

การกำจัดก๊าซผสมเฉื่อย 2 และ 3 องค์ประกอบของอะเซทิลไฮโดรเจน แอมโมเนีย และ ไตรเมทิลเอมีน  
ในไนโตรเจน โดยใช้เครื่องปฏิกรณ์การเติมอิเล็กตรอนที่อุณหภูมิสูง



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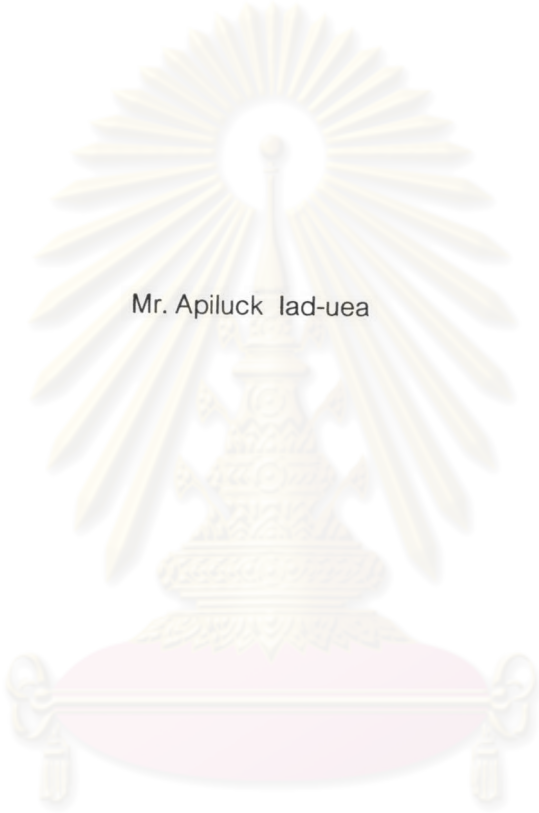
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REMOVAL OF DILUTE BINARY AND TERTIARY GAS MIXTURE OF ACETALDEHYDE, AMMONIA AND  
TRIMETHYL AMINE IN NITROGEN USING ELECTRON-ATTACHMENT REACTOR AT HIGH  
TEMPERATURE



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จุดประสงค์หลักของงานวิจัยนี้คือ ศึกษาผลของอุณหภูมิที่มีต่อการกำจัดก๊าซอะเซทัลดีไฮด์ แอมโมเนียและไตรเมทิลเอมีนออกจากกระแสก๊าซไนโตรเจนโดยใช้เครื่องปฏิกรณ์แบบเติมอิเล็กตรอน ก๊าซเป้าหมายเหล่านี้มีกลิ่นเหม็นและเป็นก๊าซองค์ประกอบของก๊าซที่ปล่อยจากเตาเผาศพที่อุณหภูมิสูง เนื่องจากก๊าซที่ปล่อยจากเตาเผาศพจะมีทั้งคาร์บอนไดออกไซด์ ออกซิเจนและไอน้ำผสมอยู่ ดังนั้นปัจจัยที่ทำการศึกษาค้นคว้าได้แก่ ร้อยละของคาร์บอนไดออกไซด์ ออกซิเจนและความเข้มข้นของไอน้ำในกระแสก๊าซไนโตรเจน เพื่อให้เข้าใจผลกระทบซึ่งกันและกันระหว่างก๊าซเป้าหมาย การทดลองจะมีทั้งการกำจัดก๊าซเป้าหมายแต่ละชนิดโดดเดี่ยว ก๊าซเป้าหมาย 2 ชนิดพร้อมกัน และทั้ง 3 ชนิดพร้อมกันด้วย ผลการทดลองชี้ให้เห็นว่าการที่มีคาร์บอนไดออกไซด์ผสมอยู่ในก๊าซไนโตรเจนจะช่วยเพิ่มประสิทธิภาพการกำจัดก๊าซเป้าหมายให้สูงขึ้น อนึ่ง การมีออกซิเจนผสมอยู่ในก๊าซไนโตรเจนจะช่วยเพิ่มประสิทธิภาพการกำจัดก๊าซเป้าหมายให้สูงขึ้นทั้งการกำจัดแบบโดดเดี่ยวและการกำจัดแบบ 2 และ 3 ชนิดพร้อมกัน ส่วนการมีไอน้ำจะช่วยเพิ่มประสิทธิภาพในการกำจัดก๊าซเป้าหมายจากก๊าซไนโตรเจนที่อุณหภูมิต่ำ แต่จะลดลงเล็กน้อยที่อุณหภูมิสูง ในกรณีที่มีคาร์บอนไดออกไซด์ในก๊าซผสมไนโตรเจน ออกซิเจนและไอน้ำ จะทำให้ประสิทธิภาพการกำจัดสูงกว่ากรณีที่ไม่มีการ์บอนไดออกไซด์

