

## XAFS analysis of arsenic and selenium in sewage sludge incinerations dust by particle size

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### Introduction

Arsenic (As) and Selenium (Se) are one of the hazardous elements because of their toxicity. In Japan, they are the environmental control led substances such as one of the toxic air pollutants in Air Control Pollution Act.

Their toxicity is different from their oxidation states. As(III) and Se(IV) compounds are generally more toxic than the other As and Se ones. So the chemical speciation is very important in evaluating the toxicity of materials contained with their compounds.

The sewage sludge incineration dusts collected by the dust precipitators contain trace-amount of As and Se[1]. In this study, As and Se in the sewage sludge incineration dusts by particle size were analyzed by X-ray Absorption Fine Structure (XAFS) technique to understand the chemical forms of As and Se emitted from those incineration facilities.

### Experiment

The dusts were sampled by the test product separators from the flue gas passed through the precipitators of three sewage sludge incineration facilities (Facility A~C). The separators were two kinds of types, the one can separate particles into coarse (larger than 1 $\mu$ m on the impactor) and fine size (smaller than 1 $\mu$ m on the filter). The other can do them into coarse (larger than 0.3 $\mu$ m on the impactor) and fine (smaller than 0.3 $\mu$ m on the filter). 1 $\mu$ m and 0.3 $\mu$ m are 50% aerodynamic cutoff diameter.

As-K edge XAFS spectra of those segregated particle dusts were measured at the beamline 12C in the PF, KEK and BL01B1 in the SPring-8. Se-K edge XAFS spectra of them were measured at BL14B2 in the SPring-8. The spectra of As<sub>2</sub>O<sub>3</sub>, As<sub>2</sub>O<sub>5</sub>, Se, and SeO<sub>2</sub> were measured for the spectra of reference materials. The spectra of the dusts samples were collected in the fluorescence mode using a 19-element Ge semiconductor detector. All of XAFS spectra data (XANES: X-ray Absorption Near Edge Structure) were analyzed by REX2000 (Rigaku Co. Ltd.).

### Results and Discussion

The XANES spectra of the references and the dusts samples are shown in Fig.1, and Fig.2 shows the results of the sample spectra analysis that fitted by linear combination between the references. In facility A, As and Se in coarse particulate dusts (>1 $\mu$ m) were mostly As(V) and Se(IV). On the other hand, As in fine (<1 $\mu$ m) contained about 45%As(III) and Se in fine was Se(0). In

facility B and C, the quantity of As(III) and Se(0) were slightly-increase in fine than that of them in coarse.

The sampling positions and conditions from the flues were different in each facilities but quantity of As(III) and Se(0) tended to increase in fine particle dust. In coarse particle dust, As and Se were mostly As(V) and Se(IV).

In this study, chemical states of As and Se in fine particle dust from a sewage sludge incineration are different from those in bulk dust[1].

### References

[1] M. Takaoka et al., Wat. Sci. Tech. 57, 411-417 (2008).

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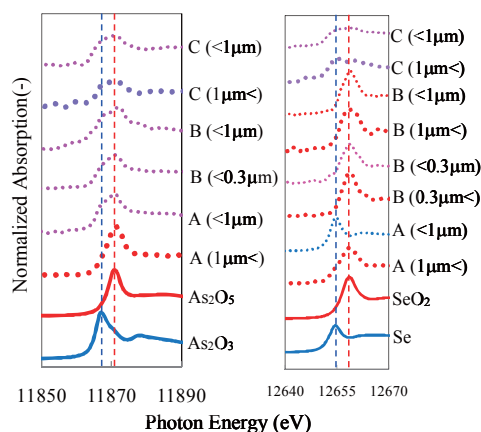


Fig.1 XANES spectra for As and Se references and the dust samples

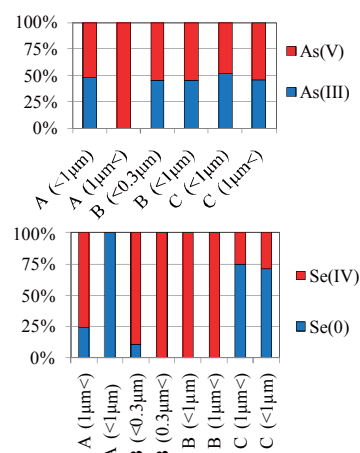


Fig.2 As and Se abundance ratio in the dust samples