

Degradation of Malachite Green using H₃PO₄ activated *Ricinus Communis* stem powder

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Abstract

In this study, a potential *Ricinus Communis* stem powder is activated with phosphoric acid (PRCS) which is used as a low-cost eco-friendly bio adsorbent and is characterized and investigated for the degradation of Malachite Green dye from an aqueous solution. The structural characterization of PRCS is done by SEM, EDX, FTIR and XRD. The removal efficiency of PRCS is investigated by performing both kinetic and isothermal studies in batch experiments. The maximum degradation efficiency for Malachite Green on PRCS is 76.58% at 120 minutes in pH 5 and PRCS dosage of 0.25g.

The adsorption data is well fitted with Langmuir isotherm and it gives monolayer adsorption capacity (Q_m) of 17.69 mg/g. The correlation coefficient value indicates a well fit for monolayer Langmuir model ($R^2=0.9952$). The q_e value for pseudo first order kinetic model is in good agreement with experimental data.

Keywords: *Ricinus Communis* Stem, Phosphoric acid, Malachite Green, Degradation, Isotherm model, Kinetics.

Introduction

In the present scenario water polluted by discharge of dyes from several industries is the major world-wide problem. Colour is the primary pollutant in dye wastewater. Photo synthesis and penetration of light are decreased by the presence of small amount of dye in huge water bodies¹. Malachite Green is a cationic dye used for dyeing jute, wool, cotton, leather and silk in textile industries. The chemical formula of Malachite Green is C₂₃H₂₅N₂Cl.

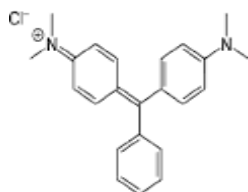


Fig. 1: Chemical structure of Malachite Green

Aqua culture industry used Malachite Green as a biocide. Malachite Green has nitrogen in its structure and that is the reason for its mutagenic, genotoxic, teratogenic and carcinogenic properties².

Discharge of Malachite Green into the aquatic environment causes chromosomal fractures and respiratory toxicity³.

Therefore, there is need to treat the dye effluent before discharging in to the environment. Numerous techniques are available to treat dye wastewater such as reverse osmosis, chemical precipitation, coagulation, ion exchange, ozonation, electro kinetic coagulation, flocculation, advanced oxidation, photocatalytic degradation and degradation by sunlight irradiation⁴. Among these methods, sunlight irradiation method is a new and effective technique to degrade the dyes from wastewater because it has number of advantage like no sludge production, rapid reaction, reusable and low-cost⁵.

In recent years, potential and inexpensive adsorbents derived from plants and agricultural operations are used as an adsorbent in wastewater treatment. *Ricinus Communis* is an agricultural waste plant located near the water area belonging to Euphorbiaceae family. The activated carbon can be prepared by two methods namely physical activation and chemical activation. In chemical activation, carbonization and activation take place simultaneously but in physical activation that is carried out separately. Due to this reason, chemical activation is better than physical activation. Hence it increases the pore size and surface area of the adsorbent⁶.

In this research work, *Ricinus Communis* Stem is activated by H₃PO₄ and used in wastewater treatment⁷. The main objective of this study is to prepare and characterise PRCS and it is used for photo catalytic degradation of Malachite Green dye from wastewater.

Material and Methods

Ricinus Communis stem is collected from Saravanampatti, Coimbatore. Phosphoric acid, Sodium Hydroxide, Hydrochloric acid and Malachite Green are purchased from Universal Scientific Company, India. The entire synthesis is carried out using double distilled water. Analytical grade chemicals and reagents purchased can be used without further purification.

Malachite Green stock solution of 1000ppm is prepared by dissolving 1g of dye in 1000 ml of double distilled water. The duplicates of all experiments are also carried out to get mean values.

Preparation and characterization of Phosphoric acid activated *Ricinus Communis* stem (PRCS): Powdered *Ricinus Communis* stem is taken in a beaker and phosphoric acid is added and it is thoroughly mixed and kept in a magnetic stirrer for 24 Hours agitation. After 24 hours, the