

**DEOXYGENATION OF BEEF FAT FOR THE PRODUCTION OF
HYDROGENATED BIODIESEL OVER Pd AND NiMo CATALYSTS:
EFFECT OF CATALYST SUPPORT**



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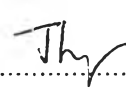
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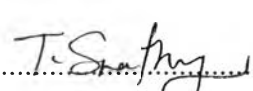
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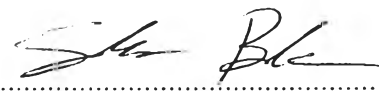
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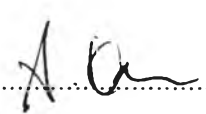

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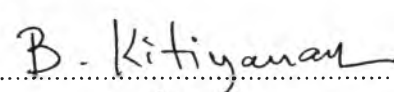
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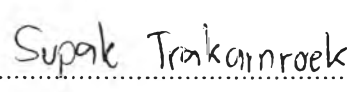

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ABSTRACT

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Rutkorn Chinsutthi: Deoxygenation of Beef Fat for the Production of Hydrogenated Biodiesel over Pd and NiMo Catalysts: Effect of Catalyst Support

Thesis Advisors: Asst. Prof. Siriporn Jongpatiwut, Asst. Prof. Thammanoon Sreethawong, Dr. Suchada Butnark, and Prof. Somchai Osuwan 73 pp.

Keywords: Deoxygenation/ Pd/Al₂O₃/ SiO₂/ TiO₂/ C/ KL/ Triglyceride/ Hydrogenated biodiesel/ Beef fat/ Pd catalysts/ NiMo catalysts

Hydrogenated biodiesel is one of the biofuels not containing oxygen in its molecules. The absence of oxygen leads to many advantages such as high cetane number, high heating value, and high miscibility with fossil fuels. In this research, the effect of catalyst supports on the production of hydrogenated biodiesel using beef fat as feedstock has been investigated. Pd-based catalysts (Pd/Al₂O₃, Pd/F-Al₂O₃, Pd/SiO₂, Pd/TiO₂, Pd/C, and Pd/KL) and NiMo-based catalysts (i.e. NiMo/Al₂O₃, NiMo/F-Al₂O₃, NiMo/SiO₂, NiMo/TiO₂, NiMo/C, and NiMo/CeO₂-ZrO₂) were prepared by incipient wetness impregnation. The fresh and spent catalysts were characterized by XRD, TPR, BET, and TPO. The prepared catalysts were tested in a continuous flow packed-bed reactor at 500 psig, 325 °C, H₂/feed molar ratio of 30, and LHSV 1 h⁻¹. The products obtained from all catalysts were hydrocarbons in diesel specification range. The results showed that by varying catalyst supports the corresponding catalyst had different properties in term of surface area and metal particle size. The triglyceride conversion increased with decreasing Pd crystallite size. However, hydrocarbon selectivity was not significantly changed with catalyst supports. The main products from Pd catalysts were heptadecane and pentadecane, resulting from hydrodecarbonylation. Among Pd catalysts, Pd/TiO₂ exhibited the highest hydrocarbon yield. For NiMo catalysts, octadecane and hexadecane were the main hydrocarbon products, resulting from hydrodeoxygenation.

บทคัดย่อ

รัตนกรณีย์ ชินสุทธิ : การกำจัดออกซิเจนออกจากไขมันวัวในเครื่องปฏิกรณ์แบบต่อเนื่อง เพื่อผลิตไฮโดรจีเนตเตทไบโอดีเซล : (Deoxygenation of Beef Fat for the Production of Hydrogenated Biodiesel over Pd and NiMo Catalysts: Effect of Catalyst Support)
 อ. ที่ปรึกษา: ผศ. ดร. ศิริพร จงผาคิวฒิ ผศ. ดร. ธรรมบุญ ศรีทะวงศ์ ดร.สุชาดา บุตรนาค และ ศ. ดร.สมชาย ไอสุวรรณ 73 หน้า

