

**MODIFIED SAPO-34 FOR DEHYDRATION OF BIO-ETHANOL TO  
LIGHT OLEFINS IN COMPARISON WITH KOH-TREATED HZSM-5**


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A Thesis Submitted in Partial Fulfilment of the Requirements  
for the Degree of Master of Science  
The Petroleum and Petrochemical College, Chulalongkorn University  
in Academic Partnership with  
The University of Michigan, The University of Oklahoma,  
Case Western Reserve University, and Institut Français du Pétrole  
2013

**Thesis Title:** Modified SAPO-34 for Dehydration of Bio-Ethanol to Light Olefins in Comparison with KOH-Treated HZSM-5  
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**Program:** Petrochemical Technology  
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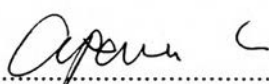
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## ABSTRACT

5471014063: Petrochemical Technology Program

Peerapong Wongwanichsin: Modified SAPO-34 for Dehydration of Bio-Ethanol to Light Olefins in Comparison with KOH-Treated HZSM-5.

Thesis Advisor: Assoc. Prof. Sirirat Jitkamka 86 pp.

Keywords: Dehydration/ Bio-ethanol/ Ethylene/ Propylene/ Light Olefins/ SAPO-34/ HZSM-5/ Oxides/ KOH

Light olefins (especially, ethylene and propylene) are primarily used for the production of petrochemicals. In recent years, with the shortage of petroleum, the high demands of light olefins, and the increase in the price of naphtha feedstock, the production of light olefins from renewable resources has received wide attention. SAPO-34 and HZSM-5 catalysts were proven to be a potential catalyst for the catalytic dehydration of bio-ethanol to light olefins; however, they must be operated at the moderate acid strength with appropriate distribution of acid sites in order to produce a high composition of propylene in the gas product, because too strong acidity might lead to propylene transformation to aromatics and fast deactivation of the catalyst. In this research the reaction was carried out in an isothermal fixed bed reactor. The temperature was controlled at 400 °C, and the liquid hourly space velocity (LHSV) was fixed at 0.5 h<sup>-1</sup>. The purpose of this research was to study the promoting effect of acidic oxides of germanium, gallium, tin, and antimony mixed with a SAPO-34 catalyst. The loading was varied as 3% and 5% by weight. The results revealed that the composition of ethylene decreased whereas that of propylene significantly increased with the loading percentage for all tested catalysts. It was found that the loading amount of 5% SnO<sub>2</sub> on SAPO-34 gave the highest composition of propylene in the gas. In addition, the catalytic performance of HZSM-5 catalysts treated with 0.1 M, 0.5 M, and 0.9 M of KOH solution were investigated as well. As a result, the treatment 0.1 M of KOH with HZSM-5 catalyst was the optimal one for the propylene production. Thus, the oxides on SAPO-34 and alkaline treatment with HZSM-5 can help to enhance the composition of propylene from bio-ethanol dehydration.

## บทคัดย่อ

พีระพงษ์ วงศ์วานิชย์ศิลป์ : การปรับปรุงตัวเร่งปฏิกิริยาซาโปสามสิบสี่เพื่อผลิตโอเลฟินส์เบาจากเอทานอลชีวภาพด้วยปฏิกิริยาดีไฮเดรชันในการเปรียบเทียบกับกำบัตตัวเร่งปฏิกิริยาแซทเอสเอ็มห้าด้วยสารละลายโพแทสเซียมไฮดรอกไซด์ (Modified SAPO-34 for Dehydration of Bio-Ethanol to Light Olefins in Comparison with KOH-Treated HZSM-5) อ.ที่ปรึกษา : รศ. ดร. ศิริรัตน์ จิตการคำ 86 หน้า

