# EFFICIENT REMOVAL OF METHYLENE BLUE FROM COLORED WASTEWATER USING MAGNETITE/CARBON NANOCOMPOSITE

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## Abstract
In this work, a new nanocomposite based on activated carbon and magnetite (PM) was synthesized and characterized by the most indicated and modern methods. The obtained magnetite/carbon nanocomposite was tested as adsorbent for the removal of *Methylene Blue* (MB) from colored wastewater. In ortder to elucidate the adsorption mechanism, kinetic and thermodynamic studies were carried out. The high adsorption capacity of the synthesized nanocomposite was highlighted by regeneration and reuse studies in consecutive adsorption/desorption cycles.

## Introduction
The efficient removal of dyes from wastewater is becoming a worldwide priority for increasing the quality of life [1].Various physical, chemical and biological methods have been tested to remove dyes from wastewater [2]. Among all the decontamination methods, adsorption is considered to be one of the most promising alternative techniques for removing non-biodegradable dyes from wastewater, due to: its simple application, superior efficiency, relatively low costs, as well as the possibility of reusing adsorbents [3]. The application of magnetic nanocomposites as adsorbents for wastewater treatment has proven effective, due to their unique physical and chemical properties and easy separation from the solution [4].

## Experimental
The magnetite/carbon nanocomposite was obtained by combustion method [5] using iron oxide as an oxidizing agent and L-arginine as a reducing agent. The synthesized magnetic nanocomposite was investigated as adsorbent material for the removal of cationic dye: *Methylene Blue* (MB) from colored wastewater. The effect of the working conditions: solution pH (2÷12), the amount of adsorbent (0.25÷3 g/L), initial dye concentration (10÷250 mg/L), and temperature (25°C, 40°C, 55°C), on the removal efficiency was investigated. The experimental data obtained at certain time intervals and at equilibrium were correlated with pseudo first-order and pseudo second-order kinetic models, respectively Freundlich, Langmuir, Sips and Redlich-Peterson adsorption isotherms. In order to evaluate the regeneration and reuse performance of the synthesized magnetic nanocomposite, the study was extended to six consecutive cycles of adsorption-desorption.

## Results and discussion
The crystalline structure of the synthesized nanocomposite was determined by X-ray diffraction analysis and infrared spectroscopy. The synthesized material has a specific surface of 930 $m^2/g$ and a saturation magnetization value of 4.02 emu/g.
Working under normal conditions: natural solution pH and room temperature very good removal yields greater than 92% were obtained, for MB dyes. Kinetic studies showed that the

adsorption process was best described by the pseudo second order model. The data obtained at equilibrium were best correlated by the Sips isotherm model, and the maximum adsorption capacitie was determined as: 132.52 mg/g for MB. The determination of thermodynamic parameters (Gibbs free energy, enthalpy and entropy) indicated that the adsorption process is spontaneous and endothermic in nature.
The regeneration capacity of the synthesized nanocomposite was studied in consecutive adsorption-desorption cycles, yields of over 75% being recorded even after the 6$^{th}$ cycle for the MB dye.

**Conclusion**

The experimental results indicate that the synthesized magnetite/carbon nanocomposite exhibits a very good adsorption capacity, which recommends it as a versatile and promising material for industrial wastewater treatment.

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