



UNIVERSITI PUTRA MALAYSIA

***PREPARATION AND CHARACTERIZATION OF POLY(ETHYL
HYDRAZIDE) GRAFTED OIL PALM EMPTY FRUIT BUNCH FOR
REMOVAL OF COPPER AND NICKEL IONS FROM AQUEOUS
SOLUTIONS***

ILI SYAZANA BINTI JOHARI

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SOLUTIONS**

By

ILI SYAZANA BINTI JOHARI

**This thesis submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in fulfillment of the requirements for the Degree of Master of Science**

November 2012

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

**PREPARATION AND CHARACTERIZATION OF POLY(ETHYL
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November 2012

Chairman : Nor Azah bt Yusof, PhD

Faculty : Science

Poly(ethyl hydrazide) grafted oil palm empty fruit bunch fiber (peh-g-opefb) has been successfully prepared by heating poly(methyl acrylate) grafted opefb (pma-g-opefb) at 60°C for 4 hours in a solution of hydrazine hydrate (15% v/v) in ethyl alcohol. The chelating ability of peh-g-opefb was evaluated using Cu(II) and Ni(II) ions in aqueous solution. The concentration of metal was determined by inductively coupled plasma optical emission spectrometry (ICP-OES). pH study was carried out in the pH range from pH 1 to pH 6. The results shows that the adsorption of Cu(II) is optimized at pH 5 while Ni(II) is at pH 6. Isotherm study conducted for both metal ions reveals that the adsorption follows Langmuir isotherm model with maximum adsorption capacity of 43.48 mgg⁻¹ at 25 °C and 76.92 mgg⁻¹ at 75 °C for copper ion whereas for nickel ion, the maximum adsorption capacity is 42.19 mgg⁻¹ at 25 °C and 51.02 mgg⁻¹ at 75 °C. Kinetic study shows that the adsorption of copper and nickel ion follows pseudo-second-order kinetic model. Thermodynamic study was carried out in order to determine the thermodynamic parameters Gibbs free energy, ΔG^0 ,

entropy, ΔS^0 and enthalpy value, ΔH^0 of the adsorption process. The negative values of ΔG^0 indicates that both copper and nickel adsorption onto poly(ethyl hydrazide) grafted opefb is a spontaneous process. Positive entropy, ΔS^0 indicates that the system became more disorder during bioadsorption process whereas positive enthalpy, ΔH^0 value shows that the adsorption of copper and nickel onto peh-g-opefb is an endothermic process. Selectivity study was done in mix solution of copper or nickel ions with various concentrations of interference ions including Na(I), Ca(II), Mg(II) and Cr(III). The results show that the adsorption of copper and nickel ions by peh-g-opefb was not affected by the presence of the interference ions even in high concentrations. Therefore, the peh-g-opefb is a potential and useful adsorbent which can be applied in many industries particularly related to toxic metal release.

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

**PENYEDIAAN DAN PENCIRIAN GENTIAN TANDAN KOSONG BUAH
KELAPA SAWIT TERCANGKUK POLI(ETIL HIDRAZIDA) UNTUK
PENYINGKIRAN ION KUPRUM DAN NIKEL DARI LARUTAN AKUEUS**

Oleh

ILI SYAZANA BT JOHARI

November 2012

Pengerusi : Nor Azah Bt Yusof, PhD

Fakulti : Sains

Gentian tandan kosong buah kelapa sawit tercangkuk poli(etil hidrazida) (peh-g-opefb) telah berjaya disediakan melalui pemanasan poli(metil akrilat)-g-opefb pada suhu 60 °C selama 4 jam dengan larutan hidrazina hidrat dalam etil alkohol (15%, v/v). Keupayaan peh-g-opefb untuk mengkelat diuji dengan ion kuprum dan ion nikel dalam larutan akueus. Kepekatan ion-ion tersebut ditentukan menggunakan spektrometri pemancaran optik plasma berganding aruh (ICP-OES). Kajian pH dilakukan dalam julat pH 1 ke pH 6. Keputusan menunjukkan pH optimum penjerapan ion kuprum adalah pada pH 5 manakala ion nikel pada pH 6. Kajian isoterma yang dijalankan menunjukkan bahawa kedua-dua ion kuprum dan nikel mematuhi isoterma model Langmuir dengan jerapan maksimum bagi ion kuprum adalah 43.48 mgg⁻¹ pada suhu 25 °C dan 76.92 mgg⁻¹ pada suhu 75 °C manakala bagi ion nikel jerapan maksimum adalah 42.19 mgg⁻¹ pada suhu 25 °C dan 51.02 mgg⁻¹ pada suhu 75 °C. Kajian kinetik pula menunjukkan bahawa jerapan ion kuprum dan nikel mematuhi model kinetik tertib kedua. Kajian termodinamik dijalankan bagi menentukan parameter-parameter seperti tenaga bebas Gibbs, ΔG° , entropi, ΔS° dan entalpi, ΔH° bagi proses jerapan ion

