

**ADSORPTIVE REMOVAL OF SULFUR COMPOUNDS FROM
TRANSPORTATION FUELS BY USING ZEOLITIC ADSORBENTS**



Ho Ngoc Linh

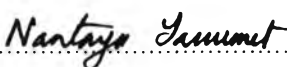
A Thesis Submitted in Partial Fulfilment of the Requirements
for the Degree of Master of Science
The Petroleum and Petrochemical College, Chulalongkorn University
in Academic Partnership with
The University of Michigan, The University of Oklahoma,
Case Western Reserve University and Institut Français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

2008


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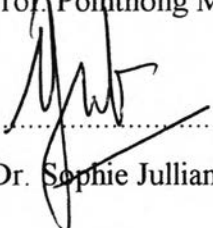
Thesis Title: Adsorptive Removal of Sulfur Compounds from
Transportation Fuels by Using Zeolitic Adsorbents
By: Ho Ngoc Linh
Program: Petrochemical Technology
Thesis Advisors: Asst. Prof. Pomthong Malakul
Dr. Sophie Jullian

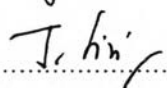
Accepted by the Petroleum and Petrochemical College, Chulalongkorn
University, in partial fulfilment of the requirements for the Degree of Master of
Science.

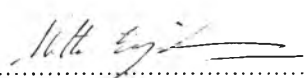

..... College Director
(Assoc. Prof. Nantaya Yanumet)

Thesis Committee:


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


.....
(Dr. Sophie Jullian)


.....
(Dr. Siriporn Jongpatiwut)


.....
(Assoc. Prof. Metta Chareonpanich)

บทคัดย่อ

โธ ฆอบ ลีน: การกำจัดสารประกอบกำมะถันจากน้ำมันเชื้อเพลิงที่ใช้ในการขนส่งโดยใช้ซีโอไลต์เป็นตัวดูดซับ (Adsorptive Removal of Sulfur Compounds from Transportation Fuels by Using Zeolitic Adsorbents) อ. ที่ปรึกษา : ผศ. ดร. ปมทอง มาลากุล ณ อยุธยา, ดร.มิเชล โทมัส, ดร. โซเฟีย จูเลียน และ ราฟาเอล ฮอยเก 120 หน้า

ในงานวิจัยนี้ ซีโอไลต์ NaX และ NaY ถูกแลกเปลี่ยนประจุกับไอออนประจุบวก Ni^{2+} และ Cu^+ โดยวิธี LPIE และ SSIE ซึ่งซีโอไลต์ที่ผ่านการแลกเปลี่ยนประจุแล้วนั้นถูกใช้เป็นตัวดูดซับสารประกอบกำมะถัน โดยประเมินประสิทธิภาพการดูดซับจากการกำจัด 3-MT และ BT ในระบบที่มีสองและสามองค์ประกอบของ ไอโซออกเทน และเบนซีน (หรือ โทลูอิน) เป็นแบบจำลองของน้ำมันเชื้อเพลิง จากการทดลองพบว่า NaX แลกเปลี่ยนไอออนได้ร้อยละ 85 และ NaY แลกเปลี่ยนไอออนได้ร้อยละ 68 โดยวิธี LPIE นอกจากนี้แล้วอุณหภูมิที่เหมาะสมในการแลกเปลี่ยนไอออนโลหะด้วยวิธีนี้สำหรับ NaX และ NaY คือ 45 และ 135 องศาเซลเซียสตามลำดับ เมื่อเปรียบเทียบกับวิธี LPIE แล้ว วิธี SSIE สามารถแลกเปลี่ยนไอออนได้ถึงร้อยละ 100 จากการศึกษาการดูดซับพบว่า การดูดซับสารประกอบกำมะถันทั้งสองชนิดนั้นมีปริมาณเพิ่มขึ้นตามลำดับ ดังนี้ NiY (LPIE ที่ 135 องศาเซลเซียส) < NiX (LPIE ที่ 45 องศาเซลเซียส) < NiY (SSIE) นอกจากนี้แล้ว ผลการดูดซับสารประกอบกำมะถันในไอโซออกเทนและในเบนซีน แสดงให้เห็นว่า อัตราการกำจัดและปริมาณการดูดซับโดยรวมของสารประกอบกำมะถันบนตัวดูดซับลดลงอย่างมีนัยสำคัญในเบนซีน ทั้งนี้เนื่องจากเบนซีนสามารถแข่งขันกับสารประกอบกำมะถันในการเกิด π -complexation กับตัวดูดซับได้ จากการดูดซับ 3-MT ที่สภาวะสมดุลมีความสามารถในการดูดซับตามลำดับดังนี้ $NaY < NiY < NiX < NaX < Cu^{0}Y$ ในขณะที่ความเฉพาะเจาะจงในการดูดซับ 3-MT ในโทลูอินมีดังนี้ $NaY < NiY < NaX < NiX < Cu^{0}Y$ นอกจากนี้แล้วยังพบว่า น้ำที่ถูกดูดซับก่อนในตัวดูดซับนั้นขัดขวางการเกิด π -complexation ระหว่างตัวดูดซับและสารประกอบกำมะถัน

