

**AUTOTHERMAL STEAM REFORMING OF ACETIC ACID:  
CATALYTIC ACTIVITY AND STABILITY OF Ni/Ce<sub>0.75</sub>Zr<sub>0.25</sub>O<sub>2</sub> CATALYST**

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**Program:** Petroleum Technology  
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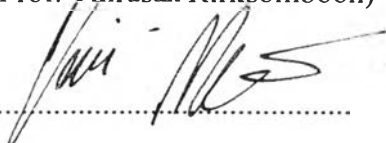


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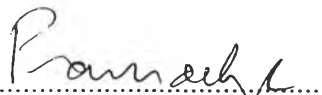
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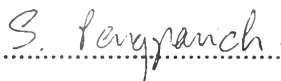
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**ABSTRACT**

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Mr. Atsadang Traitangwong: Autothermal Steam Reforming of Acetic acid: Catalytic Activity and Stability of Ni/Ce<sub>0.75</sub>Zr<sub>0.25</sub>O<sub>2</sub> Catalyst.

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Keywords: Acetic acid/ Autothermal steam reforming/ Ni/ Ce<sub>0.75</sub>Zr<sub>0.25</sub>O<sub>2</sub>/ Ceria/ Zirconia

Autothermal steam reforming of acetic acid was investigated over Ni/Ce<sub>0.75</sub>Zr<sub>0.25</sub>O<sub>2</sub> catalyst at atmospheric pressure with a gas hourly space velocity (GHSV) of 65,000 h<sup>-1</sup>, using a continuous flow fixed-bed reactor by varying the oxygen-to-acetic acid ratio (0-0.4), oxygen-to-steam ratio (0.017-0.055), and temperature (550-700°C). Ce<sub>0.75</sub>Zr<sub>0.25</sub>O<sub>2</sub> support was prepared via urea-hydrolysis (sol-gel technique) followed by Ni (15wt %) impregnation. The catalysts were characterized by BET, XRD, H<sub>2</sub>-TPR, XRF, TEM, SEM and TPO techniques. The results showed that hydrogen yield decreased with increasing oxygen-to-acetic acid molar ratio due to the oxidation reaction but oxygen helped reduce some carbon formation. The hydrogen yield was increased with decreasing oxygen-to-steam molar ratio; which resulted from the water gas shift reaction. It was also found that the highest hydrogen yield and lowest C-C breakage conversion were attained at 650 °C. On stability testing found that autothermal steam reforming and steam reforming reaction exhibited similar deactivation trends but carbon deposition on the steam reforming reaction was found to be slightly greater than autothermal reforming

## บทคัดย่อ

อัญญาศั ไตรตั้งวงษ์ : การรีฟอร์มมิ่งด้วยไอน้ำแบบอาศัยสมดุลความร้อนของกรดอะซิติก: การศึกษาความว่องไวในการเร่งปฏิกิริยาและความเสถียรของตัวเร่งปฏิกิริยานิกเกิลบนตัวรองรับซีเรียเซอร์โคเนีย (Autothermal Steam Reforming of Acetic acid: Catalytic Activity and Stability- of Ni/Ce<sub>0.75</sub>Zr<sub>0.25</sub>O<sub>2</sub> Catalyst.) อ. ที่ปรึกษา : รศ.ดร. ชีรศักดิ์ ฤกษ์สมบูรณ์ และ รศ.ดร. วิษณุ มีอยู่ 57 หน้า

การรีฟอร์มมิ่งด้วยไอน้ำแบบอาศัยสมดุลความร้อนของกรดอะซิติกได้ทำบนตัวเร่ง Ni/Ce<sub>0.75</sub>Zr<sub>0.25</sub>O<sub>2</sub> ที่ความดันบรรยากาศโดยมีเวลาในการทำปฏิกิริยา (GHSV) ที่ 65,000 h<sup>-1</sup> โดยใช้ถึงปฏิกรณ์แบบคงที่ ทำการปรับอุณหภูมิในช่วง 550 – 700 องศาเซลเซียส อัตราส่วนระหว่างไอน้ำต่อออกซิเจนในช่วง 0.017-0.055 และอัตราส่วนระหว่างออกซิเจนต่อกรดอะซิติกในช่วง 0-0.4 ตัวรองรับของตัวเร่งปฏิกิริยาเตรียมโดยวิธีการโซลเจลโดยอาศัยปฏิกิริยาละลายตัวของยูเรีย การเติมนิกเกิลลงบนตัวรองรับทำโดยวิธีการทำให้ชุ่มโดยปริมาณโลหะนิกเกิลคงที่ร้อยละ 15 ของน้ำหนักตัวเร่งปฏิกิริยา จากนั้นได้ศึกษาคุณลักษณะสมบัติของตัวเร่งปฏิกิริยาที่เตรียมได้โดยวิธี BET, H<sub>2</sub>-TPR, SEM, XRD, XRF, และ TPO ผลการศึกษาพบว่า ปริมาณไฮโดรเจนที่ได้ลดลงเมื่อทำการเพิ่มอัตราส่วนระหว่างไอน้ำต่อออกซิเจนเนื่องจากเกิดปฏิกิริยาออกซิเดชันแต่ออกซิเจนสามารถช่วยลดปริมาณของคาร์บอนได้ ไฮโดรเจนที่ได้เพิ่มเมื่อลดอัตราส่วนระหว่างไอน้ำต่อออกซิเจนเนื่องจากเกิดปฏิกิริยาปฏิกิริยาออกซิเดชันน้อยกว่า นอกจากนี้ยังให้ผลผลิตไฮโดรเจนมากที่สุดที่อุณหภูมิ 650 องศาเซลเซียส ในการศึกษาความเสถียรของปฏิกิริยาการรีฟอร์มมิ่งด้วยไอน้ำแบบอาศัยสมดุลความร้อนและปฏิกิริยาการรีฟอร์มมิ่งด้วยไอน้ำพบว่าทั้ง 2 ปฏิกิริยามีแนวโน้มการสูญเสียของผลิตภัณฑ์เท่าๆกันแต่ในปฏิกิริยาการรีฟอร์มมิ่งด้วยไอน้ำแบบอาศัยสมดุลความร้อนมีปริมาณคาร์บอนที่น้อยกว่า

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