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Fabrication of Hydroxyapatite Based Hybrid Sorbent/Ion-Exchange Media for Simultaneous Removal of Fluoride and Other Contaminants

Background

In smaller rural communities, producing potable water often does not involve the highly centralized treatment and distribution infrastructure seen in larger cities. Instead, smaller point-of-use or point-of-entry water treatment solutions provide more cost-effective approaches. With ever-tightening water quality regulations, more focused research has been devoted to discovering ways to purify water inexpensively on a small scale. The leading edge of this research revolves around nanotechnological solutions that exploit various properties of hybridized materials to remove water contaminants.

The fabrication of nano-enabled hybrid sorbent media typically includes precipitation of nanomaterials within the pores of a base support material, such as hybrid ion exchange (HIX) resin, granular activated carbon (GAC), or powder activated carbon (PAC). Precipitating nanosized iron (hydr)oxide within HIX, for instance, forms a media that can remove arsenic and organic pollutants. Similar to iron (hydr)oxide for arsenic removal, hydroxyapatite (HAP) has been shown to be suitable for fluoride removal. Thus far however, nano-enabled HAP hybrid sorbents have been unable to (1) remove contaminants apart from fluoride, (2) operate in continuous-flow systems, and (3) be fabricated at room temperature.

Invention Description

Researchers at Arizona State University have developed a new process for synthesizing nano-enabled HAP hybrid sorbents that directly addresses the above shortcomings. The simple, inexpensive process can be performed at room temperature. Even in continuous-flow systems, the fabricated HIX-HAP sorbent media simultaneously removes fluoride and other contaminants such as nitrate from complex water matrices. Not only is this unachievable with virgin ion-exchange media, but the fluoride sorption capacity of the HIX-HAP media exceeds that of activated alumina (AA), considered to be the best available fluoride removal technology.

Potential Applications

- Water treatment
- Sorbent media fabrication

Benefits and Advantages

- Superior – Fabricated HIX-HAP media exceeds AA in fluoride removal capability
- Non-restrictive – HIX-HAP media is effective in both continuous flow or batch treatments, and requires neither water pH adjustments nor membrane separation
- Broad-spectrum – HIX-HAP media removes both nitrates and fluoride
- Biocompatible – Leaching of HAP is not harmful to human health
- Energy-efficient – Media fabrication is performed at room temperature unlike most alternatives
- Adaptable – Fabrication process can be applied to a variety of base porous supports, particularly those that are temperature-sensitive

Homepage of Professor Kiril Hristovski