

論文 / 著書情報
Article / Book Information

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Title(English)	Role of Intraparticle Reactions and Anisotropic Structure in Pyrolysis and Gasification of Woody Biomass
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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

専攻 : Department of	Mechanical and Control Engineering	専攻	申請学位 (専攻分野) : Academic Degree Requested	博士 Doctor of	(Engineering)
学生氏名 : Student's Name	Teeranai Pattanotai		指導教員 (主) : Academic Advisor(main)	Prof. Ken Okazaki	
			指導教員 (副) : Academic Advisor(sub)	-	

要旨 (英文 800 語程度)

Thesis Summary (approx.800 English Words)

In this thesis, the role of intraparticle reactions and anisotropic structure in pyrolysis and gasification of woody biomass was studied. The objectives of this study were a) to clarify intraparticle secondary reactions of tar which occurred in the pyrolysis of large wood particle, b) to visualize the intraparticle structure of wood-derived char which was considered as anisotropic structure, and c) to investigate the influence of anisotropic structure on gasification characteristics.

In Chapter one, an overview of research background about the use of biomass as an alternative energy resource was given. Advantages of biomass energy were discussed. Utilization of biomass energy through gasification process was introduced as a promising option. Research motivations of this work were raised from the problems and the concerning points while utilizing large woody biomass in gasifiers. Outline and objectives of this thesis were stated.

In Chapter two, intraparticle secondary reactions of tar during pyrolysis were experimentally investigated. A comparison of sawdust and large wood cylinder pyrolysis at specified pyrolysis conditions revealed intraparticle secondary reactions of tar. It was found that intraparticle secondary reactions of tar occurred in the wood cylinder, influencing the pyrolysis products (gas, tar, and char yields). Polymerization of tar to form secondary char (intraparticle reactions) progressed at approximately 380° C. Intraparticle tar decomposition to form secondary gases (mainly CO) occurred at 400-500° C, which was relatively low for tar cracking. This was because char worked as a catalyst and lowered the temperature at which secondary tar decomposition progressed. The enhancement of intraparticle tar decomposition under high heating rate condition was also presented. It was concluded that these intraparticle reactions of tar have the potential to reduce the amount of tar produced in gasification systems.

In Chapter three, an experimental investigation of gasification characteristic of large wood cylinder with anisotropic structure was performed. The sawdust and wood cylinder with various lengths were used as samples. For pyrolysis characteristics, the effect of intraparticle secondary reactions of tar on pyrolysis products was confirmed. With increasing particle size, the decrease in tar yield and the increase in char yield were observed. Scanning electron microscopy (SEM) and X-ray computed tomography (CT) were used to visualize the anisotropic

structure of wood-derived char. X-ray CT images clearly showed the intraparticle structure and the alignment of pores inside the char sample. For gasification characteristics, the Arrhenius plot of reactivity of char with different sizes was used to discuss the importance of pore diffusion during gasification process. Moreover, it was also found that the anisotropic structure as well as the alignment of pores significantly influenced the evolution of particle shape for the large chars during gasification in the internal diffusion-controlled zone.

In Chapter four, the influence of particle aspect ratio (length/diameter) on gasification reactivity of anisotropic char was investigated. Wood cylinders with three particle aspect ratios were used as samples for pyrolysis and gasification experiment in this chapter. The 3D X-ray CT image of char structure was also shown. It was found that the effect of particle aspect ratio on char reactivity was not appeared in the kinetically controlled zone. However, the anisotropic structure significantly influenced char reactivity in the internal diffusion-controlled zone. Char reactivity was significantly increased with decreasing particle aspect ratio. Char with low aspect ratio showed the highest reactivity and fastest conversion time among three samples. This chapter suggested the selection of wood shape in term of particle aspect ratio which should be used in gasifiers for improving the total conversion rate. It was concluded that the aspect ratio of wood cylinder was an important parameter for the reactivity of anisotropic char.

In Chapter five, the important results and findings in this thesis were summarized.

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).