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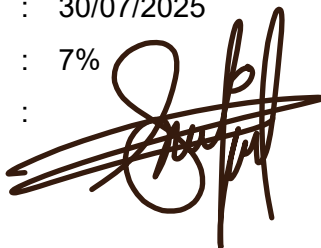
**FeCl₃-Impregnated Carbon Nanotubes (CNTs) as an Adsorbent for
Methylene Blue Removal**

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**FeCl₃-IMPREGNATED CARBON NANOTUBES AS AN ADSORBENT
FOR METHYLENE BLUE REMOVAL**

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AUGUST 2025

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ABSTRACT

FeCl₃-IMPREGNATED CARBON NANOTUBES AS AN ADSORBENT FOR METHYLENE BLUE REMOVAL

Dye pollution in wastewater presents a significant environmental challenge due to the persistent and toxic nature of synthetic dyes. Conventional adsorbents like raw carbon nanotubes (CNTs) often exhibit limited adsorption capacity, necessitating surface modifications to enhance their performance. This study aims to improve the adsorption capacity of CNTs by impregnating them with iron (III) chloride (FeCl₃) for the removal of methylene blue (MB) from aqueous solutions under various conditions. The adsorption performance was assessed based on contact time, pH, and initial dye concentration. The highest adsorption capacity, 77.93 mg/g, was achieved after 120 minutes of contact time by using the impregnated CNTs, compared to 70.93 mg/g by raw CNTs. The pH study revealed that MB adsorption was most effective under alkaline conditions, with a maximum capacity of 289.7 mg/g at pH 10 and a minimum capacity of 157.47 mg/g at pH 3. Adsorption capacity increased with increasing initial dye concentration, reaching 98.32 mg/g at 30 mg/L. However, the removal efficiency declined due to adsorbent saturation, from 68.8% at 5 mg/L to 32.8% at 30 mg/L. The adsorption kinetics followed a pseudo-second order model, which suggests a chemisorption mechanism. Isotherm analysis indicated that the Freundlich model best described the adsorption behavior, implying a heterogeneous surface. These findings demonstrated that FeCl₃-impregnated CNTs possess promising adsorption capabilities for dye removal in aqueous systems.