

A study on the adsorption of methylene blue onto gum ghatti/TiO₂nanoparticles-based hydrogel nanocomposite

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ABSTRACT:

The objective of this work was to study the isotherm and kinetic models for the adsorption of methylene blue (MB) onto a TiO₂ nanoparticle (TiO₂NP)-containing hydrogel nanocomposite (HNC) of polyacrylamide-grafted gum ghatti (PAAm-g-Gg). The grafting of PAAm onto Gg was conducted using N,N'-methylene-bis-acrylamide (MBA) as a crosslinker, and different weight percentages of TiO₂NPs were incorporated into the hydrogel matrix during the grafting reaction. The graft co-polymerization and the formation of the HNC were confirmed using FTIR, XRD, BET, SEM, TEM and EDS analyses. The adsorption of MB was studied in batch mode and it was found to be highly dependent on solution pH, ionic strength temperature and adsorbent loading. The MB-adsorption process followed the pseudo-second-order rate model and Langmuir adsorption isotherm with a maximum adsorption capacity of 1305.5 mg g⁻¹. Thermodynamic studies revealed that the adsorption of MB onto the HNC surface was spontaneous, endothermic and through a process of physisorption. The results also showed that the HNC was much more effective for the adsorption of cationic dyes than anionic dyes, and it retained its original adsorption capacity for five successive cycles of adsorption-desorption. In conclusion, the hydrogel nanocomposite showed huge potential for remediating industrial wastewater polluted by toxic cationic dyes.