Fakulti Sains Gunaan

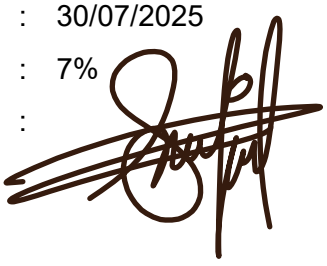
SUBMISSION FOR EVALUATION
FINAL YEAR PROJECT 2 - RESEARCH PROJECT/ CRITICAL REVIEW/ CASE STUDY

$FeCl_3$-Impregnated Carbon Nanotubes (CNTs) as an Adsorbent for Methylene Blue Removal

Name	:	Nurul Amira Farhana binti Mohd Roslan
Student ID	:	2023104295
Program	:	AS245
Course code	:	FSG671
Mobile Phone	:	013-2749048
E-mail	:	amirafarhanaroslan02@gmail.com

Approval by Main Supervisor :

I certify that the work conducted by the above student is completed and approve this report to be submitted for evaluation.

Supervisor's name	:	Dr. Sharizal bin Hasan
Date	:	30/07/2025
Turnitin Similarity %	:	7%
Signature	:	

$FeCl_3$-IMPREGNATED CARBON NANOTUBES AS AN ADSORBENT FOR METHYLYENE BLUE REMOVAL

NURUL AMIRA FARHANA BINTI MOHD ROSLAN

BACHELOR OF SCIENCE (HONS.) APPLIED CHEMISTRY
FACULTY OF APPLIED SCIENCES
UNIVERSITI TEKNOLOGI MARA

AUGUST 2025

TABLE OF CONTENTS

ABSTRACT

$FeCl_3$-IMPREGNATED CARBON NANOTUBES AS AN ADSORBENT FOR METHYLYENE 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 ($FeCl_3$) 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 $FeCl_3$-impregnated CNTs possess promising adsorption capabilities for dye removal in aqueous systems.