

**ADSORPTION OF Ni(II) FROM AQUEOUS SOLUTION ONTO
CITRIC ACID MODIFIED ALOE *VERA* (*Barbadensis miller*) LEAF
POWDER**

ROHAIZAN BINTI ABDULLAH

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

JULY 2019

ABSTRACT

ADSORPTION OF Ni(II) FROM AQUEOUS SOLUTION ONTO CITRIC ACID MODIFIED ALOE *VERA* (*Barbadensis miller*) LEAF POWDER

This research investigated the application of biosorbent derived from citric acid modified Aloe Vera (*Barbadensis miller*) powder (CAALVP) to adsorb cations Ni(II) from aqueous solutions. The biosorbent were characterized by spectroscopic and quantitative analysis. Chemical treatment had successfully changed the physicochemical characteristics of biosorbent such as pHslurry and pHpzc. Elucidation of chemical characteristics of biosorbent surface by Fourier Transfer Infrared (FTIR) spectroscopy reveal different types of functional groups. The performance of biosorbent was affected by pH, biosorbent dosage, initial concentration of the adsorbent and contact time. The adsorption of Ni(II) on biosorbent were best fitted to pseudo-second order kinetic models ($R^2 > 0.98$) and Freundlich isotherm model ($R^2 > 0.98$). However, for Langmuir isotherm, there was only slightly differences between adsorption capacities experimental and calculated which were 37.774 and 48.648 respectively. Meanwhile, for Freundlich there was huge differences between adsorption capacities experimental and calculated which were 39.938 and 8.79 respectively. The best pH and adsorbent dosage for this system were pH 6 and 0.10 g respectively.

TABLE OF CONTENTS

	PAGE
ACKNOWLEDGEMENT	III
LIST OF SYMBOLS	IV
LIST OF ABBREVIATIONS	V
LIST OF FIGURES	VI
LIST OF TABLES	VII
ABSTRACT	VIII
ABSTRAK	IX
CHAPTER 1 INTRODUCTION	1
1.1 Background of the study	1
1.2 Problem statement	3
1.3 Significant of study	4
1.4 Objective of study	5
CHAPTER 2 LITERATURE REVIEW	6
2.1 Heavy metal	6
2.1.1 Conventional method for the removal of Nickel ions	6
2.1.2 Parameters affecting Ni(II) adsorption	6
2.2 Adsorbent	10
2.2.1 Conventional sorbent for the removal of nickel ions	10
2.2.2 <i>Aloe vera</i> leaves as adsorbent	11
2.3 Citric acid	15
2.3.1 Characteristic of citric acid	15
2.3.2 Removal of heavy metal by using citric acid modified adsorbent	15
CHAPTER 3 METHODOLOGY	17
3.1 Chemicals and Materials	17
3.1.1 Raw material	17
3.1.2 The list of chemicals used	17
3.2 Instruments	17
3.2.1 The list of instruments to be used	17
3.3 Methods	18
3.3.1 Preparation of the <i>Aloe vera</i> Leaves powder (AVLP)	18
3.3.2 Pre-treatment of the <i>Aloe vera</i> leaves powder (AVLP) with citric acid.	18
3.3.3 Characterization of CAAVLP	19
3.3.4 Preparation of 1000 mg/L of Nickel (II) Nitrate [Ni(NO) ₃] ₂]	20
3.3.5 Batch Adsorption studies	20

CHAPTER 4	RESULT AND DISCUSSION	23
4.1	Biosorbent characterisation	23
4.2	Batch Adsorption studies	27
4.2.1	Effect of pH	27
4.2.2	Effect of biosorbent dosages	28
4.2.3	Effect of adsorbate initial concentration and contact time	29
4.2.4	Adsorption Kinetic	30
4.2.5	Isotherm study	33
CHAPTER 5	CONCLUSION AND RECOMMENDATION	36
5.1	Conclusion	36
5.2	Recommendation	36
CITED REFERENCES		37
APPENDIX A		
APPENDIX B		
APPENDIX C		
APPENDIX D		

CHAPTER 1

INTRODUCTION

1.1 Background of the study

The term “heavy metal” is generally applied to a class of metals/metalloids having density more than 5 g/cm³ and atomic number greater than 20 (Raut *et al.*, 2012). The existence of heavy metals in the environment may arise from natural and anthropogenic sources. Serious health effects can be caused by heavy metal, including growth retardation, organ damage, cancer, nervous system damage and in extreme case, death (Borba *et al.*, 2006).

One of the metal pollutants in the water and environments is Nickel (Ni). The discharge of water effluent rich in nickel ions into water bodies increase due to rapid development of electronic industry (Hu *et al.*, 2018). Since the pollution of heavy metals especially nickel ion into water may arise from natural and anthropogenic sources, the complete removal of nickel ions from the water is almost impossible with current technology. Industries such as stainless steels manufacturing, coins, super alloys, and batteries release high concentration of Ni(II) and cause environmental pollution. This situation may also affect human being because the released Ni(II) will flow