

UNIVERSITI TEKNOLOGI MARA

**ADSORPTION OF METHYLENE
BLUE ONTO IRON OXIDE
MAGNETIC NANOPARTICLES
COATED WITH SUGARCANE
BAGASSE**

SITI ZURAIDA BINTI RAZALI

DISSERTATION submitted in partial fulfillment
of the requirements for the degree of
Master of Environmental Health and Safety

Faculty of Health Sciences

January 2019

ABSTRACT

The removal of methylene blue (MB) from aqueous solution by Fe_3O_4 magnetic nanoparticles coated with sugarcane bagasse (Fe_3O_4 MNP-SCB) was investigated. The adsorbent was characterized with Fourier Transform Infrared Spectrophotometer (FTIR). Various physiochemical parameters such as, contact time, initial dye concentration, adsorbent dosage, and pH of dye solution were investigated in a batch-adsorption technique. Maximum adsorptions of dyes were obtained from the solutions with 98 % of dye concentration removal at pH 7. To the data obtained in the adsorption experiments, different models of adsorption and kinetics were applied, finding that the best fit to the obtained data is given by applying the pseudo-second-order models. Colour adsorption was fitted well to the Langmuir isotherm as opposed to Freundlich isotherm. It was also determined that the maximum adsorption capacity of methylene blue on the surface of the samples is 37.45 mg/g, which shows that this material has great properties as an adsorbent. These results suggest that Fe_3O_4 magnetic nanoparticles coated with sugarcane bagasse is a potential low cost adsorbent for the dye removal from industrial wastewater. The challenges and future prospects are discussed to provide a better framework for a safer and cleaner environment.

Keywords: *magnetic nanoparticles, sugarcane bagasse, dye adsorption, kinetic study, water pollution*

ACKNOWLEDGEMENT

First and foremost, to The Most Gracious and The Most Merciful Allah SWT and Nabi Muhammad SAW because can finish this project fluently. I would like to thank to my supervisor and coordinator of this project, Mr. Ahmad Razali Bin Ishak, Senior Lecturers in Faculty of Health Sciences, Universiti Teknologi Mara Puncak Alam Selangor for the valuable guidance, advices, patience, ideas, support and comments throughout the preparation of this final project thesis as he inspired me greatly to work in this project. He has not only been an excellent mentor but also a constant source of inspiration and motivation. It is difficult to imagine how to have completed this thesis without his guidance. I would also to extend my thanks to all the lecturers of Faculty of Health Sciences for comments, advices and participation.

I also want to express my appreciation to all the staff and Health Sciences Department, University Technology MARA for their dedication in delivering technical assistance and contribution towards the research in this department. My appreciation also goes to all my lab mates Ms. Khalija, Ms. Amira and Ms. Asma for their endless support throughout this dissertation. Special thanks to my colleagues and friends for for being a tremendous helper along this project.

Finally, this thesis is dedicated to the loving memory of my beloved parents for their continuous understanding, moral support throughout this period of my dissertation. Without helps of the particular that mentioned above, I would face many difficulties while doing this. The acknowledgement and completion of this thesis is for all of you. Once again, thank you Allah for this precious opportunity to complete my study successfully. Alhamdulillah.

TABLE OF CONTENT

	Page
CONFIRMATION BY PANEL OF EXAMINERS	i
AUTHOR'S DECLARATION	iii
ABSTRACT	iii
ACKNOWLEDGEMENT	iv
TABLE OF CONTENT	v
LIST OF TABLES	viii
LIST OF FIGURES	x
LIST OF PLATES	x
LIST OF SYMBOLS	xi
LIST OF ABBREVIATIONS	xii
LIST OF NOMENCLATURE	xiii
LIST OF EQUATIONS	xiv
CHAPTER ONE: INTRODUCTION	1
1.1 Research Background	1
1.2 Problem Statement	3
1.3 Objectives	5
1.4 Significance of Study	6
CHAPTER TWO: LITERATURE REVIEW	9
2.1 Water Pollution from Textile Industry	9
2.2 Industrial Dyestuff	12
2.2.1 Natural Dyes	12
2.2.2 Synthetic Dyes	12
2.2.3 Dyes of Interest (Methylene Blue)	14
2.2.4 Health and Environmental Impact of Dyes	15

CHAPTER ONE

INTRODUCTION

1.1 Research Background

Recently, environmental problems have attracted attention all over the world. Water pollution due to industrialisation processes has become critical environmental and economic issues worldwide. One of the environmental pollutants is a synthetic dye, commonly used for colouring materials such as textiles, leather, paper, wool, printed matter and cosmetics (Alzahrani, 2014). Dyes are highly coloured low biodegradable polymers. Dyes are generally classified based on their precursors either natural (derived from plants and animals) or synthetic (derived from organic and inorganic compound). Synthetic dyes are relatively inexpensive and widely used in the textiles industry (Amodu et al., 2015). Dye presence in water threatens not only aquatic life but also human population. Dyes are essential recalcitrant that when staying for a long time in flowing water will retard photosynthetic activity, inhibit the growth of aquatic biota by blocking sunlight and utilizing dissolved oxygen and also decrease the recreation value of the stream (Jain et al., 2016).

The removal of dye pollutants from wastewater effluents becomes very important because even a small quantity of dye in water is toxic and highly visible (Zhu et al., 2016). In order to treat dyed waste water, various chemical processes can be applied. They include precipitation, flocculation, electro-kinetic coagulation, other than electro-flotation, ion exchange, membrane filtration, and electrochemical destruction, irradiation and ozonation. However, these processes are not cost effective, need to comply with many rules, and are not available in the market for small industries for treating wastewater. Taking into account these factors, adsorption process is more used for wastewater treatment because of its lower cost, uncomplicated operation, less energy, no side effects of toxic substances and quality treated effluents as the absorption process is designed for coloured wastewater (Seow et al., 2016).