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Modification of Clay Mineral Montmorillonite via Graphene Quantum Dots for Use as a Nanofiller in Bio-Based Hydrogel for Wastewater

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The use of dyes in industries for coloring products is a major cause of environmental pollution [1]. This study explores the potential of semi-interpenetrating polymer networks (semi-IPN) for the removal of dyes from water. Dyes are a significant contributor to environmental pollution and are commonly used in various industries for coloring products. Semi-IPN hydrogels were synthesized by blending a cross-linked polymer with another polymer to create a new network. The resulting hydrogels exhibit excellent absorption capacity, high resistance to water and salt, and superior mechanical strength. These properties make semi-IPN hydrogels a promising candidate for the removal of dyes from water. The semi-IPN hydrogels were tested for their ability to remove dyes from water, and the results showed that they were highly effective in removing various types of dyes. The high removal efficiency of semi-IPN hydrogels is attributed to their unique structure, which provides a large surface area for adsorption and a porous structure for the diffusion of dyes. [2]. GQDs can serve as novel adsorbents for removing pollutants from wastewater. However, the lack of good water penetration of GQDs in an aqueous solution makes their separation difficult. Therefore, some researchers have focused on the immobilization of GQDs on the surface of materials such as gold and bilayer hydroxides. Montmorillonite (MMT) clay is a flaky silicate material that has layers consisting of an alumina octahedral sheet and two silica tetrahedral sheets. It has many interesting properties, including a large surface area, excellent cation exchange capacity and strong hydrophilicity [3].

This study synthesized a semi-IPN network using GQD, and MMT as nanofillers in different amounts to obtain a hydrogel nanocomposite structure. In addition, the above hydrogel nanocomposite was prepared through the solution polymerization method, and safranin (SA), methylene blue (MB), methyl green (MG), crystal violet (CV), malachite green (MlG), and concord (CR) were used to remove dyes. FTIR, FESEM, Mapping, TGA, and XRD analysis were used to check the chemical and structural properties of the hydrogel samples. Dye absorption was investigated by measuring swelling, the effect of adsorbent dose, and the effect of contact time.

Keywords: Graphene quantum dot, Montmorillonite, Hydrogel, Dye removal, Semi-IPN

References

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