ไฮโดรจีเนตเตทไบโอดีเซลเป็นน้ำมันชีวมวลที่ไม่มีออกซิเจนอยู่ในโครงสร้างโมเลกุล ทำให้มีคุณสมบัติที่ดีกว่าไบโอดีเซลทั่วไป เช่น ค่าซีเทนสูง ค่าพลังงานความร้อนสูงและมีความสามารถในการผสมรวมกับน้ำมันดีเซลที่ได้จากปิโตรเลียมดี งานวิจัยนี้ศึกษาตัวรองรับในตัวเร่งปฏิกิริยาที่มีผลต่อการผลิตไฮโดรจีเนตเตทไบโอดีเซลจากไขมันวัวผ่านกระบวนการคือออกซิเจนชัน ตัวเร่งปฏิกิริยาที่มีโลหะพัลลาเดียมบนตัวรองรับหลายชนิด (Pd/Al₂O₃, Pd/F-Al₂O₃, Pd/SiO₂, Pd/TiO₂, Pd/C, และ Pd/KL) และตัวเร่งปฏิกิริยาที่มีโลหะนิกเกิลกับ โมลิบดีนัมบนตัวรองรับหลายชนิด (NiMo/Al₂O₃, NiMo/F-Al₂O₃, NiMo/SiO₂, NiMo/TiO₂, NiMo/C, และ NiMo/CeO₂-ZrO₂) เตรียมโดยวิธีการฝังแบบขึ้น ตัวเร่งปฏิกิริยาก่อนและหลังทำปฏิกิริยาจะถูกวิเคราะห์โดยใช้เทคนิค XRD, TPR, BET, และ TPO และถูกทดสอบความว่องไวในการทำปฏิกิริยาโดยใช้เครื่องปฏิกรณ์แบบไหลต่อเนื่องชนิดเบดนิ่งที่สภาวะความดัน 500 ปอนด์ต่อตารางนิ้ว อุณหภูมิ 325 องศาเซลเซียส อัตราส่วนโดยโมลระหว่างไฮโดรเจนกับสารที่ป้อนเท่ากับ 30 และอัตราการไหลของสารป้อนต่อปริมาตรตัวเร่งปฏิกิริยาเท่ากับ 1 ต่อชั่วโมง ผลิตภัณฑ์ของเหลวที่ได้จากตัวเร่งปฏิกิริยาทุกตัวเป็นไฮโดรคาร์บอนอยู่ในช่วงน้ำหนักโมเลกุลจากผลการทดลองพบว่าตัวรองรับมีผลทำให้ตัวเร่งปฏิกิริยามีคุณสมบัติแตกต่างกันในด้านพื้นที่ผิวและขนาดของผลึกของตัวเร่งปฏิกิริยา การเปลี่ยนไครกไลเซอไรด์ไปเป็นผลิตภัณฑ์เพิ่มขึ้นเมื่อขนาดผลึกของโลหะพัลลาเดียมลดลง อย่างไรก็ตามการเลือกเกิดไฮโดรคาร์บอนไม่ขึ้นกับตัวรองรับ ตัวเร่งปฏิกิริยาที่มีโลหะพัลลาเดียมมีเฮปตะเดเคนและเพนตะเดเคนเป็นผลิตภัณฑ์หลักเป็นผลมาจากการเกิดปฏิกิริยาไฮโดรคาร์บอนิลเลชัน เมื่อเทียบในกลุ่มตัวเร่งปฏิกิริยาที่มีโลหะพัลลาเดียมพบว่า Pd/TiO₂ ให้สัดส่วนผลิตภัณฑ์ที่เป็นไฮโดรคาร์บอนสูงสุด สำหรับตัวเร่งปฏิกิริยาที่มีโลหะนิกเกิลกับ โมลิบดีนัมได้ออกตะเดเคนและเฮกซะเดเคนเป็นผลิตภัณฑ์หลักเนื่องจากเกิดปฏิกิริยาไฮโดรคือออกซิเจนชัน

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