

Design and Synthesis of Copper Doped Zeolite Composite for Antimicrobial Activity and Heavy Metal Removal from Waste Water

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Abstract : The existence of heavy metals and microbial contaminants in aquatic system of Akaki river basin, a sub city of Addis Ababa, has become a public concern as human population increases and land development continues. This is because effluents from chemical and pharmaceutical industries are directly discharged onto surrounding land, irrigation fields and surface water bodies. In the present study, we synthesised zeolites and copper- zeolite composite based adsorbent through cost effective and simple approach to mitigate the problem. The study presents determination of heavy metal content and microbial contamination level of waste water sample collected from Akaki river using zeolites and copper- doped zeolites as adsorbents. The synthesis of copper- zeolite X composite was carried out by ion exchange method of copper ions into zeolites frameworks. The optimum amount of copper ions loaded into the zeolites frameworks were studied using the pore size determination concept via iodine test. The copper- loaded zeolites were characterized by X-ray diffraction (XRD). The XRD analysis showed clear difference in phase purity of zeolite before and after copper ion exchange. The concentration of Cd, Cr, and Pb were determined in waste water sample using atomic absorption spectrophotometry. The mean concentrations of Cd, Cr, and Pb in untreated sample were 0.795, 0.654 and 0.7025 mg/L respectively. The concentration of Cd, Cr, and Pb decreased to 0.005, 0.052 and BDL mg/L for sample treated with bare zeolite X while a further decrease in concentration of Cd, Cr, and Pb (0.005, BDL and BDL) mg/L respectively was observed for the sample treated with copper- zeolite composite. The antimicrobial activity was investigated by exposing the total coliform to the Zeolite X and Copper-modified Zeolite X. Zeolite X and Copper-modified Zeolite X showed complete elimination of microbilas after 90 and 50 minutes contact time respectively. This demonstrates effectiveness of copper- zeolite composite as efficient disinfectant. To understand the mode of heavy metals removal and antimicrobial activity of the copper-loaded zeolites; the adsorbent dose, contact time, temperature was studied. Overall, the results obtained in this study showed high antimicrobial disinfection and heavy metal removal efficiencies of the synthesized adsorbent.

Keywords : waste water, copper doped zeolite x, adsorption heavy metal, disinfection

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