Abstract

Industrialization growth has polluted the environment with a lot of pollutants including different types of dyes, which can lead to several health issues in humans as well as animals and plants. A complete study was done to assess the efficacy of the Chitosan-based hydrogel enhanced with Halloysite Nano tubes (HNTs) and poly vinyl alcohol PVA to remove the toxic Congo red dye from the textile waste water. Because of its toxicity and resistance to degradation, Congo red, a common dye in the textile industry, presents serious risks to human health and the environment. In the study, chitosan-based hydrogels were made and their adsorption performance was assessed by looking at variables such contact time, pH levels, and dye concentration. The hydrogel has the best adsorption capability under slightly acidic conditions, according to the results, where the hydrogel matrix and dye molecules interact most effectively. The hydrogel's efficacy in dye adsorption was improved by the inclusion of HNTs, which also boosted surface area and durability. But drawbacks like pH sensitivity point to the necessity of additional adjustments to increase hydrogel resilience in a range of wastewater scenarios. This study opens the door for long-term uses in industrial water purification by highlighting the potential of modified chitosan-based hydrogels as an effective and environmentally acceptable treatment for textile wastewater.