

**PROCESS SIMULATION OF CARBON DIOXIDE CAPTURE  
USING IONIC LIQUID 1-ETHYL-3-METHYLIMIDAZOLIUM ACETATE**

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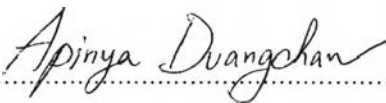
  
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## ABSTRACT

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Among the emerging technologies created to replace the conventional monoethanolamine(MEA)-based process for post-combustion CO<sub>2</sub> capture, one ionic liquid, 1-Ethyl-3-methylimidazolium acetate ([emim][Ac]) is considered a potential solvent for green CO<sub>2</sub> capture technology, with the added benefit of cost reduction. In this study, both CO<sub>2</sub> capture processes (MEA and [emim][Ac]-based processes) were simulated to capture 90 % of CO<sub>2</sub> from post-combustion flue gas based on a 180 MWe coal burning power plant, using Aspen Plus (V. 7.1). Since the databases of Aspen Plus do not provide any pure component data for [emim][Ac], the direct input information and data regression modes in Aspen Plus were employed. The “modified Lyndersen-Joback-Reid” group contribution method was used to estimate the critical properties of [emim][Ac]. The temperature-dependent correlation parameters, the binary-interaction parameters for Non-Random Two Liquid model, the parameters of Henry’s constant model, and the parameters of equilibrium calculation model were regressed based on the reported properties of [emim][Ac] available in related literature. Energy consumption and evaluated investment cost from the simulation of both processes were compared to determine the potential of [emim][Ac]. The results show both lower energy requirement and investment cost of the [emim][Ac]-based process compared to MEA by 13.5 % and 3.75 %, respectively.

## บทคัดย่อ

คุณ ขอนแก่น: การจำลองกระบวนการของการจับก๊าซคาร์บอนไดออกไซด์โดยใช้ของเหลวไอออนิก 1-เอทิล-3-เมทิลอิมิดาโซเลียม อะซิเตท (Process Simulation of Carbon Dioxide Capture Using Ionic Liquid 1-Ethyl-3-methylimidazolium Acetate) อ. ที่ปรึกษา: ผศ. ดร. กิติพัฒน์ สีมานนท์ ศ. ดร. อามาร์ เสนีย์ 192 หน้า

ในบรรดาเทคโนโลยีสมัยใหม่ที่ถูกสร้างขึ้นเพื่อนำมาแทนที่กระบวนการการจับก๊าซคาร์บอนไดออกไซด์หลังการเผาไหม้โดยใช้ตัวทำละลายเอมีน หนึ่งในเทคโนโลยีเหล่านั้นคือการใช้ของเหลวไอออนิก 1-เอทิล-3-เมทิลอิมิดาโซเลียม อะซิเตท ซึ่งได้รับการพิจารณาว่าเป็นตัวทำละลายที่เป็นมิตรกับสิ่งแวดล้อม และมีศักยภาพในการลดค่าใช้จ่ายให้กับกระบวนการการจับก๊าซคาร์บอนไดออกไซด์หลังการเผาไหม้ได้ ในงานวิจัยนี้ กระบวนการการจับก๊าซคาร์บอนไดออกไซด์ทั้งสองกระบวนการคือกระบวนการที่ใช้ตัวทำละลายเอมีนและกระบวนการที่ใช้ตัวทำละลายของเหลวไอออนิกได้ถูกจำลองขึ้นโดยใช้โปรแกรม แอสเพน พลัส เวอร์ชัน 7.1 เพื่อใช้จับก๊าซคาร์บอนไดออกไซด์หลังจากการเผาไหม้จากโรงไฟฟ้าถ่านหินขนาด 180 เมกกะวัตต์ เป็นปริมาณร้อยละ 90 ของปริมาณก๊าซคาร์บอนไดออกไซด์ทั้งหมดที่ถูกปล่อยออกมา เนื่องจากข้อมูลเกี่ยวกับของเหลวไอออนิกที่ใช้ในงานวิจัยนี้ไม่มีปรากฏอยู่ในฐานข้อมูลของโปรแกรม แอสเพน พลัส ดังนั้นการใส่ข้อมูลเกี่ยวกับของเหลวไอออนิกโดยตรงและโหมคการวิเคราะห์การถดถอยข้อมูลในโปรแกรมแอสเพน พลัส จึงถูกนำมาใช้ วิธีการของ ลินเคอร์เซน-โจแบค-เรียด ถูกนำมาใช้ในการคาดคะเนคุณสมบัติวิกฤติของ 1-เอทิล-3-เมทิลอิมิดาโซเลียม อะซิเตท พารามิเตอร์ความสัมพันธ์ของสมบัติที่เปลี่ยนแปลงตามอุณหภูมิ, พารามิเตอร์อันตรกิริยาคู่ของโมเดลนอนแรนคอม พู ลิกวิด, พารามิเตอร์ของโมเดลค่าคงที่ของเฮนรีและพารามิเตอร์สำหรับโมเดลการคำนวณสมมูลเคมี ถูกนำมาวิเคราะห์การถดถอยโดยอาศัยข้อมูลคุณสมบัติของ 1-เอทิล-3-เมทิลอิมิดาโซเลียม อะซิเตท ที่มีการรายงานไว้แล้วในงานวิจัยก่อนหน้านี้ ปริมาณการใช้พลังงานและค่าใช้จ่ายในการลงทุนของกระบวนการการจับก๊าซคาร์บอนไดออกไซด์หลังการเผาไหม้ของทั้งสองกระบวนการถูกนำมาเปรียบเทียบเพื่อพิจารณาศักยภาพของของเหลวไอออนิกชนิดนี้ในการนำมาใช้แทนที่ตัวทำละลายเอมีน ผลจากงานวิจัยพบว่า กระบวนการการจับก๊าซคาร์บอนไดออกไซด์ที่ใช้ตัวทำละลายของเหลวไอออนิก 1-เอทิล-3-เมทิลอิมิดาโซเลียม อะซิเตท ใช้พลังงานน้อยกว่าและมีค่าใช้จ่ายในการลงทุนที่น้อยกว่าเมื่อเทียบกับกระบวนการการจับก๊าซคาร์บอนไดออกไซด์ที่ใช้ตัวทำละลายเอมีนเป็นร้อยละ 13.5 และ 3.75 ตามลำดับ

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