THE RESEARCH ON THE GENERATION CONTROL OF DIOXINES FROM THE SMALL INCINERATOR

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Introduction

Recently, the quantity of a waste discharged from the medical institution increases, since the medical device becomes disposable. These medical wastes were incinerated by the small incinerator in the hospital. However, the generation of dioxines by the incineration of a waste became a problem, and the incineration in the hospital by the small incinerator became difficult. Therefore, the processing of the medical waste is entrusted to the special traders at present. Processing commission of the medical waste was expensive and oppressed the hospital management. In addition, it became a cause of the illegal dumping of medical waste.

It is considered that small organic substances such as dioxins arise by the chlorination of incomplete combustion in the burning process, heat recovery, gas cooling process and exhaust gas treatment process. Therefore, "complete burning" is considered the priority in the control of dioxins in incineration processing. Though complete burning technology is common in a large furnace, the technology that burns completely in a small furnace has not yet been established. The generation of dioxines in the burning process is explained by two mechanisms. One is the generation of the dioxines which go through pre- bodies such as chlorobenzene in 500-700 degree high-temperature range. Another one is the generation of dioxines by catalytic reaction of the metal in fly ash at 300-500 degree low temperature range. The waste must be burn completely for the generation control of dioxines in such burning process.

Generally, conditions for achieving complete burning are as follows: 1) High combustion gas temperature 2) Residence time of the gas and 3) Turbulence and secondary air inside of the furnace [1]. This is called "3-T". These conditions need to be met in order to reduce unburned hydrocarbon and precursor material in combustion gas. In this study, new combustion which combines steam injection with rotational flow as a method for achieving these conditions is tried, with the aim of realization of complete burning in a small incinerator. Not only could it be used more efficiently by small and medium sized companies, should such an incinerator be realized, but also it would be able to greatly contribute to environmental preservation.

The purpose of this study is the development of the incinerator of the medical waste which can suppress the generation of dioxines using radiant heat by fuel burning. The incinerator of the medical waste for the experiment was produced, and the experiment was carried out by the incineration of the trial medical waste. The measuring result of the inside of furnace temperature and exhaust gas components such as dioxines on the incinerator of the medical waste for the experiment is reported.

Methods and Materials

The outline of the incinerator used in this study is according to the following. To begin with, fuel such as the firewood is made to burn in the fuel incineration room. Using the radiant heat in the combustion, medical waste of plastic material put under the fuel incineration room is gasified. By the burn of the gas, it is maintained over 800 degree at the inside of furnace temperature, and inside of furnace becomes the complete combustion atmosphere, and the generation of dioxines is suppressed. Figure 1 is the experimental set-up.

The combustion test was carried out using trial medical waste in order to evaluate the incinerator. In this examination, injector, needle and PVC tube of mixing ratio shown in table of 1 were made to be trial medical waste, and it was used as combustion test. The trial medical waste was put into medical waste safety box utilized in actual medical institution to about 80%, and the weight (g) was measured. Then, the bulk specific gravity was calculated from the weight of medical waste per safety box unit capacity. As the result, the bulk specific gravity was calculated with 0.072. This capacity was multiplied by bulk specific gravity (0.072), because the capacity of medical waste insertion box in the incineration road developed in this study is 40L, and whole quantity of the trial medical waste used as a test was calculated with 2880g. PVC was mixed in the trial medical waste, because the thing made of PVC was included for the medical device of the plastic material.

Fire wood was used by the fuel for the combustion in this examination. 8 points that were shown by figure 1 and tables 2 were measured the temperature. The exhaust gas was measured the concentration of material (CO、H_2、O_2、SO_2、NO、NO_2、NO_x) and the concentration of dioxines. The still, temperature recorder for the thermometry NR-1000 (Keyence Co.) was used for recording temperature. The exhaust gas was measured by the portable flue gas analyzer testo350XL (testo Co.) that was installed in the place by shown in figure 1.