ABSTRACT

4971007063: Petrochemical Technology Program
Ho Ngoc Linh: Adsorptive Removal of Sulfur Compounds from
Transportation Fuels by Using Zeolitic Adsorbents
Thesis Advisors: Asst. Prof. Pomthong Malakul and Dr. Michel
Thomas, Dr. Sophie Jullian, and Mr. Raphael Huyghe 120 pp
Keywords: Adsorption, zeolite, ion exchange, desulfurization, π -complexation
adsorbents.

In this study, the ion-exchanged zeolites were prepared by exchanging NaX and NaY zeolites with Ni^{2+} and Cu^+ cations using both LPIE and SSIE methods. These adsorbents were evaluated for their efficiency in removing 3-MT and BT in both binary and ternary systems of isooctane and benzene (or toluene) as model fuels. The results showed only 85% exchange in NaX and 68% exchange in NaY zeolites by LPIE technique. The optimum temperature for achieving a sufficient amount of metal loading by this technique on NaX and NaY was found to be 45°C and 135°C, respectively. In comparison with LPIE, the SSIE technique obtained 100% ion-exchange. In the static adsorption, the sulfur adsorption capacity increased in the order $\text{NiY (LPIE at 135}^\circ\text{C)} < \text{NiX (LPIE at 45}^\circ\text{C)} < \text{NiY (SSIE)}$ for both sulfur compounds. Furthermore, the adsorption data of sulfur compounds in isooctane and benzene revealed that the removal rate and the overall sulfur uptake capacity of the adsorbents were significantly reduced when benzene was used, which can be attributed to the competitive π -complexation forming with the adsorbent between the aromatic (benzene) and sulfur compound. The equilibrium capacity under dynamic conditions for 3-MT adsorption increased in the order of $\text{NaY} < \text{NiY} < \text{NiX} < \text{NaX} < \text{Cu}^{(I)}\text{Y}$; while the selectivity for 3-MT over toluene exhibited the following trend $\text{NaY} < \text{NiY} < \text{NaX} < \text{NiX} < \text{Cu}^{(I)}\text{Y}$. In addition, the pre-adsorbed water was found to have detrimental effect on the π -complexation bonding between adsorbent and sulfur compounds.

ACKNOWLEDGEMENTS

I would like to sincerely express my thanks and gratitude to the following people and organization. Without their help, this thesis could not be very fruitful.

First of all, I would sincerely like to thank my Chief Advisors, Asst. Prof. Pomthong Malakul and Dr. Michel Thomas, for their help and guidance on a day to day basis during my doing research at the Petroleum and Petrochemical College and Institut Français du Pétrole (IFP). I would really appreciate their advice, suggestions, and comments, good or bad because I am in a learning stage and would love to be corrected.

I would like to give special thanks to Dr. Sophie Jullian, Dr. Cecile Barrere-Tricca, and Mr. Raphael Huyghe, for their kindly helping and assisting me during my period time at Institut Français du Pétrole (IFP).

I would really appreciate Dr. Siriporn Jongpatiwut and Assoc.Prof. Metta Chareonpanich, for kindly serving on my thesis committee.

I would also like to thank all my professors who guided me through their courses, giving me a chance to get knowledge about my thesis.

This thesis work is partially funded by the National Excellence Center for Petroleum, Petrochemicals, and Advanced Materials, Ministry of Education, Thailand.

I would also like to express my special thank to the Ratchadapisek Research Funding of Chulalongkorn University for financial support and funding from the Institut Français de Pétrole (IFP) during I stayed in France.

Thanks to Ms. Michèle Maricar-Pichon, Ms. Sandra Montpeyroux, Ms. Aurélie Marsallon, Ms. Christine Bounie, the IFP's technicians; and all the graduate students at PPC, who helped me over the year.

Finally, special thanks to my parents for all their patience and understanding through my research time. Without their support this project would not have been possible.

I have tried my level best to complete the project, hope you will like it.

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