Adsorption of Cationic Dyes Using Activated Carbon Obtained from Water Hyacinth as Adsorbent

Haradip Kumar Mahilary
PhD Scholar, Department of Civil Engineering Central Institute of Technology Kokrajhar, Assam, India

Amit Kumar Dey
Assistant Professor, Department of Civil Engineering Central Institute of Technology Kokrajhar, Assam, India

Abstract

Dye pollution poses major threats to human health and aquatic ecosystems when it contaminates surface water. This study looks at the efficacy of removing cationic dyes namely, crystal violet dye (CVD) and malachite green dye (MGD) from synthetic wastewater using activated carbon produced from water hyacinth (ACWH) as a biowaste adsorbent. Before and after the adsorption procedure, the ACWH was produced and examined using several technologies such as Fourier-transform infrared spectroscopy (FTIR) and scanning electron microscopy (SEM). ACWH's microrough and heterogeneous surface was shown by SEM pictures, and functional groups such as amines, carboxylic, and hydroxyl groups were found by FTIR analysis. Adsorption studies were used to determine the ideal circumstances by examining the effects of factors such as starting dye concentration, pH, adsorbent dose, and contact duration on removal efficiency. When adsorbed onto ACWH, the removal efficiency for MGD and CVD under these circumstances surpassed 80 %. Three isotherm models were used: the Freundlich, Temkin, and Langmuir models. For both dyes, the Langmuir model suited the data the best. The adsorption process is shown to follow pseudo-second-order kinetics, according to kinetic studies. Additionally, thermodynamic parameters were computed, and regeneration investigations demonstrated that ACWH could sustain its effectiveness for a maximum of five cycles. This study demonstrates the potential of ACWH as a useful bioadsorbent that can be used to remove MG and CV dyes from water while also providing a simple and effective manufacturing technique.

Keywords

Adsorption, Kinetics, Malachite Green, Spectroscopy, Wastewater.