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Methylene Blue Removal by Biochars from Food Industry By-Products

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Biomass produced by food industries is mainly used as feedstock or in composting. In recent years, considerable research effort has been focused on the production of biochar under oxygen-limited conditions from carbon-rich biomass, such as food industry by-products, as mitigation measure for global warming once it is used as a soil amendment. The present study presents the findings of an experimental work, which investigated the use of different biochars for the removal of methylene blue (MB) from aqueous solutions. Biochars were produced from malt spent rootlets (MSR) from brewering and espresso coffee residue from coffee shops. MSR was pyrolyzed at temperatures of 300, 400, 500, 750, 850, and 900oC and the coffee residue was pyrolyzed at 850oC. The charring process was performed under limited-oxygen conditions using specialized containers. The surface area and the porosity of the materials were determined. Batch experiments were conducted in order to evaluate the sorption capacity of the above materials, and samples were agitated for 24 h at 25oC, at an optimum pH of about 7. Kinetic analysis was conducted over a period of 24 h, and isotherm studies were also constructed. The surface area of biochar produced from MSR and the MB removal were considerably increased at pyrolysis temperatures higher than 500oC. At 850oC, the maximum surface area value (300 m2 g-1) was observed, and the MB sorption capacity was 99 mg g-1. Based on the kinetic experimental data, sorption capacities at 120 min were over 58% of their equilibrium values for the biochars used. The maximum MB sorption capacity, based on the isotherm data, was 130 mg g-1, for the two biochars employed.