Development of Hot Gas Purification System for Multi Impurities − Proposal of Mercury Absorbent and Halide Sorbent −

Background

To use biomass or wastes for high efficiency power generation, CRIEPI is investigating a high temperature dry gas cleaning system (Fig.1) which removes impurities such as heavy metals (Hg etc.), halides (HCl, HF) and sulfur compounds (H_2S etc.) in biomass/waste derived gas *1. Although high temperature dry gas cleaning system has superior purified potential applicable to the molten carbonate fuel cell, technological developments of high performance removal sorbent represent an important issue in realization of this system. Although activated carbons are utilized as Hg absorbent at waste incinerator and LNG plant, Hg removal efficiency of activated carbons in biomass/waste derived gas at driving temperature of bag filter (120-160˚C) is not clarified. And the sodium aluminate ($NaAlO_2$) sorbent, which was developed for halide removal material *2, needs to balance property between halides removability and strength characteristics for industrial-scale reactor application.

Objectives

To reveal a Hg removal efficiency of activated carbons and to develop molded halide sorbent combined removability and strength characteristics as applications of sorbent to the high temperature dry gas cleaning system for biomass/waste derived gas.

Principal Results

1. Evaluation of Hg removal efficiency of activated carbon

Impregnated activated carbon *3 was most effective for removing Hg in simulated biomass derived gas at 160˚C among eight kinds of commercially produced activated carbons for Hg, acid gas, dioxin and deodorizing treatments. Although Hg absorption capacity was reduced by increased coexisting H_2S concentration, using at low temperature around 120˚C improved Hg absorption capacity (Fig.2). It was clarified that the mercury removal process with impregnated activated carbon could be applied to the high temperature dry gas cleaning system.

2. Investigation of molded halide sorbent

Pellet formed halide sorbents were prepared with different methods in $NaAlO_2$ formation processes, additive types and molding methods. The halides reactivity in simulated biomass derived gas and strength characteristics for molded sorbents were evaluated. As a result, the extruded sodium aluminate sorbent with activated alumina additives offers an excellent compromise between HCl and HF concurrent removability (Fig.3) and practical strength to applicable potential for high temperature dry gas cleanup systems.

This work was carried out under joint research with New Energy Industrial Technology Development Organization (NEDO).

Future Developments

We will demonstrate the performance of Hg removal activated carbon and molded halide sorbent for the fuel gas produced by the biomass/waste gasifier with high temperature dry gas cleaning facilities installed in 2006 (gas quantity; 200m^3_N/h).

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References

H. Akiho, et al., 2006, “Development of Hot Gas Purification System for Multi Impurities in Biomass/Refuse Derived Fuel Gasification Gases - Screening of activated carbons for mercury removal in the simulating gasification gases and effect of the coexistent gases such as H_2S and HCl -”, CRIEPI Report M05005 (in Japanese)
M. Nunokawa, et al., 2006, “Development of Hot Gas Purification System for Multi Impurities in Biomass/Refuse Derived Fuel Gasification Gases -Investigation of preparation method for practical molded sodium based sorbent -”, CRIEPI Report M05017 (in Japanese)

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*1 : M. Kobayashi, et al., 2005, “Process Development for High Temperature Purification System for Biomass/Refuse Derived Fuel Gasification MCFC Power Plant. - Performance Evaluation of Contaminant Removal Agents and Process Design - ”, CRIEPI Report M04009 (in Japanese)
*2 : Japanese Patent No. 3571219
*3 : Carbonaceous adsorbents which have chemicals finely distributed on their internal surface.

