

ACF 6904
ACP6078

**STUDIES OF NICKEL REMOVAL
FROM
ELECTROPLATING WASTEWATERS**

BY

MD. SHAMEEM HASAN

SUPERVISED

BY

**PROF. MOHD ALI HASHIM
ASSOC. PROF. DR. BHASKAR SEN GUPTA**

**DISSERTATION SUBMITTED TO THE
INSTITUTE OF POSTGRADUATE STUDIES
AND RESEARCH
UNIVERSITY OF MALAYA
50603, KUALA LUMPUR**

**IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE
OF**

MASTER OF TECHNOLOGY (ENV. MANAGEMENT)

Perpustakaan Universiti Malaya



A505613590

Acknowledgements

First of all, I wish to express my sincere gratitude to my supervisors, Professor Mohd. Ali Hashim and Associate Professor Dr. Bhaskar Sen Gupta for their helpful advice, comments and suggestions.

I also wish to thank the following people who provided help to me during the course of this project. They are: Dr. Praven V.V., Dr. Ramakanth, En. Jasmi and En. Osman.

I would also like to thank my coursemates, Looi Chee Choong, Tan Giok Hui and Bina Kumari Dey for their assistance in the preparation of this dissertation.

Lastly, I would like to thank the IPSP staff for their assistance in the completion of this project.

CONTENTS	Pages
-----------------	--------------

Acknowledgements	i
Abstract	ii
Contents	iii

CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

1.1.1 Pollution on ground and surface waters	2
1.1.2 Toxicity to fish and other aquatic life	2
1.1.3 Effects on sewers	6
1.1.4 Effects on sewage treatment	6
1.1.5 Industrial wastewater and heavy metal pollution	7
1.1.6 Various Techniques of Treatment Technologies	8
1.1.6.1 Chemical precipitation	8
1.1.6.2 Ion exchange	9
1.1.6.3 Evaporation	10
1.1.6.4 Membrane process	10
1.1.6.5 Adsorption	11
1.2 RESEARCH OBJECTIVES	12

CHAPTER 2: LITERATURE REVIEW

2.1 NICKEL	14
2.1.1 Nickel in the Environment	15
2.1.1.1 Behaviour of nickel in aquatic environment	15
2.1.1.2 Nickel in the atmosphere	16

2.1.1.3 Nickel in the soil	17
2.1.2 Usage of Nickel	17
2.1.3 Nickel Toxicity	18
2.1.3.1 Effect of nickel on marine and freshwater organisms	19
2.1.3.2 Effect of nickel on human health	20
2.1.4 Recommended Environmental Quality Standards (EQS)	20
2.2 ADSORPTION	22
2.2.1 Kinetics of Metal Adsorption	25
2.2.2 Effect of pH	25
2.2.3 Effect of Coincidental Ions	27
2.2.4 Adsorption Kinetics and Equilibria	27
2.2.4.1 Chemical reaction	31
2.2.4.2 Ion adsorption	33
2.2.5 Adsorption Model	35
2.2.6 Effect of Coincidental Ions	38
2.3 MEMBRANE SEPARATION	41
2.3.1 Reverse osmosis	42

CHAPTER 3: MATERIALS AND METHODS

3.1 ADSORPTION	44
3.1.1 Preparation of Wood-ash	44
3.1.2 Preparation of Metal Solution	44
3.1.3 Kinetics of Metal Adsorption	45
3.1.4 Equilibria of Adsorption	47
3.1.5 Effect of Biomass Concentration	48

3.1.6	Effect of Initial pH	48
3.1.7	Zeta Potential Measurement	48
3.1.8	Effect of Coincidental anions and Complexing Agents	49
3.1.9	Effect of Coincidental Cations	49
3.1.10	Metal Ion Concentration Analysis	50
3.2	MEMBRANE SEPARATION	
3.2.1	Chemicals	50
3.2.2	Preparation of metal solutions	50
3.2.3	Membrane Unit	51
3.2.4	Metal analysis	52
 CHAPTER 4: RESULTS AND DISCUSSIONS		
4.1	ADSORPTION	53
4.1.1	Kinetics of Adsorption	53
4.1.2	Effect of Ni(ii) on Wood-ash Contact time and concentration	53
4.1.3	Adsorption Kinetics	55
4.1.4	Adsorption Dynamics and Empirical Kinetic Model	58
4.1.5	Adsorption Isotherm	60
4.1.6	Adsorption at various Temperature	61
4.1.7	Thermodynamics Parameters	64
4.1.8	Adsorption at Various pH	65
4.1.9	Effect of Coincidental Anions and Complexing Agent	67
4.1.10	Effects of coincidental Cation	70
4.2	SEPARATION OF NICKEL (II) SULFATE BY MEMBRANE	71

4.2.1 Pressure and Permeate Flow Rate	71
4.2.2 Pressure drop and Nickel (ii) in Permeate	72
4.2.3 Trans-membrane Pressure and Nickel in concentrate	74
4.2.4 Permeate Flow Rate and Nickel(ii) Concentration	75
CHAPTER 5: CONCLUSION	
5.1 Adsorption	77
5.2 Membrane Separation	79
APPENDIX	81