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Chitosan-Lignin-Titania nanocomposites for the removal of brilliant black dye from aqueous solution

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Abstract

A nanoadsorbent was synthesised from kraft lignin derived from paper and pulp black liquor, chitosan, and titania (TiO_2) and used to remove Brilliant Black dye (BB) from aqueous solution. Transmission electron microscopy measurements confirmed the material was nanoscale and BET studies showed a pore width of 11.36 nm with a BET surface area (S_{BET}) of 10.75 m^2/g. The presence of -NH, -O- and Ti-O functional groups was confirmed by ATR-FTIR, and thermogravimetric analysis indicated the nanoadsorbent was thermally stable up to 300 ^0C. Scanning electron microscopy showed that lignin had larger particles with well-defined edges, while the surface morphology of chitosan showed non-uniform, short fibrous microstructures. The diffraction patterns of the nanocomposite showed a polycrystalline anatase phase and selected area electron diffraction analysis showed the nanocomposite has small spots making up a ring, indicating the nanoparticles has a crystalline structure. The effects of contact time, solution pH, adsorbent dosage, and initial dye concentration on the adsorption of BB were investigated. The batch adsorption data obeyed the Freundlich isotherm (r^2=0.91), and the monolayer adsorption capacities calculated using the linear Langmuir isotherm was 15.8 mg/g at