

**ADSORPTION OF PARACETAMOL FROM AQUEOUS  
SOLUTION USING MAGNETIC BIOCHAR DERIVED FROM  
RICE HUSK**

**ANNIS SYAFIQA BINTI ANUAR**

**ANNIS SYAFIQA BINTI ANUAR**

**AS222 FSG**

**BACHELOR OF SCIENCE (Hons.) CHEMISTRY WITH  
MANAGEMENT  
FACULTY OF APPLIED SCIENCES UNIVERSITI  
TEKNOLOGI MARA**

**UTM 2022**

**FEBRUARY 2023**

**ASDORPTION OF PARACETAMOL FROM AQUEOUS SOLUTION  
USING MAGNETIC BIOCHAR DERIVED FROM RICE HUSK**

**ANNIS SYAFIQA BINTI ANUAR**

**Final Year Project Report Submitted in  
Partial Fulfilment of the Requirements for the  
Degree of Bachelor Science (Hons.) Chemistry With  
Management in the Faculty of Applied Sciences  
Universiti Teknologi MARA**

**FEBRUARY 2023**

This Final Year Project Report entitled “**Adsorption of Paracetamol from Aqueous Solution using Magnetic Biochar Derived from Rice Husk**” was submitted by Annis Syafiqa binti Anuar partial fulfilment of the requirements for the Degree of Bachelor of Science (Hons.) Chemistry with Management, in the faculty of Applied Sciences and was approved by

---

Dr. Zaidi Ab Ghani  
Supervisor  
B. Sc. (Hons) Applied Chemistry  
Faculty of Applied Sciences  
Universiti Teknologi MARA  
02600 Arau  
Perlis

---

Dr. Nurlia binti Ali  
Project Coordinator  
B. Sc. (Hons) Applied Chemistry  
Faculty of Applied Sciences  
Universiti Teknologi MARA  
02600 Arau  
Perlis

---

Dr. Zuliahani binti Ahmad  
Head of Programmed  
B. Sc. (Hons) Applied Chemistry  
Faculty of Applied Sciences  
Universiti Teknologi MARA  
02600 Arau  
Perlis

## TABLE OF CONTENTS

<b>ACKNOWLEDGEMENTS</b>	<b>iii</b>
<b>TABLE OF CONTENTS</b>	<b>iv</b>
<b>LIST OF TABLES</b>	<b>vi</b>
<b>LIST OF FIGURES</b>	<b>vii</b>
<b>LIST OF SYMBOLS</b>	<b>ix</b>
<b>LIST OF ABBREVIATIONS</b>	<b>x</b>
<b>ABSTRACT</b>	<b>xi</b>
<b>ABSTRAK</b>	<b>xii</b>
<b>CHAPTER 1 INTRODUCTION</b>	
1.1 Background of the study	1
1.2 Problem statement	5
1.3 Research questions	6
1.4 Significance of the study	7
1.5 Objectives of the study	7
1.6 Scope and limitation of study	8
<b>CHAPTER 2 LITERATURE REVIEW</b>	
2.1 Pharmaceutical wastewater	9
2.2 Paracetamol	10
2.3 Removal of paracetamol and other pharmaceutical using biochar	11
2.4 Magnetic biochar	11
2.5 Effect of initial pH to adsorption	13
2.6 Effect of dosage to adsorption	14
2.7 Effect of initial concentration to adsorption	14
2.8 Effect of temperature to adsorption	15
2.9 Effect of time to adsorption	15
2.10 Adsorption isotherms	16
2.11 Adsorption kinetic studies	17
2.12 Adsorption thermodynamics	18
<b>CHAPTER 3 METHODOLOGY</b>	
3.1 Chemicals	20
3.2 Apparatus	20
3.3 Instrument	20
3.4 Method	22
3.4.1 Preparation of magnetic biochar	22
3.4.2 Preparation of paracetamol	24
3.4.3 Effect of initial pH of paracetamol	24
3.4.4 Effect of adsorbent dosage	25
3.4.5 Effect of different concentration	25
3.4.6 Effect of temperature	26
3.4.7 Effect of time	26
3.4.8 Adsorption isotherm studies	26
3.4.9 Adsorption kinetic studies	27
3.4.10 Adsorption thermodynamic studies	27

## ABSTRACT

### ADSORPTION OF PARACETAMOL FROM AQUEOUS SOLUTION USING MAGNETIC BIOCHAR DERIVED FROM RICE HUSK

To reduce pharmaceutical contaminants in aqueous solution, a lot of research has been carried out to convert organic material such as rice husk into biochar, serving as an adsorbent for the adsorption of paracetamol. This review paper studies the optimization of adsorption parameters which are pH, dosage, initial concentration, contact time, and temperature on the adsorption of paracetamol using biochar derived from rice husk. This paper also aims to evaluate the adsorption isotherm (Langmuir and Freundlich), kinetic (pseudo-first-order and pseudo-second-order) and study the effect of thermodynamic ( $\Delta G^\circ$ ,  $\Delta H^\circ$ , and  $\Delta S^\circ$ ) parameters based on the obtained experimental data. The adsorption capacity was found to increase with increases in initial concentration (from 0.0029 mg/g in 1 mg/L to 0.0047 mg/g in 10 mg/L) and time (from 0.1688 mg/g in 30 min to 0.3335 mg/g in 230 min). At the same time, it decreased with an increase in the adsorbent dose (from 0.3081 mg/g in 0.5 g to 0.2203 mg/g in 1.0 g) due to aggregation. Additionally, the highest adsorption was attained at pH 8 with an optimum temperature of 40 °C. The experimental data fit well with the Langmuir isotherm equation ( $R^2 = 0.9996$ ) and the pseudo-second-order kinetic model ( $R^2 = 0.9374$ ) suggesting a chemisorption pathway. But the negative values of  $\Delta G^\circ$  were observed to indicate that the adsorption of paracetamol is a non-spontaneous process, while  $\Delta H^\circ$  value obtained was positive (4.2521 kJ/mol), which confirms the endothermic nature of the adsorption process. Meanwhile,  $\Delta S^\circ$  value is positive (104.1577 kJ/mol) indicating an increase in disorder at the solid/liquid contact during the sorption process. The findings of this study can be applied to future research to determine the optimum strategy for pharmaceutical removal treatment.