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Direct Speciation of Copper, Lead, Antimony, Zinc and Chromium in Municipal Solid Waste Incinerator Fly Ash by X-ray Absorption Fine Structure Spectroscopy

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It is important to understand the chemical states of heavy metals in municipal solid waste incinerator(MSWI) fly ash on its recycling and detoxification. As the toxicity of heavy metal is different by the compounds, the information of chemical states of heavy metals is needed to evaluate the behavior of heavy metals in environment. In this study, direct Speciation of lead, antimony and zinc in MSWI fly ash by XAFS was conducted.

3 kinds of fly ash (1-3) from continuous stoker-type MSWIs and a kind of fly ash (4) from an ash melting plant (AMP) were used. XAFS measurements were carried out on the beam line BL01B1 at SPring-8. The lead, zinc and antimony spectra were collected in fluorescence mode at room temperature with a Si(111) or Si(311) monochromator.

According to Pb LIII-edge XANES spectra, lead was mainly estimated to be $PbCl_2$ in MSWI fly ashes and PbO in AMP fly ash. Same results were also suggested from EXAFS spectra.

Figure 1 shows Zn K-edge XANES spectra. The peak shape of fly ash 2 was very similar to that of fly ash 3. Whereas, that of fly ash 4 was different from the others and the peak position shifted to higher photon energy. Zinc was mainly estimated to be $ZnCl_2$ in MSWI fly ashes and the mixture of $ZnCO_3$, ZnO and $ZnCl_2$ in AMP fly ash.

Sb K-edge XANES spectra had no difference among fly ashes. Antimony in fly ash was considered to be Sb(V) compounds. EXAFS spectra indicated that antimony combined with not only oxygen but also chlorine.

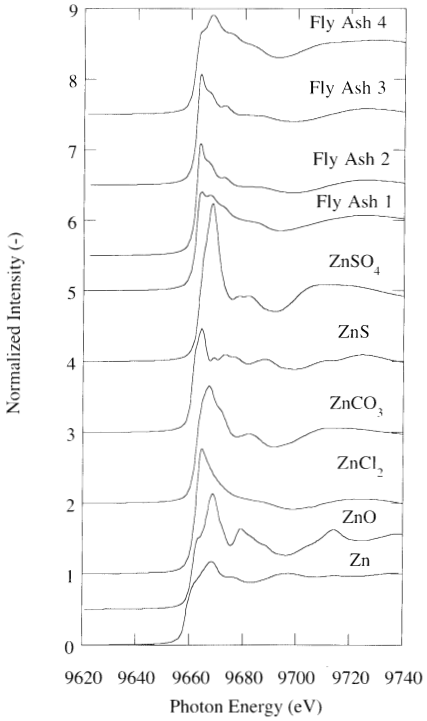

Figure 1 Zn K-edge XANES spectra

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Study on Stabilization Mechanism of Heavy Metals in Melting Slag by X-ray Absorption Fine Structure Spectroscopy

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Melting is an important method for treating ashes generated from municipal solid waste incinerator. By melting ashes at the high temperature, dioxins can be destructed and heavy metals can be enclosed in slag. However, it is uncertain of the chemical states of heavy metals in slag. Because slag is amorphous, the chemical states of heavy metals in slag cannot be analyzed by XRD. In this study,XAFS was measured to clear the stabilization mechanism of heavy metals in melting slag .

Slag1, bottom ash 1, fly ash 1 and melting fly ash 1 were sampled from a plasma type ash melting plant (AMP). Bottom ash 1 and fly ash 1 were melted and transformed to slag 1 and melting fly ash 1. Slag 2 was sampled from another plasma type AMP. Slag 3 and 4 were sampled from different surface type AMPs. XAFS measurements were carried out on the beam line BL01B1 at SPring-8. The lead, zinc and copper spectra were collected in fluorescence mode at room temperature with a Si(111) monochromator.

Figure 1 shows Cu K-edge XANES spectra. The peak shapes of fly ash 1, melting fly ash 1 and bottom ash were similar. But that of slag 1 was different from others. These results indicated that the chemical states in slag were different from those of ashes. As for slag, it was indicated that different types of melting led to different shapes of spectra. According to the shapes of spectra, copper in the slag from plasma type AMP was considered to be mainly as Cu(I) compounds. On the other hand, copper in the slag from surface type AMP was considered to be mainly as Cu(II) compounds.

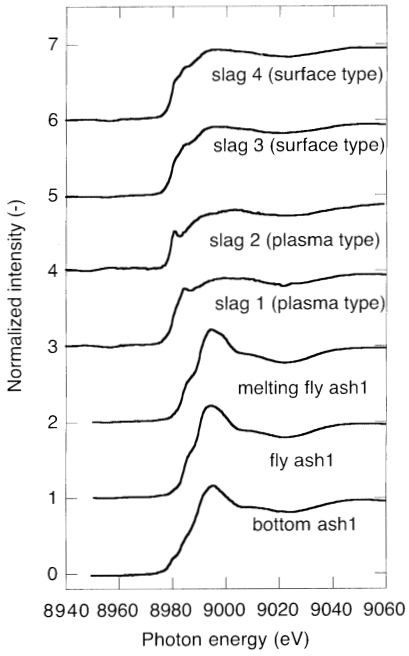

Figure 1 Cu K-edge XANES spectra