

**ADSORPTION OF LEAD (II) AND COPPER (II) FROM  
AQUEOUS SOLUTION USING BIOCHAR DERIVED  
FROM COCONUT SHELL**

**NUR LIYANA BINTI MAT AZLAN**

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

**FEBRUARY 2023**

**ADSORPTION OF LEAD (II) AND COPPER (II) FROM  
AQUEOUS SOLUTION USING BIOCHAR  
DERIVED FROM COCONUT SHELL**

**NUR LIYANA BINTI MAT AZLAN**

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

**FEBRUARY 2023**

This Final Year Project Report entitled “**Adsorption of Lead (II) and Copper (II) from Aqueous Solution Using Biochar Derived from Coconut Shell**” was submitted by Nur Liyana Binti Mat Azlan in partial fulfillment of the requirements for the Degree of Bachelor of Sciences (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. Siti Nurlia Ali  
Project Coordinator  
B. Sc. (Hons.) Chemistry with  
Management  
Faculty of Applied Sciences  
Universiti Teknologi MARA  
02600 Arau  
Perlis

---

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

February 2023

## **ABSTRACT**

### **ADSORPTION OF LEAD (II) AND COPPER (II) FROM AQUEOUS SOLUTION USING BIOCHAR DERIVED FROM COCONUT SHELL**

The demand for safe and clean water has increased by leaps and bound due to the higher number of heavy metals such as lead and copper that will pollute water. In this study, biochar derived from coconut shell was used for adsorption of lead and copper from an aqueous solution. Batch adsorption experiments were done to study the effect of several parameters such as pH (2, 3, 4, 5 and 6), contact time (15, 30, 45, 60, 75, 90, 105, 120, 135, 150, 165 and 180 min), adsorbent dose (0.5, 0.6, 0.7, 0.8, 0.9 and 1.0 g) and temperature (30, 40, 50 and 60 °C). Maximum adsorption of lead and copper has been obtained at pH 5, 150 min contact time, at an adsorbent dose of 1.0 g and a temperature of 60 °C. The data from adsorption kinetics were used to examine the feasibility of two models: pseudo-first order kinetic and pseudo-second order kinetic. The data was well-fitting to the pseudo-second order model. The Langmuir and Freundlich isotherms were used to fit the equilibrium data and the Langmuir isotherm model with maximum monolayer adsorption capacity for lead and copper are 9.1659 mg/g and 3.9262 mg/g at 25°C best described the equilibrium data. This study shows that BC can be effective at removing lead and copper from water.

## TABLE OF CONTENTS

|  | <b>Page</b> |
|--|-------------|
| <b>ABSTRACT</b>                          | iii         |
| <b>ABSTRAK</b>                           | iv          |
| <b>ACKNOWLEDGEMENTS</b>                  | v           |
| <b>TABLE OF CONTENTS</b>                 | vi          |
| <b>LIST OF TABLES</b>                    | viii        |
| <b>LIST OF FIGURES</b>                   | ix          |
| <b>LIST OF SYMBOLS</b>                   | xi          |
| <b>LIST OF ABBREVIATIONS</b>             | xii         |
| <br>                                     |             |
| <b>CHAPTER 1</b>                         |             |
| 1.1 Background of Study                  | 1           |
| 1.2 Problem Statement                    | 5           |
| 1.3 Objectives of study                  | 6           |
| 1.4 Scope and Limitation of Study        | 6           |
| 1.5 Significance of Study                | 7           |
| <br>                                     |             |
| <b>CHAPTER 2</b>                         |             |
| 2.1 Adsorption                           | 8           |
| 2.2 Adsorbent                            | 9           |
| 2.3 Biochar                              | 10          |
| 2.4 Heavy metals                         | 11          |
| 2.4.1 Lead                               | 12          |
| 2.4.2 Copper                             | 13          |
| 2.5 Removal of lead (II) and copper (II) | 14          |
| 2.5.1 Effect of pH                       | 15          |
| 2.5.2 Effect of Contact Time             | 17          |
| 2.5.3 Effect of Adsorbent Dosage         | 18          |
| 2.5.4 Effect of Temperature              | 19          |
| 2.6 Adsorption kinetics                  | 21          |
| 2.6.1 Pseudo-First Order (PFO)           | 21          |
| 2.6.2 Pseudo-Second Order (PSO)          | 22          |
| 2.7 Adsorption isotherms                 | 22          |
| 2.7.1 Langmuir Isotherm                  | 23          |
| 2.7.2 Freundlich Isotherm                | 25          |
| <br>                                     |             |
| <b>CHAPTER 3</b>                         |             |
| 3.1 Chemicals                            | 26          |