

Chloride Chemical Form in Various Types of Fly Ash

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Introduction

High chlorine concentration is one of the critical factors to prevent from recycling fly ash from municipal solid waste incinerator, hazardous waste, to be raw material in cement industry. However, there are few researches about chlorides distribution in fly ash, which could provide strong support to adopt better pretreatment technologies to reduce chlorides from fly ash more efficiently. In this research, we studied chloride chemical form and their responsible distribution by combining X-ray absorption near edge structure (XANES) and XRD.

Experimental

Three kinds of fly ashes were checked: raw fly ash (RFA) from the boiler of incinerator, fly ash collected in a bag filter with the injection of calcium hydroxide for acid gas removal (CaFA), and fly ash collected in a bag filter with the injection of sodium bicarbonate for acid gas removal (NaFA). They are all from continuous municipal solid waste incinerators.

All samples are fine powder. Cl K-edge XANES spectra were collected as fluorescence yield (FY) and total electron yield (TEY) in BL-11B [Ge(111)] and conversion electron yield (CEY) in BL-9A[Si(111)].

We composed a new identification approach by combining XANES method with XRD, which is we confirm the existence of some chlorides by XRD spectra of samples and some previous research, and then combined other two possible chlorides spectra to process linear combination fitting (LCF) program, and last according to R value, we choose the possible combination and evaluate it with washing experiments results.

Results and discussion

XRD spectra of RFA, CaFA, NaFA and samples from washing experiments of those three kinds of fly ashes suggested that NaCl and KCl must be in RFA, CaFA and NaFA, while CaClOH should be in CaFA, CaCl₂ might be in CaFA. Some literatures suggested that friedel's salt might be in fly ash, and some researchers have proved that there is friedel's salt in bottom ash from incinerator [1]. We also found the typical peak of friedel's salt in the XRD spectrum of RFA, so in the LCF analysis of the Cl K-edge XANES spectra of those fly ashes, we

added the spectra of friedel's salt and one compounds changed from friedel's salt because of temperature. Figure 1 shows the Cl K-edge XANES spectra of RFA, CaFA and NaFA.

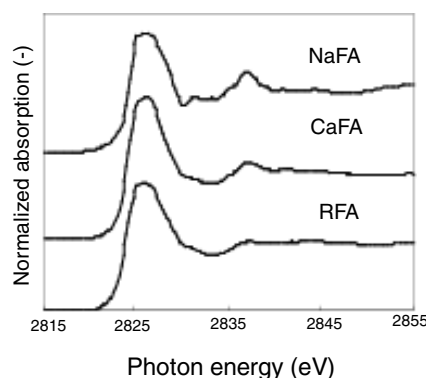


Figure 1 Cl K-edge XANES spectra of RFA, CaFA and NaFA

With the LCF processing, we found that approximately 15% of the chlorine in raw fly ash (RFA) was estimated to be in the form of NaCl, 10% in KCl, 50% in CaCl₂, and the remainder in the form of Friedel's salt, CaFA contained 35% of chlorine as NaCl, 11% as KCl, 37% as CaCl₂, 13% as Friedel's salt, and the remaining 4% as CaClOH, and in NaFA, approximately 79% of chlorine was in NaCl, 12% was in KCl, and 9% was in Friedel's salt. Those results are in good agreement with our washing experiment results. According to those results, we found out the existing form of insoluble chlorides, which is important to adopt suitable method to reduce the chlorine content, for example, friedel's salt will be decomposed by heat or CO₂ to CaClOH, CaCl₂, which is soluble and easy to be reduced.

As the chlorine concentration in fly ash is detectable by XRD method, we confirmed the existence of some chlorides by XRD instead of using principle compound analysis (PCA) methods.

Reference

[1]T. Narioka et al., Proc. of the 18th Annu. Conf. of the JSWME. 721, (2007).

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