

NOTE

Characterization of Incineration Ash for Possible PCB Congeners

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Abstract

PCBs are considered environmental pollutants because of their toxicity, their ability to accumulate in living organisms and their existence in the environment. They produce lethality, reproductive toxicity, immuno toxicity in human beings. So to get prevented from these effects it has become essential to determine the PCBs in various environmental systems. Among waste treatment methods incineration seems to be a relatively inexpensive, more flexible and reliable technology as compared to composting. A large variety of halogenated polycyclic aromatic compounds have been identified in the emission from municipal solid waste (MSW) incinerators. PCBs have been identified in fly ash and in flue gas from MSW incinerators. Although PCBs are present in lesser extent in waste, but they could also be formed by dimerization of polychlorinated benzene (PCBs) during combustion. The paper describes the methodology used for extraction and clean up. It is observed that sonication is one of the best techniques for extraction. Different solvents are also used to study the extraction efficiency. The concentration of PCBs in ash is low as the incinerated ash used was generated in NEERI campus.

Key words : PCBs, GCMs, Ash, Characterization.

One of the most effective means of dealing with many wastes to reduce its harmful potential on the earth and often to convert it to an energy form, is incineration. The increased application of municipal solid waste (MSW) has posed a problem for air pollution from these incinerators and potential secondary pollution from leaching of toxic components from incinerator fly ash. During the last decade numerous analytical investigations have shown that both fly ash and gaseous emissions from waste incinerators may introduce several undesirable compounds into the environment. Polychlorinated biphenyl's (PCBs) are some such pollutants (1). These substances usually come into the environment at trace levels, but owing to their lipophilic nature and capability to persist, they may bioaccumulate in the biota and expose man through diet to much higher levels than those experienced by direct exposure to the surrounding environment (2,3). The PCBs enter the environment by the disposal of industrial fluids into rivers and coastal waters and by volatilization in the atmosphere from incineration of PCB containing material at dumps (4). For various reasons at least some isomers of the PCBs are a general health risk. For a reasonable calculation of this risk the sources of these compounds,

their distribution in the environment and their fate must be known as accurately as possible (5).

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Ash sample was collected from the NEERI incineration plant. After proper drying and cleaning 10 g sample was taken in two 100 ml beakers. PCB standard of eight compounds (2-CB, 2,2'-DCB, 2,4,4'-TCB, 2,2',5,5'-TCB, 2,2',3,3',5,5',6-HCB, 2,2',3,3',4,5,5',6-OCB, 2,2',3,3',4,4',5,5',6-NCB) having concentration 1 ppm was spiked (100 µl) in two samples. In one beaker cyclohexane was added and in another beaker isooctane was added. It was sonicated with heating so that the PCBs should get mixed (100 µl) in two samples. In one beaker cyclohexane was added and in another beaker isooctane was added. It was sonicated with heating so that the PCBs should get mixed properly in the ash. The ash sample was dried and again 20 ml of cyclohexane and isooctane was added to the two breakers and sonicated in the ice bath for 15 min; 24 hours contact time was given. It was sonicated and filtered through Whatman filter paper 41 and it was cleaned up with florisil column to remove the interferences. The extract was concentrated on

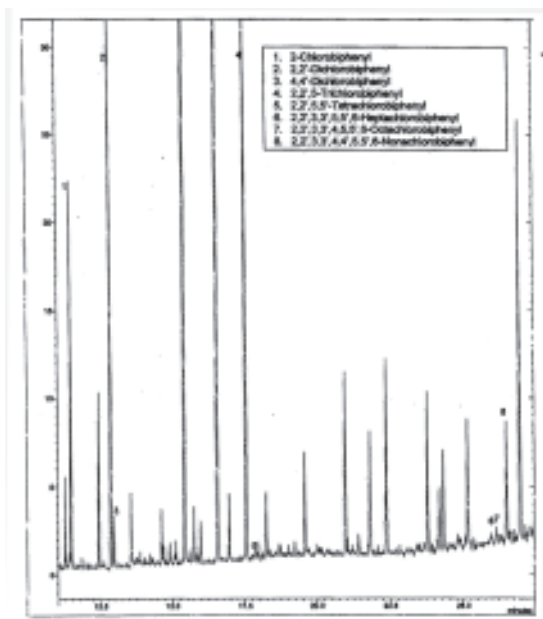


Figure 1. Chromatogram showing spiked biphenyl's in ash samples and extracted in isooctane.

