

**ALKYLATION OF BENZENE WITH ETHANOL TO ETHYLBENZENE
USING COMMERCIAL HZSM-5 CATALYSTS**

Nawarat Udomsin

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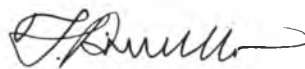
Thesis Title: Alkylation of Benzene with Ethanol to Ethylbenzene using Commercial HZSM-5 Catalysts
By: Nawarat Udomsin
Program: Petrochemical Technology
Thesis Advisors: Assoc. Prof. Thirasak Rirksomboon
Asst. Prof. Siriporn Jongpatiwut

Accepted by the Petroleum and Petrochemical College, Chulalongkorn University, in partial fulfilment of the requirements for the Degree of Master of Science.



..... Dean
(Asst. Prof. Pomthong Malakul)

Thesis Committee:



.....
(Assoc. Prof. Thirasak Rirksomboon)



.....
(Asst. Prof. Siriporn Jongpatiwut)



.....
(Asst. Prof. Thammanoon Sreethawong)



.....
(Assoc. Prof. Vissanu Meeyoo)

บทคัดย่อ

นวัตน์ อุคมศิลป์: การศึกษาปฏิกิริยาแอลคิเลชันของเบนซีนและเอทานอลเพื่อให้ได้เอทิลเบนซีนโดยใช้ตัวเร่งปฏิกิริยาทางการค้า HZSM-5 (Alkylation of Benzene with Ethanol to Ethylbenzene using Commercial HZSM-5 Catalysts) อ.ที่ปรึกษา: รศ.ดร. ชีรศักดิ์ ฤกษ์สมบูรณ์, ผศ.ดร. ศิริพร จงผาดิวฒิ 64 หน้า

เอทิลเบนซีนที่ผลิตโดยกระบวนการแอลคิเลชันของเบนซีนกับเอทิลีนนั้นเป็นหนึ่งในผลิตภัณฑ์ที่สำคัญของแอลคิลเบนซีนเนื่องจากเป็นตัวกลางในการผลิตสไตรีนซึ่งเป็นโมโนเมอร์ที่สำคัญ บางงานวิจัยได้ศึกษาสารแอลคิเลติงที่จะมาแทนเอทิลีน การใช้เอทานอลเป็นสารแอลคิเลติงได้รับความสนใจเป็นอย่างมากเนื่องจากปริมาณเอทานอลที่มากเกินไปในอุตสาหกรรมปิโตรเลียมจากการประเมินค่าต่ำกว่าความเป็นจริงในกระบวนการผลิตที่มีประสิทธิภาพสูง งานวิจัยนี้จึงได้ทำการศึกษาปฏิกิริยาในเตาปฏิกรณ์แบบต่อเนื่องที่ความดันบรรยากาศโดยใช้ตัวเร่งปฏิกิริยาทางการค้า HZSM-5 ที่มีอัตราส่วนของซิลิกาต่ออะลูมินาอยู่ในช่วง 23-195 ภายใต้สภาวะที่กำหนดได้แก่ ที่อุณหภูมิ 300-500 องศาเซลเซียส, อัตราส่วนของเบนซีนต่อเอทานอล 1-4 และ WHSV 5-20 ต่อชั่วโมง จากการทดลองพบว่าที่ อุณหภูมิ 300 องศาเซลเซียส, WHSV ที่ 20 ต่อชั่วโมง และอัตราส่วนของเบนซีนต่อเอทานอลเท่ากับ 4 ถูกพบว่าเป็นสภาวะที่ดีที่สุดสำหรับปฏิกิริยาแอลคิเลชันของเบนซีนกับเอทานอลบนตัวเร่งปฏิกิริยาโดยใช้ตัวเร่งปฏิกิริยาทางการค้า HZSM-5 ที่อัตราส่วนของซิลิกาต่ออะลูมินา 23 นอกจากนี้ตัวเร่งปฏิกิริยา HZSM-5 ที่อัตราส่วนของซิลิกาต่ออะลูมินา 23 ยังมีประสิทธิภาพในการเร่งปฏิกิริยาจนถึง 30 ชั่วโมง หลังจากนั้นปฏิกิริยาการเปลี่ยนแปลงลดลงเนื่องจากการเกิดโค้กบนตัวเร่งปฏิกิริยา

ABSTRACT

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Ethylbenzene (EB), usually produced via alkylation of benzene with ethylene, is one of the most important alkylbenzenes because it is a key intermediate in the manufacture of styrene which is one of the most important industrial monomers. Some investigations have been in search of other alkylating agents as a substitute for ethylene. The direct use of ethanol as an alkylating agent has gained more attention as ethanol has become surplus to petroleum industry due to the underestimated production with high efficacy. In this work, the reaction was carried out in a fixed-bed continuous down-flow reactor at atmospheric pressure by using commercially available HZSM-5 zeolite catalysts with $\text{SiO}_2/\text{Al}_2\text{O}_3$ ratios of 23 to 195 under various conditions: temperature (300 °C to 500 °C), benzene/ethanol (B/E) ratio (1 to 4), and WHSV (5 h^{-1} to 20 h^{-1}). The results indicate that a temperature of 300 °C, a WHSV of 20 h^{-1} , and a B/E feed ratio of 4 would be the optimal parameters for alkylation of benzene with ethanol to EB by using the commercial HZSM-5 catalyst with $\text{SiO}_2/\text{Al}_2\text{O}_3$ ratio of 23. In addition, the commercial HZSM-5 catalyst with $\text{SiO}_2/\text{Al}_2\text{O}_3$ ratio of 23 was found to be active up to 30 h before its catalytic activity was declined due to the coke formation.

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