

ANALYSIS OF PBDEs USING HRGC-HRMS AND THEIR CONGENER PROFILE IN NEARBY SOILS FROM INDUSTRIAL COMPLEX

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Abstract

Soil samples were taken from a nearby arable lands of industrial complex(Ulsan & Sihwa) used Polybrominated diphenyl ethers (PBDEs) as flame-retardant chemicals in Korea. The soil sample were analyzed to determine the concentrations and congener distribution of PBDEs using HRGC-HRMS. The sum levels of PBDEs(BDE-28, BDE-47, BDE-99, BDE-100, BDE-153, BDE-154, BDE-183) was 5~13ng/g dry wt. BDE-47 was dominant congener, with a mean contribution of about 70% .

Introduction

Polybrominated diphenyl ethers (PBDEs) are flame-retardant chemicals that are added to plastics and foam products to make them difficult to burn. There are different kinds of PBDEs, some have only a few bromine atoms attached, while some have as many as ten bromine attached to the central molecule¹. PBDEs is of potential for endocrine disruption, bioaccumulation and contamination in air, soil, water, sediment and human tissues^{5,6}. In Korea, the domestic use of BFRs have increasing 10% per year during the last decade in field of electronic industry, but the data on the detailed profiles of PBDEs in the nearby environment of industrial complex were lacking, especially, in arable lands. In this study, we have investigated on the effects of PBDEs in nearby cultural soils of industrial complex .

Table 1. Amount used of PBDEs at the major industrial complex in Korea(2002, Ministry of Environment)

Industrial complex	Amount used(ton)
Ulsan	2510
Sihwa	635.5
Banweol	103.2
Gumi	188.5

Materials and Methods

Soil samples were taken from a nearby arable lands of industrial complex(Ulsan & Sihwa) used PBDEs as flame-retardant chemicals. The samples were extracted with soxhlet using hexane for 16 hours. Extracts were subjected to a sequential cleanup using multi-layered silica column(2% KOH, 44%, 22% H₂SO₄, AgNO₃ silica)⁵. Quantification and identification of PBDEs were performed with the Finnigan mat. 95XL HRGC-HRMS system fixed DB-5MS (15m×0.25ml×0.25μm). The HRGC-HRMS program for PBDEs was operated in electron impact ionization(EI) mode at a resolution of more than 10,000 using multiple ion detection(MID)^{2,3,4}. The native(7 compounds) and ¹³C-labeled standards(7 compounds) of PBDEs were used for preliminary calibration purpose. Relative response factor (RRF) was calculated by five different level of native standard concentrations.

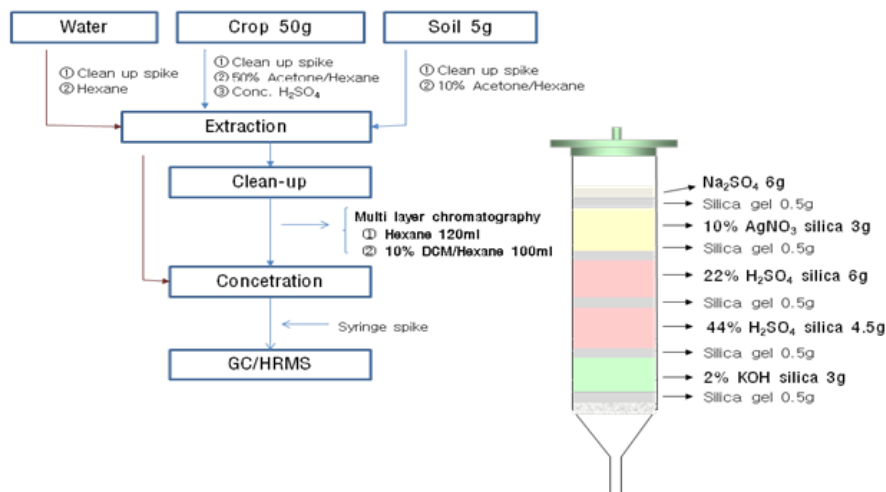


Fig. 1. Scheme for the clean-up using multi-layer silica column

Results and Discussion

PBDEs level and congener profile of soil samples collected in Ulsan(n=9) and Sihwa(n=9) industrial complex were determined by using HRGC/HRMS with ^{13}C -labeled surrogated standards(BDE-77, BDE-126) for PBDEs 7 congeners(BDE-28, BDE-47, BDE-99, BDE-100, BDE-153, BDE-154, BDE-183). The results in ng/g dry wt of two areas soils showed similar analytical level and congener profile. The sum levels of PBDEs 7 congeners were 5~13ng/g dry wt. BDE-47 was the dominant congener, with a mean contribution of about 70% .

