PYROLYSIS OF OIL SLUDGE FROM AN API SEPARATOR

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ABSTRACT

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Typically, API separator sludge can be handled via combustion and/or recycling into reusable oils. However, it has been found that such methods cause secondary pollutants. Recently, pyrolysis has been proven to be an alternative for disposal of this sludge. In this study, we investigated the API separator sludge obtained from an oil company in Thailand. Experiments were carried out by means of thermogravimetric analysis at different heating rates of 5, 10 and 20°C•min^{-1}. The weight loss data were then scrutinized for kinetic analysis. Results showed that typical derivative curves of the sludge consist of two major peaks. The first peak was found between 230-270°C while the other was found between 400-415°C. The former was resulted from the volatilization of free light volatile compounds existing in the sludge and the latter was attributed to the volatilization and main pyrolysis. The pyrolyzed products were confirmed by the mass spectroscopy results. Hydrogen and acetylene were found to be the main species in the pyrolysis products. The pseudo bi-component model showed a good fit with the experimental data.

บทคัดย่อ

เปรม ปุณณรัตนกุล: ไพโรไลซีสของกากตะกอนน้ำมันจากบ่อแยก API (Pyrolysis of Oil Sludge from an API Separator) อ. ที่ปรึกษา: ผศ. ปราโมช รังสรรค์วิจิตร ผศ. วิษณุ มีอยู่ รศ. ธีระศักดิ์ ฤกษ์สมบูรณ์ ดร. บุนยรัชต์ กิติยานันท์ และ ดร. ชัชวลี กะลัมพะเหติ 79 หน้า ISBN 974-17-2297-4

โดยหลักการทั่วไปกากตะกอนน้ำมันจากถังแยก API สามารถถูกกำจัดได้โดยผ่านกระบวนการเผาไหม้ และ/หรือ การเปลี่ยนสภาพเป็นผลิตภัณฑ์น้ำมันที่สามารถนำกลับมาใช้ประโยชน์ได้อีก อย่างไรก็ตามวิธีการดังที่กล่าวมา สามารถก่อให้เกิดสารที่เป็นมลพิษขั้นทุติยภูมิได้ เมื่อไม่นานมานี้ กระบวนการไพโรไลซีสได้ถูกพิสูจน์แล้วว่าเป็นอีกกระบวนการหนึ่งที่ดีสำหรับการกำจัดกากตะกอนน้ำมันชนิดนี้ งานวิจัยฉบับนี้ได้ทำการศึกษาปฏิกิริยาไพโรไลซีสกับกากตะกอนน้ำมันจากบ่อแยก API ของบริษัทน้ำมันปิโตรเลียมแห่งหนึ่งในประเทศไทย การทดลองนี้ทำการศึกษาโดยใช้วิธีการวิเคราะห์เชิงความร้อน (Thermogravimetric Analysis, TGA) ที่อัตราการความร้อน 5 10 และ 20 องศาเซลเซียสต่อนาที ข้อมูลน้ำหนักที่สูญเสียไปของกากตะกอนน้ำมันจากบ่อแยก API ถูกนำมาวิเคราะห์ทางจลนศาสตร์ จากผลการทดลองพบว่าเส้นโค้งอัตราการการเปลี่ยนแปลงน้ำหนักของกากตะกอนน้ำมันเทียบกับอุณหภูมิมีค่าสูงสุดสองค่า ซึ่งค่าสูงสุดค่าแรกอยู่ระหว่างอุณหภูมิ 230 ถึง 270 องศาเซลเซียส ในขณะที่อีกค่าหนึ่งอยู่ระหว่างอุณหภูมิ 400 ถึง 415 องศาเซลเซียส ส่วนแรกจะเป็นผลจาก กระบวนการระเหยของสารองค์ประกอบระเหยง่ายอิสระที่อยู่ในกากตะกอนน้ำมัน สำหรับส่วนหลังสืบเนื่องมาจากกระบวนการระเหย และถือว่าเป็นปฏิกิริยาไพโรไลซีสหลัก ผลิตภัณฑ์ที่ได้จากปฏิกิริยาไพโรไลซีสถูกยืนยันโดยผลจากการวิเคราะห์แยกเชิงมวล (Mass Spectroscopy) จากการตรวจสอบพบว่า ก๊าซไฮโดรเจน และก๊าซอะเซทิลีน เป็นผลิตภัณฑ์หลักที่ได้จากปฏิกิริยาไพโรไลซีสหลัก สำหรับการศึกษาพฤติกรรมทางจลนพลศาสตร์ของปฏิกริยาไพโรไลซีสของกากตะกอนน้ำมันจากบ่อแยก API ทำได้โดยใช้แบบจำลองทางคณิตศาสตร์ ชนิดองค์ประกอบเทียมสององค์ประกอบ ผลการทดสอบพบว่า ค่าการคำนวณที่ได้จากแบบจำลองทางคณิตศาสตร์เทียบเท่ากับข้อมูลที่ได้จากการทดลอง

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LIST OF SYMBOLS

A_i	Arrhenius's constant of reaction I
β	Heating rate
E_{ai}	Activation energy of reaction i
f_i	Mass fraction of component i
k	Rate coefficient
n	Reaction order
R	Gas constant
r_A	Reaction rate of component A
T	Absolute temperature (K)
T_H	Characteristic heating time
T_R	Characteristic reaction time
T_{ref}	Absolute referenced temperature
t	Time
W_e	Final mass percentage of material
W_i	Mass percentage of sample at any time
W_o	Initial mass percentage of material
Φ	Heating rate