

**EFFECT OF CARBON DIOXIDE ON METHANE CONVERSION
UNDER ELECTRIC DISCHARGE**

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for the Degree of Master of Science
The Petroleum and Petrochemical College, Chulalongkorn University
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The University of Michigan, The University of Oklahoma
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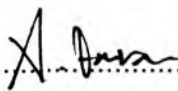
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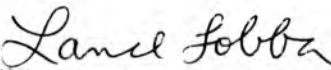
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ABSTRACT

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KEYWORDS : Methane Reaction / Methane Conversion /

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Malinee Leethochawalit : Study of Carbon Dioxide on Methane Conversion Under Electric Discharge. Thesis Advisors : Assoc. Prof. Lance L. Lobban and Dr. Sumaeth Chavadej, 92 pp., ISBN 974-638-540-2

The behavior of direct methane conversion processed in an applied AC electric discharge at ambient conditions was investigated by using a Dielectric-Barrier Discharge (DBD) reactor. The main objectives of this study were to determine the feasibility of DBD for conversion of methane to higher hydrocarbons under in the presence of carbon dioxide and to determine the effects of carbon dioxide and helium on methane conversion. The studies were conducted by operating a reactor in the range of 5,500 to 7,700 V at which the space time was 4 to 8 minutes. $\text{CO}_2:\text{CH}_4$ ratios of 0:1, 1:1, 1:2 and 2:1 were used. Helium was also added in the methane feed at different concentrations. It was found that methane conversion increased remarkably with increases in $\text{CO}_2:\text{CH}_4$ ratio, voltage, helium concentration and space time. The C_2 products selectivities decreased but the carbon monoxide and hydrogen selectivities increased when voltage, helium concentration and space time were increased. Under the condition studied, small amounts of methanol were produced while most reaction products were ethane, ethylene, acetylene, carbon monoxide and hydrogen. It can be concluded that under the conditions studied, most of CO_2 is simply converted into CO but very low amount of methanol is produced.

บทคัดย่อ

มาลินี ลีโทชวลิต : ผลกระทบของก๊าซคาร์บอนไดออกไซด์ต่อการเปลี่ยนแปลงทางเคมีของก๊าซมีเทนภายใต้สนามไฟฟ้าแรงสูง (Effect of Carbon Dioxide on Methane Conversion Under Electric Discharge) อ. ที่ปรึกษา : รศ.ดร. แลนซ์ ลอบแบน (Assoc. Prof. Lance Lobban) และ ดร. สุเมธ ชวเดช 92 หน้า ISBN 974-638-540-2

การศึกษาพฤติกรรมของการเปลี่ยนแปลงทางเคมีของก๊าซมีเทน ภายใต้สภาวะไฟฟ้าแรงสูง ได้ถูกดำเนินการโดยใช้เครื่องปฏิกรณ์เคมีแบบ DBD วัตถุประสงค์หลักของการศึกษานี้เพื่อศึกษาความเป็นไปได้ในการเปลี่ยนก๊าซมีเทนภายใต้สภาวะที่มีก๊าซคาร์บอนไดออกไซด์ร่วมอยู่ให้เป็นก๊าซไฮโดรคาร์บอนชนิดอื่น ๆ ที่มีน้ำหนักโมเลกุลสูงขึ้นและศึกษาถึงผลกระทบของก๊าซคาร์บอนไดออกไซด์ และ ก๊าซซีเลียมที่มีต่อการเปลี่ยนแปลงก๊าซมีเทน การศึกษานี้ควบคุมเครื่องปฏิกรณ์เคมีที่ความต่างศักย์อยู่ในช่วงระหว่าง 5,500 ถึง 7,700 โวลต์ เวลาในเครื่องปฏิกรณ์เคมีของก๊าซมีเทนอยู่ในช่วง 4 ถึง 8 นาที อัตราส่วนระหว่างก๊าซคาร์บอนไดออกไซด์และก๊าซมีเทนเป็น 0:1 1:1 1:2 และ 2:1 โดยมีก๊าซซีเลียมร่วมอยู่ในสารตั้งต้นที่ปริมาณต่าง ๆ กัน จากการศึกษาพบว่า การเปลี่ยนแปลงของก๊าซมีเทนเพิ่มสูงขึ้นเมื่อปริมาณก๊าซคาร์บอนไดออกไซด์ในสารตั้งต้นความต่างศักย์ไฟฟ้า เวลาในเครื่องปฏิกรณ์ของก๊าซ ตลอดจนปริมาณก๊าซซีเลียมที่ร่วมในปฏิกิริยาเพิ่มสูงขึ้น โดยทั่วไปอัตราการเลือกเกิดของก๊าซไฮโดรคาร์บอนที่มีคาร์บอน 2 อะตอมลดต่ำลง แต่อัตราการเลือกเกิดของก๊าซคาร์บอนมอนอกไซด์และก๊าซไฮโดรเจนเพิ่มสูงขึ้น เมื่อเพิ่มความต่างศักย์ไฟฟ้า เวลาในเครื่องปฏิกรณ์ของก๊าซ และปริมาณซีเลียมในสารตั้งต้น ภายใต้สภาวะที่ทำการศึกษาพบว่า มีเมทานอลเกิดขึ้นในปริมาณน้อย ในขณะที่ผลิตภัณฑ์ส่วนใหญ่ที่เกิดขึ้น ได้แก่ อิเทน เอทิลีน อะเซทิลีน คาร์บอนมอนอกไซด์ และ ก๊าซไฮโดรเจน

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