



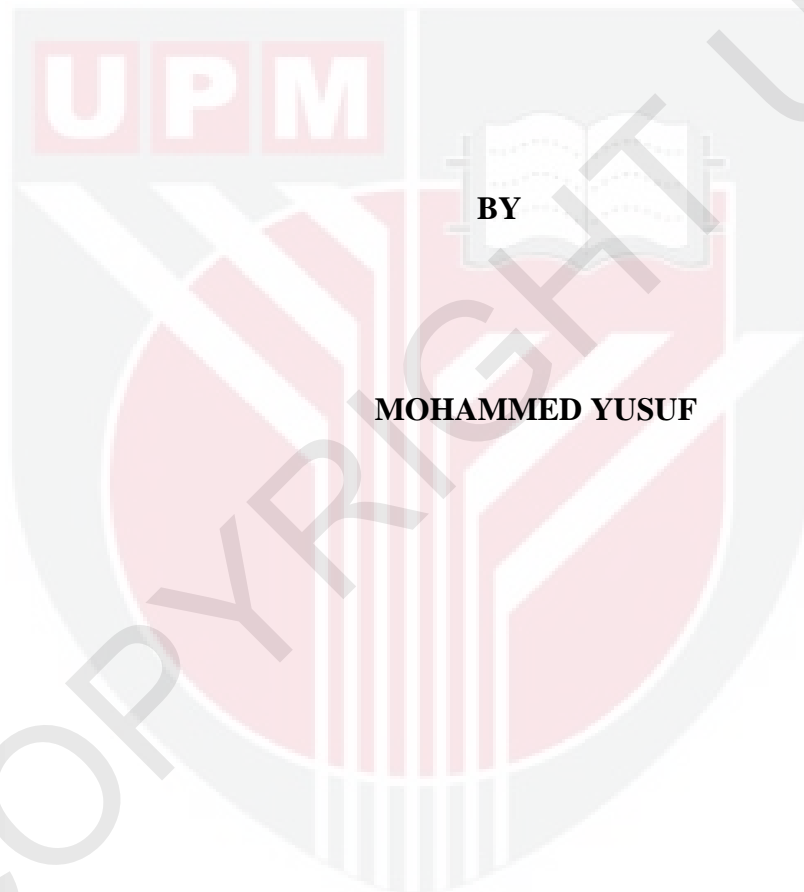
UNIVERSITI PUTRA MALAYSIA

***REMOVAL OF NICKEL FROM AQUEOUS SOLUTION USING ELECTRIC ARC
FURNACE SLAG***

MOHAMMED YUSUF

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**REMOVAL OF NICKEL FROM AQUEOUS SOLUTION USING ELECTRIC
ARC FURNACE SLAG**



BY

MOHAMMED YUSUF

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfillment of the Requirement for the Degree of Master of Science**

October 2012

DEDICATION

This thesis is specially dedicated to my parents.



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Abstract of the thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

REMOVAL OF NICKEL FROM AQUEOUS SOLUTION USING ELECTRIC ARC FURNACE SLAG

By

MOHAMMED YUSUF

October 2012

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Electric Arc Furnace (EAF) slag is a major abundant by-product in Malaysia steel industry. It has potential to be used as low cost adsorbent for heavy metal removal from waste water. The aim of this study was to examine the potential capability of an electric arc furnace slag on the removal of nickel in both batch and fixed bed column system. The ability of electric arc furnace slag (EAFS) to remove nickel was investigated in term of adsorption kinetics and isotherm as well as the adsorption capacity in batch and fixed column system. Moreover, the effects of pH, adsorbent dosage, initial metal ion concentration and particle size were determined in batch process using artificial neural network (ANN) and the effect of bed height and flow rate were examined in the fixed bed column system.

From the experimental result obtained, it is found that the EAFS adsorption kinetics obeyed the pseudo-second-order kinetic model with fairly high correlation coefficient. The adsorption process obeyed the Langmuir isotherm model and the maximum uptake of nickel (II) from the solution is 160.9 mg/g.