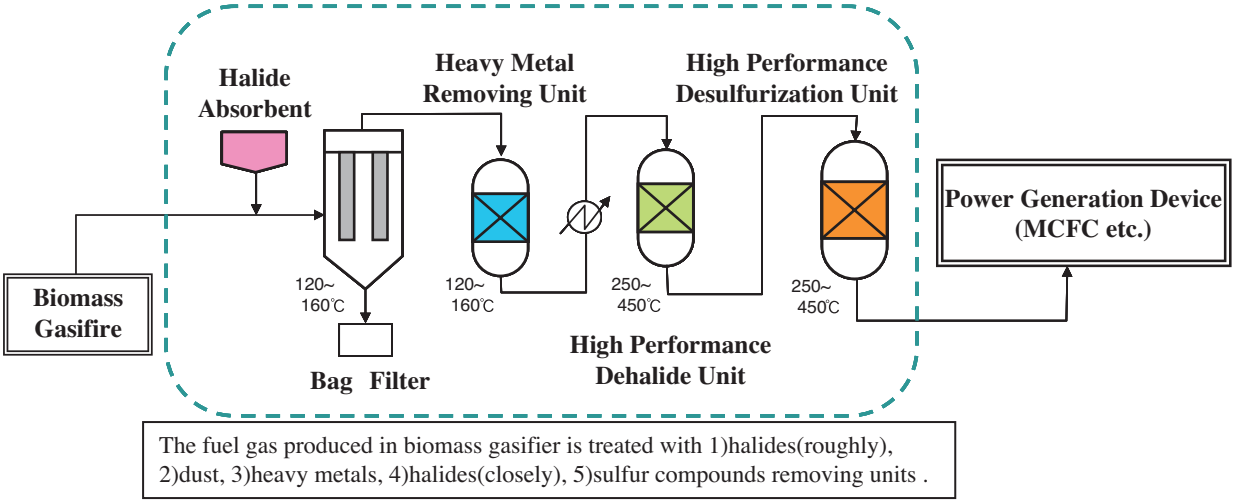

Fig.1 High temperature dry gas cleaning system proposed CRIEPI

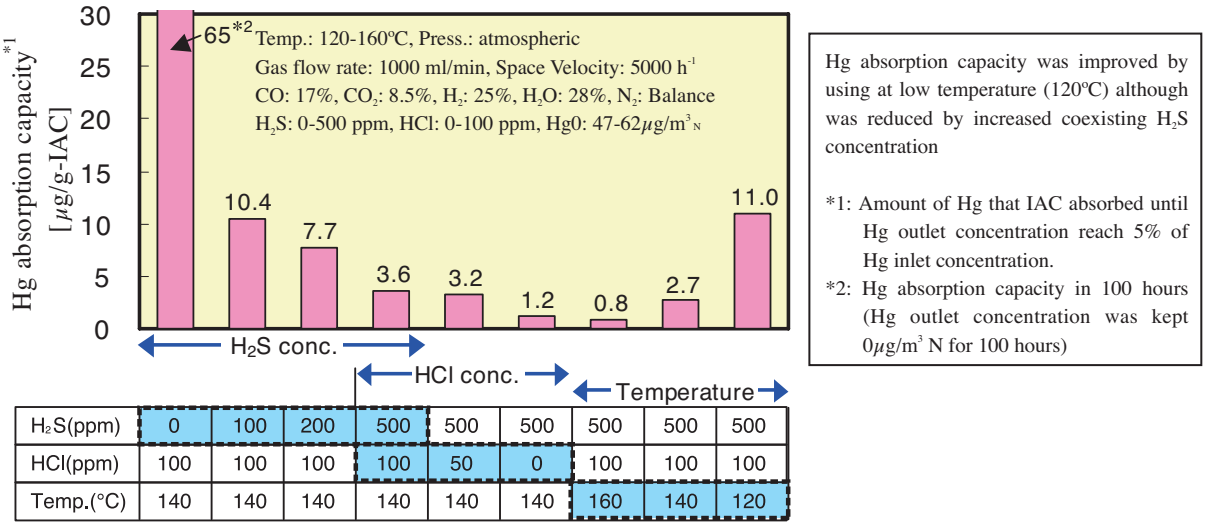

Fig.2 Relationship between Hg absorption capacity and coexisting gas concentration and reaction temperature

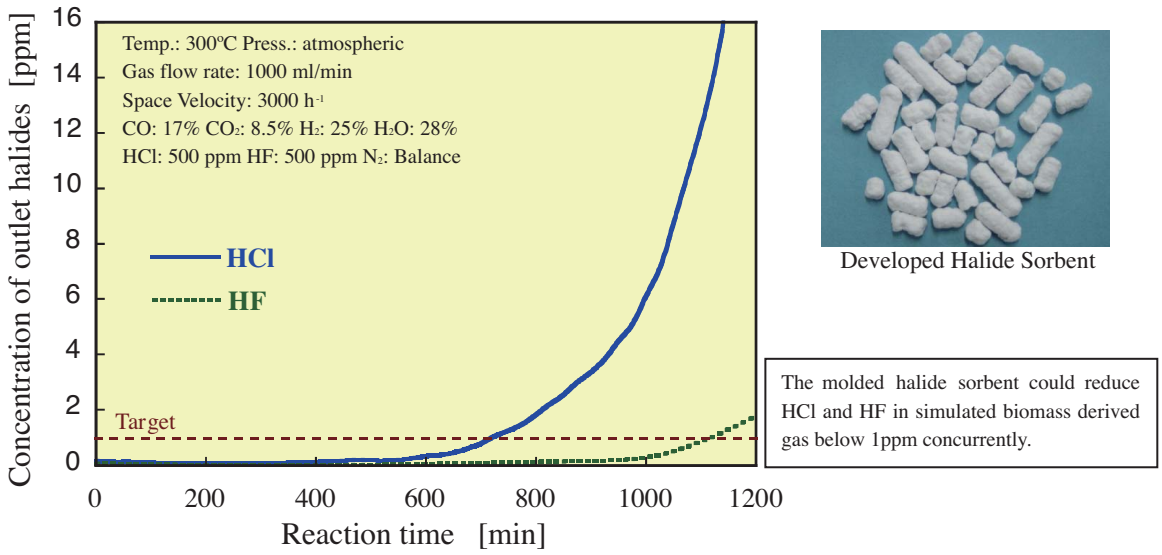

Fig.3 HCl/HF breakthrough curves of molded halide sorbent