

DETERMINATION OF ATMOSPHERIC CHLOROBENZENES BY PASSIVE SAMPLING METHOD

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Introduction

Various methods for determination of atmospheric chlorobenzenes have ever been developed by other researchers^{1,2}. They are the active sampling method (active method) which use electric pump for sampling. However, because active method requires pump, flow meter, and other devices, it is inadequate for simultaneous sampling in many sites. On the other hand, passive sampling method (passive method) is based on molecular diffusion phenomenon of substance, so it does not need electric source. In this study, the determination of atmospheric chlorobenzenes by passive method was examined for the purpose of comprehending the state of environmental pollution in most sites and evaluating the environmental impact.

Materials and Method

A. Measuring procedure of ambient air sample

Passive method

As the diffusive sampler for passive method, VOC-TD (Sigma-Aldrich Co.) was used. It was placed on a level with air suction port in active method (about 1m above the ground). Ambient air sample was collected for 24 hours by applying molecular diffusion phenomenon. After sampling, adsorbent packing in the diffusive sampler was transferred into the vacant tube, and then silica wool was packed to both end of adsorbent. So this prepared tube was used for analysis.

Active method

The device which consists of flow controller, pump and flow meter was used. Sampling tubes were prepared by packing adsorbent (Carbopack B (60-80mesh), Sigma-Aldrich Co.) and silica wool into vacant tubes (6.3mm (O.D.) × 89mm (L), Perkin-Elmer Co.). Prepared tube was attached to the device. Ambient air sample was collected for 24 hours at the rate of 100mL per minute with a pump.

The target compounds were determined and analyzed by thermal desorption system and GC/MS.

B. Calculational procedure of uptake rate

$$UR = W / CT$$

UR: uptake rate (ng / ppb / h)

W: collection amount in passive method (ng)

C: ambient air concentration in active method (ppb)

T: sampling time (h)

Results and discussions

A. Uptake rate of chlorobenzenes

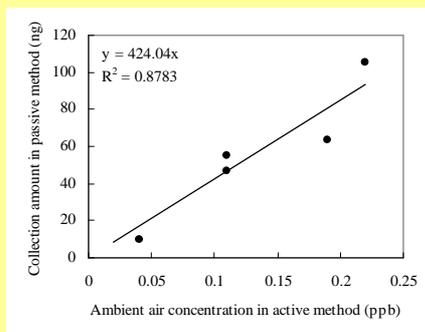


Fig. 1 The relationship between collection amount in passive method and ambient air concentration in active method (p-dichlorobenzene)

Table 3 Uptake rate and correlation coefficient

	UR (ng/ppb/h)	R ²
monochlorobenzene	19.8	0.740
<i>o</i> -dichlorobenzene	14.9	0.776
<i>p</i> -dichlorobenzene	17.7	0.878

Passive method had a high correlation with active method.

B. Variation of measured values

Table 4 Variation of measured values (n=5)

	Average concentration (µg/m ³)	SD	CV (%)
monochlorobenzene	0.015	0.0017	12
<i>o</i> -dichlorobenzene	0.020	0.0024	12
<i>p</i> -dichlorobenzene	1.3	0.10	7.7

The diffusive samplers were reliable.

C. Ambient air sampling

Table 5 Measurements of ambient air by using passive method

	Measurements of ambient air by using passive method		Previous nationwide measurements ³ by using active method	
	Concentration range (µg/m ³)	Detection limit (µg/m ³)	Concentration range (µg/m ³)	Detection limit (µg/m ³)
monochlorobenzene	0.013 - 0.029	0.0050	ND - 0.16	0.020
<i>o</i> -dichlorobenzene	0.017 - 0.040	0.0030	ND - 2.2	0.015
<i>p</i> -dichlorobenzene	0.70 - 1.8	0.0030	ND - 17	0.13

The concentrations of chlorobenzenes were within the nationwide measurements.

References

- Barro, R., Ares, S., Garcia-Jares, C., Llompart, M., Cela, R., 2004, Development of a Sensitive Methodology for the Analysis of Chlorobenzenes in Air by Combination of Solid-phase Extraction and Headspace Solid-phase Microextraction, *J. Chromatogr. A.*, 1045(1), 189-196
- Abe, Y., Tanimoto, T., Yokoya, M., Nakano, T., 2008, Analysis of Chlorobenzenes in Ambient Air by Thermal Desorption Method, 17th Symposium on Environmental Chemistry, 112-113
- Ministry of the Environment, Japan, 2010, Chemicals in the Environment