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CRACKING OF HIGH DENSITY POLYETHYLENE AND POLYPROPYLENE OVER ZEOLITE
BETA/Al-HMS MIXED CATALYSTS


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for the Degree of Master of Science Program in Petrochemistry and Polymer Science
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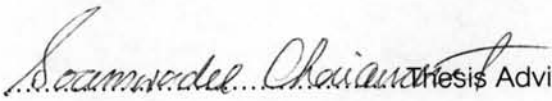
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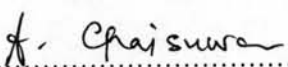
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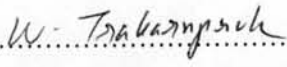

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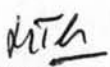
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นุริยา กาเจ: การแตกตัวของพอลิเอทิลีนชนิดความหนาแน่นสูงและพอลิโพรพิลีนบนตัวเร่งปฏิกิริยาผสมซีโอไลต์บีตา/อะลูมิเนียมเอชเอ็มเอส. (CRACKING OF HIGH DENSITY POLYETHYLENE AND POLYPROPYLENE OVER ZEOLITE BETA/Al-HMS MIXED CATALYSTS) อ.ที่ปรึกษา: ผศ. ดร. โสภณวี ไชยอนันต์สุจริต, อาจารย์ที่ปรึกษาร่วม: ดร.อริชา ฉายสุวรรณ 102 หน้า

ได้ทำการแตกย่อยพลาสติกพอลิโพรพิลีนและพอลิเอทิลีนชนิดความหนาแน่นสูงด้วยตัวเร่งปฏิกิริยาผสมซีโอไลต์บีตาและอะลูมิเนียมเอชเอ็มเอส ได้สังเคราะห์ซีโอไลต์บีตาซึ่งมีอัตราส่วนองค์ประกอบโดยโมลในเจลเป็น $1\text{SiO}_2 : 0.0083\text{Al}_2\text{O}_3 : 0.73\text{TEAOH} : 19\text{H}_2\text{O}$ อัตราส่วนซิลิกาต่ออะลูมิเนียมเท่ากับ 60 ตกผลึกด้วยวิธีไฮโดรเทอร์มัลที่อุณหภูมิ 135°C และอะลูมิเนียมเอชเอ็มเอส มีอัตราส่วนองค์ประกอบโดยโมลในเจลเป็น $1\text{SiO}_2 : 0.0125\text{Al}_2\text{O}_3 : 0.25\text{HDA} : 8.3\text{EtOH} : 100\text{H}_2\text{O}$ ตกผลึกด้วยวิธีโซลเจลที่อุณหภูมิห้อง นำอะลูมิเนียมเอชเอ็มเอส มาทำการบำบัดด้วย แอมโมเนียมคลอไรด์ที่ความเข้มข้น 1 โมลาร์ ที่อุณหภูมิเดือดเป็นเวลา 3 ชั่วโมงเพื่อลดปริมาณอะลูมิเนียมในออกตะฮีดรัล ตรวจสอบตัวอย่างด้วยเทคนิคการเลี้ยวเบนของรังสีเอ็กซ์ กล้องจุลทรรศน์แบบส่องกราด ไอซีพี-เออีเอส อะลูมิเนียมนิวเคลียร์แมกเนติกเรโซแนนซ์ชนิดสปินนวมเฉพาะ การดูดซับไนโตรเจนและการคายแอมโมเนียโดยใช้อุณหภูมิที่ตั้งโปรแกรม ศึกษาการแตกย่อยของพอลิโพรพิลีนและพอลิเอทิลีนชนิดความหนาแน่นสูงภายใต้ภาวะที่แตกต่าง เมื่อใช้ตัวเร่งปฏิกิริยาผสมซีโอไลต์บีตาและอะลูมิเนียมเอชเอ็มเอส ในการแตกย่อย ภาวะที่เหมาะสมสำหรับการแตกย่อยพอลิโพรพิลีนคือ 95%อะลูมิเนียมเอชเอ็มเอส ในตัวเร่งปฏิกิริยาผสม 10%โดยน้ำหนักของตัวเร่งปฏิกิริยา ที่อุณหภูมิ 380 องศาเซลเซียส ส่วนภาวะที่เหมาะสมสำหรับการแตกย่อยพอลิเอทิลีนชนิดความหนาแน่นสูง คือ 5%อะลูมิเนียมเอชเอ็มเอส ในตัวเร่งปฏิกิริยาผสม 10%โดยน้ำหนักของตัวเร่งปฏิกิริยา ที่อุณหภูมิ 410 องศาเซลเซียส การเพิ่มอุณหภูมิจะช่วยเร่งปฏิกิริยาให้เกิดขึ้น แต่องค์ประกอบของผลิตภัณฑ์ที่ได้ไม่แตกต่างกัน ของเหลวที่ได้จากการแตกย่อยพอลิโพรพิลีนและพอลิเอทิลีนชนิดความหนาแน่นสูงมีช่วงจุดเดือดเดียวกันกับแก๊ซลินมาตรฐาน ตัวเร่งปฏิกิริยาผสมที่ใช้งานแล้วสามารถทำให้กลับคืนสภาพเดิมได้ โดยให้ค่าการเปลี่ยนพลาสติกมากกว่าร้อยละ 80 สำหรับ 1-2 ครั้ง ซึ่งเป็นค่าที่ยอมรับได้ อย่างไรก็ตามควรระวังโครงสร้างที่มีรูพรุนขนาดกลางอะลูมิเนียมเอชเอ็มเอสหลังจากนำตัวเร่งปฏิกิริยาที่นำกลับมาใช้ใหม่

