

MIXED MATRIX MEMBRANES FOR CO₂/CH₄ SEPARATION

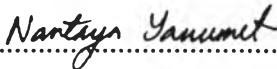
Jidapa Soontraratpong

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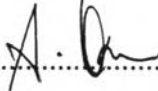
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By: Jidapa Soontraratpong
Program: Petrochemical Technology
Thesis Advisors: Assoc.Prof. Thirasak Rirksomboon
Prof. Somchai Osuwan
Dr. Santi Kulprathipanja

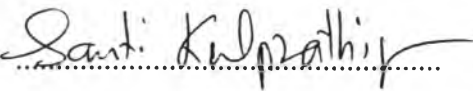
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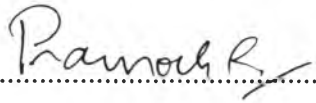

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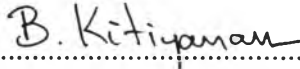
Thesis Committee:


.....
(Assoc.Prof. Thirasak Rirksomboon)


.....
(Prof. Somchai Osuwan)


.....
(Dr. Santi Kulprathipanja)


.....
(Assoc. Prof. Pramoch Rangsunvigit)


.....
(Asst. Prof. Boonyarach Kitiyanan)

บทคัดย่อ

จิตาภา สุนทรรัตน์พงษ์ : การศึกษาการแยกก๊าซคาร์บอนไดออกไซด์ออกจากก๊าซมีเทนโดยใช้เยื่อเลือกผ่านเนื้อผสม (Mixed Matrix Membranes for CO₂/CH₄ Separation) อ. ที่ปรึกษา : รศ. ดร. ธีรศักดิ์ ฤกษ์สมบูรณ์ ศ. ดร. สมชาย โอสุวรรณ และ ดร. สันติ กุลประทีปปัญญา 99 หน้า ISBN 974-9651-91-X

การใช้เยื่อเลือกผ่านได้รับการพิจารณาให้เป็นอีกทางเลือกหนึ่งสำหรับกระบวนการแยก เนื่องจากมีต้นทุนการผลิตต่ำและสิ้นเปลืองพลังงานน้อยเมื่อเทียบกับกระบวนการแบบอื่น การแยกก๊าซคาร์บอนไดออกไซด์ออกจากก๊าซธรรมชาติเป็นกระบวนการที่จำเป็นเพื่อลดการกักเก็บและคงค่าความร้อนของก๊าซไว้ เยื่อเลือกผ่านเนื้อผสมได้รับการพัฒนาอย่างต่อเนื่องเพื่อเพิ่มการซึมผ่านของก๊าซและเพิ่มประสิทธิภาพในการแยก ในงานนี้ได้พัฒนาเยื่อเลือกผ่านเนื้อผสมซึ่งประกอบด้วยของแข็ง - ของเหลว - พอลิเมอร์ขึ้นและนำไปศึกษาการแยกระหว่างก๊าซคาร์บอนไดออกไซด์กับก๊าซมีเทน และก๊าซคาร์บอนไดออกไซด์กับก๊าซไนโตรเจน โดยทำการวัดปริมาณก๊าซที่ผ่านเยื่อเลือกผ่านที่ละก๊าซที่อุณหภูมิห้อง ได้นำของแข็ง ได้แก่ ถ่านกัมมันต์, ซีโอไลด์ชนิดโซเดียมเอกซ์และลิเทียมเอกซ์ ของเหลว ได้แก่ พอลิเอทิลีนไกลคอลและไดเอทานอลเอมีน พอลิเมอร์ ได้แก่ ขางซิลิโคนและเซลลูโลสอะซิเตทเป็นแผ่นรองรับสำหรับเตรียมเยื่อเลือกผ่านเนื้อผสม ผลการทดลองพบว่า การผสมของแข็งและของเหลวในการเตรียมเยื่อเลือกผ่านมีผลในการปรับปรุงการแยก อย่างไรก็ตามการซึมผ่านของก๊าซทุกตัวลดลงตามปริมาณของสารที่เติมลงไป เนื่องจากสารเหล่านั้นทำให้เนื้อของเยื่อเลือกผ่านหนาแน่นขึ้น พอลิเอทิลีนไกลคอลเพิ่มประสิทธิภาพในการแยกได้ดีกว่าไดเอทานอลเอมีนตามหลักของกระบวนการละลาย-การแพร่ ในการศึกษาพลาสติกไซเซชัน มีเพียงก๊าซคาร์บอนไดออกไซด์เท่านั้นที่เกิดการพลาสติกไซซ์กับเยื่อเลือกผ่านเนื้อผสม โดยพบว่าอัตราการซึมผ่านเพิ่มขึ้นเมื่อเพิ่มความดันก๊าซขาเข้า ในขณะที่อัตราการซึมผ่านของก๊าซมีเทนและก๊าซไนโตรเจนไม่ขึ้นกับความดันขาเข้า

ABSTRACT

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Membrane separations have been considered as an alternative to conventional separation methods due to their low capital cost and high energy savings. For natural gas separation, the removal of CO₂ is most important in order to minimize corrosion as well as to maintain a high heating value of the gas stream. Mixed matrix membranes (MMMs) have been developed to enhance gas permeability and selectivity. In this work, solid/liquid/polymer MMMs were developed and investigated for CO₂/CH₄ and CO₂/N₂ separations using pure gas measurements at room temperature. Activated carbon (AC), NaX and LiX zeolites were used as solids, polyethylene glycol (PEG) and diethanolamine (DEA) were used as liquids, and silicone rubber (SR) and cellulose acetate (CA) were utilized as the polymer phase and support. It was found that the incorporation of solid and liquid were effective to improve the separation performance of MMMs. However the gas permeation rates decreased as an increase in component loading since those components densified the intersegmental packing of membrane phase. Based on solution-diffusion mechanism, PEG significantly enhanced the properties over DEA. In this work, plasticization studies showed that only CO₂ had a plasticizing effect, in which CO₂ permeation rate increased with increasing feed pressure, while the permeation rates of CH₄ and N₂ were independent of pressure.

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