Peanut Shell Biochar for Indigo Carmine Removal From Wastewater

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A serious worldwide environmental problem is the increasing generation of agro-industrial and food waste and its improper disposal. Peanuts' global annual production, for example, is approximately 46.4 million tons, of which 22% is peanut shell waste. A promising approach to valuing this biomass is to produce an adsorbent to treat effluents containing toxic dyes, such as indigo carmine, which have adverse environmental and human health effects. This study aimed to produce activated biochar from cooked peanut shells and evaluate its structure, properties, and capacity to remove indigo carmine from water. Shell samples were washed, dried, ground, and sieved, then chemically activated with phosphoric acid and carbonized. The resulting solids were characterized by scanning electron microscopy, energy-dispersive X-ray, and Fourier-transform infrared spectroscopy, thermogravimetric analysis, X-ray diffraction, and specific surface area measurement. The indigo carmine adsorption performance was evaluated by contacting the solid with dye solutions at 5-120 min intervals, and the final concentration was determined by visible spectrophotometry. The results showed that the peanut shells had low moisture (8.3%) and ash (3.5%) contents. The biochar exhibited a heterogeneous, porous surface morphology with a carbon-rich, predominantly amorphous structure, properties that favor adsorption. The peanut shell biochar removed all dye from solutions at 15 and 25 ppm after 40 min, achieving effectiveness comparable to that of commercial activated carbon. This study concluded that activated biochar from recycled peanut shells represents an innovative and sustainable technological approach to treating contaminated water, while simultaneously addressing waste accumulation and water pollution.

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