kuprum dan nikel ke atas peh-g-opefb. Nilai negatif bagi ΔG° , menunjukkan bahawa proses jerapan bagi kedua-dua ion adalah spontan. ΔS° yang bernilai positif menunjukkan sistem menjadi lebih rawak semasa proses jerapan berlaku manakala nilai ΔH° yang positif pula menunjukkan proses jerapan ion kuprum dan nikel yang bersifat endotermik. Kajian selektiviti telah dijalankan bagi ion kuprum atau nikel dengan mencampur ion tersebut secara berasingan dengan ion asing termasuk Na(I), Ca(II), Mg(II) dan Cr(III) dalam pelbagai kepekatan. Keputusan menunjukkan bahawa jerapan ion kuprum dan nikel tidak terjejas dengan kehadiran ion-ion asing tersebut walaupun pada kepekatan yang tinggi. Oleh yang demikian, peh-g-opefb merupakan penyerap yang berpotensi dan berguna untuk digunakan dalam pelbagai industri yang berkaitan dengan pelepasan logam toksik.

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I certify that an Examination Committee has met on **1st November 2012** to conduct the final examination of Ili Syazana bt Johari on her Master thesis entitled "Preparation and characterization of Poly(ethyl hydrazide) grafted oil palm empty fruit bunch for removal of copper and nickel ions from aqueous solutions" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the student be awarded the Master of Science.

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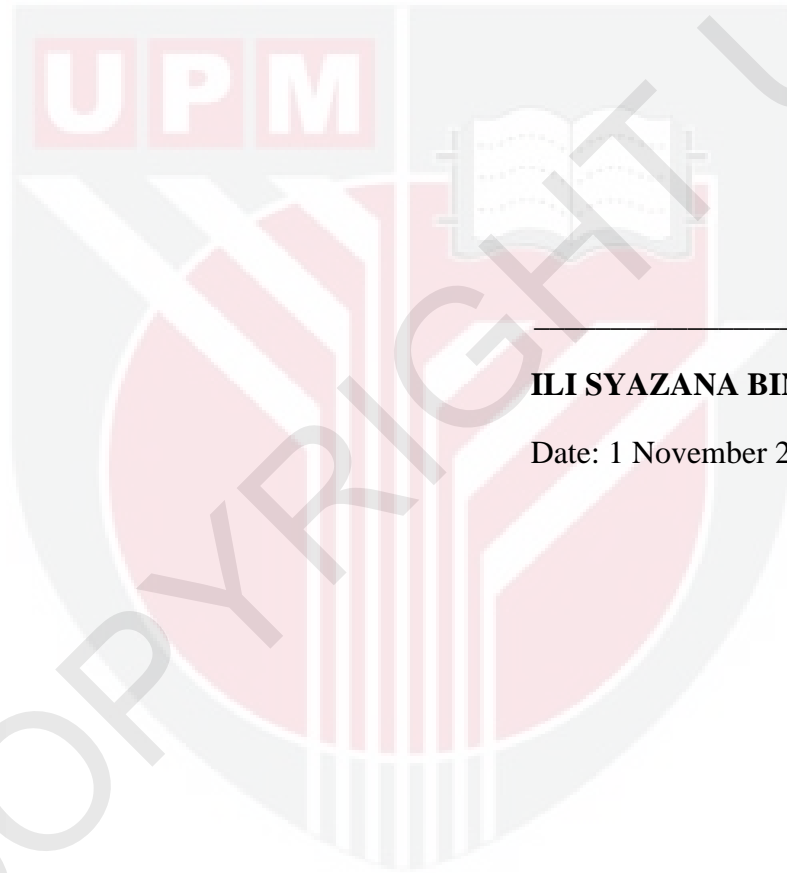
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DECLARATION

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 institution.



ILI SYAZANA BINTI JOHARI

Date: 1 November 2012

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