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| 指導教員 承認印 | 主 | 副 | 副 |
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2020年 3月 25日
Year Month Day

学位 (博士) 論文要旨
(Doctoral thesis abstract)

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| 論文提出者 Ph. D. Candidate | 生物システム応用科学府 <u>生物機能システム科学</u> 専攻 博士後期課程 <u>第1</u> 専修/グループ(Department Course) 平成 <u>28</u> 年度入学(Your Entrance Fiscal Year) 氏名 <u>高居冠</u> (Your Name(Family, First) and Seal) | | | | |
| 主指導教員 氏名 Chief Advisor's Name | 神谷 秀博 | 副指導教員 氏名 Vice Advisor's Name | Lenggoro Wuled | 副指導教員 氏名 Vice Advisor's Name | |
| 論文題目 Title | Analysis and control of adhesion behavior of solid fuel combustion ash at high temperature 固体燃料燃焼で生じる灰粒子の高温付着性の評価と制御 | | | | |

論文要旨 (和文要旨(2000字程度)または英文要旨(500words))

※欧文・和文どちらでもよい。但し、和文の場合は英訳を付すこと。

Write a summary in Japanese (2000 characters) or in English (500words).

If the abstract is written in Japanese, needed to translate into English.

In sewage sludge incineration plants, fly ash can adhere to the surfaces of both the incinerator and dust filter and then accumulate over time. Since this grown layer can potentially block the gas flow and damage the filter, thus preventing stable and long-term operation of incineration plants, fly ash adhesion must be monitored carefully and suppressed as much as possible. Firstly, we used three different fly ash samples to demonstrate that the merger of experimental and theoretical approaches enabled a rational choice of additive that could suppress fly ash adhesion. The tensile strength of ash powder beds provided a benchmark for the adhesive properties, which were further studied by thermodynamic calculations. Experimental and theoretical results suggest that the use of alumina nanoparticles is a promising approach to suppress the adhesion of fly ash containing a relatively high concentration of phosphorus components.

Besides, ash particles included various main and trace elements and chemical compounds. It is impossible to remove certain elements from real combustion ash particles to discuss the effect of target element on the ash adhesion phenomena at high temperature. In order to analyze the effect of certain element on ash adhesion behavior, the preparation method of model ash particles only contained target elements were developed by using pure nano-sized particles and chemical compounds. Firstly, we focused on main 7 elements, Si, Al, Ca, Mg, Na, K and P in real sewage sludge ash, and synthesized model ashes with almost same chemical compounds of real combustion ash. The synthetic ashes showed similar adhesion property as the real ashes at high temperature condition. The adhesion property of each ash particles was characterized by tensile strength of ash powder bed, which was developed in our previous work. Secondly, in order to discuss the effect of Ca, Mg and Al on adhesion behavior, 2 kinds of model ash with only included 5 elements, Si, Al, Na, K and P were prepared and characterized adhesion behavior at high temperature. In this model ash, the amount of Ca and Mg was replaced with Al and the other elements were fixed to the same concentration with 7 element ash. Since the tensile strength of 5

elements model ash was much larger than that of 7 elements model ash, Ca and Mg were important to stabilize phosphorus-rich sewage sludge combustion ashes at high temperature.

In the studies of adhesiveness of ash particles, a new system which can measure the adhesion force between an individual particles and a plate in micrometer scale was proposed. This system can help researchers measure and evaluate the adhesiveness directly. By changing measurement conditions, it was found that temperature and compressive force can influence the tensile force. By adding different amount of CaO additive to the coal ash, it was found that the CaO additive can promote the adhesiveness of ashes within some extent. Combining with the results of thermomechanical analysis results, the author found that the deformation properties determined by temperature and thermomechanical properties have effects on the tensile force between a spherical particle and a metal flat. Meanwhile, fitted curves based on Hertz theory were calculated.

(英訳) ※和文要旨の場合(300 words)

If the abstract is written in Japanese, needed to translate into English.(300 words)