อนึ่งกรณีการศึกษาผลกระทบซึ่งกันและกันในการกำจัดก๊าซเป้าหมาย 2 และ 3 ชนิดพร้อมกันพบว่า จำนวนโมเลกุลก๊าซอะเซทัลดีไฮด์ แอมโมเนียและไตรเมทิลเอมีนที่ถูกจับด้วยหนึ่งอิเล็กตรอนเมื่อกำจัดพร้อมกันทั้ง 3 ชนิด จะมากกว่าเมื่อเทียบกับกรณีกำจัดก๊าซเป้าหมาย 2 ชนิดพร้อมกัน นอกจากนี้เพื่อลดการเกิดผลิตภัณฑ์ที่ไม่ต้องการ การประยุกต์ใช้เครื่องปฏิกรณ์สองตัวต่ออนุกรม ซึ่งใช้เงื่อนไขในการทำงานที่แตกต่างกัน แสดงให้เห็นแนวโน้มที่ดีสำหรับการเพิ่มประสิทธิภาพในการกำจัดและการลดการเกิดขึ้นของผลิตภัณฑ์ที่ไม่ต้องการ โดยพบว่า โอโซน และ  $\text{NO}_x$  ถูกกำจัดได้ทั้งหมดแต่คาร์บอนมอนอกไซด์จะเพิ่มมากขึ้นเมื่อกระแสเพิ่มมากขึ้น

ภาควิชา.....วิศวกรรมเคมี..... ลายมือชื่อนิสิต..... อภิสิทธิ์ เอียดเอื้อ.....  
 สาขาวิชา.....วิศวกรรมเคมี..... ลายมือชื่ออาจารย์ที่ปรึกษา..... รศ.ดร. ตัณฑะพานิชกุล.....  
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## 4470643521 : MAJOR CHEMICAL ENGINEERING

KEY WORD: GASEOUS POLLUTANT / GAS PURIFICATION / ELECTRON ATTACHMENT / CORONA DISCHARGE / HIGH TEMPERATURE

APILUCK IAD-UEA : THESIS TITLE. (REMOVAL OF DILUTE BINARY AND TERTIARY GAS MIXTURE OF ACETALDEHYDE, AMMONIA AND TRIMETHYL AMINE IN NITROGEN USING ELECTRON-ATTACHMENT REACTOR AT HIGH TEMPERATURE) THESIS ADVISOR: PROF. WIWUT TANTHAPANICHAKOON, Ph.D., THESIS CO-ADVISOR : ASSOC. PROF. TAWATCHAI CHARINPANITKUL, D.Eng, 296 pp. ISBN 974-17-4531-1.