โอเลฟินส์เบา (โดยเฉพาะอย่างยิ่งเอทิลีนและโพรพิลีน) เป็นสารตั้งต้นที่ใช้อย่างแพร่หลายในการผลิตสารปิโตรเคมี ในปีที่ผ่านมาการขาดแคลนปิโตรเลียม ความต้องการของโอเลฟินส์เบาที่เพิ่มมากขึ้นรวมถึงราคาเนฟทาที่เพิ่มสูงขึ้น ทำให้การผลิตโอเลฟินส์เบาจากแหล่งทรัพยากรทางเลือกจึงเป็นที่ได้รับความสนใจอย่างกว้างขวาง ซาโปสามสิบสี่และแซทเอสเอ็มห้าต่างเป็นตัวเร่งปฏิกิริยาที่มีศักยภาพในการผลิตโอเลฟินส์เบาจากเอทานอลชีวภาพด้วยปฏิกิริยาดีไฮเดรชัน อย่างไรก็ตามตัวเร่งปฏิกิริยาดังกล่าวควรมีความเป็นกรดและการกระจายตัวของกรดที่เหมาะสมในการผลิตโพรพิลีน เนื่องด้วยความเป็นกรดที่สูงเกินไปส่งผลให้โพรพิลีนเปลี่ยนรูปไปเป็นสารอะโรมาติกส์ ในการทดลองนี้ได้ควบคุมอุณหภูมิการทำปฏิกิริยาที่ 400 องศาเซลเซียส ความเร็วในการไหลของเอทานอล 0.5 ต่อชั่วโมง ในงานวิจัยนี้เป็นการศึกษาปริมาณที่เหมาะสมระหว่างร้อยละ 3 ถึง 5 ของธาตุดอกไซด์ (เจอร์เมเนียม แกลเลียม ดีบุก และแอนติโมนี) บนตัวเร่งปฏิกิริยาซาโปสามสิบสี่ จากการศึกษาพบว่า เมื่อเพิ่มปริมาณของธาตุดอกไซด์ลงบนตัวเร่งปฏิกิริยาส่งผลให้ปริมาณของเอทิลีนลดลงในขณะที่โพรพิลีนเพิ่มสูงขึ้น และที่ปริมาณร้อยละ 5 ของดีบุกออกไซด์บนตัวเร่งปฏิกิริยาซาโปสามสิบสี่สามารถผลิตโพรพิลีนได้ปริมาณสูงสุด นอกจากนี้ได้ศึกษาปริมาณความเข้มข้นที่เหมาะสมของสารละลายโพแทสเซียมไฮดรอกไซด์ในช่วง 0.1 ถึง 0.9 โมลาร์ ที่ใช้บำบัดตัวเร่งปฏิกิริยาแซทเอสเอ็มห้า จากการศึกษาทดลองพบว่า สารละลายโพแทสเซียมไฮดรอกไซด์ที่ความเข้มข้น 0.1 โมลาร์ สามารถผลิตโพรพิลีนได้ปริมาณเหมาะสม ดังนั้นการเติมธาตุดอกไซด์บนตัวเร่งปฏิกิริยาซาโปสามสิบสี่และการบำบัดตัวเร่งปฏิกิริยาแซทเอสเอ็มห้าด้วยสารละลายเบสต่างส่งผลให้โพรพิลีนเพิ่มสูงขึ้นด้วยการผลิตโอเลฟินส์เบาจากเอทานอลชีวภาพภายใต้ปฏิกิริยาดีไฮเดรชัน

## ACKNOWLEDGEMENTS

This work could not be accomplished without the assistances and supports from the following people and organizations.

First and foremost, I am deeply thankful to my advisor, Assoc. Prof. Sirirat Jitkarnka, for a great opportunity for me to do this work, valuable guidance, advantageous recommendations, and the heedfulness throughout this thesis work.

Secondly, I would like to thank Saphip Company Limited for bio-ethanol used in this work.

Next, I would like to extend my gratitude to the thesis committee, Assoc. Prof. Apanee Luengnaruemitchai and Asst. Prof. Wanida Koo-amornpattana for their valuable comments and suggestions.

Unforgettably, I would like to thank all my friends, Mrs. Jintana Chamnanmanoontham, Mrs. Jiraprapa Neumparn, and research staffs for their understanding, moral support, and helpful assistance at all time.

My gratitude also extends to all of The Petroleum and Petrochemical staff members for many useful technical supports.

This thesis work is funded by the Petroleum and Petrochemical College, and by the Center of Excellence on Petrochemical and Materials Technology, Thailand.

Lastly, I am deeply appreciated to my family for their love, great support, and worth encouragement.

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