



UNIVERSITI PUTRA MALAYSIA

***EQUILIBRIUM AND KINETIC STUDIES OF METALLIC IONS AND
RESIDUAL OIL REMOVAL FROM PALM OIL MILL EFFLUENT USING
NATURAL ZEOLITE***

MOHAMMAD AMIN SHAVANDI

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RESIDUAL OIL REMOVAL FROM PALM OIL MILL EFFLUENT USING
NATURAL ZEOLITE**

By

MOHAMMAD AMIN SHAVANDI

**Thesis Submitted to the School of Graduate Studies, Universiti Putra
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Science**

August 2012

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Faculty: Engineering

The removal of heavy metals (Fe, Zn and Mn) and residual oil from palm oil mill effluent using natural zeolite was studied in this research. In order to evaluate the effectiveness of natural zeolite as a low cost and abundant adsorbent, different laboratory experiments were performed, including batch studies, desorption studies, equilibrium and kinetic tests, and column studies. Equilibrium studies show that, pH plays a major role in removal of both heavy metal and residual oil. Uptake of the tested heavy metals increased with pH and maximum removal was observed at pH 6.0, while maximum residual oil was removed at pH 3.0. Equilibrium data obtained from metal removal and oil removal followed the Langmuir and Freundlich isotherm models respectively while the kinetic data of both metal ions and oil removal were well described by the pseudo-second-order equation. The results obtained demonstrated that up to 70% of residual oil along with more than 50% of Zn(II) and Mn(II) and about 60% of Fe(III) could be removed by natural zeolite in the experiments. Column studies results also indicated that natural zeolite can be used for oil and heavy metal removal from flowing POME. The time of

breakthrough increased with a higher bed depth and slower flow rate. The Bohart and Adams model and the bed depth service time model (BDST) were used to estimate the experimental data.



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

**KAJIAN KESEIMBANGAN DAN KINETIK ION-ION LOGAM DAN SISA
MINYAK KAEDAH PENYINGKIRAN DARI EFLUEN KILANG MINYAK SAWIT
MENGUNAKAN ZEOLIT SEMULAJADI**

Oleh

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Penyingkiran logam berat (Fe, Zn dan Mn) dan sisa minyak daripada efluen kilang minyak sawit menggunakan zeolit semulajadi telah dikaji dalam kajian ini. Dalam usaha untuk menilai keberkesanan zeolit semulajadi sebagai bahan kos rendah dan mudah didapati, ujikaji makmal yang berbeza telah dijalankan, termasuk kajian kelompok, kajian penyahjerapan, ujian keseimbangan dan kinetik, dan kajian turus. Kajian keseimbangan menunjukkan bahawa, pH memainkan peranan utama dalam penyingkiran logam berat dan sisa minyak. Pengambilan logam berat diuji meningkat dengan pH dan penyingkiran maksimum diperhatikan pada pH 6.0, manakala sisa minyak maksimum disingkirkan adalah pada pH 3.0. Data keseimbangan yang diperolehi dari penyingkiran logam dan penyingkiran minyak masing-masing berdasarkan model isoterma Langmuir dan Freundlich manakala data kinetik penyingkiran logam dan minyak telah dihuraikan oleh persamaan pseudo peringkat kedua. Keputusan yang diperolehi menunjukkan sehingga 70% daripada sisa minyak serta lebih daripada 50% Zn (II) dan Mn (II) dan kira-kira 60% daripada Fe (III) boleh disingkirkan menggunakan zeolit semulajadi. Selain itu, keputusan

kajian turus juga menunjukkan bahawa zeolit semulajadi boleh digunakan untuk penyingkiran minyak dan logam berat daripada POME yang mengalir. Masa penemuan meningkat dengan kedalaman dasar yang lebih tinggi dan kadar aliran yang lebih perlahan. Model Bohart dan Adams dan model dasar kedalaman masa servis (BDST) telah digunakan untuk menganggarkan data eksperimen.



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I certify that a Thesis Examination Committee has met on 29 August 2012 to conduct the final examination of Mohammad Amin Shavandi on his thesis entitled “Removal of Metallic Ions and Residual Oil from Palm Oil Mill Effluent by Natural Zeolite” 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 degree of Master of Science.

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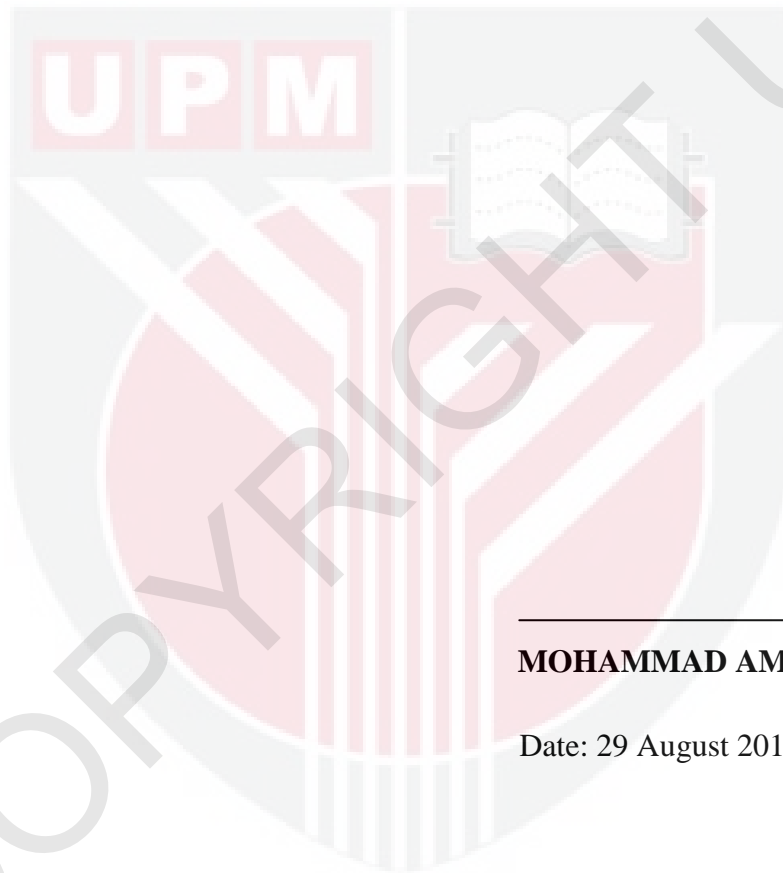
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DECLARATION

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.



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Date: 29 August 2012

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