

EXPERIMENTAL STUDY ON ORGANIC COMPOUNDS EMISSIONS OF PVC COMBUSTION IN FULL-SCALE FLUIDIZED BED

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Introduction

PVC was the most common chlorinated plastics, and is widely used in household application, which was assumed to be the main source of HCl in fires of private houses^[1]. Furthermore PVC presented in waste can form dioxins and other toxic organic compounds during incineration^[2]. Previous research had showed that the present of sulfur dioxide can inhibit dioxins formation and sulfur may sulfonate dioxins precursors, preventing their chlorination, suggested co-firing high sulfur coal with waste to reduce the pollutants emission^[3,4].

In this work, experiment were conducted in pilot-scale fluidized bed combustor. The PAHs and PCDD/Fs emission from PVC combustion and the effect of high sulfur coal(Sad=3.88%) co-firing were studied.

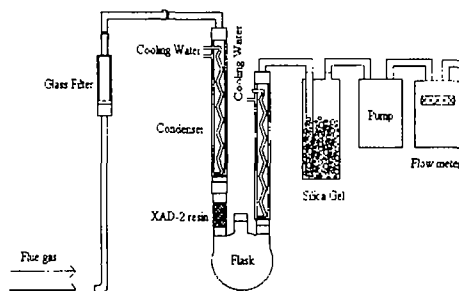
Methods and Materials

Test was run in pilot-scale three stage fluidized bed incinerator (internal diameter 80mm). Table 1 list the operating condition and combustion materials. PVC was obtained from Hangzhou Plastics Industry Company. In run 2 high sulfur coal was co-firing with PVC, S/Cl ratio was 0.35.

Table 1 List of the combustion conditions

No.	Combustion materials ratio		Temperature °C	Air flow m ³ /h
	PVC	Coal		
Run.1	100%	0	800	1.4
Run.2	66.7%	33.3%	800	1.4

Isokinetic sampling was performed. The sampling apparatus ws shown in Fig.1. Analytical procedure for determination of PCDD/Fs was refer to US EPA method 8280B, and PAHs was refer to US EPA method 8270 and 8100.



Results and Discussion

In experiments, 17 kinds of PAHs are qualified and quantified, which are

Fig.1 the sampling train for organic compounds

Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, pyrene, Benzo[a]anthracene, Chrysene, Benzo[b]fluoranthene, Benzo[k]fluoranthene, Benzo[a]pyrene, Benzo[e]pyrene, Indeo[123-c,d]pyrene, Dibenz[a,h]anthracene, Benzo[g,h,i]perylene. Table 2 shows the PAHs emission from the PVC combustion. These results indicated that the unstable alkynes and alkene organics were formed from straight chain and branch chain aliphatic compounds. Most organics were destroyed and formed CO₂ and H₂O, however, some of them formed more stable compounds at high temperature, such as aromatic compounds. PVC can lead long train alkenes cyclization through a dechlorine reaction, and generate aromatic compounds.

Table 3 The concentration of 17 PAHs during PVC combustion(ug/Nm³)

PAHs	PVC	PVC+Coal
Naphthalene	18.47091	43.06515
Acenaphthylene	17.56192	41.57258
Acenaphthene	17.2434	42.47067
Fluorene	11.09748	28.20632
Phenanthrene	27.01856	52.49793
Anthracene	18.78977	42.08875
Fluoranthene	6.378328	9.913351
Pyrene	8.354174	12.61213
Benzo[a]anthracene	20.39813	58.04868
Chrysene	34.87353	52.70927
Benzo[b]fluoranthene	40.19176	90.87729
Benzo[k]fluoranthene	38.75984	96.18665
Benzo[a]pyrene	33.41029	80.7149
Benzo[e]pyrene	27.83603	65.04412
Indeo[123-c,d]pyrene	38.28934	90.91246
Dibenz[a,h]anthracene	39.16498	93.28554
Benzo[g,h,i]perylene	39.05111	94.70791

In high sulfur coal co-firing condition, PAHs in flue gas were increased respectively. The increased PAHs comes from combustion of coal. Adding coal can promote the formation of aromatic compounds.

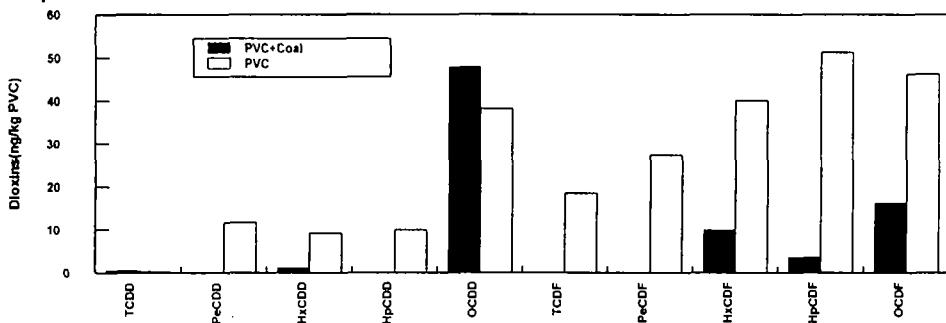


Fig.2 the formation of PCDD/Fs in PVC incineration

In the test, more PCDD/Fs were formed in PVC combustion than PVC and high sulfur coal co-firing incineration(Fig.2) In PVC combustion, 271.15ng/kgPVC (4.5998ng I-TEQ/kgPVC) were generated 。 However in co-firing combustion, 87.7562ng/kgPVC(为 2.40854ng I-TEQ/kgPVC) were formed. The total dioxin emissions cut down 68%, and I-TEQ emission

ORGANOHALOGEN COMPOUNDS

reduce nearly 50%.

Conclusion

1. PVC can lead long train alkenes cyclization through a dechlorine reaction, and generate aromatic compounds in high temperature combustion.
2. Co-firing high sulfur coal in PVC combustion can promote to produce PAHs.
3. Adding high sulfur coal in PVC combustion can decrease emission of PCDD/Fs.

Acknowledgments

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