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Adsorption of Heavy Metals Using Chemically-Modified Tea Leaves

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Abstract : Copper is perhaps the most prevalent heavy metal used in the manufacturing industries, from food additives to metal-mechanic factories. Common methodologies to remove copper are expensive and produce undesired by-products. A good decontaminating candidate should be environment-friendly, inexpensive, and capable of eliminating low concentrations of the metal. This work suggests chemically modified spent tea leaves of chamomile, peppermint and green tea in their thiolated, sulfonated and carboxylated forms as candidates for the removal of copper from solutions. Batch experiments were conducted to maximize the adsorption of copper (II) ions. Effects such as acidity, salinity, adsorbent dose, metal concentration, and presence of surfactant were explored. Experimental data show that maximum adsorption is reached at neutral pH. The results indicate that Cu(II) can be removed up to 53%, 22% and 19% with the thiolated, carboxylated and sulfonated adsorbents, respectively. Maximum adsorption of copper on TPM (53%) is achieved with 150 mg and decreases with the presence of salts and surfactants. Conversely, sulfonated and carboxylated adsorbents show better adsorption in the presence of surfactants. Time-dependent experiments show that adsorption is reached in less than 25 min for TCM and 5 min for SCM. Instrumental analyses determined the presence of active functional groups, thermal resistance, and scanning electron microscopy, indicating that both adsorbents are promising materials for the selective recovery and treatment of metal ions from wastewaters. Finally, columns were prepared with these adsorbents to explore their application in scaled-up processes, with very positive results. A long-term goal involves the recycling of the exhausted adsorbent and/or their use in the preparation of biofuels due to changes in materials' structures.

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