CARBON DIOXIDE GASIFICATION OF CELLULOSE

Wasan Cheewasukthaworn

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By:	Wasan Cheewasukthaworn
Program:	Petrochemical Technology
Thesis Advisors:	Asst. Prof. Boonyarach Kitiyanan
	Prof. Johannes Schwank
	Assoc. Prof. Pramoch Rangsunvigit
	Assoc. Prof. Vissanu Meeyoo
	Assoc. Prof. Thirasak Rirksomboon

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Nantaya Yanumet ..... College Director

(Assoc. Prof. Nantaya Yanumet)

Thesis Committee:

B. Kitiyanan .....

(Asst. Prof. Boonyarach Kitiyanan)

Pramoch R. .....

(Assoc. Prof. Pramoch Rangsunvigit)

.....

(Assoc. Prof. Vissanu Meeyoo)

.....

(Assoc. Prof. Thirasak Rirksomboon)

.....

(Prof. Johannes Schwank)

.....

(Asst. Prof. Sirirat Jitkanka)

Suksun Amornraksa .....

(Dr. Suksun Amornraksa)

ABSTRACT

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Keywords: Biomass/ Carbon dioxide/ Cellulose/ Gasification/ Dry reforming

Biomass can be converted to gaseous products via the gasification process. Major components of biomass are cellulose, hemi-cellulose and lignin. This work focused on the gasification of cellulose using CO_2 as the gasifying agent. Cellulose was gasified at specified temperatures ranging from 600 to 900 °C with ZSM-5, Fe, Co, and Co-Fe bimetallic as catalysts. The main gasification products were CO, CH_4 and H_2. An increase in gasifying temperature led to higher total gas yield and lower liquid yield. The use of CO_2 produced CO rich gas products. When steam was used as the gasifying agent, H_2 was produced more, while CO was produced less. The use of catalysts produced more CO and H_2 yields in the gas phase , and reduced the amount of liquid yield. Some light hydrocarbons such as ethylene, ethane, and propane were also found in the gaseous products. The liquid products from both CO_2 and steam gasification contained mainly aliphatic and alicyclic compounds, alcohols, esters, nitrogenated and oxygenated compounds.

บทคัดย่อ

วสันต์ ชีวาสุขถาวร : กระบวนการแกสิฟิเคชั่นของเซลลูโลสในสภาวะที่มีแก๊ซคาร์บอนไดออกไซด์ (Carbon dioxide Gasification of Cellulose) อ. ที่ปรึกษา : ผศ.ดร. บุนยรัชต์ กิติยานันท์, ศ.ดร. โจฮานเนส ชวางค์, รศ.ดร. วิษณุ มีอยู่, รศ.ดร. ปราโมช รังสรรค์วิจิตร และ รศ. ดร. ธีรศักดิ์ ฤกษ์สมบูรณ์ 96 หน้า ISBN 974-9937-07-4

งานวิจัยนี้ศึกษาถึงการแปรรูปของเซลลูโลสเป็นผลิตภัณฑ์ที่มีคุณค่าเพิ่มจากกระบวนการแกสิฟิเคชันในสภาวะที่มีแก๊ซคาร์บอนไดออกไซด์และใช้ตัวเร่งปฏิกิริยาได้แก่ เหล็ก, โคบอลท์, โลหะผสมของเหล็กกับโคบอลท์ และ ZSM-5 การศึกษานี้ได้ศึกษาถึงผลของอุณหภูมิ ตัวเร่งปฏิกิริยา และไอน้ำ จากการศึกษาพบว่าผลิตภัณฑ์หลักเกิดในรูปของก๊าซได้แก่ ไฮโดรเจน คาร์บอนมอนอกไซด์ และมีเทน การเพิ่มอุณหภูมิส่งผลให้ปริมาณผลิตภัณฑ์ในรูปก๊าซเพิ่มขึ้น ในขณะที่ผลิตภัณฑ์ในรูปของเหลว และของแข็งลดลง สำหรับกระบวนการแกสิฟิเคชันภายใต้บรรยากาศของก๊าซคาร์บอนไดออกไซด์จะให้สัดส่วนของก๊าซคาร์บอนมอนอกไซด์มากที่สุด ในขณะที่กระบวนการแกสิฟิเคชันภายใต้บรรยากาศของไอน้ำจะให้สัดส่วนของก๊าซไฮโดรเจน มากที่สุด ผลิตภัณฑ์ในรูปของเหลวจะลดลงเมื่อใช้ตัวเร่งปฏิกิริยา และจะให้ผลิตภัณฑ์ที่เป็นก๊าซ ไฮโดรเจน กับคาร์บอนมอนอกไซด์เพิ่มขึ้นเนื่องจากตัวเร่งปฏิกิริยามีส่วนช่วยส่งเสริมการเกิด ปฏิกิริยารีฟอร์มมิ่งของผลิตภัณฑ์ที่เป็นของเหลว จากการศึกษายังพบว่ามีสารไฮโดรคาร์บอน น้ำหนักเบาเช่น เอธิลีน อีเทน และ โพรเพนเกิดขึ้นในผลิตภัณฑ์ที่เป็นก๊าซ สำหรับผลิตภัณฑ์ที่เป็นของเหลวจะประกอบไปด้วยสารประกอบหลายประเภทเช่น อะลิฟาติก, อะลิไซคลิก, เอสเทอร์, แอลกอฮอล์, สารประกอบที่มีออกซิเจน และสารประกอบที่มีไนโตรเจน

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