

CATALYTIC PYROLYSIS OF WASHED PALM
PRESSED FIBER USING COBALT OXIDE COATED
ONTO SILICA CATALYST

RONNY LING LEH LUNG

SCHOOL OF BIOPROCESS ENGINEERING
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PRESSED FIBER USING COBALT OXIDE COATED
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by

RONNY LING LEH LUNG

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APPROVAL AND DECLARATION SHEET

This project report titled catalytic pyrolysis of washed palm pressed fiber (PPF) using cobalt oxide coated onto silica catalyst was prepared and submitted by Ronny Ling Leh Lung (Matrix Number: 071140857) and has been found satisfactory in terms of scope, quality and presentation as partial fulfillment of the requirement for the Bachelor of Engineering (Bioprocess Engineering) in Universiti Malaysia Perlis (UniMAP).

Checked and Approved by

(MDM. ALINA RAHAYU MOHAMED)
Project Supervisor

School of Bioprocess Engineering
Universiti Malaysia Perlis

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PIROLISIS BERMANGKIN BAGI FIBER KELAPA SAWIT TERTEKAN DALAM KEHADIRAN MANGKIN OKSIDA KOBALT DISALUTKAN KEPADA OKSIDA SILIKA

ABSTRAK

Fiber kelapa sawit tertekan (PPF) merupakan salah satu bahan buangan daripada industri pemrosesan kelapa sawit. Projek ini adalah untuk mengkaji tindak balas pirolisis bermangkin dari PPF dengan menggunakan mangkin oksida kobalt. Mangkin (Co/SiO_2) disediakan secara teknik “pengandungan basah” di mana mangkin oksida kobalt (II) disalutkan ke atas oksida silika dengan perkadaran 1:10. Eksperimen pirolisis dilakukan pada kategori yang berbeza (bermangkin dan tak-bermangkin) di mana suhu dikawal pada 450-550 °C dengan tempoh penahanan antara 30-90 saat di dalam reaktor. Kajian menunjukkan bahawa penghasilan bio-minyak melalui pirolisis bermangkin adalah lebih banyak jika dibandingkan dengan pirolisis tak-bermangkin. Hasil minyak-bio bagi pirolisis tak-bermangkin adalah sebanyak 47.5 % manakala hasil yang diperolehi melalui pirolisis bermangkin mencatat peratusan yang setinggi 49.5 %. Perisian “design expert” digunakan dalam kajian ini untuk menyaring parameter-parameter eksperimen yang memainkan peranan penting dalam penghasilan minyak-bio. Analisis varian (ANOVA) menunjukkan parameter yang memberi kesan positif terhadap penghasilan minyak-bio adalah suhu pirolisis (A), kategori (C) dan interaksi antara masa penahanan dan kategori (BC). Minyak-bio dianalisis dengan menggunakan spektroskopi inframerah pengubah Fourier (FTIR) untuk mengenalpasti kumpulan berfungsi yang hadir dalam minyak-bio. Berdasarkan kajian, sebatian yang didapati dalam minyak-bio ialah alkana, alkena, aldehid, keton, fenol dan alkohol. Sifat fizikal mangkin yang telah disintesis dijalankan dengan menggunakan mikroskop imbasan elektron (SEM) serta penyerakkan sinar-x (XRD). Analisis XRD menunjukkan bahawa Co/SiO_2 mempunyai struktur berhablur. Manakala analisis SEM menunjukkan bentuk mangkin yang tidak dapat dikenal pasti.

ABSTRACT

Palm pressed fiber (PPF) is one of the oil palm wastes of the rapidly expanding palm oil industry. The research describe in this paper is to investigate the behavior of catalytic pyrolysis of washed PPF using cobalt oxide catalyst. The catalyst was prepared by using wet-impregnation technique in which cobalt (II) oxide was coated onto silica oxide (Co/SiO₂) according to molar ratio 1:10. The pyrolysis experiments were carried out in a fixed bed tubular reactor under inert atmosphere at temperature range from 450 – 550 °C, holding time of 30 – 90s and category of catalytic and non-catalytic. It was found that the pyrolysis of washed PPF in the presence of catalyst can derived a higher yield of bio-oil than non-catalytic reaction. The highest percentage of bio-oil obtained for catalytic reaction was 49.5 %, whereas the highest yield of bio-oil for uncatalytic reaction was 47.5 %. This study uses Design Expert software to screen out the important parameters that play significant role in the production of bio-oil. From the analysis of variance (ANOVA), factors that imposed the most significant effect on the yield of bio-oil were pyrolysis temperature (A), category (C) and interaction between holding time and category (BC). The liquid products were analyzed by using fourier transform infrared (FTIR) spectroscopy to identify the functional groups of bio-oil. From the FTIR analysis, the major compounds found in the bio-oil were alkanes, alkenes, aldehydes, ketones, phenols and alcohols. The physical properties of the synthesized catalyst were analyzed using scanning electron microscope (SEM) and x-ray diffraction (XRD) method. SEM analysis revealed the indefinite shape of synthesized catalyst. For XRD analysis, the studied catalyst was a crystalline structure with lots of impurities.

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LIST OF SYMBOLS, ABBREVIATIONS OR NOMENCLATURE

PPF	Palm Pressed Fiber
EFB	Empty Fruit Bunch
FFB	Fresh Fruit Bunch
POM	Palm Oil Mill
DOE	Design of Experimental Software
SEM	Scanning Electron Microscope
XRD	X-ray Diffraction
LHV	Level Heating Value
FTIR	Fourier Transform Infrared Spectroscopy
NREL	National Renewable Energy Laboratory
ANOVA	Analysis of Variance
Std. Dev	Standard Deviation
3FI	Three Factor Interaction
d.f.	Degree of freedom
CV	Coefficient of Variation
A	Pyrolysis Temperature
B	Holding Time
C	Category