

**CATALYTIC CONVERSION OF JATROPHA OIL TO BIO-JET FUEL
OVER Pt, Ru, AND Ir SUPPORTED CATALYSTS**



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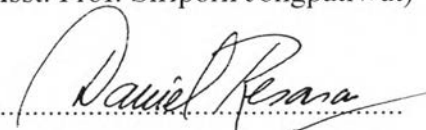
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ABSTRACT

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Teerarut Montai: Catalytic Conversion of Jatropha Oil to Bio-jet Fuel over Pt, Ru, and Ir Supported Catalysts

Thesis Advisors: Asst. Prof. Siriporn Jongpatiwut, Prof. Danial E. Ressayco, and Prof. Somchai Osuwan 66 pp.

Keywords: Deoxygenation/ Bio-jet Fuel/ Hydrocracking/ Hydroisomerization/ Pt/Al₂O₃/ Pt/H-Y/ Y Zeolite/ Jatropha Oil

Bio-jet fuel (jet fuel derived from biomass) is an interesting alternative for future aviation fuels. In this work, the production of bio-jet fuel from jatropha oil was studied using bifunctional catalysts including, Pt/Al₂O₃, Pt/F-Al₂O₃, Pt/H-Y, Ir/H-Y, Ru/H-Y, and H-Y. The catalysts were prepared by incipient wetness impregnation and characterized by TPR, TPD, TPO, TGA, and BET. The prepared catalysts were tested in a continuous flow packed-bed reactor at 325-400°C, 500-600 psig, liquid hourly space velocity (LHSV) of 0.5-1.0 h⁻¹, and H₂/feed molar ratio of 38. The major products obtained over Pt/Al₂O₃, Pt/F-Al₂O₃, Ir/H-Y, Ru/H-Y, and H-Y were n-heptadecane (n-C17) and n-pentadecane (n-C15) which are in the diesel specification range. The promotion of fluorine resulted in higher selectivity to isomerized products but it did not improve the cracking activity, required to produce bio-jet fuel. Pt/H-Y catalyst gave a major fraction of light hydrocarbons which could result from its stronger acidity. Moreover, fatty acids and fatty alcohols were observed as intermediates of the reaction. Based on this result, bio-jet fuel has the possibility to be produced over Pt/H-Y catalyst. The optimum reaction condition over the Pt/H-Y catalyst was found at 375 °C, 550 psig, and 0.5 h⁻¹.

บทคัดย่อ

ธีรรัตน์ มอญใต้ : การผลิตน้ำมันไบโอดีเซลจากน้ำมันเมล็ดสบู่ดำโดยใช้ตัวเร่งปฏิกิริยา Pt, Ru และ Ir บนตัวรองรับ (Catalytic Conversion of Jatropha Oil to Bio-jet Fuel over Pt, Ru, and Ir Supported Catalysts) อ. ที่ปรึกษา : ผศ. ดร. ศิริพร จงผาคิวฒิ ศ. ดร.แคเนียล รีซัสโก้ และ ศ. ดร. สมชาย โอสุวรรณ 66 หน้า

ปัจจุบันน้ำมันไบโอดีเซลที่ผลิตจากชีวมวลมีความน่าสนใจในการผลิตเพื่อนำมาใช้เป็นเชื้อเพลิงทดแทนในเครื่องบินสำหรับอนาคต งานวิจัยนี้ศึกษาการผลิตน้ำมันไบโอดีเซลจากน้ำมันเมล็ดสบู่ดำโดยใช้ตัวเร่งปฏิกิริยาชนิดที่มีโลหะและกรด ได้แก่ Pt/Al₂O₃, Pt/F-Al₂O₃, Pt/H-Y, Ir/H-Y, Ru/H-Y, และ H-Y ตัวเร่งปฏิกิริยาดังกล่าวเตรียมโดยใช้วิธีการฝังแบบขึ้น และทำการวิเคราะห์ตัวเร่งปฏิกิริยาโดยใช้เทคนิค TPR, TPD, TPO, TGA, และ BET ตัวเร่งปฏิกิริยาที่เตรียมขึ้นจะถูกนำมาทดสอบความว่องไวในการเร่งปฏิกิริยาโดยใช้เครื่องปฏิกรณ์แบบบดนิ่งชนิดไหลต่อเนื่อง ที่สภาวะ อุณหภูมิ 325-400 องศาเซลเซียส, ความดัน 500-600 ปอนด์ต่อตารางนิ้ว, สัดส่วนสารป้อนต่อปริมาณตัวเร่งปฏิกิริยา (LHSV) 0.5-1.0 ต่อชั่วโมง, และ อัตราส่วนโดยโมลระหว่างไฮโดรเจนกับสารที่ป้อนเท่ากับ 40 ผลิตภัณฑ์หลักที่พบโดยใช้ตัวเร่งปฏิกิริยา Pt/Al₂O₃, Pt/F-Al₂O₃, Ir/H-Y, Ru/H-Y, และ H-Y คือ เฮปตะเดเคน (n-C17) และ เพนตะเดเคน (n-C15) ซึ่งเป็นผลิตภัณฑ์ที่อยู่ในช่วงของน้ำมันดีเซล ในส่วนของการเพิ่มเติมฟลูออรีนลงในตัวรองรับอะลูมินาพบว่าให้ผลิตภัณฑ์ที่เป็นไฮโดรคาร์บอนที่มีกิ่งมากขึ้นแต่ไม่มีผลในการปรับปรุงความสามารถในการเกิดปฏิกิริยาไฮโดรแครกกิง ตัวเร่งปฏิกิริยา Pt/H-Y ให้ผลิตภัณฑ์ในช่วงของไฮโดรคาร์บอนเบาเนื่องจากความเป็นกรดของตัวเร่งปฏิกิริยาเอง นอกจากนี้ยังพบกรดไขมันอิสระ แอลกอฮอล์ และอนุพันธ์เกิดเป็นสารมัธยันต์ของปฏิกิริยาอีกด้วย และจากผลการทดลองดังที่กล่าวมาแล้วพบว่าตัวเร่งปฏิกิริยา Pt/H-Y เป็นตัวเร่งปฏิกิริยาที่มีความเป็นไปได้ในการนำมาพัฒนาในการผลิตน้ำมันไบโอดีเซลซึ่งสภาวะที่เหมาะสมในการผลิตคือที่อุณหภูมิ 375 องศาเซลเซียส ความดัน 550 ปอนด์ต่อตารางนิ้ว และ สัดส่วนสารป้อนต่อปริมาณตัวเร่งปฏิกิริยา 0.5 ต่อชั่วโมง

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