# LIQUID-LIQUID EXTRACTION OF NEUTRAL DEGRADATION PRODUCTS IN MONOETHANOLAMINE ABSORPTION SOLUTION USED IN CARBON DIOXIDE CAPTURE

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# ABSTRACT

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The liquid-liquid extraction technique was used to separate the neutral amine degradation products (imidazole, N-acethylethanolamine, 2-oxazolidone and N-(2-hydroxyethyl)-succinimide) from the monoethanolamine (MEA) absorption solution for carbon dioxide capture. The extraction efficiency of neutral MEA degradation products was determined and investigated under various experimental conditions including the effects of 2-ethyl-1-hexanol diluent alone and extractant (quaternary amine) in 2-ethy-l-hexanol solution, the absence and presence of MEA in the neutral amine degradation products solutions at different temperature (25 °C, 40 °C and 60 °C) and the $CO_2$ loading of 0.05, 0.10 and 0.30 mol/mol amine. All the neutral MEA degradation products were analyzed by using a gas chromatography with flame ionization (GC-FID). The percentages of extraction efficiency of neutral MEA degradation products with extractant in diluent for N-(2-hydroxyethyl)-succinimide was the most extracted, followed by 2-oxazolidone, imidazole and N-acethylethanolamine, respectively. In case of present MEA solution in aqueous phase, the extraction efficiency of neutral MEA degradation products decreased from 39.77±1.12 %, 27.83±1.66 %, 84.09±0.47 % and 99.44±0.02 % to 16.42±1.36 %, 20.18±1.19 %, 56.93±1.09 % and 72.31±2.54 % for imidazole, N-acethyl ethanolamine, 2-oxazolidone and N-(2-hydroxyethyl)-succinimide, respectively. The extraction efficiency of all neutral MEA degradation with absence and presence MEA increased with increasing extraction temperature. Lastly, the extraction efficiency was decreased dramatically with loading $CO_2$ in neutral MEA degradation products.

# บทคัดย่อ

วัลลภา กระจ่างพิศ : การสกัดแบบลิควิด-ลิควิดผลิตภัณฑ์เสื่อมสลายเป็นกลางในสารละลายดูดซับโมโนเอทาโนลามีนที่ใช้จับคาร์บอนไดออกไซด์ (Liquid-Liquid Extraction of Neutral Degradation Products in Monoethanolamine Absorption Solution Used in Carbon Dioxide Capture) อาจารย์ที่ปรึกษา : รศ.ดร. จินตนา สายวรรณ์ และ ดร. ธีรเดช สุภาพ 157 หน้า

เทคนิคการสกัดแบบ ลิควิด-ลิควิด ถูกนำมาใช้แยกผลิตภัณฑ์เสื่อมสลายเป็นกลางของเอมีน (อิมิดาโซล, เอ็น-อะซิทิวเอทาโนลามีน, 2-อ็อกซาโซลิโดน และเอ็น-(2-ไฮดร็อกซีเอทิว)-ซัคซินิไมด์) จากสารละลายดูดซับโมโนเอทาโนลามีน (MEA) เพื่อใช้จับคาร์บอนไดออกไซด์ การศึกษาประสิทธิภาพการสกัดผลิตภัณฑ์เสื่อมสลายเป็นกลางของสารละลาย MEA ที่เป็นกลาง ได้ทำการทดสอบภายใต้เงื่อนไขต่างๆ คือ ผลกระทบของ สารละลายอินทรีย์ 2-เอททิว-1-เฮกซานอล เพียงอย่างเดียว, สารสกัด (ควอเตอนารีเอมีน) ในสารละลายอินทรีย์ 2-เอททิว-1-เฮกซานอล, การปรากฏและไม่ปรากฏของ MEA ในสารละลายของผลิตภัณฑ์เสื่อมสลายเป็นกลางของเอมีน ที่อุณหภูมิแตกต่างกัน (25, 40 และ 60 องศาเซลเซียส) และการเติมคาร์บอนไดออกไซด์ที่ 0.05, 0.10 และ0.30 โมลต่อโมลเอมีน ทำการวิเคราะห์ผลิตภัณฑ์เสื่อมสลายเป็นกลางของสารละลาย MEA ทั้งหมดโดยก๊าซโครมาโตกราฟี-เฟลมไอออนไนเซชัน (จี ซี-เอฟ ไอ ดี) พบว่าเปอร์เซ็นต์ของประสิทธิภาพการสกัดผลิตภัณฑ์เสื่อมสลายเป็นกลางของสารละลาย MEA ด้วยสารสกัดเกลือเอมีนในสารละลายอินทรีย์ เอ็น-(2-ไฮดร็อกซีเอทิว)-ซัคซินิไมด์ถูกสกัดมากที่สุด ตามด้วย 2-อ็อกซาโซลิโดน, อิมิดาโซล, และเอ็น-อะซิทิวเอทาโนลามีนตามลำดับ ในกรณีที่มี MEA อยู่ในเฟสน้ำด้วย ประสิทธิภาพการสกัดผลิตภัณฑ์เสื่อมสลายเป็นกลางของ MEA ลดลง สำหรับอิมิดาโซลจาก 39.77±1.12 % เป็น 16.42±1.36 %, สำหรับ เอ็น-อะซิทิวเอทาโนลามีน จาก 27.83±1.66 % เป็น 20.18±1.19 % สำหรับ 2-อ็อกซาโซลิโดน จาก 84.09±0.47 % เป็น 56.93±1.09 % และ เอ็น-(2-ไฮดร็อกซี่เอทิว)-ซัคซินิไมด์ จาก 99.44±0.02 % เป็น 72.31±2.54 % ประสิทธิภาพการสกัดผลิตภัณฑ์เสื่อมสลายเป็นกลางทั้งที่มีและไม่มี MEA เพิ่มขึ้นเมื่อเพิ่มอุณหภูมิการสกัด ท้ายที่สุดประสิทธิภาพการสกัดลดลงอย่างมากเมื่อใส่คาร์บอนไดออกไซด์ในผลิตภัณฑ์เสื่อมสลายเป็นกลาง MEA

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