ISOTHERM AND KINETIC STUDIES OF COOKING OIL ADSORPTION ONTO TREATED OIL PALM MESOCARP FIBERS

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In the Name of ALLAH, the most Gracious, the most Compassionate
(SUBHANALLAH, ALHAMDULILAH,ALLAHUAKBAR)
Indeed We have granted you a clear victory (1)
And grant you a might victory (3)
[Surah Al- Fath]

Dedicated this thesis to:

My super amazing and kind supervisor (Dr Mazidah Mamat), My beloved parents (As'ari b.Taib and Zainun Seman) and siblings. Special thanks go to my super caring friends.

Thanks for the endless love

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January 2017

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One of the major pollutants that deteriorate aquatic system quality is originated from cooking oil waste (COW). Moreover, the amount of cooking oil waste produced increased annually. Cooking oil waste discharges into drainage system without proper disposal method that blockage water system. An oil layer covers water surface and prevents the dissolution of oxygen which will be disturbing the aquatic system. Due to this improper cooking oil waste disposal method, a step must be taken to overcome this problem. Mostly, palm oil is extracted from the mesocarp of oil palm fruit, leaving behind the solid waste of oil palm mesocarp fiber (OPMF). Therefore, the ability of OPMF to adsorb cooking oil waste from synthetic oily wastewater was investigated. OPMF was collected from local oil palm mills and washed to remove dirt particles. Due to the presence of hydoxyl group in OPMFs, the fibers were subjected to alkali, peroxide and acetylation treatments to modify the hydrophilic characteristic of OPMF. The untreated and treated OPMFs were examined and characterized by scanning electron microscope (SEM), Fourier transform infrared spectrophotometer (FTIR), and accelerated surface area and porosity analyzer (ASAP). A detailed batch study was carried out at different OPMF

dosages and preset times for untreated and treated OPMFs. The study shows that amount of oil adsorbed onto the OPMF was increased proportionally with the increased of OPMF dosages. The equilibrium time were obtained at 100 minutes of adsorption for all OPMFs. Acetyl-treated OPMF shows the best adsorption capacity as compared to the untreated, and the treated alkali and peroxide OPMFs. The untreated OPMF was able to adsorb 58% of oil from synthetic oily water, while acetyl-treated-OPMF was found to adsorb up to 90% of oil compared to the alkali- and peroxide-treated that were recorded to adsorb 63% and 69% of oil, respectively. Equilibrium adsorption data were tested by four isotherms, namely the Langmuir, Freundlich, Temkin and Dubinin-Radushkevich. The equilibrium data for peroxide and acetyl-treated OPMF were defined well by the Freundlich isotherm model, with assumption that some heterogeneity on the both surface affects in oil adsorption. Temkin isotherm was fitted well with untreated OPMF suggests that increasing of surface coverage would drops linearly with heat of adsorption. For alkali-treated OPMF, Dubinin-Radushkevich is the best isotherm model which showing that physisorption contributes to the adsorption process. The adsorption kinetic tested for all OPMFs were found to follow the pseudo-second order kinetic model which considers that chemisorption plays important role as the rate controlling step between oil and OPMFs.

Abstrak tesis yang dikemukakan kepada Senat Universiti Malaysia Terengganu sebagai memenuhi keperluan untuk Ijazah Sarjana Sains

KAJIAN ISOTERMA DAN KINETIK BAGI PENJERAPAN MINYAK MASAK KE ATAS SERAT MESOKARPA KELAPA SAWIT TERAWAT

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Januari 2017

Penyelia Utama : **Mazidah Mamat, Ph.D**

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Pusat pengajian : **Pusat Pengajian Sains Asas**

Salah satu pencemaran utama yang merosakkan kualiti sistem akuatik berpunca daripada sisa mimyak masak (COW). Tambahan pula, jumlah sisa minyak masak yang dikeluarkan meningkat saban tahun. Pembuangan sisa minyak masak ke dalam sistem perparitan tanpa kaedah yang sistematik akan menyebabkan sistem air tersumbat. Lapisan minyak akan melindungi permukaan air dan menghalang penyerapan oksigen seterusnya mengganggu sistem akuatik. Langkah pencegahan haruslah diambil bagi menangani masalah ini. Kebiasaanya minyak sawit diekstrak daripada mesokarpa buah kelapa sawit yang ditinggalkan oleh sisa pepejal serat mesokarpa kelapa sawit (OPMF). Oleh kerana minyak sawit berasal daripada mesokarpa, keupayaan OPMF untuk menyerap sisa minyak dari sisa minyak sintetik telah dikaji. OPMF diperoleh daripada kilang kelapa sawit tempatan dan dibasuh bagi menyingkirkan partikel-partikel kotoran. Disebabkan oleh kehadiran kumpulan hidroksil dalam OPMF, rawatan beralkali, peroksida dan asetilasi telah dijalankan ke atas fiber untuk mengubah sifat hidrofiliknya. OPMF yang dirawat dan tidak dirawat telah diperiksa dan dicirikan menggunakan mikroskop imbasan elektron (SEM), spektroskopi inframerah Fourier-transform (FT-IR) dan analisa keliangan dan

kelajuan luas permukaan (ASAP). Satu siri kajian penjerapan minyak oleh OPMF yang dirawat dan tidak dirawat telah dijalankan menggunakan dos OPMF dan masa yang berbeza. Kajian menunjukkan peningkatan minyak yang diserap oleh OPMF meningkat seiring dengan pertambahan dos OPMF. Masa keseimbangan bagi semua OPMF adalah pada masa ke 100 minit. OPMF-asetil menunjukkan kapasiti penjerapan yang maksimum berbanding OPMF yang tidak dirawat, OPMF-beralkali dan OPMF-peroksida. OPMF yang tidak dirawat berupaya menyerap 58% minyak dari sintetik minyak masak, manakala OPMF-asetil menyerap sehingga 90% minyak berbanding 63% dan 69% masing-masing untuk OPMF-beralkali dan OPMF peroksida. Data penjerapan keseimbangan boleh dijelaskan melalui empat isoterma penjerapan iaitu Langmuir, Freundlich, Temkin dan Dubinin-Radushkevich isoterma. Data keseimbangan bagi OPMF-peroksida dan OPMF-asetil sesuai untuk isoterma penjerapan Freundlich dengan anggapan kepelbagaian permukaan bagi kedua-dua OPMF mempengaruhi penjerapan minyak. Isoterma penjerapan Temkin sesuai untuk OPMF tidak dirawat, dimana peningkatan liputan permukaan akan mengurangkan haba serapan secara linear. Bagi OPMF-beralkali, isoterma Dubinin-Radushkevich adalah yang terbaik bagi menunjukkan penjerapan fizikal menyumbang kepada proses penjerapan. Malah, kinetik penjerapan bagi semua OPMF adalah mematuhi model kinetik tertib kedua pseudo yang menganggap penjerapan kimia memainkan peranan penting bagi kadar pengawalan di antara minyak dan OPMF.