

**ETHYLENE EPOXIDATION IN A LOW-TEMPERATURE
CORONA DISCHARGE SYSTEM: EFFECT OF DISTANCE BETWEEN
PLATE ELECTRODE AND ETHYLENE FEED POSITION**



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ABSTRACT

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Sirirath Yaowapong-aree: Ethylene Epoxidation in a
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Ethylene oxide (C_2H_4O , EO) is an important industrial chemical. Its major use is in the production of ethylene glycol. It can also be used to produce detergents by a process called ethoxylation, sterilants for foodstuffs, sterilants for medical equipment and supplies, solvents, antifreezes, adhesives, and cosmetics. Therefore, the ethylene epoxidation is a very important process for ethylene oxide production. In this work, the epoxidation of ethylene in a low-temperature corona discharge system was studied to improve the ethylene epoxidation performance using the corona discharge system by initially producing an O_2 plasma prior to reacting it with ethylene, which was fed into the system at various positions of the plasma zone. Various operating parameters, including distance between plate electrode and C_2H_4 feed position, O_2/C_2H_4 feed molar ratio, applied voltage, input frequency, total feed flow rate, and gap distance between pin and plate electrodes, were optimized. It was found that the highest EO yield of 1.76% was achieved under the operating conditions of a distance between plate electrode and C_2H_4 feed position of 0.2 cm, an O_2/C_2H_4 feed molar ratio of 1:2, an applied voltage of 18 kV, an input frequency of 500 Hz, a total feed flow rate of $100\text{ cm}^3/\text{min}$, and an electrode gap distance of 10 mm. Under these optimum conditions, the power consumption was found to be as low as 6.07×10^{-16} Ws/molecule of EO produced.

บทคัดย่อ

ศิริรัตน์ เยาวพงษ์อารีย์: ปฏิกริยาอีพอกซิเดชันของเอธิลีนภายใต้ระบบพลาสมาอุณหภูมิ ต่ำชนิดโคโรนาดีสชาร์จ: ผลของระยะห่างระหว่างขั้วไฟฟ้าแบบแผ่นและตำแหน่งป้อนก๊าซเอธิ ลีน (Ethylene Epoxidation in a Low-Temperature Corona Discharge System: Effect of Distance between Plate Electrode and C_2H_4 Feed Position) อ. ที่ปรึกษา : ผศ. ดร. ชรรณบุญ ศรีทะวงศ์ และ รศ. ดร. สุเมธ ชวเดช 56 หน้า

เอธิลีนออกไซด์เป็นผลิตภัณฑ์ปิโตรเคมีชั้นกลางที่มีบทบาทสำคัญอย่างยิ่งในการผลิต ผลิตภัณฑ์อุตสาหกรรมหลายชนิด เช่น เอธิลีนไกลคอล, สารต้านจุลชีพสำหรับผลิตภัณฑ์อาหาร และอุปกรณ์ทางการแพทย์, ตัวทำละลาย, สารต้านการเยือกแข็ง, สารที่ใช้สำหรับการเชื่อมติด, และเครื่องสำอาง ด้วยเหตุนี้กระบวนการอีพอกซิเดชันของเอธิลีนไปเป็นเอธิลีนออกไซด์จึงเป็น กระบวนการที่มีความสำคัญเป็นอย่างยิ่งสำหรับการผลิตเอธิลีนออกไซด์ ในงานวิจัยนี้กระบวนการ อีพอกซิเดชันของเอธิลีนถูกทำการทดลองในเครื่องปฏิกรณ์พลาสมาชนิดโคโรนาดีสชาร์จ ซึ่ง ได้ถูกปรับปรุงลักษณะเครื่องปฏิกรณ์เพื่อพัฒนากระบวนการอีพอกซิเดชัน โดยเริ่มทำให้เกิด ออกซิเจนพลาสมาก่อนที่จะทำปฏิกริยากับเอธิลีนที่ใส่เข้าไปในระบบที่ตำแหน่งต่างๆของอาณา เขตพลาสมา ตัวแปรต่างๆที่ทำการศึกษาได้แก่ ระยะห่างระหว่างขั้วไฟฟ้าแบบแผ่นและตำแหน่ง ป้อนก๊าซเอธิลีน อัตราส่วนโดยโมลของออกซิเจนต่อเอธิลีน ความต่างศักย์ไฟฟ้า ความถี่ไฟฟ้า อัตราการไหลของสารตั้งต้น และระยะห่างระหว่างขั้วไฟฟ้า จากการทดลองพบว่าผลได้ของ เอธิลีนออกไซด์มีค่ามากที่สุด 1.76 เปอร์เซ็นต์ เมื่อดำเนินการระบบภายใต้สภาวะดังต่อไปนี้ ระยะห่างระหว่างขั้วไฟฟ้าแบบแผ่นและตำแหน่งป้อนก๊าซเอธิลีน 0.2 เซนติเมตร อัตราส่วนโดย โมลของออกซิเจนต่อเอธิลีน 0.25:1 ความต่างศักย์ไฟฟ้า 18 กิโลโวลต์ ความถี่ไฟฟ้า 500 เฮิร์ตซ์ อัตราการไหลของสารตั้งต้น 100 ลูกบาศก์เซนติเมตรต่อนาที และระยะห่างระหว่างขั้วไฟฟ้า 1 เซนติเมตร ภายใต้สภาวะที่เหมาะสมดังกล่าว พลังงานที่ใช้ในการผลิตเอธิลีนออกไซด์มีค่า เท่ากับ 6.07×10^{-16} วัตต์วินาทีต่อโมเลกุลของเอธิลีนออกไซด์ที่ผลิตได้

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