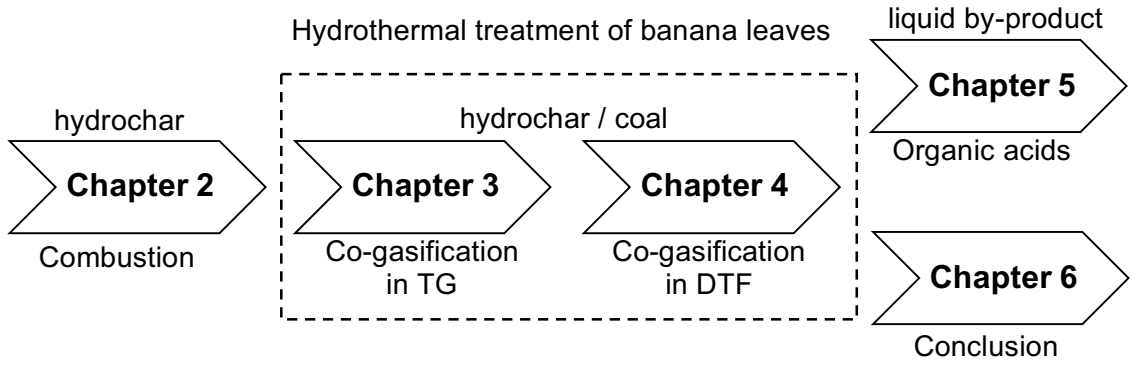
論文 / 著書情報
Article / Book Information

題目(和文)	
Title(English)	Hydrothermal treatment of banana leaves for solid fuel applications and organic acid production
著者(和文)	MOSQUEDA Alexander O.
Author(English)	Alexander O. Mosqueda
出典(和文)	学位:博士(工学), 学位授与機関:東京工業大学, 報告番号:甲第11174号, 授与年月日:2019年3月26日, 学位の種別:課程博士, 審査員:吉川 邦夫,竹下 健二,中﨑 清彦,高橋 史武,時松 宏治,梶谷 史朗
Citation(English)	Degree:Doctor (Engineering), Conferring organization: Tokyo Institute of Technology, Report number:甲第11174号, Conferred date:2019/3/26, Degree Type:Course doctor, Examiner:,,,,,
学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	要約
Type(English)	Outline

Outline_16D50366_Alexander Obrero Mosqueda



Chapter 1. Introduction

For this chapter, the background of the hydrothermal treatment of banana leaves for solid fuel applications and organic acid production are introduced. The advantages of employing HT as a pretreatment technology are reviewed. Recent trends on applying hydrochar as solid fuel for combustion and gasification are also presented. In addition, some literatures on biomass conversion to organic acid are discussed, as well as the potential applications of organic acids. The general objective and significance of the study are stated. Specific objectives are given in the following chapters

Chapter 2. Hydrothermal treatment of banana leaves for solid fuel combustion

In this study, lab-scale production of hydrochar from banana leaves by HT for solid fuel combustion was investigated. HT was conducted at 180^{o}C, 200^{o}C and 220^{o}C for 30 min. The fuel properties of BL were enhanced after HT, where the carbon content increased with increasing the reaction temperature, while the oxygen and ash contents reduced. Consequently, the higher heating value (20.4-22.7 MJ/kg) of the solid products were comparable to sub-bituminous coal, with an energy yield of up to 94.0%. Changes in the structural and fuel properties of hydrochars influenced its combustion behavior and reactivity in the thermogravimetric analysis. A second-order reaction mechanism by the Coats-Redfern approximation was adopted to describe the kinetics of the non-isothermal combustion.

Chapter 3. Influence of blending hydrochar with coal on reactivity and synergy in CO_2 co-gasification

The retained active alkali and alkaline earth metals (AAEM) after HT, may still have significant catalytic effect in the co-gasification reactivity with coal. In this chapter, the reactivity in the isothermal CO_2-gasification of char from hydrochar (HT180) derived from banana leaves by HT was examined using the thermogravimetric analyzer at 800, 850 and 900^oC. The AAEM concentration retained in the hydrochar after HT was analyzed. Washed hydrochar (WHT180) was also tested to examine the effect of AAEM concentration reduction. The results show that the gasification reactivity at 800^oC in terms of the reactivity index, $R_{0.9}$ is in the order of BL>HT180>WHT180. The same trend was observed at 850^oC and 950^oC which is consistent for an endothermic reaction. The decreasing gasification reactivity correlates to the reduction of AAEM concentration in the hydrochars. Then the effect of blending of hydrochars (10, 30, 50%) with anthracite coal on the reactivity and the synergy in gasification at 1000^oC was evaluated. The co-gasification reactivity of hydrochars and coal was enhanced and increased with increasing the proportion of hydrochars, that was attributed to the synergistic effect brought by the catalytic effect of the retained alkali metals in hydrochars. The synergy factor was higher for HT180 than WHT180 blending with coal in all ratios. HT not only improved the fuel properties and reduced the ash content of banana leaves but also influenced the co-gasification reactivity with coal.

Chapter 4. Synergistic effect on co-gasification of coal and hydrochar in a drop tube furnace (DTF)

In this study, the co-gasification of hydrochar and washed hydrochar with coal was conducted in a drop tube furnace under CO_2 atmosphere. The co-gasification in DTF was done at 1000^oC in 5% CO_2 balanced by N_2 at 5L/min on a volume basis. A syringe pump was used to feed the fuels at 0.08 g/min. Different blending ratios of hydrochars (10%, 30% and 50%) with coal were tested to determine its effect on the syngas produced. The synergistic effect was determined and correlated with the alkali index (AI). The results show that the gas

volume % of H_2 and CO produced increased with increasing blending proportion of hydrochars. There was a synergistic effect in the co-gasification of blended fuels and it was stronger at higher hydrochar proportion. At 50% blending ratio however, there was a decreased in the synergistic effect and consequently, a reduction in volume % of the producer gas. The synergistic effect positively correlated with AI and therefore it can be concluded that the synergy behavior arises from the catalytic effect of the retained AAEM in the hydrochars.

Chapter 5. Effect of reaction temperature on the organic acids produced from hydrothermal treatment

In this chapter, the formation and decomposition of organic acids from a wide range of reaction temperature (120-240^{o}C) were investigated. The concentration of formic, acetic, lactic and succinic acids tended to increase with increasing the reaction temperature, while oxalic, citric and malic acids decreased. The concentration of acetic and formic acids at 200^{o}C and above, was much higher than that seen at lower temperatures. At a higher reaction temperature, oxalic, citric and succinic acids must have undergone a secondary degradation and, for citric acid, it may have caused the increase of the acetic acid concentration due to the thermal reaction pathways. Furthermore, a decrease in pH (5.35-4.60) of the liquid by-product was observed with the increase of the reaction temperature. This implies that the aqueous solution becomes more acidic at a higher reaction temperature as an effect of the formation and secondary degradation of organic acids.

Chapter 6. Conclusions and Recommendations

This chapter summarizes the important concluding remarks and recommendations of this thesis.