

Registration form for participation in the 1st and 2nd round of inter-laboratory study for the determination of POP-BFRs in plastic waste.

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Introduction: Our group is undertaking a research project focused on POP-BFRs in end-of-life plastic products. Part of the goal of this project is to develop and promulgate a simple, quantitative method based on gas chromatography–mass spectrometry (GC/MS) or gas chromatography – electron capture detector (GC/ECD) for determination of the contents of BFRs in plastic waste. It is expected that the method will facilitate implementation of the Low POP Content (LPC) provisions of the Basel Convention. The first step of this project was to conduct a round of inter-laboratory comparisons of quantitative analyses of polybrominated diphenyl ethers (PBDEs) and hexabromocyclododecanes (HBCDs). The aim of this study was to evaluate the accuracy of the simplified method that we proposed and to promulgate the method as widely as possible to facilitate the proper management of plastic waste containing POP-BFRs. In this study, we report the results of the inter-laboratory study conducted in FY 2019 and FY 2020 for the determination of POP-BFRs in plastic wastes.

Materials and Methods: The 1st round consisted of 6 samples (one mix standard (STD) solution and two plastic extracts containing POP-BFRs), and the 2nd round consisted of 5 samples (four types of plastic fragments containing POP-BFRs and one extract of automobile shredder residue (ASR))(Fig.1). In addition to the usual in-house methods used by each laboratory, we asked each laboratory to conduct the assay by the simplified analytical method developed by our group. The number of participating institutions in the 1st round was 35, and 26 in the 2nd round.



Fig. 1 Distribution samples

Results and Discussions: The statistical analysis results of the inter-laboratory study are shown in Table 1.

Summary of the 1st round results: For PBDEs, both the in-house method and the simplified method showed large variations in mix STD solution, but the in-house method and the simplified method showed good results in the extracts of POP-BFRs in plastic wastes. For HBCDs, the in-house method showed good results, but the simplified method showed a large variation. It was indicating that the measurement sensitivity may be insufficient depending on the manufacturer and model of the measurement device.

Summary of the 2nd round results: For PBDEs, the analytical values were generally consistent between the in-house method and the simplified method, although there was a larger variation comparing with the 1st round. The results of HBCDs were also similar to PBDEs, confirming the reliability of the simplified method, which had been an issue in the 1st round.

Table 1 Statistical analysis results of the inter-laboratory study (Upper:1st round, Lower:2nd round)

Sample names	Compounds	In-house method			Simplified method		
		Average (µg/mL) *	STDEV (µg/mL) *	CV%	Average (µg/mL) *	STDEV (µg/mL) *	CV%
No.1: PBDE mix STD solution							
	PBDEs	0.283	0.135	47.7	0.306	0.145	47.5
No.2: Extracts of PBDE containing plastic-Low							
	PBDEs	53.4	6.93	13.0	56.8	10.2	18.0
No.3: Extracts of PBDE containing plastic-High							
	PBDEs	1095	183	16.7	1057	213	20.2
No.4 : HBCD mix STD solution							
	HBCDs	0.149	0.0205	13.8	0.131	0.0571	45.0
No.5 : Extracts of HBCD containing plastic-Low							
	HBCDs	72.8	13.8	18.9	63.4	16.4	26.5
No.6 : Extracts of HBCD containing plastic-High							
	HBCDs	1056	173	16.3	1053	322	31.4
Sample names	Compounds	in-house method			Simplified method		
		Average (mg/g) *	STDEV (mg/g) *	CV%	Average (mg/g) *	STDEV (mg/g) *	CV%
No.1: Sample pieces of TV casing							
	PBDEs	111	34.1	30.5	116	29.1	25.2
No.2: Sample pieces of Textile							
	PBDEs	39.6	12.2	30.9	41.2	12.1	29.4
No.3: Sample pieces of EPS							
	HBCDs	4.36	1.67	38.4	4.26	1.29	30.3
No.4: Sample pieces of XPS							
	HBCDs	22.4	8.12	36.3	24.3	7.37	30.3
No.5: Extract of ASR							
	PBDEs	321	111	34.7	283	74.6	26.4
	HBCDs	117	45.3	38.6	105	30.9	29.3

*) No.5:µg/mL

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