Removal of Arsenic(III) and Chromium(VI) From Contaminated Water Using Novel Chitosan Coated Polyamide Adsorbent With Ethylenediaminetetraacetic Acid, EDTA, Regeneration

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Access to clean water has been a global challenge since long-term exposure to pollutants such as metalloid, arsenic (As(II) and heavy metal, chromium (Cr(VI)) have detrimental health effects. Thus, developing a low-cost technology to provide clean drinking water is vital. A novel adsorbent was developed by coating chitosan, a naturally biopolymer, with recycled plastics. Three plastic materials, polypropylene (PP), polyamide (PA), and polystyrene (PS), were screened for adsorbent support, and polyamide (Nylon-12 nano-bead) was selected. The adsorbent was characterized by Fourier-transform infrared spectroscopy (FTIR), thermogravimetric analysis, surface charge analysis, and imaging techniques. The removal of Cr(VI) and As(III) was determined using inductively coupled plasma-atomic emission spectrometry (ICP-AES). Equilibrium and column flow adsorption of As(III) and Cr(VI) on the adsorbent were studied and the effect of pH, concentration of adsorbate and amount of adsorbent on the removal efficiency were investigated. Equilibrium data were fitted to Langmuir and Freundlich adsorption isotherms, and the maximum monolayer adsorption capacities were 98.9mg/L and 21.5mg/g for Cr(VI) and As(II), respectively. Kinetics studies and column performance were studies on the effects of chitosan–PA for inlet Cr(VI) and As(III) solutions. The adsorbent's breakthrough curve was analyzed using the bed-depth service time model and Thomas model to define the breakthrough behavior. Novel regeneration and reuse of exhausted adsorbents was achieved via use of a chelating ligand complex EDTA (ethylendiaminetetraacetate) solution, effectively lengthening the lifespan of the adsorbent. Use of this system could improve the quality and accessibility of water in developing countries.

Awards Won:

Third Award of $1,000