

**DEOXYGENATION OF BEEF FAT FOR THE PRODUCTION OF
HYDROGENATED BIODIESEL: EFFECT OF ACTIVE METALS**



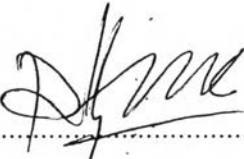
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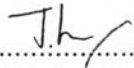
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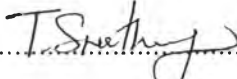
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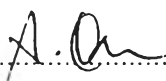

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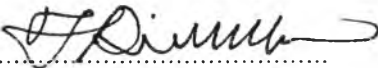
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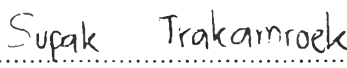

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ABSTRACT

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The production of hydrogenated biodiesel through the catalytic deoxygenation of vegetable oil has been extensively studied; however, the study of animal fats as feedstock is still limited. The objective of this research is to investigate the catalytic deoxygenation of animal fats (beef tallow) to hydrogenated biodiesel over various alumina-supported active metal catalysts, i.e. Ni-based catalysts (Ni, NiMo, NiCo, NiCu, NiW, NiRu, NiRh, NiIr), Cu-based catalysts (Cu, CuMo, CuCo, CuW, CuZn), Pt, and Pd. All catalysts were prepared by sequential incipient wetness impregnation. The prepared catalysts were tested for their catalytic activity in a continuous flow packed-bed reactor for 12 h at 325°C, 500 psig, LHSV of 1 h⁻¹, and H₂-to-feed molar ratio of 30. The results show that all catalysts gave the products in the diesel specification range. The monometallic Ni/Al₂O₃, Pt/Al₂O₃, and Pd/Al₂O₃ catalysts gave high selectivity towards hydrodecarbonylation reaction, which resulted in n-heptadecane (n-C17) and n-pentadecane (n-C15). On the other hand, the Cu-based catalysts gave high selectivity towards hydrodeoxygenation reaction, which resulted in n-octadecane (n-C18) and n-hexadecane (n-C16). The presence of second metals could alter the reaction pathway depending on the reactivity of second metals. In addition, the presence of second metals could reduce the coke formation over Ni-based and Cu-based catalysts.

บทคัดย่อ

วิทยุศักดิ์ ประระวรรณ : การผลิตไฮโดรจีเนตเตทไบโอดีเซลโดยใช้ไขมันวัว: ผลของชนิดโลหะธาตุ (Deoxygenation of Beef Fat for the Production of Hydrogenated Biodiesel: Effect of Active Metals) อ. ที่ปรึกษา: ผศ. ดร. ศิริพร จงผาดิวุฒิ ผศ. ดร. ธรรมบุญ ศรีทะวงศ์ ดร.สุชาดา บุตรนาค และ ศ. ดร. สมชาย โอสุวรรณ 99 หน้า

การผลิตไฮโดรจีเนตเตทไบโอดีเซล จากน้ำมันพืชโดยผ่านปฏิกิริยาการกำจัดออกซิเจนออก ได้มีการศึกษาอย่างกว้างขวางแต่อย่างไรก็ตามการศึกษาการใช้ไขมันสัตว์เป็นวัตถุดิบนั้นยังคงมีอย่างจำกัด ดังนั้นวัตถุประสงค์ของการวิจัยนี้คือการตรวจสอบปฏิกิริยาการกำจัดออกซิเจนของไขมันวัว เพื่อผลิตไฮโดรจีเนตเตทไบโอดีเซลโดยใช้ตัวเร่งปฏิกิริยาโลหะบนพื้นผิวอะลูมินา ซึ่งประกอบด้วย กลุ่มตัวเร่งปฏิกิริยาโลหะนิกเกิล (NiMo NiCo NiCu NiW NiRu NiRh NiIr) กลุ่มตัวเร่งปฏิกิริยาโลหะทองแดง (Cu CuMo CuCo CuW CuZn) และตัวเร่งปฏิกิริยาโลหะชั้นสูง เช่น แพลตตินัม และ พัลเลเดียม โดยที่ตัวเร่งปฏิกิริยาที่ใช้ได้เตรียมโดยวิธีฝังชั้นและฝังชั้นแบบลำดับ สำหรับตัวเร่งปฏิกิริยาที่ประกอบด้วยโลหะสองชนิด ตัวเร่งปฏิกิริยาที่ได้เตรียมไว้ได้ทำการทดสอบการเร่งปฏิกิริยาในเครื่องปฏิกรณ์ที่มีการไหลของสารตั้งต้นอย่างต่อเนื่องเป็นเวลา 12 ชั่วโมงที่อุณหภูมิ 325 องศาเซลเซียส ความดันในระบบ 500 ปอนด์ต่อตารางนิ้ว อัตราการไหลของเหลวที่เป็นสารตั้งต้น 1 มิลลิลิตรต่อกรัมของตัวเร่งปฏิกิริยาต่อชั่วโมง และ อัตราส่วนโดยโมลของไฮโดรเจนต่อสารตั้งต้น คือ 30 ผลแสดงให้เห็นว่าตัวเร่งปฏิกิริยาที่ใช้ได้ให้ผลิตภัณฑ์ทั้งหมดที่อยู่ในช่วงสเปคของน้ำมันดีเซล

ตัวเร่งปฏิกิริยาโลหะนิกเกิล (Ni) พัลเลเดียม (Pd) และ แพลตตินัม (Pt) บนอะลูมินา ให้การเลือกในการเกิดปฏิกิริยาไฮโดรดีคาร์บอนิลเลขชั้นสูงซึ่งส่งผลให้ได้ผลิตภัณฑ์เฮปตะเดคคาเคนที่เป็นโซ่ตรง (n-C17) และเพนตะเดคเคนที่เป็นโซ่ตรง (n-C15) ในทางกลับกันกลุ่มตัวเร่งปฏิกิริยาทองแดงที่ใช้ให้การเลือกในการเกิดปฏิกิริยาไฮโดรดีออกซิเจนชั้นที่ก่อให้เกิดออกตะเดคเคนที่เป็นโซ่ตรง (n-C18) และเฮกซะเดคเคนที่เป็นโซ่ตรง (n-C16) การเพิ่มของตัวโลหะตัวที่สอง สามารถที่จะเปลี่ยนเส้นทางปฏิกิริยาที่เกิดขึ้น ได้ซึ่งขึ้นอยู่กับการทำปฏิกิริยาของโลหะตัวที่สองด้วย นอกจากนี้การที่มีโลหะตัวที่สองสามารถลดการเกิดไค้กบนตัวเร่งปฏิกิริยาโลหะนิกเกิล (Ni) และโลหะทองแดง (Cu) ได้

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