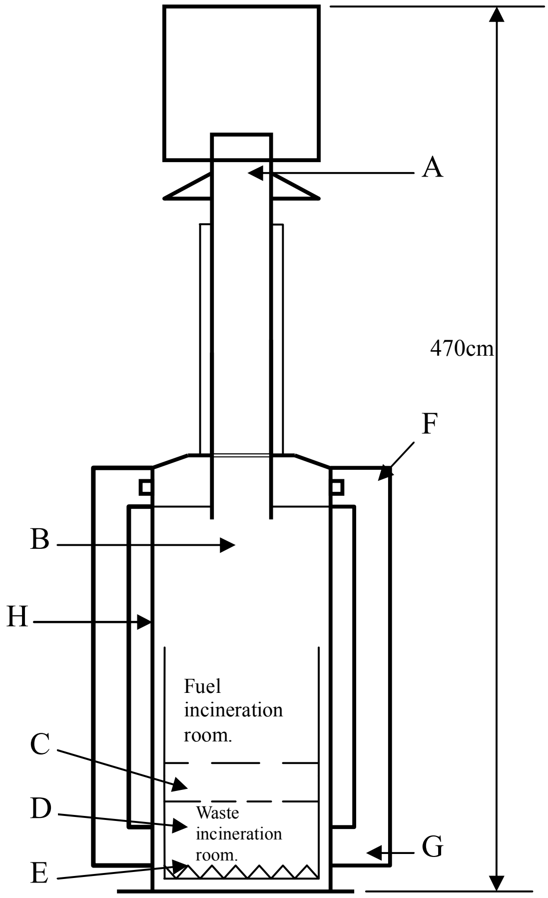

Fig. 1 Experimental set-up

Table. 1 Composition breakdown of the trial medical waste.

trial medical waste	PVC (%)	Injector and needle(g)	PVC (g)	Total weight (g)
Sample-1	0.5	2875.6	14.4	2880
Sample-2	5	2736	144	2880
Sample-3	10	2592	288	2880
Sample-4	20	2304	576	2880

Table. 2 The thermometry place.

Symbol.	The thermometry place	Symbol	The thermometry place
A	Exhaust gas	E	Lower part of the waste incineration room
B	Upper part of the furnace	F	Suction port of the preheating
C	Upper part of the waste incineration room	G	Air hatch for mixing
D	Middle part of the waste incineration room	H	Surface of the furnace

Results and Discussion

The figure 2-4 are shown the results of the thermometry of the each point of the furnace and the exhaust gas analysis while incinerated trial medical waste contained 20% PVC. The upper part in inside of furnace (point B shown in Fig.1) was controlled in management temperature (800 degree) that was determined by the standard of the construction and the maintenance of "Act on Special Measures against Dioxins". About 15 minutes were needed in order to increase the temperature of inside of furnace to 800 degree, (Fig. 2). Upper part and center part in the waste incineration room also showed temperature increase, when inside of furnace upper part showed temperature increase. The polypropylene was a main component on plastic material of trial medical waste for this examination. The gasification temperature of the polypropylene is over 530degree. Therefore, it seems to be generating the gasification of the trial medical waste, when the temperature of the waste incineration room reaches 600 degree. And, the input of the firewood decreased, when the temperature of the waste incineration room exceeded 600 degree. From this fact, it seems to maintain the temperature of inside of furnace by gasification combustion of the trial medical waste made of the plastic at 800 degree. Still, the temperature of the upper part of waste incineration room exceeded 1000degree for 50-70 minutes from the start of the combustion. It is considered that this is based on the remarkable temperature rise by the combustion of trial medical waste of the waste incineration indoor. The combustion of medical waste was able to confirm it in the visual observation from the clearance in the waste incineration room. The concentration of CO in the exhaust gas decreased, when the combustion temperature was stabilized even in the little charge on the firewood of the fuel this time and was kept 800 degree.

It was indicated that CO concentration in the exhaust gas was the best 190ppm in about 15 minutes from the combustion start, and inside of furnace is the incomplete combustion condition from Fig. 3. However, the concentration of CO in exhaust gas was a low level to the end (after 140 minutes) of the incineration, after the inside of furnace upper temperature was maintained over 800 degree. From this result, it seemed inside of furnace was burning completely. And, the discharge of the air contaminants was little, because the concentration of SO_2 and NO_x in exhaust gas was low level about 10 ppm or less from Fig. 4.

