A polymeric/inorganic hybrid sorbent with active nano-particles for arsenic removal from natural waters

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Abstract

This study reports the results of an extensive investigation pertaining to arsenic removal properties of a polymeric/inorganic hybrid sorbent. Each hybrid sorbent particle is essentially a spherical macroporous cation exchanger bead within which agglomerates of nanoscale hydrated Fe oxide (HFO) particles have been uniformly and irreversibly dispersed using a simple chemical-thermal treatment. The new sorbent, referred to as hybrid ion exchanger or HIX, combines excellent mechanical and hydraulic properties of spherical polymeric beads with selective As(III) and As(V) sorption properties of HFO nanoparticles at circum-neutral pH. Comparison of the results of fixed-bed column runs between the new sorbent and the polymeric anion exchanger confirmed that both As(V) and As(III) were removed very selectively with HIX. Equally important, no pH adjustment, pre- or post-treatment was warranted. Besides the absence of arsenic, the treated water composition was identical to that of influent water. HIX was amenable to efficient in situ regeneration with caustic soda and could subsequently be brought into service following a short rinse with carbon dioxide sparged water. During fixed-bed column runs, intraparticle diffusion was identified as the primary rate-limiting step for both As(III) and As(V) sorption. Repeated use of the same HIX particles during various laboratory investigations provided strong evidence that the new sorbent possesses excellent attrition resistance properties and retains its arsenic removal capacity over cycles.