The optimum pH and temperature was observed to be at pH 8 and 28°C respectively for the maximum removal of nickel. The equilibrium time was determined at 9 hours for the nickel and it was observed that the metal adsorption capacity decreased as the particle size of the EAFS increased from 0.5 mm to 3 mm. The bed depth service time (BDST) model fitted well with the experimental data where the service time decreased accordingly as the bed depth decreased. Thomas model also described well the adsorption behavior of the effect of flow rate on adsorption capacity and break through curves.

From the study, it was concluded that the EAFS, can be an efficient low cost adsorbent to remove heavy metals particularly nickel from industrial waste water.

Abstrak tesis ini dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master

PENYINGKIRAN NIKEL DARIPADA LARUTAN AKUES MENGGUNAKAN SANGA RELAU ARKA ELEKTRIK

Oleh

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Oktober 2012

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Sanga Relau Arka Elektrik (EAF) ialah hasil sampingan utama dalam industri keluli di Malaysia. Bahan ini berpotensi untuk digunakan sebagai bahan penjerap berkos rendah untuk penyingkiran logam berat daripada air sisa. Tujuan penyelidikan ini ialah untuk mengkaji kemampuan dan kebolehan sanga relau arka elektrik ke atas penyingkiran nikel dalam kedua-dua sistem kajian kelompok dan kolum lapisan tetap. Kebolehan sanga relau arka elektrik (EAFS) dalam menyingkirkan nikel telah dikaji berdasarkan kinetik dan isoterma penjerapan serta kapasiti penjerapan dalam sistem kelompok dan kolum tetap. Tambahan pula, kesan pH, dos penjerap, kepekatan awal ion logam dan saiz partikel telah dikenalpasti dalam proses kelompok dengan menggunakan jaringan neural tiruan (ANN) dan kesan ketinggian lapisan serta kadar aliran telah diperiksa dalam sistem kolum lapisan tetap.

Daripada keputusan yang diperoleh melalui eksperimen, didapati bahawa kinetik penjerapan EAFS mematuhi model kinetik tertib kedua pseudo dengan pekali perkaitan yang agak tinggi. Proses penjerapan mematuhi model isoterma Langmuir dan penyerapan maksimum ion nikel (II) daripada larutan adalah sebanyak 160.9 mg/g.

pH dan suhu optimum telah dikenalpasti masing-masing berada pada pH 8 dan 28°C untuk penyingkiran nikel yang maksimum. Masa keseimbangan telah ditentukan pada 9 jam untuk nikel dan ianya juga telah diperhatikan bahawa kapasiti penjerapan logam berkurangan apabila saiz partikel EAFS meningkat daripada 0.5 mm kepada 3mm. Model masa servis kedalaman lapisan (BDST) menepati data eksperimen di mana tempoh servis menurun apabila kedalaman berkurangan. Model Thomas juga menerangkan dengan baik berkenaan sifat penjerapan kesan kadar aliran terhadap kapasiti penjerapan dan lengkungan pemecahan.

Berdasarkan kepada hasil kajian, rumusan yang boleh dibuat ialah EAFS mampu digunakan sebagai penjerap berkos rendah yang efisien untuk menyingkirkan logam-logam berat terutamanya nikel daripada air sisa industri.

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Finally, I would like to thank all and sundry who in one way or the other helped to make my master degree programme a sounding success, but whose name I failed to mention due to my own limitations as a human being.

APPROVAL

I certify that a Thesis Examination Committee has met on to conduct the final examination of Mohammed Yusuf on his thesis entitled “use of electric arc furnace slag as nickel adsorber to waste water” in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U. (A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institutions.

MOHAMMED YUSUF

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TABLES OF CONTENT

	Page
DEDICATION	II
ABSTRACT	III
ABSTRAK	V
ACKNOWLEDGEMENTS	VII
APPROVAL PAGE	VIII
DECLARATION	X
LIST OF TABLES	XVI
LIST OF FIGURES	XVIII
LIST OF ABBREVIATIONS	XX
1 INTRODUCTION	
1.1 Background of the Study	1
1.2 Toxicity of Nickel	2
1.3 Problem Statement	4
1.4 Objective of the Study	4
1.5 Scope of the Study	5
1.6 Contribution	6
1.7 Thesis Organization	6
2 LITERATURE REVIEW	
2.1 Heavy Metal Pollution and their Sources	8
2.1.1 Types of Heavy Metal and their Sources	10
2.2 Methods of Heavy Metal Removal	10
2.2.1 Carbon Adsorption	10

