Experimentally Designing Sustainable Clay-Based Adsorbents to Remove Arsenic from Drinking Water

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Arsenic is a carcinogenic contaminant that pollutes the groundwater, a consequence of poor arsenic disposal. Current arsenic separating agents have a limited adsorption capacity. To address this problem, a Computer-Aided Molecular Design (CAMD) was leveraged to optimize a novel molecule to remove arsenic from drinking water more efficiently. The Efficient Ant Colony Optimization (EACO) algorithm maximizes the adsorption capacity with certain structural and thermodynamic constraints. It was found that the newly designed adsorbent has an order of magnitude higher removal capacity than top adsorbents reported in the literature. Here, the adsorption capacity estimated for the designed adsorbent was simulated in groundwater conditions; however, arsenic contamination is not solely confined to groundwater since it is also highly prevalent in wastewater effluent of coal-burning power plants. An expansion of the work was conducted to test the adsorption capacity of the novel adsorbent in coal power plant's wastewater flows to understand how a different ionic environment affects it. The absorption capacity of the novel adsorbent in wastewater conditions is 314 mg of arsenic per gram of adsorbent, which is roughly six times higher than top-rated alternates on market. Moreover, the novel adsorbent has also been synthetically prototyped to determine the actual adsorption capacity in varying ionic environments and arsenic concentrations. Upon conducting experimentation, the novel adsorbent has demonstrated an enhanced adsorption capacity higher than any naturally occurring adsorbent. Further experimentation is conducted to determine the amount of time the filter could be used until it reaches saturation as well as finding the optimal filter size to reach a high removal efficiency.

Awards Won:

Second Award of $1,500

American Chemical Society: Third Award of $2,000