JOURNAL OF ZHEJIANG UNIVERSITY SCIENCE A

Emission characteristics of hazardous components in municipal solid waste incinerator residual ash

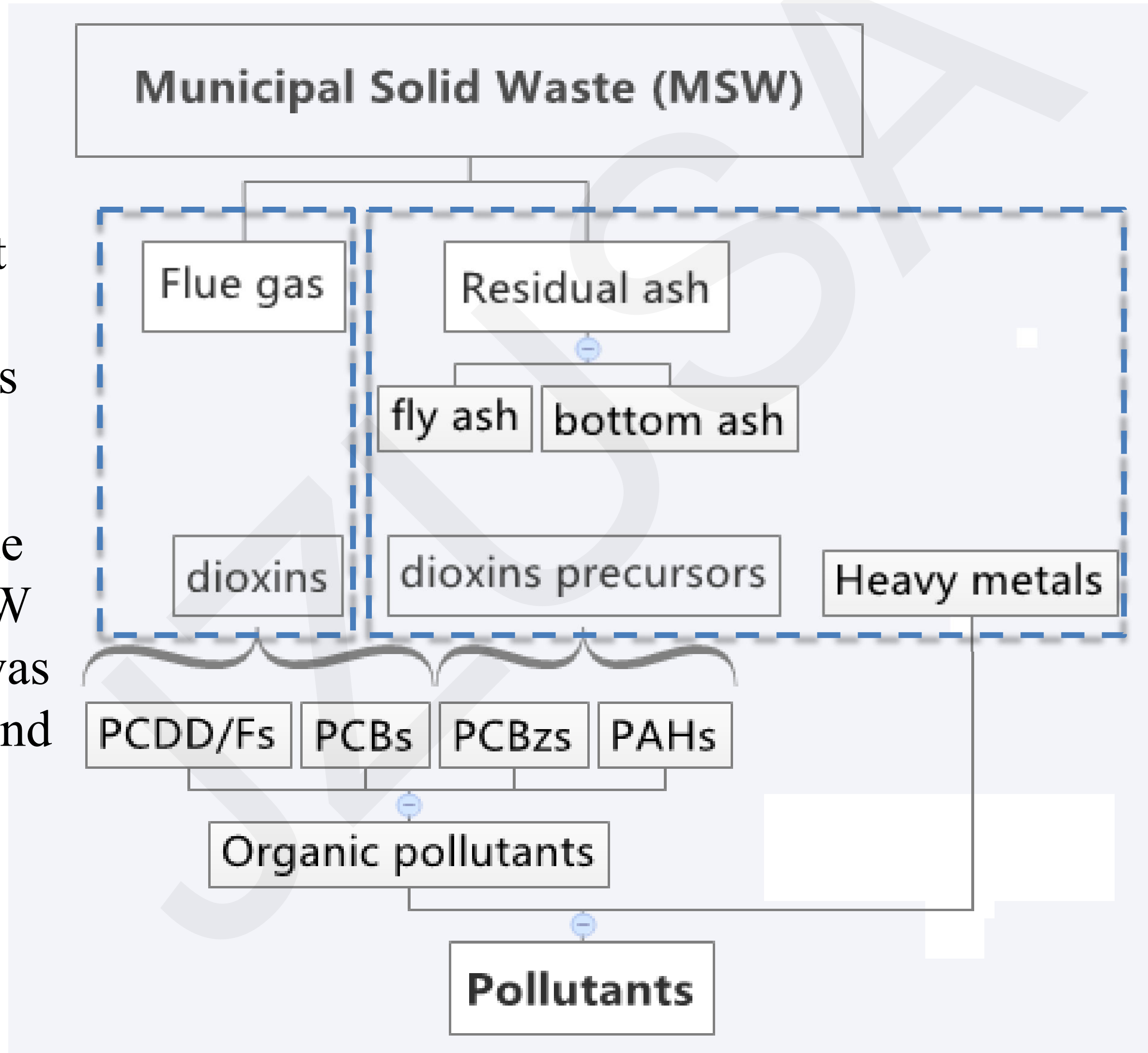
Key words: Residual ash, Poly-chlorobenzenes (PCBzs), Polycyclic aromatic hydrocarbons (PAHs), Heavy metal, Municipal solid waste incineration (MSWI)

