe of 170.2, 158.0, and 144.0 mg/g with humic acid, deionized water, and groundwater ions, respectively, best fit to the Langmuir model. Groundwater ions decreased sulfamethazine’s activity coefficient owing to the shielding effect of neighboring ions and/or electric double layer phenomena, decreasing Qe by 15% and reducing the 6 to 24 hour adsorption rate by 48%. Equilibration required between 120 to 168 hours, best fit with Ho’s model. Humic acid likely acts as a carrier for sulfamethazine onto MN250 and/or causes network expansion causing 8% increased Qe compared to deionized water. The maximum humic acid adsorption capacity onto MN250 was 3.35 mg C/g, equilibrating at 24 hours. MN250’s high capacity for sulfamethazine with dissolved humic acid, a common groundwater constituent, demonstrates high potential for groundwater remediation.