

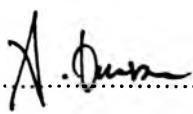
**DIRECT CONVERSION OF METHANE TO
HIGHER HYDROCARBONS UNDER
DIELECTRIC-BARRIER DISCHARGE INFLUENCE**

Mr. Khanti Thanyachotpaiboon

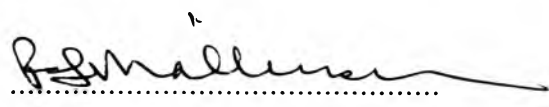
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under Dielectric-Barrier Discharge Influence
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ABSTRACT

##941005 : Major Petrochemical Technology

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The behaviors of the direct methane conversion reaction processed under the environment of the applied AC electric discharges at ambient conditions were investigated in this study. The aim was to determine the success of introducing this process as a new route for direct production of higher hydrocarbons from feeding methane. The generation of such electric discharge environment implemented by the applying of high voltage to the so-called Dielectric-Barrier Discharge (DBD) reactor which has long been utilized in the ozone production application. The voltage was varied from 3,750 V. to 10.9 kV. at which the total flow rate of 20 to 80 ml/min. was employed. It was found that, with increase in voltage, the methane conversion was increased, whereas all the product selectivities were nearly independent on this change at those extreme values. The highest methane conversion obtained by using the reaction residence time of nearly 12 min. was about 25% with the ethane as the primary product. This conversion dropped very significantly with decreasing residence time. Some amounts of propane, butane and ethylene could also be detected. The selectivities of those paraffin products were found to decrease when the residence time was decreased. It was observed that higher selectivities of C₃ and C₄ hydrocarbons could be obtained by the addition of ethane into the feed.

บทคัดย่อ

ขันติ รัญญโชติไพบุลย์ : ปฏิริยาการเปลี่ยนก๊าซมีเทนเป็นก๊าซไฮโดรคาร์บอนโมเลกุลใหญ่ภายใต้สนามไฟฟ้าแรงสูง (Direct Conversion of Methane to Higher Hydrocarbons under Dielectric-Barrier Discharge Influence) อ. ที่ปริศึกษา : รศ. ดร. ริชาร์ด จี แมลลินสัน (Assoc. Prof. Richard G. Mallinson) และ ดร. สุเมธ ชวเดช, 65 หน้า, ISBN974-634-150-2

โครงการวิจัยชิ้นนี้ได้ทำการศึกษาพฤติกรรมของการเปลี่ยนแปลงทางเคมีของก๊าซมีเทนภายใต้สถานะไฟฟ้าแรงสูงโดยมีวัตถุประสงค์เพื่อมุ่งที่จะศึกษาความเป็นไปได้ในการเปลี่ยนก๊าซมีเทนให้เป็นก๊าซไฮโดรคาร์บอนชนิดอื่น ๆ ที่มีมูลค่าสูงขึ้น ในการทดลองชุดนี้ ปฏิริยาของก๊าซมีเทนได้ถูกกระตุ้นโดยอาศัยการจ่ายสนามไฟฟ้าแรงสูงให้คร่อมผ่านเตาปฏิริยาที่มีก๊าซมีเทนไหลผ่าน โดยที่เตาปฏิริยาที่ถูกนำมาใช้ได้รับการดัดแปลงมาจากเตาปฏิริยาที่ใช้สำหรับการผลิตก๊าซโอโซน สนามไฟฟ้าแรงสูงที่ใช้ในการทดลองอยู่ในช่วงระหว่าง 3,750 โวลต์ ถึง 10.9 กิโลโวลต์ โดยให้อัตรากาไหลของก๊าซผ่านเตาปฏิริยามีค่าอยู่ในช่วง 20 ถึง 80 ลูกบาศก์เซนติเมตรต่อนาที

จากการศึกษาพบว่า เมื่อมีการเพิ่มแรงดันไฟฟ้าที่ป้อนให้กับก๊าซมีเทนการเกิดปฏิริยาทางเคมีของก๊าซมีเทนจะเพิ่มสูงขึ้นโดยพบว่าอัตรากาเปลี่ยนแปลงทางเคมีของก๊าซมีเทนไปเป็นผลิตภัณฑ์ชนิดอื่นมีค่าสูงถึงประมาณ 25 เปอร์เซ็นต์เมื่อใช้แรงดันไฟฟ้าขนาด 10.9 กิโลโวลต์ และอัตรากาไหลของก๊าซที่ 20 ลูกบาศก์เซนติเมตรต่อนาที อย่างไรก็ตาม ในขณะที่อัตรากาไหลของก๊าซมีค่าเพิ่มขึ้น อัตราการเปลี่ยนแปลงของก๊าซมีเทนมีค่าลดน้อยลง จากผลการตรวจสอบพบว่า การเปลี่ยนแปลงทางเคมีของก๊าซมีเทนนั้นนอกจากจะได้ก๊าซอีเทนเป็นผลิตภัณฑ์ส่วนใหญ่แล้วยังมีการตรวจพบก๊าซชนิดอื่นๆ ได้แก่ ก๊าซโพรเพน, บิวเทนและเอทิลีนจากปฏิริยาอีกด้วย นอกจากนี้ ผลการทดลองยังระบุว่าอัตราส่วนของการสลายตัวของก๊าซมีเทนไปเป็นสารประกอบชนิดไฮโดรคาร์บอนอิมตัวชนิดต่างๆมีค่าลดต่ำลงในขณะที่มีการเพิ่มอัตรากาไหลของก๊าซให้สูงขึ้น อย่างไรก็ตาม ได้มีการค้นพบในภายหลังว่าอัตราส่วนของการสลายตัวของก๊าซมีเทนไปเป็นสารประกอบโพรเพน, บิวเทนและเอทิลีน จะมีค่าเพิ่มสูงขึ้นเมื่อมีการผสมก๊าซอีเทนในปริมาณเล็กน้อยเข้าร่วมในระหว่างการทำปฏิริยา

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*“The more different the research is...the more likelihood that
there will be problems.*

But... the different, new , research is where progress is made...”

Richard G. Mallinson

School of Chemical Engineering and Materials Science,
University of Oklahoma

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