Cite this as: Xiao-dong Li, Yong Ren, Sha-sha Ji, Xia-li Hou, Tong Chen, Sheng-yong Lu, Jian-hua Yan, 2015. Emission characteristics of hazardous components in municipal solid waste incinerator residual ash. *Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)*, 16(4):316-325. [doi:10.1631/jzus.A1400142]

BACKGROUND AND RESEARCH PURPOSE

Have got a lot of attentions and researches

Dioxins in flue gas from MSW incinerators was well studied and surveyed.



Lack of attentions and researches

Research purpose in this paper

METHOD

Materials and methods	
Basic characteristics of residual ash	• BET surface analyzer • Energy Dispersive Spectrometer (EDS) • X-Ray Diffraction (XRD)
Poly- chlorobenzenes (PCBzs)	• Gas Chromatography with Electron Capture Detector (GC-ECD)
Polycyclic Aromatic Hydrocarbons (PAHs)	• Gas Chromatography with Mass Spectrometry (GC-MS)
Metals in residual ash	• Microwave Accelerated Reaction System (MARS) • Inductively Coupled Plasma-Atomic Emission Spectometry (ICP-AES)

Research objects

4 Fire grate incinerator + 4 Fluidized bed incinerator

→8 fly ash samples + 3 bottom ash samples

RESULTS AND CONLUSIONS

Sample		Average particle diameter (nm)	BET surface area (m^2/g)	Pore volume (cm^3/g)	Micropore volume (cm^3/g)	Pore size (nm)
Fire grate	FA1	7.07×10^{2}	8.49	9.31×10^{-3}	1.32×10^{-3}	10.67
	FA2	2.99×10^{3}	2.01	4.75×10^{-3}	2.44×10^{-4}	22.74
	FA3	1.42×10^{3}	4.23	6.07×10^{-3}	1.82×10^{-4}	10.14
	FA4	8.60×10^{2}	6.98	1.56×10^{-2}	1.54×10^{-3}	25.69
Fluidized bed	FA5	3.79×10^{3}	1.58	3.42×10^{-3}	9.20×10^{-5}	27.04
	FA6	4.35×10^{3}	1.38	4.35×10^{-3}	1.30×10^{-3}	48.92
	FA7	3.06×10^{3}	1.96	3.60×10^{-3}	4.45×10^{-4}	23.87
	FA8	1.04×10^{3}	5.75	1.82×10^{-2}	7.03×10^{-4}	28.26
Fire grate	BA1	2.38×10^{3}	2.45	6.78×10^{-3}	1.00×10^{-4}	25.91
	BA2	1.80×10^{3}	3.44	9.61×10^{-3}	5.10×10^{-5}	18.41
Fluidized bed	BA3	1.11×10^{3}	0.52	1.38×10^{-3}	1.10×10^{-4}	42.71

