

**STUDY OF IMPROVING CARBON DIOXIDE ADSORPTION CAPACITY
USING ADSORBENTS IMPREGNATED WITH PIPERAZINE**

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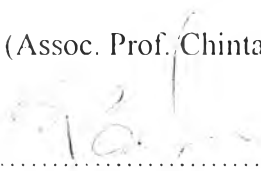
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Using Adsorbents Impregnated with Piperazine
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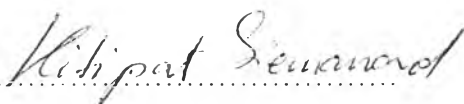
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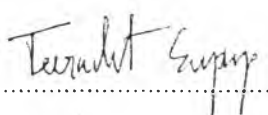

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ABSTRACT

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Danai Praekiat: Study of Improving Carbon Dioxide Adsorption Capacity Using Adsorbents Impregnated with Piperazine.

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The adsorption of carbon dioxide (CO₂) for the natural gas processing application was performed with adsorbents modified with piperazine (PZ). To optimize CO₂ adsorption capacity, the effects of adsorption pressure, PZ loading, and types of adsorbents (activated carbon, or AC, and silica gel, or SG) were studied. Piperazine was impregnated onto the surface of AC and SG adsorbents by the wet impregnation method. The surface morphology of the unimpregnated and impregnated adsorbents was characterized using a surface area analyzer. The PZ loading was detected by a gas chromatography-flame ionization detector. It was found that the maximum PZ loading on the AC and SG were 3.45 wt% and 8.33 wt%, respectively. In the CO₂ adsorption and regeneration experiments, the adsorbents were tested in a stainless steel reactor. The breakthrough curves obtained from the feed gas containing 15% CO₂/N₂ with a flow rate of 15 mL/min were determined by using a gas chromatography-thermal conductivity detector. The effects of adsorption pressure were carried out at 298 K at various pressures, i.e. 14.7, 30, 50, and 70 psi. The results showed that PZ impregnated on AC and SG at pressure 70 psi showed the highest CO₂ adsorption capacity of 6.7 mmol/g and 7.7 mmol/g, respectively. The efficiency of regeneration of the impregnated adsorbents was more than 85 % during three consecutive test cycles.

บทคัดย่อ

คณัฏ แพร่เกียรติ : การศึกษาประสิทธิภาพการดูดซับของคาร์บอนไดออกไซด์โดยใช้ตัวดูดซับที่อิมแพกเนทด้วยสารปิเปอราซีน (Study of Improving Carbon Dioxide Adsorption Capacity Using Adsorbents Impregnated with Piperazine) อ. ที่ปรึกษา : รศ.ดร. จินตนา สายวรรณ และ ศ.ดร. ไพฑูรย์ ตันติเวชวุฒิกุล, 98 หน้า

การดูดซับก๊าซคาร์บอนไดออกไซด์จากขบวนการแปรรูปก๊าซธรรมชาติโดยใช้ตัวดูดซับที่อิมแพกเนทด้วยสารปิเปอราซีน มีวัตถุประสงค์เพื่อหาความจุของการดูดซับก๊าซคาร์บอนไดออกไซด์ โดยศึกษาความดันของการดูดซับ, ปริมาณการใส่สารปิเปอราซีน รวมถึงชนิดของตัวดูดซับ (ถ่านกัมมันต์ และ ซิลิกาเจล) ปิเปอราซีนถูกอิมแพกเนทลงบนผิวหน้าของถ่านกัมมันต์และซิลิกาเจลด้วยวิธีอิมแพกเนทแบบเปียก การวิเคราะห์พื้นที่ผิวตัวดูดซับทั้งชนิดไม่ได้อิมแพกเนท และชนิดอิมแพกเนท วิเคราะห์โดยใช้เครื่องวิเคราะห์พื้นที่ผิว ปริมาณสารปิเปอราซีนมากที่สุดที่ฝังอยู่ในตัวดูดซับ ถูกวัดด้วยเครื่องแก๊สโครมาโทกราฟี-เฟลมไอออไนเซชัน โดยปริมาณสารปิเปอราซีนที่ฝังอยู่ในถ่านกัมมันต์และซิลิกาเจลวัดได้ 3.45 และ 8.33 เปอร์เซ็นต์เฉลี่ยโดยน้ำหนักตามลำดับ ในขั้นตอนการวัดค่าความจุของการดูดซับก๊าซคาร์บอนไดออกไซด์ และการนำกลับมาใช้ใหม่ของตัวดูดซับเดิม ตัวดูดซับถูกทดลองในเครื่องปฏิกรณ์สแตนเลส โดยกราฟเบรคทรูจากก๊าซคาร์บอนไดออกไซด์ 15% ที่อัตราการไหล 15 มิลลิลิตรต่อนาที ถูกวัดโดยเครื่องแก๊สโครมาโทกราฟีเทอร์มัลคอนดักทีวิตีร์ การศึกษาผลกระทบของความดันต่างๆในการดูดซับที่อุณหภูมิห้อง ที่ความดันต่างๆคือ ความดันบรรยากาศ, 30, 50 และ 70 ปอนด์ต่อตารางนิ้ว พบว่าที่การดูดซับด้วยความดัน 70 ปอนด์ต่อตารางนิ้ว ถ่านกัมมันต์และซิลิกาเจล ที่มีปิเปอราซีน มีความจุในการดูดซับมากที่สุด ได้ค่า 6.7 มิลลิโมลต่อกรัม และ 7.7 มิลลิโมลต่อกรัม ตามลำดับ การศึกษาผลของการนำตัวดูดซับกลับมาใช้ซ้ำ พบว่าประสิทธิภาพในการดูดซับมีค่ามากกว่า 85 % ตลอดการทดลองต่อเนื่อง 3 รอบติดกัน

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