H2Oh No: Pharmaceuticals Contaminate Groundwater! Sulfamethazine Adsorption Isotherms and Kinetics with Hypercrosslinked Polymer MN250 at Varying Ionic Strengths

Grimmett, Maria

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 treatment methods to remove sulfamethazine are not universally effective, 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 under conditions of varying ionic strength (KCL ranging from 0.005 to 0.5M). The maximum adsorption capacity of MN250 for sulfamethazine (Qe) was 181.00 mg/g in 0.005M KCl solution, which decreased by 34% in 0.05M KCL. In 0.5M KCl, the maximum Qe value (153.4 mg/g) increased by 26% over MN250's capacity in 0.05M KCl. The adsorption kinetics displayed prolonged adsorption over 144 to 168 hours at all concentrations, best fitting Ho's pseudo-second order model. The decrease in capacity and kinetics from 0.005 to 0.05M KCL is likely due to potassium and chloride ions interacting with MN250's adsorption sites and electric double layer phenomena, which decrease the activity of the sulfamethazine molecule. At ionic strengths simulating seawater (0.5M), salting-out phenomena likely decreases sulfamethazine's solubility, which acts as an additional driving force for sulfamethazine adsorption onto MN250. MN250's high capacity for sulfamethazine adsorption across a wide range of ionic strengths highlights its potential for groundwater remediation.

Awards Won:
Third Award of $1,000
King Abdulaziz &amp
his Companions Foundation for Giftedness and Creativity: $1,000 will be awarded to the winner's school.