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Studies on malachite green removal from aqueous solution using biosorption: Modelling and optimization using response surface methodology

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Wastewater contamination, particularly the waste aqueous effluent containing dyes, is one of the most serious environmental problems of the present day. Dye effluents are carcinogenic and mutagenic to humans and other life forms; they may cause skin allergy, vomiting, eye irritation, cancer, etc. Thus, removal of dyes from effluents is crucial before their discharge into natural water streams. A clean & green technology is needed in preventing and or reducing the adverse effects of pollutants on the environment for a sustainable human society. Globally, the current trend of research is focused on usage of one waste material for the removal of pollution caused with another waste material. Thus, in the present study "A Clean and Green Technology" i.e., biosorption based on agricultural waste material, i.e. Vigna unguiculata pod, was selected for the removal of Malachite green dye from simulated colored wastewater. The biosorbent characteristics were studied by using Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), and X-ray diffraction (XRD) analyses. The characteristic studies revealed that the biosorption could be due to the involvement of various functional groups such as carboxylic acids, amino acids etc.

The effect of various parameters such as temperature, solution pH, initial dye concentration and biosorbent dosage on dye removal efficiency was studied by conducting batch experimental runs. Response surface methodology was used to design the experimental runs. The effect of all these variable on the percentage of dye removal was represented by mathematical model. The experimental results revealed that dye removal increased with an increase in solution pH, and biosorbent dosage. These values decreased with an increase in initial dye concentration and temperature. The results also indicated the exothermic nature of the biosorption process. Interaction effect of all these variable also studied by ANOVA analysis. Response surface optimization results showed that more than 96% dye removal achieved with the present biosorbent. This experiment revealed that the adsorbent exhibited high adsorption capacities and could be efficiently used for the Malachite green removal from the aqueous solutions.

Biography

Narayana Saibaba K.V. has completed his B.Tech in Chemical Engineering with Biotechnology as specialization from Andhra University and Masters in Chemical Engineering with Petroleum Refining Engineering as specialization from Andhra University. He also completed MBA with dual specialization in HRM and Finance. He completed his Ph.D. under the guidance of Prof. P. King. He has published more than 25 papers in international journals of repute.

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