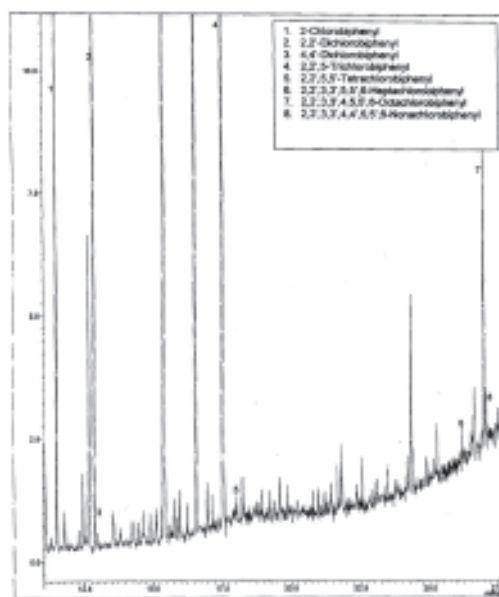


Figure 2. Chromatogram showing spiked biphenyl's in ash samples and extracted in cyclohexane.

the flash evaporator to make up the volume to 0.5 ml. Ash sample was taken in two more beakers and the same method was adopted by using isooctane and cyclohexane as a solvent but without spiking PCB standard. The analysis was done on GC-MS. Extract was analyzed on DB-5 column 30 m long, 0.25 mm i.d., 0.25 μ film thickness; 0.5 μ l of the sample was injected into GCMS keeping all the parameters of GCMS according to EPA method 525.2.

Figures 1 and 2 show the reconstructed total ion chromatogram (RTIC) for ash sample, which were extracted in isooctane and cyclohexane, respectively. It can be pointed out that the selectivity and the sensitivity for each PCB congener differs due to selectivity

of the particular solvent. Lower side of PCBs i.e. having less chloro-atoms extracts more in both the solvents than higher side of PCBs. Table 1 gives the extraction efficiency of the isooctane and cyclohexane solvents. It reveals that the extraction efficiency of the isooctane is more than the cyclohexane.

But other solvents can also be tried which will have the better extraction efficiency to detect the femtogram of analyte present in the samples. The experiments are in progress. It was also been experimented that rod type sonication system is much more efficient than other techniques used for extraction. Other extraction techniques need more solvent (100–500 ml) which is costly. Time consumed for these tech-

Table 1. Extraction efficiency of isooctane and cyclohexane solvents for PCBs in incinerated ash.

Compound	Solvent isooctane		Percent recovery	Solvent cyclohexane		Percent recovery
	Blank	Spiked		Blank	Spiked	
2-chlorobiphenyl	0.025	0.419	64.26	0.014	0.298	45.70
2,2'-dichlorobiphenyl	0.047	0.622	92.14	0.024	0.502	74.37
4,4'-dichlorobiphenyl	0.051	0.701	91.99	0.034	0.645	85.82
2,4,4'-trichlorobiphenyl	–	0.542	76.44	–	0.297	41.88
2,2',5,5'-tetrachlorobiphenyl	0.037	0.728	90.6	0.014	0.589	72.97
2,2',3,3',5,5', 6-heptachlorobiphenyl	–	0.482	71.72	–	0.328	48.80
2,2',3,3',4,5,5', 6-octachlorobiphenyl	–	0.422	62.67	–	0.362	53.70
2,2',3,3', 4,4',5,5',6-nonachlorobiphenyl	–	0.345	47.00	–	0.269	36.64

niques is also more and needs operators attention continuously. While sonication technique needs less solvent (5—10 ml) and needs no attention of the operator. It is also easy for operation.

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