論文 / 著書情報
Article / Book Information

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種別(和文)	論文要旨
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（博士課程）
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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	(Engineering)
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

This thesis is entitled "Development of small-scale biomass gasification and power generation system" and this system can be used for the electrification of rural or disaster areas as a supplement of grid power.

Chapter one is introduction. In this chapter, the background of this research, the previous work, the originality of this research was discussed.

Chapter two is focus on the carbonization of woody biomass. In this chapter, a pilot scale non-electric heating carbonizer was used for carbonization. Firstly, the influence of the carbonization temperature on the fuel properties of the produced char was discussed. Higher temperature is preferred to produce wood char with better fuel properties. From the ultimate analysis, we can see that there was a huge decrease of oxygen and hydrogen contents, whilst the carbon content increased. A lower O/C ratio can bring a higher gasification efficiency, and, with the change of C, H and O contents, the higher heating values (HHV) of raw cedar wood increased apparently from 19.5 $MJ•kg^{-1}$ to 33.5 $MJ•kg^{-1}$ after 500 ºC carbonization. Higher carbonization temperature decreased the energy efficiency of the carbonization process. The energy recovery of the carbonization process decreased from 40.68% to 35.25% with increasing the carbonization temperature from 300 ºC to 500 ºC. For this carbonizer, higher moisture content of the feedstock will increase the carbonization time dramatically. When the moisture of feedstock increased from 10.0% to 33.3%, the carbonization time increased from 125 min to 212 min.

Chapter three is about the densification of carbonized wood char. Densification are needed to increased the density and the strength of the wood char and this is important to ensure the stable operation of gasification process by using a up-draft gasifier. Carbonized pellet and carbonized briquette were produced by using PVA and starch solution as binder, respectively. Optimum ration of the binder and the feedstock was determined. A new densification method was suggested by using BGR as additive to produce pellet with comparable strength with lower binder usage. More than that, recycle the produced BGR as the feedstock in a biomass gasification plant can further improve the energy efficiency of the whole process.

Chapter four is about the gasification and power generation by using the carbonized pellet or briquette as feedstock. Both using briquette and pellet can ensure the stable operation of gasification. The stable operation can be proved from the stable temperature layer in the gasifier and stable syngas composition during the gasification process. Differences were observed between gasification by using different feedstock. Gasification using carbonized pellet can achieve stable operation earlier than briquette gasification. LHV of the syngas from pellet gasification was higher than the briquette gasification. For this reason, CCE and CGE by using pellet for gasification was higher than briquette gasification. Carbonized pellet expressed superior performance for gasification utilization. Gasification using briquette from different carbonization temperature was conducted. The feedstock with lower carbonization temperature contained higher volatile matter which can produce the syngas with higher LHV as well as achieve higher CCE and CGE during the gasification process. Stability of the gasification and power generation system was proved by a 100 h continuous operation. The syngas blower stopped two times after 70 h operation, but we can continue the gasification by cleaning the blower. CCE and CGE of the whole gasification process was 73.4% and 49.2%, respectively. The maximum power output was 21 kW at the air flow rate of 40 Nm3·h-1. Even at the late stage of the experiment, the power output can still over 15 kW.

Chapter 5 is focus on the gasification of food waste. The food waste was collected from the restaurant of the campus. A carbonization experiment was conducted with the carbonization temperature ranged from 200 to 500 oC with the interval of 100 oC. Carbonization can be used as an effective method to increase the fuel property of the food waste. The gasification temperature has a huge effect on the gasification rate of the FW char. A higher gasification temperature is preferred to increase the gasification rate. Co-gasification with wood char can be a suitable method for the gasification of the FW char. The mixing ratio can affect the gasification performance of the mixture feedstock. Even at a high mixing ratio of 6 to 4 (the weight ratio of the wood char to the weight of the FW char), the gasification rate of the mixture still can reach to 86% of the gasification rate of the pure wood char. A synergy effect was observed during co-gasification. The mechanism of synergy effect should be further studied. After all, co-gasification with wood char could give us a new potential for the gasification of food waste.

Chapter six is the conclusion chapter gave a summary based on the whole thesis.

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).

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