Fluidized bed ↕ **Fire grate**

smaller raw waste → smaller bottom ash particles

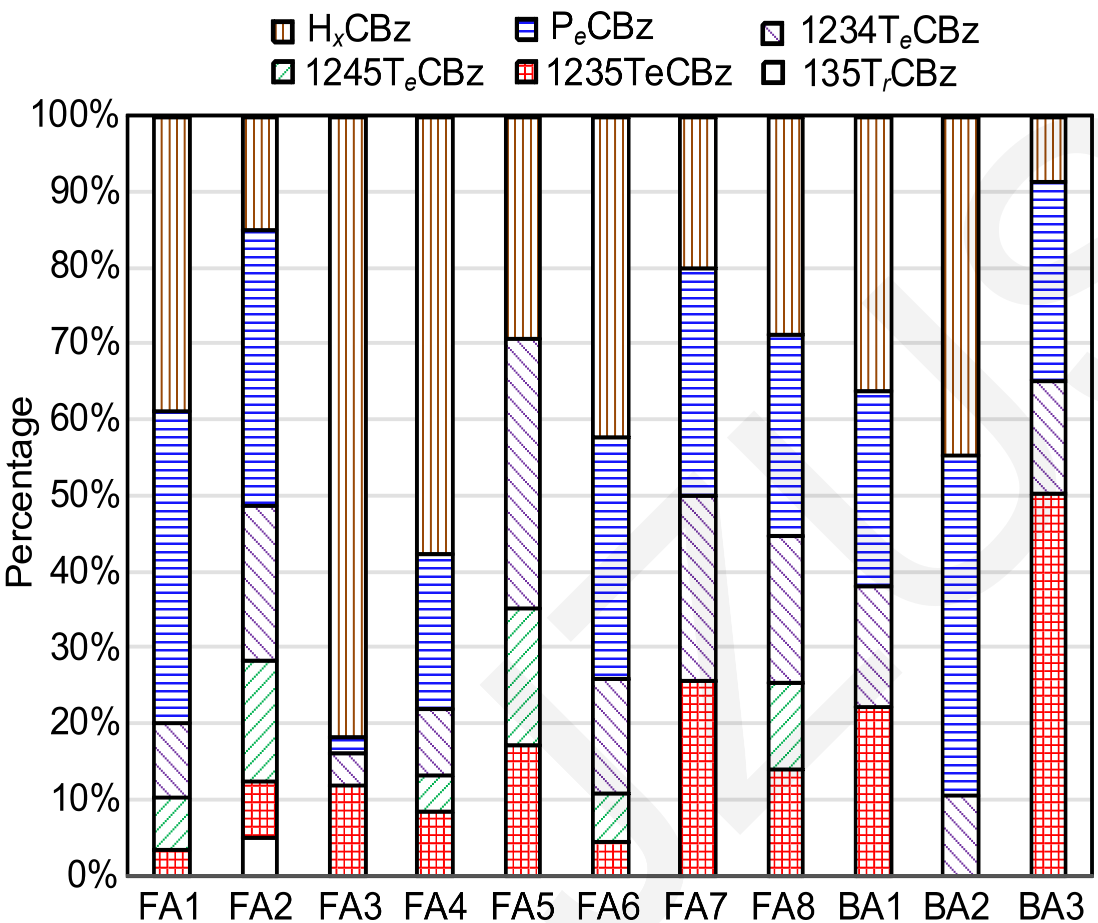
strong fluidization state → larger and heavier fly ash particles

→ rapid release of flammable constituents

more micropore structure

better adaptabilities → smaller discrepancies of same type incinerator

RESULTS AND CONLUSIONS



Distribution of PCBzs (more than three chlorine substituted congeners) in MSWI residual ash samples

