

**FORMULATION OF HETEROGENEOUS CATALYSTS FROM NATURAL
AND SYNTETIC MATERIALS FOR BIODIESEL PRODUCTION**



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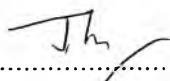
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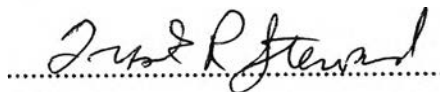
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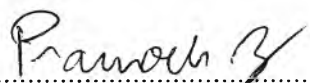
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ABSTRACT

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Naravit Leukosol: Formulation of Heterogeneous Catalysts from Natural and Synthetic Materials for Biodiesel Production.

Thesis Advisors: Assoc. Prof. Thirasak Rirksomboon, Asst. Prof. Siriporn Jongpatiwut, Assoc. Prof. Laura Romero-Zerón, and Prof. Frank R. Steward. 60 pp.

Keywords: Biodiesel/ Heterogeneous Catalyst/ Metal Oxide/ Crustacean Shell/ Mollusk Shell/Combination

The transesterification of canola oil with methanol at various conditions such as types of catalysts, catalysts concentrations, reaction temperatures, and the ratios of metal oxide to natural material as a catalyst were investigated in this work. A series of alkaline earth and transition metal oxides including complex transition metal oxides were used as synthetic catalysts. The natural materials used were animal shell, crustacean shell and mollusk shell. The reaction temperatures were set to 45°C, 55°C, and 65°C. The reaction times evaluated were 30 and 60 minutes. The methanol to oil molar ratio, mixing rate and reaction pressure were kept constant at 6:1, 800 rpm, and 15 psig under nitrogen atmosphere, respectively. The ¹H-NMR spectroscopy was used to identify the biodiesel product and calculate the yield percentage. The experimental results demonstrated that the combination of metal oxide 1 (M1O) and crustacean shell type 1 (CS1) as well as the combination of metal oxide 1 (M1O) and crustacean shell type 2 (CS2) improved the biodiesel yield at 45°C, 30 minutes. In addition, some of the metal oxides and metal carbonates combinations could achieve a higher biodiesel yield as compared to the yield obtained from the use of M1O alone.

บทคัดย่อ

นรวิศ เหลือโกศล : การสร้างตัวเร่งปฏิกิริยาแบบวิวิธพันธ์ โดยใช้วัสดุจากธรรมชาติ และวัสดุสังเคราะห์ สำหรับการผลิตไบโอดีเซล (Formulation of Heterogeneous Catalysts from Natural and Synthetic Materials for Biodiesel Production) อาจารย์ที่ปรึกษา: รศ. ดร. ชีรศักดิ์ ฤกษ์สมบูรณ์, ผศ. ดร.ศิริพร จงผาคิวภูมิ, รศ. ดร. ลอรร่า โรมิโร-ซีรอน และ ศ. ดร. แฟรงค์ ริชาร์ด สจ๊วต

งานวิจัยชิ้นนี้ ได้ทำการศึกษาเกี่ยวกับปฏิกิริยาทรานเอสเทอร์ฟิเคชัน ระหว่างน้ำมันพืช (คาโนลา) กับเมทานอล ด้วยตัวเร่งปฏิกิริยาแบบวิวิธพันธ์ชนิดต่าง ๆ โดยทำการศึกษาผลจากการใช้ตัวเร่งปฏิกิริยาชนิดต่าง ๆ, ปริมาณของตัวเร่งปฏิกิริยา, อุณหภูมิของปฏิกิริยา, และอัตราส่วนระหว่างออกไซด์ของโลหะ กับวัสดุจากธรรมชาติ ซึ่งออกไซด์ของโลหะหมู่สอง และออกไซด์ของสารประกอบเชิงซ้อนบางชนิดถูกนำมาใช้เป็นสารเร่งปฏิกิริยา ทั้งนี้วัสดุธรรมชาติที่นำมาใช้นั้นเตรียมมาจาก เปลือกหอย เปลือกปู และเปลือกไข่ อุณหภูมิที่ใช้ในการทดลองแบ่งออกเป็นสามช่วงคือ 45, 55, และ 65 องศาเซลเซียส โดยระยะเวลาของปฏิกิริยาได้ถูกแบ่งเป็นสองช่วงคือ 30 และ 60 นาที ทั้งนี้อัตราส่วนระหว่างเมทานอล และน้ำมันคาโนลา ได้ถูกกำหนดคงตัว ไว้ที่ 6 ต่อ 1 เช่นเดียวกับอัตราการกวนที่ 800 รอบต่อนาที ภายใต้บรรยากาศไนโตรเจนที่ 15 ปอนด์ต่อตารางนิ้ว การคำนวณร้อยละผลได้ของปฏิกิริยา จากนิวเคลียร์แมกเนติกเรโซแนนซ์สเปคโตรมิเตอร์ ซึ่งจากผลการทดลองที่ได้ พบว่า สารเร่งปฏิกิริยาผสมที่ทำจาก ออกไซด์โลหะชนิดที่ 1 (M1O) กับเปลือกกุ้งชนิดที่ 1 (C1S) และออกไซด์โลหะชนิดที่ 1 (M1O) กับเปลือกกุ้งชนิดที่ 2 (C2S) สามารถเพิ่มร้อยละผลได้ของปฏิกิริยาได้ เมื่อเทียบกับการใช้ M1O เป็นตัวเร่งปฏิกิริยาเพียงอย่างเดียว ที่อุณหภูมิ 45 องศาเซลเซียส และ ระยะเวลาในการทำปฏิกิริยานานเท่ากับ 30 นาที นอกจากนี้เรายังพบว่า สารเร่งปฏิกิริยาที่ผสมจาก ออกไซด์โลหะ กับสารประกอบคาร์บอนेट ก็สามารถเพิ่มร้อยละผลได้ของไบโอดีเซลได้เช่นเดียวกัน

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LIST OF SYMBOLS

$^1\text{H-NMR}$	Proton-Nuclear Magnetic Resonance
AS	Animal Shell
FFA	Free Fatty Acid
CS1	Crustacean Shell Type 1
CS2	Crustacean Shell Type 2
MS1	Mollusk Shell Type 1
MS2	Mollusk Shell Type 1
M1CA	Carbonate of Metal 1
M3CA	Carbonate of Metal 3
M6CA	Carbonate of Metal 6
M1O	Oxide of Metal 1
M2O	Oxide of Metal 2
M3O	Oxide of Metal 3
M4O	Oxide of Metal 4
M5O	Oxide of Metal 5