論文 / 著書情報
Article / Book Information

題目(和文)	不均一触媒を導入した溶融塩反応器によるバイオマスの熱化学変換
Title(English)	Thermochemical Conversion of Biomass in Molten Salt Reactor with Heterogeneous Catalysts
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種別(和文)	要約
Type(English)	Outline

（博士課程）
Doctoral Program

東京工業大学
Tokyo Institute of Technology

論文要約

THESIS OUTLINE

専攻： Department of	Chemical Engineering 専攻	申請学位（専攻分野）： Academic Degree Requested	博士 (Engineering) Doctor of
学生氏名： Student's Name	Sakhon Ratchahat	指導教員（主）： Academic Advisor(main)	Prof. Sekiguchi H.

Thesis Outline

In this research work, thermochemical conversion of biomass (mainly pyrolysis and CO_2 gasification) in molten salt reactor with heterogeneous catalysts was experimentally investigated. The experiments were carried out in two systems consisting of non-preheated molten salt and preheated molten salt, to investigate the enhancements of pyrolysis and CO_2 gasification by adding catalyst. The non-preheated molten salt system is simply method by constantly heating a well mixture of cellulose, molten salt, and catalyst, thereby noncontact of cellulose to salt and catalyst was minimized. In pyrolysis experiments, a suitable fraction of catalyst in molten salt, an appropriate ratio of molten salt to cellulose, and reaction temperature were determined. In CO_2 gasification, it is not only cellulose but also biomass wastes and char were experimentally studied. In the preheated molten salt system, a sudden submerge of cellulose pellet to preheated molten salt was carried out to demonstrate whether the catalyst suspending in molten salt can still enhance the reactions. Finally, based on the experimental results in both two systems, conceptual process designs of pyrolysis and CO_2 gasification were carried out to demonstrate the efficient continuous process of syngas production in the molten salt with heterogeneous catalyst. The outline of thesis are set in the following chapter.

Chapter I: Introduction, describes the background, motivation, literature survey, objectives, and research approach. Utilization of solar-heated molten salt as reaction medium in pyrolysis and gasification is a promising way to store solar energy in a form of syngas with upgrading biomass to transportable biofuel. Addition of heterogeneous catalyst to molten salt was expected to enhance the production yield, rate, and H_2 fraction.

Chapter II: Non-preheated molten salt, demonstrates the experimental results of cellulose pyrolysis and CO_2 gasification in the non-preheated molten salt system. A best catalyst fraction in molten salt (7wt%), an appropriate mass ratio of salt to cellulose (140) and suitable temperature range (700-800^oC), were determined. In CO_2 gasification, the enhancements were relatively similar to the pyrolysis case. However, the reverse water gas shift reaction was observed, resulting in decreased H_2 fraction. Activation energies from both pyrolysis and gasification were calculated to show the catalytic enhancements of the nickel catalyst.

Chapter III: Preheated molten salt, demonstrates a feasibility of practical utilization of molten salt combined with heterogeneous catalyst as reaction medium for syngas production. Among various catalysts including Ni/Activated carbon, Ni/γAl_2O_3, Ni/αAl_2O_3, and nickel powder, the Ni/Ac exhibited the best performance for syngas production in term of production yield, rate, as well as catalyst deactivation. It was ascribed to the high surface area of activated carbon support. The mechanisms of cellulose pyrolysis and kinetics of CO_2 gasification were proposed.

Chapter IV: Conceptual process design, describes the calculation results from conceptual process designs of thermochemical conversions in molten salt with heterogeneous catalyst. It was developed and designed for a demonstration of pilot plant construction. Combined pyrolysis and gasification (CO_2 gasification of cellulose) decreased H_2 content due to the effect of reverse water gas shift reaction (RWGR). However, separated pyrolysis and gasification can solve the RWGR problem and produce high quality and high yield of syngas.

Chapter V: Conclusion, summarizes the findings obtained from this study, and provide to future prospects.