FGIs fly ash
→ 7.35 to 357.94 μg/kg
FGIs bottom ash
→2.23 to 2.99 μg/kg

FBIs bottom ash
→6.74 to 96.52 μg/kg
FBIs bottom ash
→2.75 μg/kg

PCBzs in fly ash 25–150 times more than bottom ash

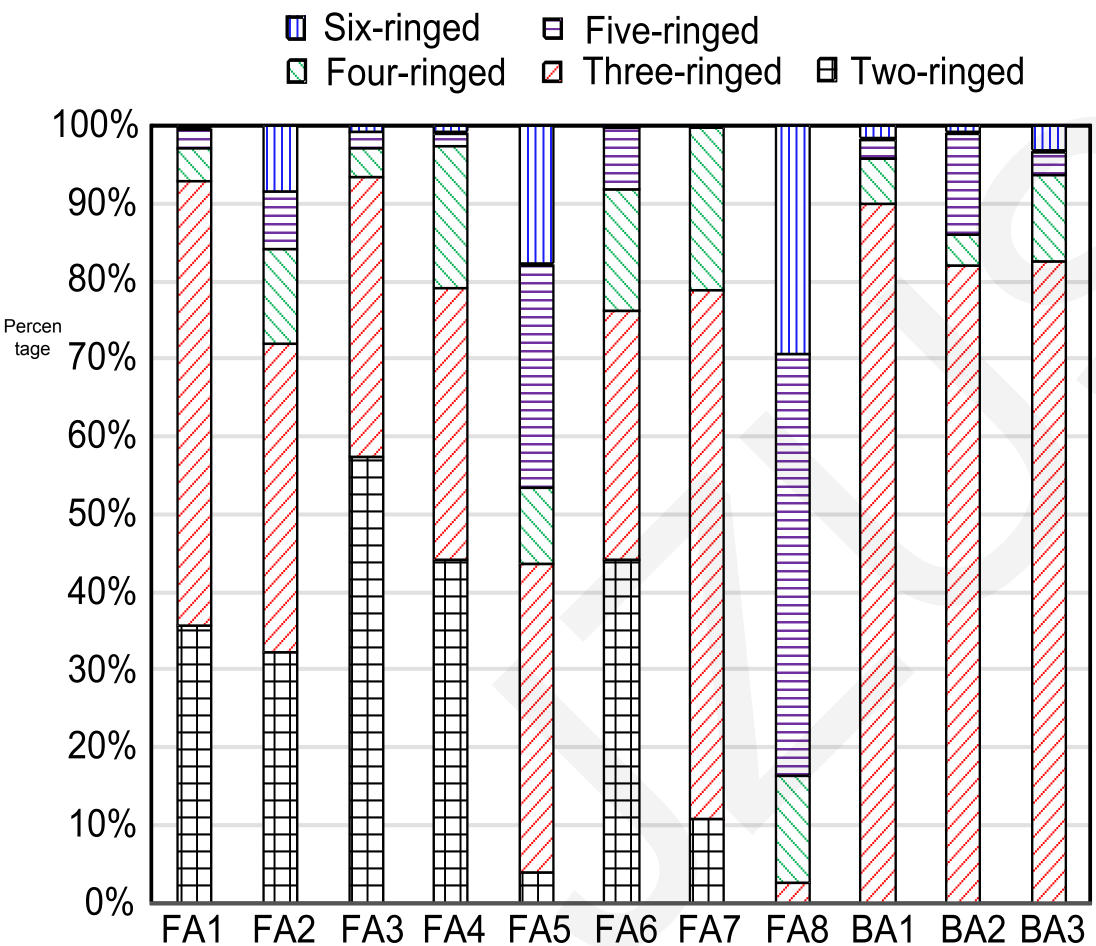
Partial positive correlation with *BET surface area and micropore volume*

Negative partial correlation with *pore size*

H_xCB and P_eCBz →majority of PCBzs

high chlorine-substituted PCBzs easily survive in high temperature, abundant O_2 and strong mixture furnace cavity conditions

RESULTS AND CONLUSIONS



Distribution of different ringed PAHs (2- to 6-ringed PAH) in MSWI residual ash samples

FGIs fly ash
→0.293 to 1.783 mg/kg,
FGI bottom ash
→0.512–1.940 mg/kg

FBIs fly ash
→1.820–38.012 mg/kg
FBIsbottom ash
→0.299 mg/kg

PAHs in fly ash more than bottom ash

FGIs fly ash
→2- and 3-ringed PAHs with majority
FBIs fly ash
→2- and 3-ringed PAHs with majority in FA6 and FA7, rather than FA5 and FA8
bottom ash
→ 3-ringed PAHs with majority, hardly any 2-ringed PAHs

Low boiling point PAHs and high boiling point PCBzs were in the majority in residual ash → PAHs and PCBzs come from different pathways and play different roles

RESULTS AND CONLUSIONS