Dyes Adsorption Using Activated Carbon From Coffee Capsule Grounds

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Brazil is a world leader in coffee production and is the second-largest consumer. As a result, over 1,000,000 t of coffee grounds accumulate in landfills yearly and decompose, releasing greenhouse gasses. An option to reuse grounds is as an adsorbent to treat textile effluents, which contain dyes harmful to water and the earth. Thus, this study aimed to evaluate the composition, structure, properties, and dye adsorption capacity of activated carbon obtained from coffee capsule grounds using different chemical activator agents. During preparation, grounds were collected from capsules, dried, macerated, sieved, and impregnated with phosphoric acid or zinc chloride before being pyrolyzed, washed, and dried. Solids were characterized by ash and moisture content, thermal analysis, Fourier transform infrared spectroscopy, specific area, X-ray diffraction, scanning electron microscopy, and energy dispersive X-ray spectroscopy. Removal activity was evaluated by carbon contact with methylene blue solution during defined time intervals. Concentration after adsorption was determined by visible spectroscopy. Results showed that coffee grounds had low moisture (6.5%) and ash (1.8%) content, favorable to adsorption. Pyrolysis temperature was adequate to obtain carbons with different surface functional groups, and solids morphology changed with the activators employed. Adsorption tests indicated that activated carbons were efficient in removing dye from water (98-100%), and the best activator was phosphoric acid, which sample presented the highest carbon content and specific area (789 m^2/g). Therefore, activated carbons from coffee capsule grounds are an economical and sustainable way to remove dyes from textile effluents and prevent damage caused by inadequate residue disposal.

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