

**POTENTIAL USE OF Co-SUPPORTED CATALYSTS  
AS A TIRE PYROLYSIS CATALYST FOR PRODUCTION OF  
VALUABLE PETROCHEMICALS**



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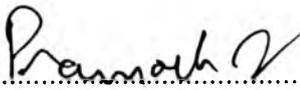
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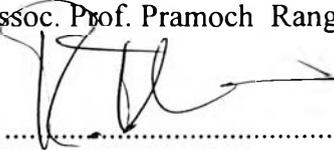
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## ABSTRACT

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According to the increasing mono-aromatics consumption and the increasing price of oil, the aromatic prices increase. The catalytic waste tires pyrolysis is one of the alternative techniques, which has potential to convert the waste to valuable aromatic products. In this work, the advantages of bifunctional catalysts are taken to improve the quality of tire pyrolysis products, especially on mono-aromatics production by using 5 % of cobalt supported on different zeolites, namely HY, HBETA, HMOR, HZSM-5 and SAPO-34. Moreover, 5 % cobalt-supported binary support catalysts, namely HY/SAPO-34, HBETA/SAPO-34, and HMOR/SAPO-34 were studied. It is well known that HY, HBETA, HMOR and HZSM-5 have the advantages in isomerization and aromatization, whereas SAPO-34 has the advantage in cracking large molecules due to its pores. Therefore, combining SAPO-34 with HY, HBETA, HMOR, and HZSM-5 can be considered beneficial for the catalytic pyrolysis of waste tire. It was found that 5 %Co loaded on all supports increased gas yields and the concentration of mono-aromatics in oil products as compared to those of the pure zeolite and non-catalytic cases. Moreover, 5 %Co/HY catalyst gave the highest production of light olefins, whereas 5 %Co/HZSM-5 gave the highest production of cooking gas. Among the catalysts supported with acid zeolites, 5 %Co/HZSM-5 catalyst was found to give the highest mono-aromatics production in the pyrolytic oil. Furthermore, the binary support catalyst, 5 %Co/(HMOR+SAPO-34), gave the highest mono-aromatics production among all catalysts.

## บทคัดย่อ

ปารีสสา สภารักษ์ปัญญา: การใช้ตัวเร่งปฏิกิริยาโคบอลต์ที่บรรจุในตัวรองรับประเภทต่างๆ ในกระบวนการไพโรไลซิสยางรถยนต์หมดสภาพสำหรับเพิ่มมูลค่าผลิตภัณฑ์ปิโตรเคมี (Potential Use of Co-Supported Catalysts as a Tire Pyrolysis Catalyst for Production of Valuable) อ. ที่ปรึกษา: รศ. ดร. ศิริรัตน์ จิตการคำ 113 หน้า

เนื่องจากการบริโภคสารประกอบโมโนอะโรมาติกส์มีปริมาณสูงขึ้น และประกอบกับน้ำมันมีราคาสูงขึ้น จึงส่งผลกระทบต่อทำให้โมโนอะโรมาติกส์ที่ใช้กันอย่างแพร่หลายนั้นมีราคาสูงขึ้น การใช้ตัวเร่งปฏิกิริยาในกระบวนการไพโรไลซิสยางรถยนต์ในการเปลี่ยนของเสียให้เป็นผลิตภัณฑ์ที่มีค่าอย่าง โมโนอะโรมาติกส์นั้นเป็นทางเลือกหนึ่งที่น่าสนใจ งานวิจัยนี้เป็นการศึกษาผลของการใช้ซีโอไลต์ร่วมกับโลหะโคบอลต์ ทั้งทางเชิงคุณภาพและปริมาณของผลิตภัณฑ์ โดยเฉพาะอย่างยิ่งผลิตภัณฑ์โมโนอะโรมาติกส์ โดยการใช้โลหะโคบอลต์ร้อยละ 5 โดยน้ำหนักบนซีโอไลต์ชนิดต่างๆ ได้แก่ เอชวาย, เอชเมอร์, เอชเบต้า, เอชซีเอสเอ็มไฟว์, และซาโป้เรอดีไฟร์ นอกจากนี้ยังศึกษาถึงผลของการใช้ตัวรองรับผสม ได้แก่ เอชวาย/ซาโป้เรอดีไฟร์, เอชเมอร์/ซาโป้เรอดีไฟร์, เอชเบต้า/ซาโป้เรอดีไฟร์ และ เอชซีเอสเอ็มไฟว์/ซาโป้เรอดีไฟร์ ซึ่งเป็นที่รู้กันว่า เอชวาย, เอชเมอร์, เอชเบต้า, และเอชซีเอสเอ็มไฟว์สามารถทำให้เกิดปฏิกิริยาไอโซเมอร์ไรเซชัน และอะโรมาไตเซชันได้ ในขณะที่ซาโป้เรอดีไฟร์สามารถแตกพันธะโมเลกุลใหญ่ของสารตั้งต้นได้ เนื่องจากมีรูพรุนในระดับมีโซ ดังนั้นการผสม เอชวาย, เอชเมอร์, เอชเบต้า, และเอชซีเอสเอ็มไฟว์กับซาโป้เรอดีไฟร์จึงน่าจะส่งผลที่ดีในกระบวนการไพโรไลซิสยางรถยนต์หมดสภาพ เมื่อเปรียบเทียบกับกรณีที่ไม่ใช้ตัวเร่งปฏิกิริยา จากการทดลองพบว่าการใช้ซีโอไลต์ และการใช้โคบอลต์ร้อยละ 5 เดิมลงบนซีโอไลต์นั้น ตัวเร่งปฏิกิริยาทั้งหมดสามารถผลิตแก๊ส และโมโนอะโรมาติกส์ในน้ำมันได้มากกว่าการไม่ใช้ตัวเร่งปฏิกิริยาหรือการใช้ตัวรองรับเพียงอย่างเดียว นอกจากนี้ร้อยละ 5 ของโลหะโคบอลต์บนเอชวายผลิตโอเลฟินส์เบามากที่สุด ในขณะที่ร้อยละ 5 ของโลหะโคบอลต์บนเอชซีเอสเอ็มไฟว์ผลิตแก๊สหุงต้ม และปริมาณโมโนอะโรมาติกส์ในน้ำมันมากที่สุดเมื่อเทียบกับตัวเร่งปฏิกิริยาชนิดที่มีคุณสมบัติเป็นกรดด้วยกัน สุดท้ายนี้ยังพบว่าการผสมโลหะโคบอลต์ร้อยละ 5 บนเอชเมอร์กับการผสมโคบอลต์ร้อยละ 5 บนซาโป้เรอดีไฟร์นั้นผลิตโมโนอะโรมาติกส์มากที่สุดเมื่อเทียบกับตัวเร่งปฏิกิริยาชนิดใดๆ

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C5	Gas yields obtained from pyrolysis with 5 %Co/HZSM-5 catalyst.	85
C6	Gas yields obtained from pyrolysis with 5 %Co/(HY+SAPO-34) catalyst.	86
C7	Gas yields obtained from pyrolysis with 5 %Co/(HMOR+SAPO-34) catalyst.	87
C8	Gas yields obtained from pyrolysis with 5 %Co/(HBETA+SAPO-34) catalyst.	88
C9	Gas yields obtained from pyrolysis with 5 %Co/(HZSM-5+SAPO-34) catalyst	89