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Removal of Phenol Red Dye from Polluted Water Using Sustainable Low-Cost Sewage Sludge Activated Carbon: Adsorption and Reusability Studies

The use of sewage sludge activated carbon (thickened samples ACS1 and non-thickened samples ACS2) in a variety of applications and simple environmentally friendly production techniques are attracting more and more attention. We offer here a novel environmentally friendly method based on the green synthesis of activated carbons (ACS1/ACS2) using sewage sludge (SS). These activated carbons are then used to effectively remove the water-based reactive dye phenol red (PR). The ACS1 and ACS2 produced are porous materials with an average diameter of 20.72–13.30 and 6.20–7.34 nm, respectively. These ACS1/ACS2 were analyzed using a range of characterization techniques including X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FT-IR), scanning electron microscopy (SEM), transmission electron microscopy (TEM) and Brunauer–Emmett–Teller (BET) analysis. Elimination of toxic PR dye was investigated using several operational factors, including ACS1/ACS2 dose, initial PR dye concentration, pH and temperature. Under the best experimental conditions, the ACS1 and ACS2 adsorbents absorbed nearly 89.58% and 97.69% of the PR dye, respectively. It was found that both ACS1 and ACS2 adsorption corresponded to pseudo-first-order kinetics ($R = 0.996$ and 0.980) and fulfilled Langmuir's (ACS1) and Freundlich's (ACS2) models well, with maximum adsorption capacities of 65.35 and 122.72 mg/g, respectively. It was found that the adsorption processes are basically exothermic. The results suggest that sewage sludge can be effective as a low-cost and environmentally beneficial synthesis of ACS1 and ACS2 in the purification of water sources contaminated with hazardous dyes.

Biography

Dr. Eid Alosaimi earned his Ph.D. in 2018, focusing on the preparation of complexes for compounds with medicinal effects and investigating ways to enhance their efficacy as antibiotics and anticancer agents. He is currently an Associate Professor of Analytical Chemistry at the University of Bisha. His ongoing research involves converting wastewater residues into activated carbon to purify irrigation water. Dr. Eid has published more than 45 research papers.