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Raw water lily leaves (*nymphaea lotus*) powder as an effective adsorbent for the adsorption of malachite green dye from aqueous solution.

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ABSTRACT

In this present study, raw water lily leaves (RWL) powder was prepared and used as low cost, efficient and environmental friendly adsorbent for the removal of malachite green (MG) from aqueous solution. The adsorbent's surface functional group, net neutral charge and morphology were analysed by FT-IR, Point of Zero charge and Scanning Electron (SEM) spectroscopic techniques which confirmed the effective adsorption of MG dyes onto the RWL adsorbent surface. Batch adsorption technique was employed under various optimized conditions including contact time, adsorbent dosage, adsorbate concentration, pH and temperature respectively with an adsorption capacity of 216.66mg/g and percentage adsorption of 99.5. The physical properties: moisture content (13.49%), ash content (9.81%), organic matter (90.19%), bulk density (0.263g/cm^3), pore volume (1.66cm^3), pH (5.74) of the adsorbent were obtained using standard methods. The kinetic data were best fitted by pseudo-second order in all the models tested under different operating temperatures. The adsorption isotherms were estimated, established and found to fit into Freundlich isotherm as compared to other models tested. Thermodynamics of the adsorption was found to be spontaneous and feasible with values of Gibb's free energy (ΔG) ranging between -9.481 to -9.880kJ/mol, exothermic with enthalpy (ΔH) of -11.75kJ/mol and a decrease in randomness of the adsorption process during the transfer of molecules between the adsorbent and adsorbates with entropy (ΔS) of -6.33kJ/mol. This study confirmed that RWL could be employed as a low cost and environmental friendly adsorbent for the removal of toxic dyes such as Malachite Green from aqueous solution.

1. Introduction

Textile, paper, printing and dye industries consume large quantities of water at different stages of dyeing and finishing processes [1]. The contamination of drinking water by dyes at even minute concentration could significantly impact on its colour making it unfit for human consumption [2] as these dyes are non-biodegradable, highly toxic, carcinogenic and mutagenic pollutants [3].

Malachite green (MG), a cationic, water soluble organic dye is a member of the triphenylmethane family [4]. Its employed in variety of substrate materials including wool, textile, paper, leather, cotton, and acyrilics fibres in silk, textile and jute industries [5]. Also, it is used as colorants [6], biocide in agricultural industries [7], therapeutic agent, anthelminthic and medical disinfectant [8]. Despite its wide range of applications, reports describe it as carcinogenic, hazardous, tumour promoting agent in mammalian liver cell [9]. Therefore, present of MG in drinking water, foodstuff, fishes and animal milk used by human is of great concern [10].

A variety of methods have been employed for removal of dyes from coloured effluents such as membrane filtration, oxidation, coagulation-flocculation, biological treatment, electrochemical processes and adsorption [11-13]. However, these methods have shown their limit especially with regards to the rate of removal of the pollutants and the cost of their

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