The main objective of this research is to investigate the effect of temperature on the removal of acetaldehyde, ammonia and trimethyl amine gases from  $N_2$  using electron attachment reactor. The target gases are malodorous gaseous components emitted at high temperature from a crematory furnace. Since the emitted gases from a crematory furnace consist of  $CO_2$ ,  $O_2$  and water vapor, the factors investigated are percentage of coexisting  $CO_2$ ,  $O_2$  and the concentration of water vapor in the  $N_2$  gas stream. To understand the effect between the target gases, the experiments are carried out both for the separate removal of target gases and the simultaneous removal of 2 and 3 target gases. The experimental results reveal that, it is found that the presence of carbon dioxide does significantly affect the removal efficiency. The higher the  $CO_2$  concentration is employed, the higher the removal efficiency become, the presence of oxygen enhances the removal efficiency of the target gases both in the separate removal of target gases and the simultaneous removal of 2 and 3 target gases. The presence of water vapor enhances the removal efficiency of the target gases from  $N_2$  at low temperature but slightly retards it at high temperature. The presence of  $CO_2$  in nitrogen, oxygen and water vapor mixture has adverse effect on the removal efficiency.

The effects between the target gases on the simultaneous removal of 2 and 3 target gases are investigated. It is found that in the case of the simultaneous removal of 3 target gases, the number of acetaldehyde, ammonia and trimethyl amine gas molecules captured by an electron are higher than in the case of simultaneous removal of these 2 target gases. Furthermore, the application of two independently operated corona-discharge reactors in series is shown to have a good and promise for enhancing the removal efficiency and minimizing the generation of byproducts. It is found that the effluent  $O_3$  and  $NO_x$  are removed completely. On the other hand, CO increases, current increases.

Department.....Chemical Engineering..... Student's signature..... *Apiluck Iad-uea*.....  
 Field of study.....Chemical Engineering..... Advisor's signature..... *W. Tanthapanichakoon*.....  
 Academic year.....2003..... Co-advisor's signature..... *J. Charinpanitkul*.....

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 ศูนย์วิทยุพัชกร  
 จุฬาลงกรณ์มหาวิทยาลัย

## NOMENCLATURE

$C_{in}$	=	inlet concentration [ppm]
$C_{out, 0 mA}$	=	outlet concentration [ppm] when using zero current
$C_{out, Any mA}$	=	outlet concentration [ppm] when using non-zero current
$[ ]_{in}$	=	inlet concentration [ppm]
$[ ]_{out}$	=	outlet concentration [ppm]
$A$	=	cross sectional area [m <sup>2</sup> ]
$D_i$	=	anode diameter [m]
$D_o$	=	cathode diameter [m]
$E$	=	electric field strength [V m <sup>-1</sup> ]
$I$	=	discharge current [mA]
$N$	=	gas density [mol m <sup>-1</sup> ]
$N_r$	=	number of gas molecules removed per unit time [s <sup>-1</sup> ]
$N_{e0}$	=	number of emitted electrons per unit time [s <sup>-1</sup> ]
$q_{out, 0 mA}$	=	the molar flow rate at reactor outlet without current [mol s <sup>-1</sup> ]
$q_{out at any mA}$	=	the molar flow rate of at reactor outlet with current [mol s <sup>-1</sup> ]
$p$	=	total pressure [atm]
$P$	=	power consumption [W]
$R$	=	radial distance from the cylindrical axis [m]
$R$	=	gas constant [0.082057 dm <sup>3</sup> atm K <sup>-1</sup> mol <sup>-1</sup> ]
$T$	=	temperature [°C]
$SV$	=	space velocity [hr <sup>-1</sup> ]
$V$	=	discharge voltage [V]
$V_r$	=	effective volume of the corona discharge reactor [m <sup>3</sup> ]
$\theta$	=	mean residence time [s]
$\langle v \rangle$	=	superficial velocity [m/s]
$\psi$	=	apparent removal efficiency [-]
$\psi'$	=	removal efficiency excluding adsorption effect [-]
$\psi''$	=	removal efficiency per unit residence time [-]
$\psi_{elec}$	=	electron-based efficiency [-]
$\psi_{ener}$	=	energy-based efficiency [mol gas .J <sup>-1</sup> ]