Abstract

The rising amount of agricultural waste and the rise in demand for sustainable wastewater treatments have led to the production of low-cost adsorbents that are produced using biomass resources. This experiment involves using sesame husk waste resulting from tahini production as the biomass source material used to produce biochar.

The preparation of the biochar involved washing, drying, and grinding of the sesame husks, followed by conversion to biochar via pyrolysis at 400°C for 30 minutes in a nitrogen environment. The obtained biochar was then activated using KOH to improve the properties of the product. The characterization process included yield calculation, pH determination, water-holding capacity (WHC) measurement, analysis of ash content, a wettability test, Fourier-transform infrared spectroscopy, and iodine value determination. Adsorption of methylene blue was carried out tong capacity test the ability of raw and activated biochar as an adsorbent.

The results of this study demonstrated that sesame husk is a suitable biomass feedstock for biochar production, yielding 61.29% biochar. Furthermore, the produced biochar exhibited a moderately alkaline pH of 8.28, a high water-holding capacity (WHC) of 268%, and a hydrophilic surface character, indicating its potential suitability for soil amendment and agricultural applications.. The chemical activation had been found to increase the porosity of the studied biochar as evidenced by an increase in the iodine number to 1085 mg/g. The improved physicochemical properties of the activated biochar resulted in a significant increase in dye removal efficiency, from 38.8% to 94.0%. Isotherm analysis showed that the Freundlich model provided the best fit to the experimental data, suggesting that adsorption occurred on a heterogeneous surface with sites of varying adsorption energies. Kinetic analysis indicated that the pseudo-second-order model described the experimental data better than the other models tested. Furthermore, intraparticle diffusion analysis revealed that the adsorption process proceeded through multiple mass-transfer stages.

In summary, the results demonstrate that sesame husks can be effectively converted into biochar-adsorption performance of the biochar, indicating that sesame husk-derived biochar is a promising and sustainable material for wastewater treatment.