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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 ( $\text{TiO}_2$ ) 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  $\text{m}^2/\text{g}$ . 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  $^{\circ}\text{C}$ . 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  $\text{mg/g}$  at

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