EFFECT OF AMINES ON HIGH INTERNAL PHASE EMULSION ADSORBENTS FOR CARBON DIOXIDE ADSORPTION

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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
2013

I 28372621

Thesis Title:	Effect of Amines on High Internal Phase Emulsion Adsorbents for Carbon Dioxide Adsorption
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Program:	Petroleum Technology
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ABSTRACT

5473006063 : Petroleum Technology Program
Narit Athipongarporn: Effect of Amines on High Internal Phase Emulsion Adsorbents for Carbon Dioxide Adsorption.
Thesis Advisors: Assoc. Prof. Chintana Saiwan, Professor Paitoon Tontiwachwuthikul 100 pp.
Keywords : PolyHIPE/ Oil in water emulsion/ Amine/ CO_2 adsorption

High internal phase emulsion polymers (PolyHIPE) with amines, i.e. hexylamine and 1,3-diaminopropane were prepared. The oil-in-water emulsion system was obtained by mixing divinylbenzene (DVB), vinylbenzylchloride (VBC) and surfactants (SpanR 80, oil soluble surfactant and Triton X-100, water soluble surfactant). The optimum condition of the emulsion system was obtained by varying the ratio of the surfactants. The ratio of SpanR80 to Triton X-100 of 1.18 was optimum for polyHIPE reference, while an addition of amines, hexylamine showed the optimum at 1.50 and 1,3-diaminopropane at 0.81. A Fourier transform infrared spectroscope was used to confirm the presence of amine in polyHIPE by using the peak ratio change of C– vinyl at 900 cm^{-1} to 920 cm^{-1} to C–chloride at 729 cm^{-1}. Scanning electron micrograph showed that the morphology of polyHIPE was spherical. Voids and fractures on the surface morphology were formed by agglomeration of small spheres and the surface area was a consequence of the effect of the oil soluble surfactant (SpanR80) that was dissolved into oil droplets and formed water-in-oil emulsion system. CO_2 adsorption capacities in dried and moisturized condition were measured by feeding 4% CO_2 in N_2 balanced through the adsorbent which was packed in the column, then the quantity of CO_2 was detected by gas chromatography (GC) and taken the value to calculate the CO_2 adsorption capacity. In the dried condition and the surfactant ratio of 0.72, the polyHIPE-1,3-diaminopropane showed the highest CO_2 adsorption capacity (0.3770 mmol/g). In the moisturized condition, all values of CO_2 adsorption capacities were lower than those of the dried conditions because the adsorption of moisture reduced the adsorption sites of CO_2.

บทคัดย่อ

นาย นฤตย์ อธิพงษ์อาภรณ์ : ผลของเอมีนต่อตัวดูดซับที่ได้จากอิมัลชันชนิดเฟสภายในสูงสำหรับการดูดซับก๊าซคาร์บอนไดออกไซด์ (Effect of Amines on High Internal Phase Emulsion Adsorbents for Carbon Dioxide Adsorption) อ. ที่ปรึกษา : รศ.ดร. จินตนา สายวรรณ์ และ ศ.ดร. ไพฑูร์ ตันติเวชวุฒิกุล 100 หน้า