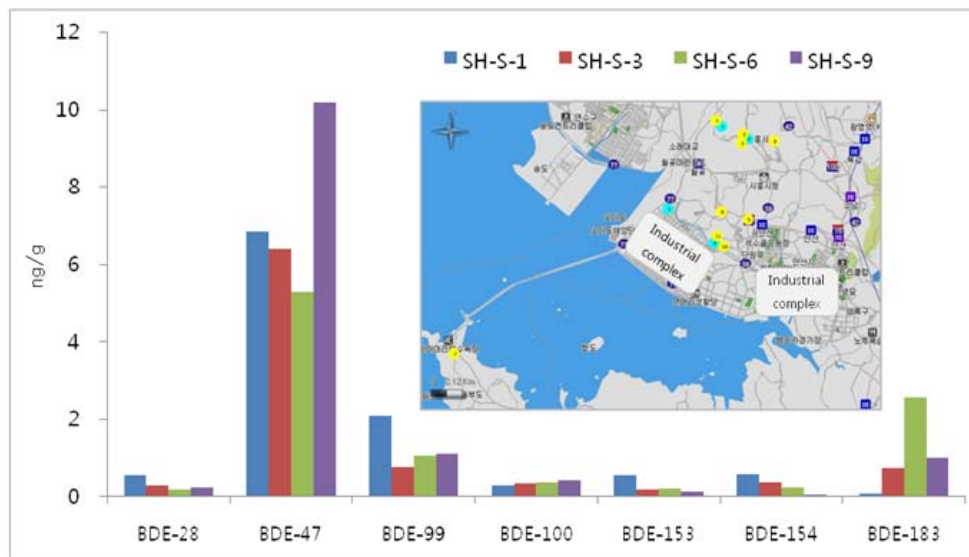


Fig. 2. PBDEs level and congener profile in a nearby cultural soils from Sihwa industrial complex

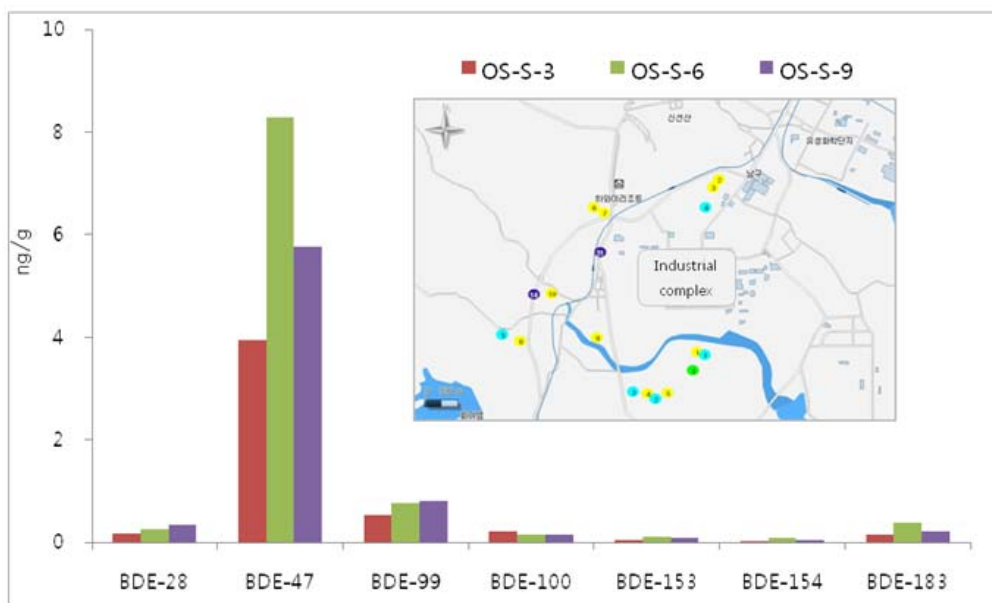


Fig. 3. PBDEs level and congener profile in a nearby cultural soils from Ulsan industrial complex

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