

**TRANSESTERIFICATION OF VEGETABLE OIL TO BIODIESEL USING  
CaO-ZnO CATALYST**

Pathravut Klinklom

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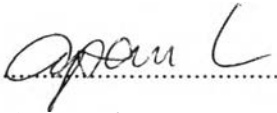
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**By:** Pathravut Klinklom  
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**Thesis Advisors:** Assoc. Prof. Apanee Luengnaruemitchai  
Captain Dr. Samai Jai-In

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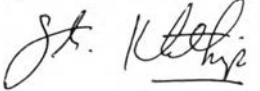
Accepted by The Petroleum and Petrochemical College, Chulalongkorn University, in partial fulfilment of the requirements for the Degree of Master of Science.

  
..... College Dean  
(Asst. Prof. Pomthong Malakul)

**Thesis Committee:**

  
.....  
(Assoc. Prof. Apanee Luengnaruemitchai)

  
.....  
(Captain Dr. Samai Jai-In)

  
.....  
(Dr. Sarawut Kaewtathip)

  
.....  
(Assoc. Prof. Pramoch Rangsunvigit)

## ABSTRACT

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CaO-ZnO catalysts (with various Ca:Zn atomic ratios of 1:5, 1:3, 1:1, and 3:1) was prepared by incipient-wetness impregnation (IWI) or co-precipitation (CP) method. The samples were evaluated to find the best CaO-ZnO catalyst for use in the transesterification of palm oil with methanol for biodiesel production under condition of 15:1 methanol to oil molar ratio, 6 wt% catalyst, reaction temperature at 60 °C, and reaction time of 8 h. The fresh and spent catalysts were characterized by several techniques, including BET method, CO<sub>2</sub>-TPD, TPR, SEM, XRF, FTIR, XRD and Hemmett Indicator. The effects of precursor concentration, type of precipitant, Ca:Zn atomic ratio and calcination temperature on the catalytic performance were studied. The highest FAME yield (83.82 and 81.73 % for IWI and CP catalysts, respectively) was obtained at the Ca:Zn atomic ratio of 1:3, and calcination temperature of 900 °C for IWI catalysts and 800 °C for CP catalysts, respectively. The results from characterization indicated that the activity of catalyst depended on their basic properties, particle size and surface area. However, surface area of CaO-ZnO catalyst slightly affected to the biodiesel yield.

## บทคัดย่อ

ภัทรารุณี กลิ่นกล่อม : การผลิตไบโอดีเซลจากน้ำมันพืชผ่านปฏิกิริยาทรานส์เอสเทอร์ฟิเคชันโดยใช้แคลเซียมออกไซด์-สังกะสีออกไซด์เป็นตัวเร่งปฏิกิริยา (Transesterification of Vegetable Oil to Biodiesel Using CaO-ZnO Catalyst) อ. ที่ปรึกษา : รศ. ดร. อาภาณี เหลืองนฤมิตชัย และ นาวาเอก ดร. สมัย ใจอินทร์ 84 หน้า

ในงานวิจัยนี้แคลเซียมออกไซด์-สังกะสีออกไซด์ (CaO-ZnO) (ที่อัตราส่วนแคลเซียม:สังกะสีเท่ากับ 1:5, 1:3, 1:1 และ 3:1) ถูกเตรียมผ่านกระบวนการ incipient-wetness impregnation (IWI) และ co-precipitation (CP) ตัวเร่งปฏิกิริยาดังกล่าวถูกนำมาทดสอบเพื่อหาสภาวะที่เหมาะสมในการเตรียมตัวเร่งปฏิกิริยาเพื่อใช้ในการทำปฏิกิริยาทรานส์เอสเทอร์ฟิเคชันเพื่อผลิตไบโอดีเซลระหว่างน้ำมันปาล์มกับเมทานอลที่อัตราส่วนโดยโมลระหว่างเมทานอลกับน้ำมันเท่ากับ 15:1 ปริมาณตัวเร่งปฏิกิริยาร้อยละ 6 โดยน้ำหนัก อุณหภูมิในการเกิดปฏิกิริยา 60 องศาเซลเซียส และเวลาที่ใช้ในการทำปฏิกิริยา 8 ชั่วโมง ตัวเร่งปฏิกิริยาที่ยังไม่ได้ใช้และตัวเร่งปฏิกิริยาที่ใช้แล้วถูกพิสูจน์เอกลักษณ์โดยใช้เทคนิคต่างๆ ประกอบด้วย CO<sub>2</sub>-TPD, TPR, SEM, XRF, FTIR, XRD และ Hemmett Indicator นอกจากนี้ยังได้ศึกษาผลของความเข้มข้นของสารตั้งต้นในการเตรียมตัวเร่งปฏิกิริยา ชนิดของตัวทำให้ตกตะกอน อัตราส่วนโดยอะตอมของแคลเซียม:สังกะสี และอุณหภูมิในการเผาของตัวเร่งปฏิกิริยาต่อประสิทธิภาพในการเร่งปฏิกิริยาของตัวเร่งปฏิกิริยาชนิดแคลเซียมออกไซด์-สังกะสีออกไซด์ จากผลการทดลองพบว่าร้อยละของไบโอดีเซลที่สูงที่สุด (83.82 และ 81.73 สำหรับตัวเร่งปฏิกิริยาที่ถูกเตรียมด้วยวิธี IWI และ CP ตามลำดับ) เกิดจากการใช้อัตราส่วนของแคลเซียม:สังกะสี เท่ากับ 1:3 ใช้อุณหภูมิในการเผา 900 องศาเซลเซียสสำหรับตัวเร่งปฏิกิริยาที่ถูกเตรียมด้วยวิธี IWI และ 800 องศาเซลเซียสสำหรับตัวเร่งปฏิกิริยาที่ถูกเตรียมด้วยวิธี CP จากผลการพิสูจน์เอกลักษณ์ของตัวเร่งปฏิกิริยาพบว่าประสิทธิภาพในการเร่งปฏิกิริยาทรานส์เอสเทอร์ฟิเคชันขึ้นอยู่กับคุณสมบัติความเป็นเบส ขนาดของอนุภาค และพื้นที่ผิวสัมผัสของตัวเร่งปฏิกิริยา อย่างไรก็ตามในงานวิจัยชิ้นนี้พบว่าพื้นที่ผิวสัมผัสของตัวเร่งปฏิกิริยาส่งผลเพียงเล็กน้อยต่อประสิทธิภาพในการเร่งปฏิกิริยาของตัวเร่งปฏิกิริยาชนิดแคลเซียมออกไซด์-สังกะสีออกไซด์

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