

**CATALYTIC CONVERSION OF GLYCEROL TO PROPYLENE GLYCOL  
OVER COPPER/ZINC OXIDE-BASED CATALYSTS:  
EFFECT OF CATALYST SUPPORTS**

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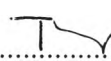
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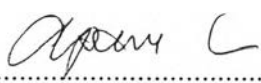
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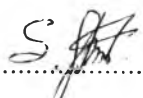
  
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## ABSTRACT

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Natcha Wongpraphairoat: Catalytic Conversion of Glycerol to  
Propylene Glycol over Copper/Zinc Oxide-based Catalysts:  
Effect of Catalyst Supports

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In this work, the catalytic conversion of glycerol to propylene glycol (PG) was investigated over the copper/zinc oxide-based catalysts prepared by different supports—i.e. Alumina ( $\text{Al}_2\text{O}_3$ ), amorphous silica-alumina (ASA), magnesium oxide (MgO), and hydrotalcite ( $\text{Mg}_6\text{Al}_2\text{CO}_3(\text{OH})_{16}\cdot 4(\text{H}_2\text{O})$ ). The prepared catalysts were tested for the catalytic activity in a packed-bed reactor at 250 °C and 500 psig under hydrogen atmosphere. CuZnO/ $\text{Al}_2\text{O}_3$  gave the highest glycerol conversion and PG selectivity compared to CuZnO/MgO, CuZnO/Hydrotalcite, and CuZnO/ASA. This might be because the surface area of CuZnO/ $\text{Al}_2\text{O}_3$  was larger than the other catalysts. Noticeably, CuZnO/MgO exhibited the highest performance in terms of stability. The effect of Na and K addition in feed was investigated on CuZnO/MgO and CuZnO/ $\text{Al}_2\text{O}_3$ . The results showed that the refined glycerol exhibited a higher conversion compared to the refined glycerol mixed with 0.1% Na or with 0.1% K over CuZnO/ $\text{Al}_2\text{O}_3$ . On the other hand, the refined glycerol mixed with 0.1% Na or with 0.1% K exhibited a higher conversion compared to the refined glycerol feed on CuZnO/MgO. The glycerol conversion of the regenerated CuZnO/MgO catalyst was as good as that of the fresh catalyst.

## บทคัดย่อ

ณัชชา วงศ์ประไพโรจน์ : การผลิตโพรพิลีนไกลคอลจากกลีเซอรอลโดยตัวเร่งปฏิกิริยาที่มีทองแดงและสังกะสีออกไซด์เป็นส่วนประกอบพื้นฐาน: ผลกระทบจากตัวรองรับของตัวเร่งปฏิกิริยา (Catalytic Conversion of Glycerol to Propylene Glycol over Copper/Zinc Oxide-based Catalysts: Effect of Catalyst Supports) อาจารย์ที่ปรึกษา: ผศ. ดร. ศิริพร จงผาคิวฒิ และ รศ. ดร. ธีรศักดิ์ ฤกษ์สมบูรณ์ 67 หน้า

ในงานวิจัยนี้ได้ศึกษาการผลิตโพรพิลีนไกลคอลจากกลีเซอรอลโดยตัวเร่งปฏิกิริยาที่มีทองแดงและสังกะสีออกไซด์เป็นส่วนประกอบพื้นฐาน โดยเตรียมตัวเร่งปฏิกิริยาที่มีตัวรองรับแตกต่างกัน ได้แก่ อลูมินา ( $\text{Al}_2\text{O}_3$ ), อสัณฐานซิลิกาอลูมินา (Amorphous Silica Alumina), แมกนีเซียมออกไซด์ ( $\text{MgO}$ ), และไฮโดรทัลไคต์ (Hydrotalcite ( $\text{Mg}_6\text{Al}_2\text{CO}_3(\text{OH})_6 \cdot 4(\text{H}_2\text{O})$ )) ตัวเร่งปฏิกิริยาที่เตรียมขึ้นทั้งหมดถูกนำไปทดสอบประสิทธิภาพของการทำปฏิกิริยาในเครื่องปฏิกรณ์แบบต่อเนื่องชนิดเบดนิ่งที่อุณหภูมิ 250 องศาเซลเซียส ภายใต้ความดันของไฮโดรเจนที่ 500 ปอนด์ต่อตารางนิ้ว ผลการทดลองแสดงให้เห็นว่าตัวเร่งปฏิกิริยาทองแดงและสังกะสีออกไซด์บนอลูมินา ( $\text{CuZnO}/\text{Al}_2\text{O}_3$ ) ให้สัดส่วนการทำปฏิกิริยาของกลีเซอรอลและการเลือกเกิดโพลีโพรพิลีนไกลคอลมากที่สุด ซึ่งอาจเกิดเนื่องมาจากพื้นที่พื้นผิวของตัวเร่งปฏิกิริยาทองแดงและสังกะสีออกไซด์บนอลูมินามีมากที่สุด เป็นที่น่าสังเกตว่า ตัวเร่งปฏิกิริยาทองแดงและสังกะสีออกไซด์บนแมกนีเซียมออกไซด์ ( $\text{CuZnO}/\text{MgO}$ ) มีความเสถียรที่สูงที่สุด งานวิจัยนี้จึงศึกษาผลกระทบของโซเดียมและโพแทสเซียมที่ผสมในสารตั้งต้นบนตัวเร่งปฏิกิริยาทองแดงและสังกะสีออกไซด์บนแมกนีเซียมออกไซด์และตัวเร่งปฏิกิริยาทองแดงและสังกะสีออกไซด์บนอลูมินา ผลการทดลองแสดงให้เห็นว่ากลีเซอรอลบริสุทธิ์ผสมกับ 0.1 เปอร์เซ็นต์ของโซเดียมและกับ 0.1 เปอร์เซ็นต์ของโพแทสเซียมให้สัดส่วนการทำปฏิกิริยาของกลีเซอรอลมากกว่ากลีเซอรอลบริสุทธิ์ ในทางตรงกันข้ามกลีเซอรอลบริสุทธิ์ให้สัดส่วนการทำปฏิกิริยาของกลีเซอรอลมากกว่ากลีเซอรอลบริสุทธิ์ผสมกับ 0.1 เปอร์เซ็นต์ของโซเดียมและกับ 0.1 เปอร์เซ็นต์ของโพแทสเซียม ตัวเร่งปฏิกิริยาทองแดงและสังกะสีออกไซด์บนแมกนีเซียมออกไซด์ที่นำกลับมาใช้ใหม่ให้สัดส่วนการทำปฏิกิริยาของกลีเซอรอลดีเท่ากับตัวเร่งปฏิกิริยาใหม่

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