The correlation of content of PVC in the trial medical waste and dioxines in the exhaust gas was shown in Fig. 5. The emission standard of dioxines has been determined as 5ng-TEQ/m^3N by "Act on Special Measures against Dioxins". As a result of this examination, the experiment of the 0.5% content of PVC did not exceed the emission standard of dioxines. It is considered that there is the relation of the straight line in the relation between generation of dioxines and content of PVC, since there is a little error by the difference between sampling situations and precision of analysis, etc.,. It is necessary to consider that dioxines arise, even if the medical waste including PVC is incinerated in the good condition with small generation of CO.

Conclusions

By using firewood in the small incinerator for the demonstration, the incineration experiment was carried out. The results are as follows:

1) It was confirmed the decrease in the concentration of CO, when the temperature of inside of furnace of incinerator exceeded 800 degree. However, it was proven that the control of the generation of dioxines was difficult with much content of PVC, even if it burns completely.

2) From result of analysis of exhaust gas, it is possible to carry out the incineration with small discharge of NO_x, SO_2, etc. (10 ppm or less).

3) In the incinerator used by present experiment, it was possible to satisfy emission standard of dioxins (5ng-TEQ/m3N), when simulation medical waste contained 0.5% PVC was burnt.

References

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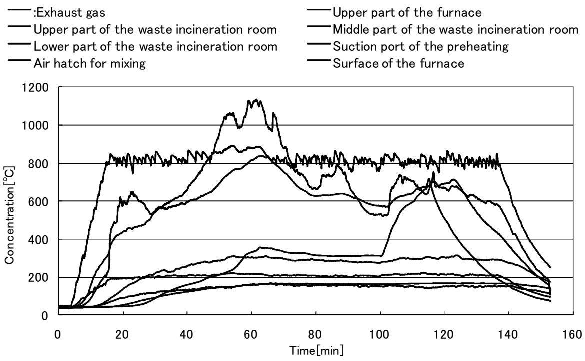

Fig. 2 The result of the thermometry of he measuring point (contained 20% PVC).

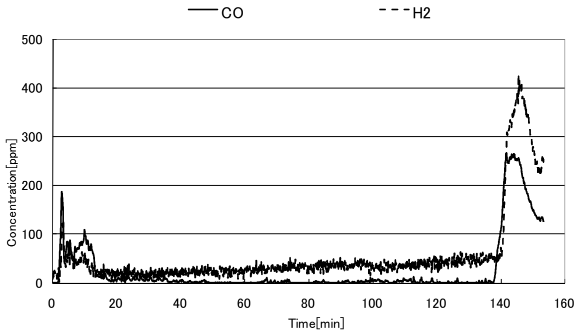

Fig. 3 Analysis result of CO and H_2 in exhaust gas (contained 20% PVC).

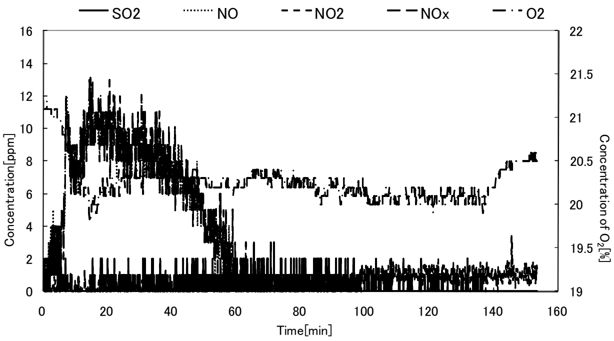

Fig. 4 Analysis result of SO_2, NO, NO_2, NO_x and O_2 in exhaust gas (contained 20% PVC).

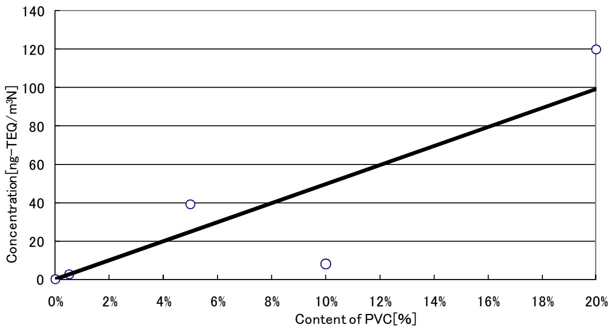

Fig. 5 Analysis result of dioxines in exhaust gas.