

論文 / 著書情報  
Article / Book Information

題目(和文)	流動床炉型一般廃棄物焼却飛灰の不均一性および粒子特性の解明
Title(English)	Geochemical Heterogeneity and Characterization of Fly Ash Generated from A Fluidized Bed Incineration of Municipal Solid Wastes
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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

# 論文要旨

THESIS SUMMARY

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

Thesis Summary (approx.800 English Words )

The thesis entitled “Geochemical heterogeneity and characterization of fly ash generated from a fluidized bed incineration of municipal solid wastes” discusses the quantitative analysis of heterogeneity characterization in the municipal solid waste incineration fly ash from fluidized bed combustor. The heterogeneity analysis proposed fly ash formation and the impact on heavy metal leachability. The thesis is composed of the following chapters.

## Chapter 1. Introduction

The introduction contains the background and objectives of the research. The treatment of municipal solid waste by using incinerators is firstly discussed. Further explanation about municipal solid waste incineration fly ash, which focused on this research. The previous study introduced in this Chapter to better understand the importance of the research. Finally, the current research objectives are presented, followed by the structure in this thesis.

## Chapter 2. Heterogeneity analysis of fly ash particles generated from fluidized bed incinerator

This Chapter quantitatively investigated two categories of heterogeneity of fly ash produced from a fluidized bed incinerator. They are the intra-particle heterogeneity (heterogeneity of a single fly ash particle body) and inter-particle heterogeneity (heterogeneity among fly ash particles). Heterogeneity was observed in all components fly ash particles that are surface, semi-soluble, and insoluble core components. This analysis focused on a single fly ash particle by using SEM-EDX. The surface component of the fly ash is more heterogeneous than other components of fly ash particles. Fly ash from fluidized bed combustor has intra- and inter-particle heterogeneity. Besides, heterogeneity analysis can explain the fly ash formation process. Heterogeneity analysis suggests that Si plays more critical roles in the fly ash formation process of the fluidized bed. Fly ash has various bodies, and it might give non-negligible impacts on the leaching of metals included in fly ash components.

## Chapter 3. Comparison heterogeneities of fly ash particles generated from a fluidized bed combustor and a stoker combustor of municipal solid waste incineration

Comparison heterogeneity of fly ash produced from a stoker and fluidized bed combustors are investigated in this Chapter. In all particle components (surface, semi-soluble, and insoluble core matrices), the fluidized bed combustor fly ash has 4-760 % larger intra-particle heterogeneities than the stoker combustor fly ash. In the surface and semi-soluble components, the fluidized bed combustor fly ash has 14-177 % larger inter-particle heterogeneities of Al, Ca, and Si than the stoker combustor fly ash. Heterogeneity analysis suggests that the core component of fly ash from a fluidized bed derived from silica. It plays critical roles in the fly ash formation process of the fluidized bed combustor than that of the stoker combustor. The core component of stoker fly ash consists of Al-, Ca-, Si-rich insoluble core. Semi-soluble component and surface of fly ash from both combustors mainly consisted of Ca-based matrices that aluminosilicate domains included.

## Chapter 4. Micro-scale correlation of heavy metals speciation within single fly ash particles of municipal solid waste incineration

Besides heterogeneity, heavy metal speciation in all components of fly ash from a fluidized bed is investigated. Metal associations can determine the leachability of metals during leaching processes and

have been observed by using several methods. This study aims to propose new possible metal speciation in all components of the fly ash particle by using micro-scale correlation analysis. Micro-scale correlation analysis can estimate possible metal speciation at individual particle levels that can be in an amorphous phase or low concentration of the crystalline phase. Correlation analysis at the micro-scale suggested that heavy metal speciation is different in the individual fly ash particle.

### **Chapter 5. Impact of heterogeneity characterization on heavy metal leachability by geochemical modeling**

This study is using geochemical simulation, PHREEQC, to investigate the impact of heterogeneity on elemental leachability. Heterogeneity characterization was included in the geochemical modeling of the leaching behavior of major elements and heavy metals. This study aims to evaluate the impact of elemental heterogeneities on their leachabilities. Elemental heterogeneity proposed local pH in the individual level of fly ash particle. pH after leaching is in the range 11- 13, in the high alkaline pH range. Alkaline pH in most of the scenarios might be due to dissolution CaO as the main factor of alkalinity in the fly ash. Heterogeneity affecting solid-phase concentration that is formed after leaching. Major elements are precipitated into the solid phase, which has dispersed concentration. It suggested elemental heterogeneity can affect the formation of element speciation in their solid phase. Elemental heterogeneity might have a negligible effect on heavy metal leachability.

### **Chapter 6. Conclusion and recommendation**

In this Chapter, the significant results and findings of the study are summarized. Following the conclusion, recommendations for further work are suggested.

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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