

ADSORPTION OF MERCURY FROM AQUEOUS SOLUTIONS USING ACTIVATED SLUDGE SOLIDS

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**ADSORPTION OF PHENOL FROM AQUEOUS SOLUTIONS
USING INCINERATED SEWAGE SLUDGE**

By

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**Thesis submitted to the School of Graduate Studies, Universiti Putra
Malaysia, in Fulfillment of the Requirements for the Degree of
Masters of Science**

November 2004

To mum and dad,

This is for you...

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ABSTRACT

A study had been carried out to determine the potential use of sewage sludge ash (SSA) as an adsorbent in removing phenol from aqueous solution. Parameters which contributed to affect phenol removal were initial phenol concentration, contact time, adsorbent dosage, pH and particle size of adsorbent. Results showed that the adsorption capacities of adsorbent (K_f) for phenol decreased from 14.89 mg/g to 0.68 mg/g as initial phenol concentration increased from 0.1 mg/l to 5.0 mg/l. Results revealed that solution with higher initial phenol concentration required longer time to reach equilibrium state. Adsorption capacity of adsorbent (K_f) decreased from 14.89 mg/g to 0.66 mg/g as contact time increased from 240 minutes to 1200 minutes. Furthermore, pH was found to affect the adsorption capacity where as pH decreased from original (9 - 12) to neutral (7 - 8), adsorption capacity of adsorbent increased from 0.68 mg/g to 3.0 mg/g. Moreover, it was shown that as particle size of adsorbent decreased from 150 - 212 μm to 63 - 149 μm , adsorption capacity of adsorbent (K_f) was decreased from 2.06 mg/g to 0.68 mg/g. Adsorption isotherm analysis showed that the experimental data fit Freundlich model in most conditions.

ABSTRAK

Kajian telah dilakukan untuk mengetahui potensi abu enapcemar kumbahan dalam penyingkiran "*phenol*" daripada larutan berair. Parameter-parameter yang mempengaruhi penyingkiran '*phenol*' terdiri daripada kepekatan awal "*phenol*", masa tindakbalas, dos penyerap, nilai pH dan saiz butiran penyerap. Keputusan menunjukkan bahawa kapasiti penyerapan abu enapcemar (K_f) bagi "*phenol*" menurun daripada 14.89 mg/g kepada 0.68 mg/g apabila kepekatan awal "*phenol*" meningkat daripada 0.1 mg/l kepada 5.0 mg/l. Keputusan mendedahkan bahawa larutan dengan kepekatan awal "*phenol*" yang lebih tinggi memerlukan lebih lama masa untuk mencapai keadaan keseimbangan. Kapasiti penyerapan bagi abu enapcemar (K_f) menurun daripada 14.89 mg/g kepada 0.66 mg/g apabila masa tindakbalas meningkat daripada 240 minit kepada 1200 minit. Selain itu, nilai pH didapati mempengaruhi kapasiti penyerapan iaitu apabila nilai pH menurun daripada keadaan semulajadi (9 - 12) kepada neutral (7 - 8), kapasiti penyerapan abu enapcemar meningkat daripada 0.68 mg/g kepada 3.0 mg/g. Selain daripada itu juga, telah ditunjukkan bahawa apabila taburan saiz butiran abu enapcemar menurun daripada 150 - 212 μm kepada 63 - 149 μm , kapasiti penyerapan abu enapcemar (K_f) menurun daripada 2.06 mg/g kepada 0.68 mg/g. Analisis penyerapan isoterma menunjukkan bahawa data ujikaji sesuai dengan model Freundlich dalam kebanyakan keadaan.

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I sincerely hope that this study will be a contribution toward the goal of better engineering in the field of water quality. I constantly remind myself of the following quote from Baba Diodum; "In the end we will conserve only what we love, we will love only what we understand and we will understand only what we are taught".

Should there be any omissions, I would like to offer my apologies in advance. There is little, apart from mistakes, for which I can claim credit. My contribution, if any, is in correlation and interpretation of the available information. Even on this there are bound to be differing views, because the entire scientific truth on the subject has not yet been revealed, and interpretations at variance do not imply criticism or disrespect.

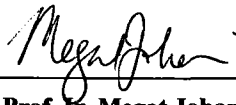
Finally, I would like to thank all people, whose have been helping me in this study and especially to my parent for giving me support in my life.

I certify that an Examination Committee met me on **3 November 2004** to conduct the final examination of **Wan Afnizan Bin Wan Mohamed** on his **Masters of Science** thesis entitled “**Adsorption of Phenol from Aqueous Solution Using Incinerated Sewage Sludge**” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:



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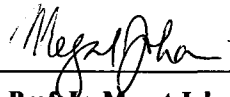
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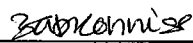
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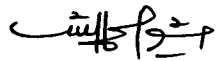


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DECLARATION

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



WAN AFNIZAN BIN WAN MOHAMED

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Figure C.7	pH for mixture was measured using pH-meter, Cyberscan 500, Singapore.	141
Figure C.8	UV spectrophotometer, Genesys™ 2PC, model 336003, USA.	141

LIST OF SYMBOLS

C_0	Initial phenol concentration (mg/l).
C_e	Phenol concentration in solution at equilibrium (mg/l).
K_d	The equilibrium constant.
K_f	Adsorption capacity (mg/g).
$1/n$	Adsorption intensity.
M_1	Phenol concentration of stock solution (mg/l).
M_2	Phenol concentration to be prepared (mg/l).
q_e	The amount of phenol adsorbed at equilibrium (mg/g).
q_m	The maximum adsorption capacity of adsorbent (mg/g).
V_1	Volume of solution needed to be taken from stock solution (ml).
V_2	Volume of distilled water to be added into diluted volumetric flask until it reached the mark (ml).
ϕ	Diameter.