พอลิเมอร์จากอิมัลชันชนิดเฟสภายในสูง (พอลิฮิป) ที่มีเอมีนด้วย เช่น เฮ็กซิลเอมีน และ 1,3ไดอะมิโนโพรเพน ถูกเตรียมขึ้นโดยใช้อิมัลชันชนิดน้ำมันในน้ำโดยการผสมไดไวนิลเบนซีน (ดีวีบี), ไวนิลเบนซิลคลอไรด์(วีบีซี) และสารลดแรงตึงผิว (สแปนอาร์แปดสิบ ละลายในน้ำมัน และไทรตันเอ็กหนึ่งร้อย ละลายในน้ำ) ภาวะที่เหมาะสมของระบบอิมัลชันได้จากการแปรผัน อัตราส่วนของสารลดแรงตึงผิว อัตราส่วนของสแปนอาร์แปดสิบต่อไทรตันเอ็กหนึ่งร้อย ของพอลิฮิปอ้างอิง เท่ากับ 1.18 ขณะที่ เมื่อเติมเอมีนลงไปพอลิฮิปเป็นเฮ็กซิลเอมีนมีอัตราส่วนที่เหมาะสมเท่ากับ 1.50 และพอลิฮิปที่เติม 1,3 ไดอะมิโนโพรเพน เท่ากับ 0.81 ฟลูเรียทรานส์ฟอร์ม สเปคโตรสโคป (เอ็ฟทีไออาร์) ยืนยันการเกิดปฏิกิริยาระหว่างไวนิลเบนซิลคลอไรด์และ เอมีน โดยดูการเปลี่ยนแปลงค่าอัตราส่วนของพีคของหมู่ คาร์บอน-ไวนิล ที่ช่วงของ เลขคลื่น 900 ต่อเซ็นติเมตร ถึง 920 ต่อเซ็นติเมตร ต่อพีคของหมู่คาร์บอน-คลอไรด์ ที่เลขคลื่น 729 ต่อเซ็นติเมตร สแกนนิ่งอิเล็คตรอน ไมโครกราฟแสดงสัณฐานของพอลิฮิป เป็นทรงกลม และมี ช่องว่างหรือรอยแตกบนพื้นผิว เป็นผลจากการรวมตัวกันของพอลิฮิปทรงกลมเล็กๆ และจากการที่สารลดแรงตึงผิวที่ละลายในน้ำมัน (สแปนอาร์แปดสิบ) เกิดเป็นอิมัลชันแบบน้ำในน้ำมัน การทดสอบหาการดูดซับก๊าซคาร์บอนไดออกไซด์ในพอลิฮิปทั้งในสภาวะที่แห้งและที่มีความชื้น โดยการผ่านก๊าซคาร์บอนไดออกไซด์ความเข้มข้น 4 เปอร์เซ็นต์ ที่ผสมในก๊าซไนโตรเจนไปในคอลัมน์ที่บรรจุตัวดูดซับพอลิฮิป และวัดหาปริมาณก๊าซคาร์บอนไดออกไซด์ที่ผ่านพ้นคอลัมน์ด้วยเครื่องก๊าซโครมาโตกราฟฟี่ (จีซี)และนำค่าที่ได้ไปคำนวณหาปริมาณก๊าซคาร์บอนไดออกไซด์ที่ถูกดูดซับ พบว่า ในสภาวะที่แห้งและที่อัตราส่วนของสารลดแรงตึงผิวเท่ากับ 0.72 พอลิฮิปที่มี1,3-ไดอะมิโนโพรเพน ให้ค่าการดูดซับก๊าซคาร์บอนไดออกไซด์สูงที่สุด (0.3770 มิลลิโมลต่อกรัม) ในสภาวะที่มีความชื้น ทุกค่าของการดูดซับก๊าซคาร์บอนไดออกไซด์ ให้ค่าต่ำกว่าเมื่อเทียบกับสภาวะแห้ง เนื่องจากความชื้นดูดซับที่ผิวหน้าของตัวดูดซับทำให้การดูดซับก๊าซคาร์บอนไดออกไซด์ได้น้อยลง

ACKNOWLEDGEMENTS

I would like to express my gratitude to my advisor Associate Professor Chintana Saiwan and my co-advisor Professor Paitoon Tontiwachwuthikul for the useful comments, remarks and engagement through the learning process of this master thesis. I would also like to thank Dr. Teeradet Supap for his advice and give me the great full ideas to solve the problems in this thesis. I would like to thank Mr. Watana Kangwanwatana for the design and construction of the CO_2 adsorption equipment.

This thesis work is funded by the Petroleum and Petrochemical College, and the National Center of Excellence for Petroleum, Petrochemicals, and Advanced Materials, Thailand and the 90th Year Anniversary of Chulalongkorn University Fund (Ratchadaphisekssomphot Endowment Fund) for the scholarship and funding to the research work.

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