สาขาวิชา ปิโตรเคมีและวิทยาศาสตร์พอลิเมอร์ ลายมือชื่อนิสิต.....
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NURIYA KACHE: CRACKING OF HIGH DENSITY POLYETHYLENE AND

POLYPROPYLENE OVER ZEOLITE BETA/AI-HMS MIXED CATALYSTS. THESIS

ADVISOR: ASSIST. PROF. Soamwadee Chaianansutcharit, Ph.D. THESIS CO-

ADVISOR: ATICHA CHAISUWAN, Ph. D, 102 pp.

PP and HDPE cracking were investigated over zeolite beta/AI-HMS mixed catalysts. Zeolite beta with gel the mole composition of 1SiO_2 : $0.0083\text{Al}_2\text{O}_3$: 0.73TEAOH : $19\text{H}_2\text{O}$ ($\text{Si}/\text{Al} = 60$) were synthesized by hydrothermal crystallization at 135°C whereas AI-HMS with the gel mole composition of 1SiO_2 : $0.0125\text{Al}_2\text{O}_3$: 0.25HDA : 8.3EtOH : $100\text{H}_2\text{O}$ were synthesized by sol-gel method and crystallization at room temperature. Octahedral aluminium from AI-HMS was removed by treating with $1\text{M NH}_4\text{Cl}$ at boiling temperature for 3 h. The catalysts were characterized by X-ray power diffraction, scanning electron microscope, ICP-AES, ^{27}Al -MAS-NMR, nitrogen adsorption and ammonia-temperature programmed desorption techniques. Catalytic cracking of PP over mixed catalysts between zeolite beta and AI-HMS were studied with various conditions. The optimal condition for PP cracking was 95%AI-HMS in the presence of mixed catalysts, 10%wt catalyst and at the reaction temperature of 380°C whereas for HDPE was 5%AI-HMS in the presence of mixed catalyst, 10%wt catalyst and at the reaction temperature of 410°C . With increasing reaction temperature, degradation rate were faster but the products distribution of gas and liquid fraction were not different. The liquid products had the same boiling point range compared to that of standard gasoline. The regeneration of catalysts was acceptable for 1-2 cycles due to a high conversion of PP and HDPE cracking over 80%. However, the structure of mesoporous AI-HMS should be aware after reusing of catalyst.

Field of study Petrochemistry and Polymer Science. Student's signature.....*Nuriya Kache*

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LIST OF ABBREVIATIONS

BET	Brunauer-Emmett-Teller method
HMS	Hexagonal Mesoporous Silica
MCM-41	Mobil's Composite of Matters-41
°C	degree Celsius
GC	gas chromatography
g	gram (s)
h	hour (s)
ICP	Inductively Coupled Plasma Emission
min	minute
SEM	Scanning Electron Microscopy
TPD	Temperature-programmed desorption
XRD	X-ray diffraction