

**INVESTIGATION OF NON-NOBLE METALS (Ni AND Fe) AS
SUBSTITUTES OF NOBLE METALS (Pd AND Ru) SUPPORTED ON
ACID ZEOLITES FOR WASTE TIRE PYROLYSIS**



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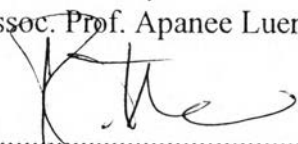
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ABSTRACT

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Pyrolysis of waste tire is one of alternative techniques to produce petrochemical products. Noble metals supported on acid zeolite catalysts, especially Pd and Ru supported on acid zeolites (HMOR and HBeta), were reported as potential catalysts to produce the valuable petrochemical products from waste tire pyrolysis. Due to the high prices of noble metal catalysts, the objective of this research work was to use non-noble metal catalysts as substitutes of noble metal catalysts. The non-noble metals (Ni and Fe) supported on acid zeolites (HMOR and HBeta) were used in this research because Ni and Fe catalysts have high activity in isomerization, cracking, and the ring opening of hydrocarbons. Moreover, Ni and Fe are elements in the same group as Pd and Ru noble metals, which is the VIII B group, aiming to produce high valuable products similar to those obtained from the noble metals. It was found that 5%Ni/HBeta can be used as a substitute of 1%Pd/HBeta as a naphtha-producing catalyst since it produced the similar quantity of full range naphtha as 1%Pd/HBeta. Moreover, 5%Ni/HBeta produced the good quality of petroleum oil which contained high sat HCs/total aromatics and low sulfur content in oil. With using HMOR as a support, 20%Ni/HMOR appeared to be a capable catalyst for substituting 1%Pd/HMOR because 20%Ni/HMOR can produce as high quantity and quality as 1%Pd/HMOR. Furthermore, the petrochemical production by using 1%Ru/HBeta can be substituted by using 10%Fe/HBeta since it can produce the higher yields of light olefins, cooking gases, mixed C₄, and light mono-aromatics (BTXs) than those of 1%Ru/HBeta. Similarly, 20%Fe/HMOR can be used as a substitute of 1%Ru/HMOR for petrochemical products.

บทคัดย่อ

ลลิตา แซ่เอี้ยะ: การศึกษาการใช้นิกเกิลและไอรอนแทนพลาตินัมและรูทีเนียมซึ่งบรรจุบนซีโอไลต์ชนิดกรดสำหรับกระบวนการไพโรไลซิสยางรถยนต์หมดสภาพ (Investigation of Non-noble Metals (Ni and Fe) as Substitutes of Noble Metals (Pd and Ru) Supported on Acid Zeolites for Waste Tire Pyrolysis) อ. ที่ปรึกษา: รศ. ดร. ศิริรัตน์ จิตการคำ 121 หน้า

กระบวนการไพโรไลซิสยางรถยนต์หมดสภาพเป็นกระบวนการทางเลือกสำหรับการผลิตผลิตภัณฑ์ปิโตรเคมี โลหะมีตระกูลที่บรรจุบนซีโอไลต์ชนิดกรดโดยเฉพาะอย่างยิ่งพลาตินัมและรูทีเนียมบรรจุบนซีโอไลต์ชนิดมอร์และชนิดเบต้า ถูกค้นพบว่าเป็นตัวเร่งปฏิกิริยาที่มีศักยภาพในการผลิตผลิตภัณฑ์ปิโตรเคมีจากกระบวนการไพโรไลซิสยางรถยนต์หมดสภาพ เนื่องจากโลหะมีตระกูลนั้นมีราคาแพง งานวิจัยนี้จึงศึกษาการใช้โลหะไม่มีตระกูลแทนโลหะมีตระกูล นิกเกิลและไอรอนซึ่งเป็นโลหะไม่มีตระกูลได้ถูกเลือกนำมาศึกษาเนื่องจากตัวเร่งทั้งสองนั้นมีความสามารถสูงในการทำปฏิกิริยาไอโซเมอร์ไรเซชัน ปฏิกิริยาการแตกตัวของโมเลกุล และปฏิกิริยาเปิดวงของไฮโดรคาร์บอน ยิ่งไปกว่านั้นนิกเกิลและไอรอนอยู่ในกลุ่มโลหะทรานซิชันเดียวกันกับพลาตินัมและรูทีเนียมคือกลุ่ม 8 บี จึงมีความเป็นไปได้ว่าจะสามารถผลิตผลิตภัณฑ์ปิโตรเคมีประเภทเดียวกันได้ จากการศึกษาพบว่า ตัวเร่งปฏิกิริยานิกเกิลร้อยละ 5 โดยน้ำหนักซึ่งบรรจุบนซีโอไลต์ชนิดเบต้า นั้นสามารถนำไปใช้แทนตัวเร่งปฏิกิริยาพลาตินัมร้อยละ 1 โดยน้ำหนักที่บรรจุบนซีโอไลต์ประเภทเดียวกัน ในการผลิตน้ำมันที่มีคุณภาพและปริมาณที่ใกล้เคียงกัน ซึ่งน้ำมันที่ผลิตได้นั้นมีสารประกอบอะโรมาติกส์และซัลเฟอร์ในปริมาณที่ต่ำ ส่วนการเปรียบเทียบพลาตินัมกับนิกเกิลบรรจุบนซีโอไลต์ชนิดมอร์พบว่า ตัวเร่งปฏิกิริยาของนิกเกิลร้อยละ 20 โดยน้ำหนักซึ่งบรรจุบนซีโอไลต์ชนิดมอร์นั้นสามารถใช้ในการผลิตน้ำมันที่มีปริมาณและคุณภาพใกล้เคียงกับการใช้ตัวเร่งปฏิกิริยาพลาตินัมร้อยละ 1 โดยน้ำหนักที่บรรจุบนซีโอไลต์ชนิดเดียวกัน นอกจากนี้การผลิตผลิตภัณฑ์ปิโตรเคมีด้วยตัวเร่งปฏิกิริยาไอรอนร้อยละ 10 โดยน้ำหนักที่บรรจุบนซีโอไลต์ชนิดเบต้าเป็นตัวเร่งปฏิกิริยานั้น มีประสิทธิภาพเทียบเคียงกับการใช้รูทีเนียมร้อยละ 1 โดยน้ำหนักที่บรรจุบนซีโอไลต์ชนิดเบต้า เนื่องจากสามารถผลิตโอเลฟินส์ แก๊สหุงต้ม และสารประกอบโมโนอโรมาติกส์ได้มากกว่าการใช้รูทีเนียมร้อยละ 1 โดยน้ำหนักที่บรรจุบนซีโอไลต์ชนิดเดียวกัน นอกจากนี้ตัวเร่งปฏิกิริยาไอรอนร้อยละ 20 โดยน้ำหนักที่บรรจุบนซีโอไลต์ชนิดมอร์ก็สามารถผลิตผลิตภัณฑ์ปิโตรเคมีได้เทียบเคียงกับการใช้รูทีเนียมร้อยละ 1 โดยน้ำหนักที่บรรจุบนซีโอไลต์ชนิดเดียวกัน

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