2.2.2 Chemical Precipitation	11
2.2.3 Coagulation	11
2.2.4 Ion Exchange	12
2.2.5 Membrane Filtration Technology	13
2.3 Steel Slag Characterization	13
2.3.1 Chemical Precipitation of Steel Slag	14
2.3.2 Physical Properties of Steel Slag	15
2.3.3 Mechanical and Thermal Properties of Steel Slag	16
2.4 Principle of adsorption	17
2.4.1 Physisorption	17
2.4.2 Chemisorption	18
2.5 The Nature of Adsorbent	20
2.6 Structure of Adsorbent	20
2.7 Adsorption from Liquid	21
2.8 Factors Affecting Adsorption Capacity	22
2.8.1 Effect of pH	22
2.8.2 Effect of Initial Concentration of Metal	23
2.8.3 Effect of temperature	23
2.8.4 Effect of Physical Properties of Adsorbent	24
2.8.5 Effect of Surface Area and Pore Size of Adsorbent	24
2.8.6 Presence of Functional Groups on Adsorbent	24
2.8.7 Effect of Presence of Cation	25
2.8.8 Effect of Solubility and Ionization of Adsorbent	25
2.9 Single Component Adsorption Isotherm	26
2.9.1 Langmuir Isotherm	27
2.9.2 Freundlich Isotherm	28
2.9.3 Redlich-Peterson Isotherm	29
2.10 Kinetic Modeling	30

2.10.1 Pseudo First-Order	30
2.10.2 Pseudo Second-Order	31
2.10.3 Inter Particle Diffusion	32
2.11 Recent Studies on the Removal of Nickel Ions from Aqueous Medium	33
2.12 Artificial Neural Network (ANN)	37
2.12.1 How do Artificial Neuron Net Model the Brain	38
2.13 Column Study	39
2.13.1 Bed Depth Service Time Model	40
2.13.2 Thomas Model	41
2.14 Conclusion	41
3 MATERIALS AND METHODS	
3.1 Material	44
3.1.1 Adsorbent	44
3.1.2 Adsorbate	44
3.1.3 Characterization of particle size	45
3.2 Experimental Procedure	45
3.2.1 Boehm Titration	45
3.2.2 Point of Zero Charge	46
3.2.3 Selection of Models for the Experiments	47
3.2.4 Batch Adsorption Studies	48
3.2.5 Effect of pH	49
3.2.6 Effect of Particle Size	49
3.2.7 Effect of Initial Metal Ion Concentration and Contact time	50
3.2.8 Batch Kinetic Studies	50
3.2.9 Binary Batch Equilibrium Studies	50
3.2.10 Adsorption Isotherm Studies	51
3.2.11 Artificial Neural Network Optimization	52

3.2.12 Fixed Bed Column Studies	54
3.2.13 Effect of Bed Height	54
3.2.14 Effect of Flow Rate	55
4 RESULTS AND DISCUSSION	
4.1 Introduction	57
4.2 Characterization of adsorbent (EAFS)	57
4.2.1 Braunauer- Emmeh-Teller (BET) Analysis	57
4.2.2 Fourier Transform Infrared Spectroscopy	60
4.2.3 Scanning Electron Microscope (SEM) Analysis	63
4.2.4 Energy Dispersive X-Ray Spectrometer (EDX) Analysis	64
4.3 Artificial Neural Network (ANN) Modeling	65
4.3.1 Effect of pH	67
4.3.2 Effect of Time and Concentration	70
4.3.3 Effect of Particle Size	73
4.3.4 Effect of Adsorbent Dosage	74
4.4 Adsorption Isotherm Studies	75
4.4.1 Kinetic Studies	77
4.4.1.2 Pseudo First-Order Kinetic Model	78
4.4.1.3 Pseudo Second-Order Kinetic Model	78
4.5 Fixed-Bed Column System	81
4.5.1 Effect of Bed Height	81
4.5.2 Effect of Flow Rate	84
5 CONCLUSION AND RECOMMENDATION	
5.1 Conclusion	87
5.2 Recommendation	87
REFERENCES	90

APPENDICES	97
BIODATA OF STUDENT	124
LIST OF PUBLICATIONS	125



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