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A newly-devised automatic and continuous system to monitor chlorobenzenes in the exhaust gas at an MSW incineration plant

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Abstract

A newly-devised automatic and continuous system to monitor chlorobenzenes (CBs) in the exhaust gas at an MSW (Municipal Solid Waste) incineration plant has been developed. An experiment was set up for ten days at an MSW incineration plant in Japan. The features in this system are that a) the sampling gas is concentrated at low temperature in a *Tenax* tube and b) the volume of the sampling gas is only 250 ml. Since a large amount of chlorobenzene (M1CB) is detected under this measurement condition, M1CB is detected easily and precisely. The concentration of M1CB might be correlated with that of PCDD/PCDFs and so this system will be an important on-line measurement technique to estimate these toxic chemicals.

Introduction

Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDDs and PCDFs) are toxic chemicals and so it is important to control these compounds at an operating MSW incineration plant. Recently it has been necessary to employ a continuous-monitoring system of PCDD / PCDFs in the exhaust gas[1], but the concentration of PCDD/PCDFs is so low that the measurement itself is very difficult.

The exhaust gas contains chlorobenzenes (CBs), chlorinated aromatic compounds, in addition to PCDD/PCDFs. The concentration of CBs seems to be highly correlated with that of PCDD/PCDFs[2,3] and also CBs are 100 ~ 1000 times higher in content than PCDD/PCDFs in the exhaust gas. The monitoring procedure of CBs is simpler than that of PCDD/PCDFs, while with the conventional method it takes a lot of time to determine the CBs content and also only the spot data can be measured.

The authors have developed a prototype of an automatic and continuous system to monitor CBs in the exhaust gas in order to overcome these problems. In this paper this system is illustrated and the results tested at an operating MSW incineration plant are mentioned.

Experimental Methods

1. Automatic and continuous analyzing system of CBs

The automatic and continuous monitoring system is shown in Figure 1. This system has two filters to remove dusts in the exhaust gas. The sampling gas is concentrated in the tube

packed with a *Tenax* for 10 minutes. This tube is kept at low temperature during sampling and then is heated up to 300℃. The concentrated sampling gas in the tube is moved to the cold trap in the GC. Finally the concentrated gas is injected into the GC and CBs are determined by using ECD.

The analytical condition of GC/ECD is listed in Table 1. In this system an electric dehumidifier is not necessary due to the fact that the volume of the sampling gas is only 250 ml using ECD.

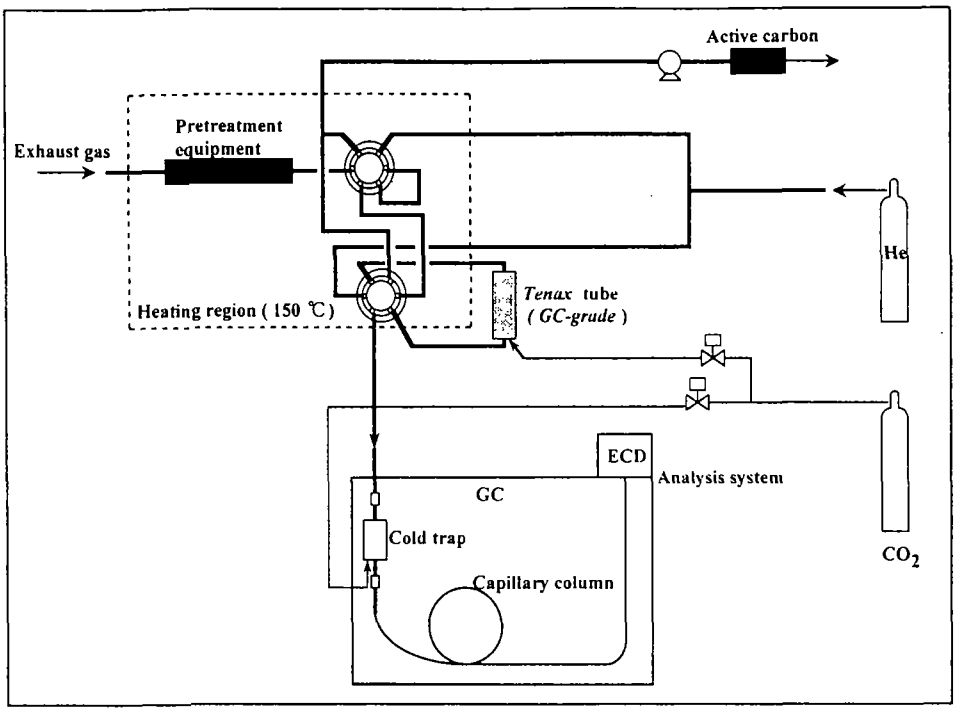

Figure 1: The schematic diagram of the automatic and continuous analyzing system

Table 1 GC/ECD condition

Instrument	HP 5890
Column	SPB-5 50 m X 0.25 mm X 0.25 μm
Detector	ECD
Column Temp.	60℃ 5℃/min. 100℃ (2 min. hold) 10℃/min. 300℃ (20 min. hold)
Carrier Gas	He 1.5 ml/min.

