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Elucidating Efficacy of Biomass Derived Nanocomposites in Water and Wastewater Treatment

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Abstract

In the present study, two synthesis methods of nanocomposites- one involving a mixture of biomass and the other using chemical modification were investigated to evaluate practical application of green approach in pollution control, specifically for water and wastewater treatment. Newer multifunctional superparamagnetic nanocomposites using biomaterials such as unripened fruit of *Cassia fistula* (Golden shower) and *Aloe vera* were developed as an example of green approach while chemical modification was illustrated using n-octanol. Two specific model applications were studied for the developed materials- dye removal (Methyl Blue and Congo Red) and disinfection- demonstrating antimicrobial property. To elucidate the multifunctional character, the texture, morphology and composition of the prepared bionanocomposites were studied. The surface area values were 6.2 and 9.8 m^2/g for *Aloe vera* and octanol based nanocomposites while the average pore diameters were 1.79 nm and 5.7 nm respectively, indicating presence of highly developed micropores in the first material having a honeycomb shape and the later showing excellent staircase type formation with larger pores. A very high dye removal to the extent of 100% was obtained that can be attributed largely to the functionalities imparted from *Cassia fistula* compared to ingredients from *Aloe vera* and octanol. The nanomaterials could be completely separated with absolute ease by applying simple magnetic field. Also, successful application of the developed materials in disinfection, removal of *E. coli,* was demonstrated with a very high efficiency of over 95%. The biomass derived nanocomposites exhibit excellent pollutant removal and disinfection properties, even at very low nanoparticle content; octanol based material indicating ~5 times lowered cost, while the *Aloe vera* based bionanocomposites have potential for cost reduction to the extent of 10 times as compared to only magnetite nanoparticles, thereby highlighting techno-economical alternative in water and wastewater treatment.

Key words: Nanomaterial, Pollution control, Disinfection, Adsorbent, Colour removal

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