Name(s)

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Project Number

J0619

Project Title

Designing Efficient, Low-Cost, Eco-Friendly Activated Carbon for Removal of Heavy Metals from Water

Abstract

Objectives

Heavy metal contamination continues to threaten the SF Bay & cleanup of mercury & copper from watersheds is costly & time-consuming. Designing a cheap & effective activated carbon (AC) for filtration of industrial waste is an unmet need for heavy metal adsorption from water.

Methods

Biowaste materials (coconut & walnut shells, sawdust, ash) were used as precursors because of high lignin & cellulose content. Precursors were treated with dilute sulfuric acid to increase lignin & cellulose content. Adsorbents were activated using 85% phosphoric acid (288 C x 6h). For Phase 2, repeated 8% NaHCO(3) rinses were performed to raise pH. Adsorbents were treated with 15% NaF or NaCl halogen solution to increase mercury (Hg) s affinity to the carbons. These activated carbons were designed for Hg adsorption but given Hg s toxicity, copper (Cu) was used as a test contaminant. All ACs were packed in burettes & 10mL 0.02 g Cu/L solution introduced as a contaminant. To test effluents from AC columns, 3 quantitative spectrophotometric assays & 1 qualitative assay were performed.

Results

3 spectrophotometric assays were attempted to determine Cu concentration in effluents & the Cu-ammonium-cuprizone assay was most accurate & reproducible. During Phase 1, the most efficient ACs were the sawdust & coconut controls. Cu levels in effluents were reduced to levels of Cu remaining in commercially produced AC, but control carbons achieved similar results to treated carbons. In Phase 2 synthesis, the objective was to rinse the carbons to neutralize pH. Testing of effluents from Phase 2 chemically treated carbons demonstrated a marked drop in Cu concentrations compared to Phase 1 syntheses, concluding that high pH increased Cu removal.

Conclusions

Low-cost, AC syntheses removed the same amount of Cu as the commercially available AC for the Phase 1 synthesis, & up to 30 times more for the Phase 2. About 90% of the test Cu(II) on average was removed on the first pass through the test carbon column in Phase 1 & up to 99.67% of test Cu(II) was removed in Phase 2 to levels below the allowable EPA Cu concentration for drinking water. Home design & synthesis of effective AC using low-cost materials is a usable option for heavy metal adsorption, especially in high-risk environments with few resources.

Summary Statement

I synthesized and tested cheaper, effective, eco-friendly activated carbon that removed 99.67% of copper from a standard copper solution.

Help Received

My parents helped me wash dishes and let me use the garage to conduct experiments.