



UNIVERSITI PUTRA MALAYSIA

**ADSORPTION OF CARBON DIOXIDE BY ACTIVATED
CARBON MODIFIED WITH MIXTURE OF Cu/Zn**

IMAN BAYESTI

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**MASTER OF SCIENCE
UNIVERSITI PUTRA MALAYSIA**

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

ADSORPTION OF CARBON DIOXIDE BY ACTIVATED CARBON MODIFIED WITH MIXTURE OF Cu/ Zn

By

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JANUARY 2013

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Faculty : Engineering

Because of the greenhouse effect, removal of carbon dioxide has become an important topic nowadays. In this study a fixed-bed column has been designed to adsorb the CO₂ from the mixture of CO₂/He. The adsorption characteristics of carbon dioxide on powder activated carbon have been measured over the temperature range of (30 to 50°C) at pressure up to 200 kPa in concentrations of CO₂ in ranging from 5 to 50%.

The commercial activated carbon was modified by impregnation of binary mixture of Cu/Zn with loading ranging from 4 to 20 %. The modification with mixture of Cu/Zn had significantly increased the adsorption capacity of CO₂. Also the breakthrough curves for single and mixture metals demonstrates that the CO₂ adsorption is higher when the modification is carried out when the mixture of Cu/Zn rather than single metals. The reason that pre-treatment is used is because the acid treatment affect the metal loading. The amount of metal loaded on the HNO₃ treated sample (HAC) is more than the original activated carbon (AC) sample. The adsorption capacity for original activated carbon in the temperature of 30°C, pressure of 100 kPa and 15% concentration of CO₂ is 1.52 mol/ kg and after 20% of metal loading the capacity increased to 2.25 mol/ kg. The adsorption

capacity decreased with increasing temperature, while increasing the CO₂ inlet concentration increase the amount of adsorption capacity. The adsorption capacity decreased with increasing temperature, while increasing the CO₂ inlet concentration increase of adsorption capacity. The adsorption capacity increased from 2.33 mol/kg at 150 kPa to 3.61 mol/kg at 200kPa. The deactivation model (DM) derived using the analogy between the adsorption of CO₂ and the deactivation of catalyst particles. Observed adsorption rate constants (K_s) and first-order deactivation rate constants (K_d) were obtained from the model. It was found that the deactivation model describes the experimental breakthrough curves very well. The isotherm was fitted well with either the Toth or Freundlich equation.

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

PENJERAPAN KARBON DIOKSIDA OLEH KARBON TERAKTIF DIUBAH SUAI DENGAN CAMPURAN Cu/Zn

Oleh

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Kerana kesan rumah hijau, penyingkiran karbon dioksida telah menjadi satu topik yang penting pada masa kini. Dalam kajian ini, kolum tetap katil telah direka untuk menjerap CO₂ dari campuran CO₂/He. Ciri-ciri penjerapan karbon dioksida ke atas karbon teraktif serbuk telah diukur sepanjang julat suhu (30-50°C) pada tekanan sehingga 200kPa dalam kepekatan CO₂ antara 5 hingga 50%.

Karbon teraktif komersil telah diubahsuai oleh penghamilan campuran perduaan Cu/Zn dengan muatan antara 4-20%. Pengubahsuaian dengan campuran Cu/Zn telah meningkat kapasiti penjerapan CO₂ dengan ketara. Kapasiti penjerapan bagi karbon teraktif asal pada suhu 30°C, tekanan 100 kPa dan kepekatan 15% CO₂ ialah 1.52 mol/kg dan kapasiti itu meningkat kepada 2.25 mol/kg selepas 20% logam dimuatkan. Kapasiti penjerapan menurun dengan peningkatan suhu, manakala peningkatan kepekatan inlet CO₂ meningkatkan jumlah kapasiti penjerapan. Kapasiti penjerapan akan meningkat dengan peningkatan tekanan operasi, pada suhu 30°C, tekanan 150 kPa untuk kepekatan 15% CO₂

dalam suapan, kapasiti penjerapan adalah 2.33 mol/kg, nilai ini meningkat 3.61 mol/kg pada tekanan 200 kPa. Model penyahaktifan (DM) telah diuji untuk kurva-kurva tersebut dengan menggunakan analogi antara penjerapan CO₂ dan penyahaktifan zarah pemangkin. Pemalar kadar penjerapan tertunjuk (K_s) dan pemalar pertama-order kadar penyahaktifan (K_d) telah diperolehi daripada model. Ia telah mendapati bahawa model penyahaktifan menerangkan kurva kejayaan eksperimen lebih tepat berbanding dengan sesuhu penjerapan yang ditunjukkan dalam kesusasteraan (Toth dan Freundlich).



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I certify that a Thesis Examination Committee has met on 17 January 2013 to conduct the final examination of Iman Bayesti on his thesis entitled "Adsorption of Carbon Dioxide by Activated Carbon Modified with the Mixture of Cu/Zn" in accordance with the Universities and University College 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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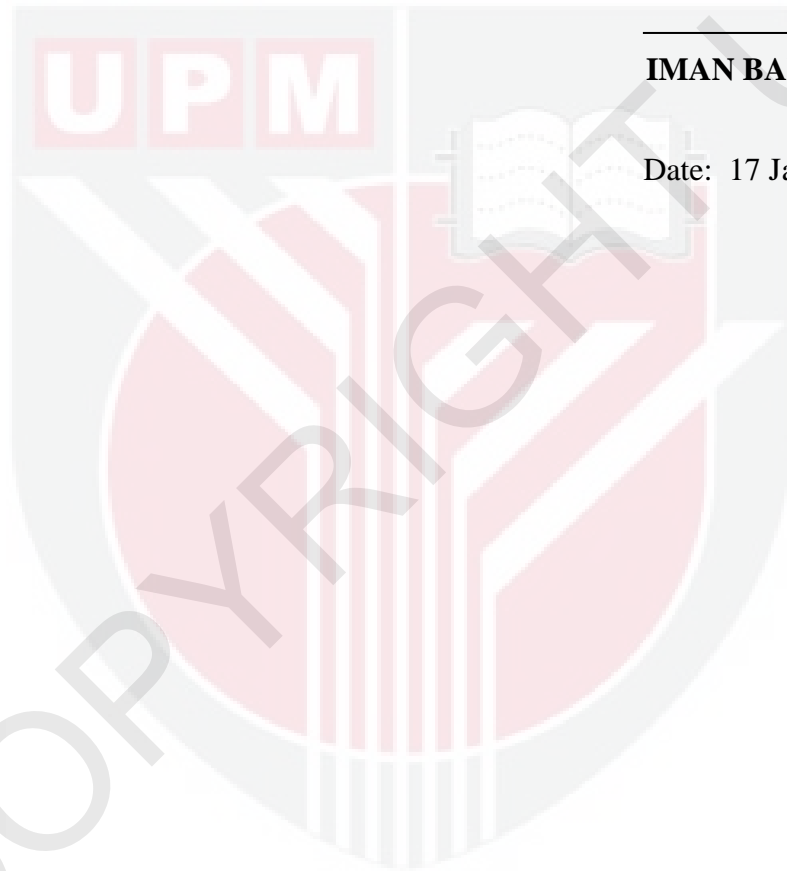
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DECLARATION

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 or concurrently submitted for any other degree at Universiti Putra Malaysia or other institutions.

IMAN BAYESTI

Date: 17 January 2013



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