

**A STUDY OF CLOUD POINT EXTRACTION FOR REMOVAL OF
AROMATIC CONTAMINANTS FROM WASTEWATER**



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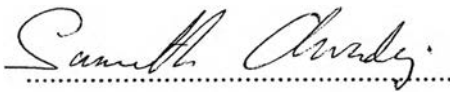
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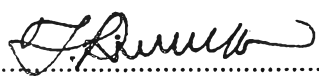

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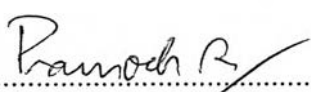
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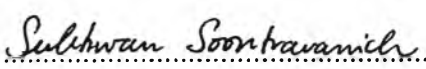

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ABSTRACT

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Cloud point extraction (CPE) has been successfully scaled up to continuously remove aromatic contaminants from wastewater in a multi-stage rotating disc contactor. When the nonionic surfactant solution has a temperature higher than the cloud point, phase separation occurs, forming the coacervate phase, and the dilute phase. Most of contaminants contained in the wastewater will solubilize into the surfactant micelles and concentrate in the coacervate phase, thus the dilute phase can be discharged as treated water. The extraction performances for removal of organic solutes with difference structures and initial concentrations were compared for both batch and continuous CPE. The higher the K_{ow} (octanol-water partition coefficient) or hydrophobicity of solutes, the better the extraction due to the greater affinity of solutes to solubilize into micelles. The empirical linear correlations between $\log K_{ow}$, \log (solute partition ratio), and \log (height of transfer unit) were developed. The extraction ability decreases as the initial concentration of solute in the wastewater increases mainly due to the coacervate entrainment into the overhead effluent. In addition, the effect of nonionic surfactant molecular structure on the CPE of phenol in batch experiment was studied. Phenol coacervate solubilization equilibrium constant is shown to increase linearly with EO number, but is unaffected by alkyl carbon number or hydrophobe branching. A model is developed which can predict the phenol partition ratio at a given temperature for any AE surfactant structure dependent on only one simple measured parameter: fractional coacervate volume. Finally, potential solutions for surfactant entrainment in the dilute phase after CPE were proposed and studied.

บทคัดย่อ

แพนภัทร เตชางาม : การศึกษาการแยกสารอะโรมาติกส์ออกจากน้ำเสียโดยอาศัยการสกัดแบบขุ่น (A Study Cloud Point Extraction for Removal of Aromatic Contaminants from Wastewater) อ. ที่ปรึกษา: ศ. สมชาย โอสุวรรณ ศ. ดร. จอห์น สแกมมอร์น และ รศ. ดร. วีรศักดิ์ ฤกษ์สมบูรณ์ 105 หน้า

การสกัดแบบขุ่นเพื่อใช้ในการแยกสารประกอบอะโรมาติกส์ออกจากน้ำเสียแบบต่อเนื่อง ถูกทำได้เป็นผลสำเร็จโดยการใช้เครื่องสกัดแบบโรตึงดิสค์คอนแทคเตอร์ เมื่อสารละลายของสารลดแรงตึงผิวชนิดไม่มีประจุมีอุณหภูมิสูงกว่าจุดขุ่น สารละลายจะเกิดการแยกวัฏภาคออกเป็นวัฏภาคที่มีไมเซลล์เป็นจำนวนมาก (วัฏภาคโคเอกเซอร์เวท) และวัฏภาคที่มีไมเซลล์เป็นจำนวนน้อย (วัฏภาคเจือจาง) ตัวถูกละลายอินทรีย์ที่อยู่ในน้ำเสียจะละลายเข้าไปในไมเซลล์และถูกทำให้เข้มข้นอยู่ในวัฏภาคโคเอกเซอร์เวท วัฏภาคเจือจางจึงสามารถถูกปล่อยออกดังเช่นน้ำที่บำบัดแล้ว ผลของโครงสร้างทางโมเลกุลและความเข้มข้นเริ่มต้นของตัวถูกละลายถูกศึกษาและเปรียบเทียบทั้งในแบบกะและแบบต่อเนื่อง พบว่าตัวถูกละลายที่มีความชอบน้ำต่ำหรือมีค่าสัมประสิทธิ์การละลายระหว่างออกทานอลและน้ำสูง มีประสิทธิภาพในการสกัดได้ดีกว่าเนื่องจากมีความสามารถในการละลายเข้าไปยังไมเซลล์ได้มาก และพบความสัมพันธ์เชิงเส้นของค่าล็อกฐานสิบระหว่างค่าสัมประสิทธิ์การละลายระหว่างออกทานอลและน้ำ ค่าสัดส่วนการละลายของตัวถูกละลาย และความสูงต่อหนึ่งหน่วยถ่ายโอนมวลในเครื่องสกัด ความสามารถในการสกัดตัวถูกละลายออกจากน้ำเสียนั้นลดลง เมื่อความเข้มข้นเริ่มต้นของตัวถูกละลายในน้ำเสียเพิ่มขึ้น สาเหตุหลักเกิดจากการมีวัฏภาคโคเอกเซอร์เวทติดไปกับส่วนของน้ำสะอาดที่ไหลออกทางด้านบนของเครื่องสกัดมากขึ้น นอกจากนี้ผลของโครงสร้างทางโมเลกุลของสารลดแรงตึงผิวที่ไม่มีประจุต่อการสกัดฟีนอลออกจากน้ำเสียได้ถูกศึกษาในแบบกะ ผลการทดลองพบว่าค่าคงที่สมดุลการละลายของฟีนอลในวัฏภาคโคเอกเซอร์เวทเพิ่มขึ้นเป็นเส้นตรงเมื่อสารลดแรงตึงผิวมีโครงสร้างของหมู่เอทิลีนอ็อกไซด์เพิ่มขึ้น แต่ไม่เปลี่ยนแปลงอย่างมีนัยสำคัญกับความยาวคาร์บอนและความเป็นกึ่งของสารลดแรงตึงผิว จากผลการทดลองสามารถสร้างโมเดลเพื่อคาดคะเนประสิทธิภาพการสกัดของสารลดแรงตึงผิวที่มีโครงสร้างแตกต่างกันได้เพียงวัดค่าสัดส่วนปริมาตรวัฏภาคโคเอกเซอร์เวท วิธีแก้ปัญหาลดปริมาณสารลดแรงตึงผิวติดไปกับส่วนของน้ำสะอาดที่ไหลออกได้ถูกเสนอแนะและศึกษาเพิ่มเติมในงานวิจัยนี้

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