論文 / 著書情報
Article / Book Information

題目(和文)	相互反応や反応速度論的解析および反応メカニズムに着目した精油汚泥または精油汚泥チャーとバイオマスの熱分解および共燃焼挙動の解明
Title(English)	Pyrolysis and combustion of oil sludge/oil sludge char with biomass focusing on interactions, kinetics, and mechanisms
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学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

（博士課程）
Doctoral Program

論 文 要 旨

THESIS SUMMARY

系・コース： Department of, Graduate major in	融合理工学 地球環境共創	系 コース	申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of	（ 工学 ）
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

Integrated pyrolysis and combustion treatment can efficiently recover resources in oil sludge and remove the hazards of oil sludge. However, for ash-rich oil sludge, especially oilfield sludge, this integrated treatment is still limited by some shortcomings, such as low pyrolysis efficiency and low energy recovery efficiency. Aiming at this problem, this study introduces biomass into this treatment system, investigating the interactions and kinetics of co-pyrolysis/co-combustion of oil sludge/oil sludge char and biomass, and deducing the reaction mechanism.

Chapter 1 introduced the background of this research, including the classification, characterization, and hazards of oil sludge, the overview of treatment methods of oil sludge, the integrated pyrolysis and combustion of oil sludge, and two typical biomass pretreatment methods to give a comprehensive understanding about the research objective and significance of this work.

To obtain hydrocarbon-rich pyrolysis oil, torrefaction is an effective method to pretreat biomass. In Chapter 2, the effect of torrefaction on the morphological structure evolution and pyrolysis reactivity of biomass was investigated. The results indicated: (1) Intensified torrefaction led to enhanced surface aromaticity, rougher surface structure, and decreased crystallinity of rice straw. (2) The pyrolysis reactivity of rice straw was weakened after torrefaction, and the decomposition temperature ranges of TS were shifted to higher temperatures with increasing torrefaction temperature. (3) Torrefaction altered the pyrolysis pathway of torrefied rice straw to enhance char production at the expense of oil and gas. (4) Torrefaction pretreatment enhanced hydrocarbon production, especially alkanes and aromatics.

The results in Chapter 2 indicated that torrefaction of rice straw enhanced hydrocarbon production in pyrolysis oil and enriched lignin content in torrefied rice straw. Therefore, in Chapter 3, co-pyrolysis of oil sludge and raw/torrefied biomass to enhance hydrocarbon production and evaluate the co-pyrolysis synergistic behavior among oil sludge and model biomass components were conducted. According to the results: (1) Co-pyrolysis of OS and RS promoted char conversion to volatiles, especially gas products. (2) The incorporation of OS into either RS or TS promoted hydrocarbon production at the expense of oxygenates. A significant synergistic effect was witnessed in enhancing hydrocarbon production after OS addition. (3) RS/OS mass ratio of 1:1 was a critical point considering the degree of promoting the formation of hydrocarbons. A higher blending ratio of OS hindered mass and heat transfer, thereby suppressing the gas formation and lowering the synergy for hydrocarbon generation. (4) Severe torrefaction increased TS's main decomposition temperature range close to that of OS, and positive synergistic effects for oil generation were observed when OS was blended into TS obtained at 250 and 300 °C. (5) A notable result in this work is that OS addition supplied ample hydrogen atoms and Ni/SiO2 minerals, which further promoted the hydrogenation and ring-opening of aromatic structures, enhancing alkane and olefin formation at the consumption of aromatics.

Chapter 2 and Chapter 3 focused on incorporating biomass into co-pyrolysis with oil sludge. Additionally, adding biomass to combustion with oil sludge char is also an effective method to enhance energy recovery. In Chapter 4, co-combustion of oil sludge char and raw/hydrothermally treated biomass is performed to promote combustion efficiency and evaluate the effect of alkali metals on co-combustion interactions, kinetics, and mechanisms. The results showed: (1) RW or HW addition significantly improved combustion property and efficiency of OSC regarding the conventional combustion parameters. (2) The RW blending caused negative interactions in co-combustion with OSC, although it decreased apparent activation energy. It mainly resulted from inhibited diffusion of volatile matters. (3) On the contrary, HW blending yielded positive interactions owing to the developed porosity of HW, which effectively promotes volatiles diffusion, coupled with catalytic support by metal oxides in OSC. (4) Not only the catalytic effect of inorganic elements on co-combustion but also their physical influence on heat and volatiles transfers can contribute to improving co-combustion performance.

備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。
Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).