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Comparative Adsorption Experiments for Groundwater Flux Measurement: Evaluating Polysulfone and Polysulfone-Activated Carbon Carriers

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Improving the accuracy and applicability of groundwater flux measurements is critical for the sustainable management of groundwater resources, particularly at the Terrestrial-Aquatic Interface (TAI), where porous media can promote high-velocity water exchange due to the interaction of groundwater and surface water. The passive fluxmeter (PFM), designed for *in situ* measurement of groundwater flux, consists of carriers adsorbed with alcohol tracers of varying retardation factors. Despite PFMs offering low-cost production and long-term monitoring capabilities, their current designs are limited by a measurable flow velocity range of < 11 m/day. This study aimed to address these limitations by comparing the adsorption mechanisms and efficiencies of polysulfone (P) and polysulfone (90%)-activated carbon (10%) composite (C) carriers. Carriers of two sizes, 3 mm (P-3, C-3) and 5 mm (P-5, C-5), were produced to investigate the impact of carrier size on adsorption efficiency, using 1-Hexanol at concentrations of 0, 10, 25, 50, and 70 mg/L as the alcohol tracer. The Freundlich model (R^2 > 0.99) effectively described the adsorption behavior of 1-Hexanol on both carrier types, indicating that physical adsorption predominates due to the carriers having a large surface area. The 3 mm carriers (P-3 = 99%, C-3 = 98.9%) showed significantly greater adsorption efficiency than the 5 mm carriers (P-5 = 38%, C-5 = 7.3%). Furthermore, the Freundlich constant (K_F) was higher in the 3 mm carriers, with the adsorption strength (n) more pronounced in the polysulfone carriers (P-3 = 0.98, P-5 = 0.95) compared to the composite carriers (C-3 = 0.65, C-5 = 0.54). These results advocate for the use of 3 mm polysulfone carriers to enhance PFM performance in measuring high-rate groundwater fluxes. Future research should assess the measurable range of PFM equipped with polysulfone carriers, considering the groundwater flow rate at the TAI.