2. Test at an operating MSW incineration plant

The automatic and continuous monitoring system was set and tested at an operating MSW incineration plant. The sampling point was at the outlet of the bag filter in the MSW incineration plant. The exhaust gas was collected in a Teflon tube (8 ϕ X 20 m) heated at 150℃ and the sampling gas was transferred into the monitoring system. The measurement of CBs was carried out once an hour for 19 hours with the automatic and continuous system.

Result and discussion

The concentration of M1CB is shown in Figure 2. The characteristic of the measurement condition in this system is that a) the sampling gas is concentrated at low temperature in a *Tenax* tube and b) the volume of the sampling gas is only 250 ml. This measurement condition is able to detect no less than 20 ~ 60 μg/m3 of M1CB. This amount is about 100 times higher than the sampling at room temperature.

The key parameter here is the sampling temperature. The analytical procedure to concentrate the sampling gas at low temperature is important to detect low boiling point compounds similar to M1CB. The continuous monitoring of M1CB is easy by controlling the sampling condition at low temperature. Some workers have reported that the concentration of pentachlorobenzene is correlated with that of PCDD/PCDFs[3], and that the sum of tri-hexachlorobenzenes is also correlated with that of PCDD/PCDFs[4]. However, there has never been any published research showing that the concentration of M1CB is correlated with that of PCDD/PCDFs. If M1CB is a good indicator of PCDD/PCDFs, the newly-devised automatic and continuous monitoring system will be an effective and convenient technique to monitor PCDD/PCDFs in the exhaust gas at MSW incineration plant.

Conclusions

1. An automatic and continuous system to monitor chlorobenzenes in the exhaust gas at an MSW incineration plant has been developed and tested at an operating MSW incineration plant. This system will be an important on-line measurement technique to analyze PCDD/PCDFs, provided that the concentration of chlorobenzene correlates with that of these toxic chemicals.

2. The features in this automatic and continuous system are that a) the sampling gas is concentrated at low temperature in *Tenax* tube and b) the volume of the sampling gas is only 250 ml.

3. A large amount of chlorobenzene can be easily and precisely determined.

4. Chlorobenzene was detected about 100 times higher in the sampling at low temperature than at room temperature.

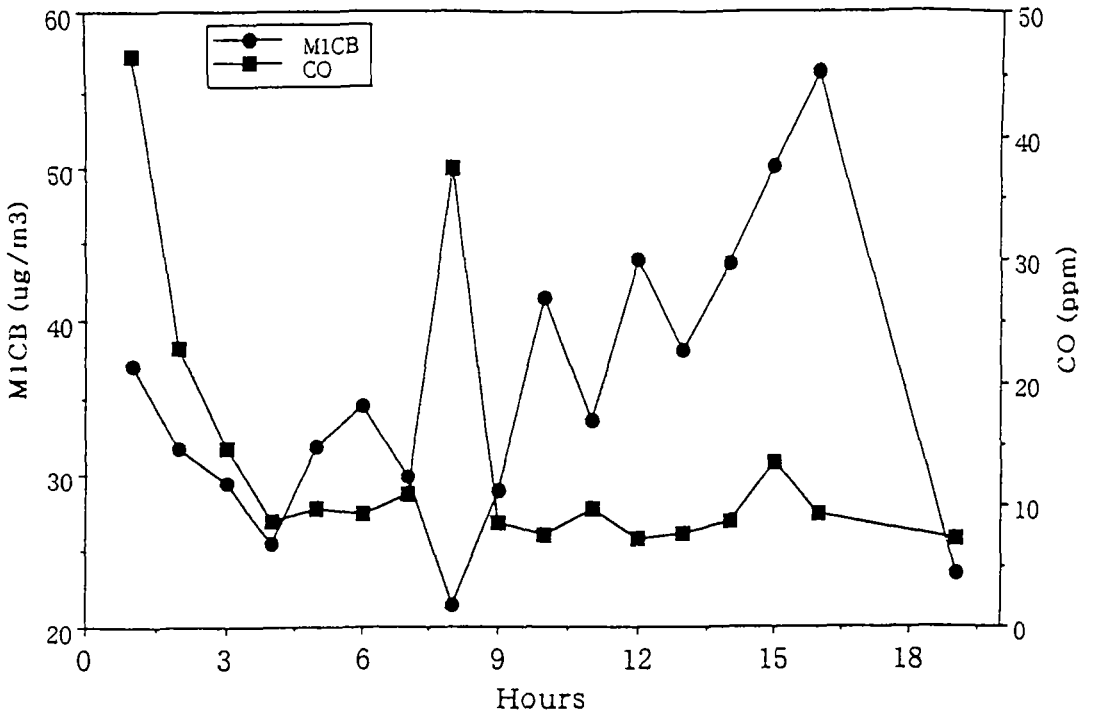

Figure 2 : The concentration of M1CB and CO gas

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