REDUCTION OF DIOXINS EMISSION THROUGH THE IMMOBILIZATION OF DIOXINS PRECURSORS BY CHEMICAL INHIBITOR

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Introduction

The pathway of dioxins formation in waste combustion process has been well investigated from the end of 1980's and two major pathways were proposed. One was catalytic conversion[1] from hydrocarbons and another is *de novo* synthesis[2] from inorganic carbon particles. In both pathways, it seemed that chlorophenols (dioxins precursors) play an important role for PCDD/Fs (dioxins) formation. Good correlation between chlorophenols and dioxins concentration was reported in flue gas from municipal solid waste incinerators[3]. As the optimum temperature of this dioxins formation was about 300C, most part of dioxins was considered to be formed between boiler and dust precipitator in full scale incinerators. Especially, dioxins formation in ESP was very active and dioxins concentration in ESP outlet gas was higher than that of ESP inlet gas in some cases[4].

Therefore, prevention of dioxins formation is considered to be possible through the immobilization of dioxin precursors in flue gas not to contact fly ash, the strong catalyst. In this paper, reduction of chlorophenols concentration in flue gas and accompanied prevention of dioxins are investigated by the injection of special chemical (inhibitor) which has immobilization activity of chlorophenols.

Materials and Methods

The inhibitor is mainly composed of powdered active alkaline compounds which can react with acidic hydroxyl group of chlorophenols.

The evaluation test was performed in Sakai South Incineration Plant, Japan, which has three lines and each combustion ability was 150 ton per day. The schematic view of flue gas treatment process and inhibitor injection site are shown in Fig-1. The combustion conditions throughout the test was kept to be almost same. Carbon monoxide concentration in flue gas was about 5-20ppm and ESP temperature was nearly 190C.

Dioxins concentration in flue gas and fly ash was measured according to Japanese authorized method. Chlorophenols and chlorobenzenes in flue gas were analyzed by GC/MS. Moreover,

2,4,6-trichlorophenol (2,4,6-TCP) in ESP outlet gas was measured by the TCP monitoring system, CP-2000, Hitachi, Ltd.

Results and Discussion

Fig-2 shows the relationship between inhibitor injection volume and 2,4,6-TCP concentration by CP-2000 in ESP outlet gas. 2,4,6-TCP concentration was 4μg/Nm^3 without inhibitor. When 200mg/Nm^3 of inhibitor was injected before ESP, it was reduced to 2.8μg/Nm^3. It still decreased to 1.5μg/Nm^3 with 300mg/Nm^3 of inhibitor. It was clear that 2,4,6-TCP in flue gas decreased in proportion to inhibitor injection volume. Fig-3 shows that not only 2,4,6-TCP but also other homologues could be removed from flue gas by this inhibitor.

Dioxins concentration in ESP outlet gas decreased by 79%, from 0.22ng-TEQ/Nm^3 to 0.046ng-TEQ/Nm^3, with 300mg/Nm^3 of inhibitor as shown in Table-1. Fig-4 shows the homologues distribution patterns in which it was cleared that all homologues decreased very well. On the other hand, dioxins concentration in ESP fly ash was also decreased from 0.68ng-TEQ/g to 0.06ng-TEQ/g. From this results, it was supposed that dioxins formation both in flue gas and fly ash was very active in ESP and its prevention was quite effective by immobilizing dioxin precursors with the inhibitor. As a result, this inhibitor seems to have prevented dioxin precursors from contacting fly ash, the strong dioxins formation catalyst.

Fig-5 shows total dioxins emission from ESP. About 138μg-TEQ/h of dioxins was emitted and fly ash was responsible for nearly 90% of the emission in normal operation. While it decreased to 17μg-TEQ/h with 300mg/Nm^3 of inhibitor. It seems that this inhibitor is very easy and effective method to reduce total dioxins emission. As a next step, optimization of application, especially prevention of dioxins formation at higher temperature, and the effect of inhibitor on heavy metal elution from fly ash must be investigated.

Acknowledgment

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References

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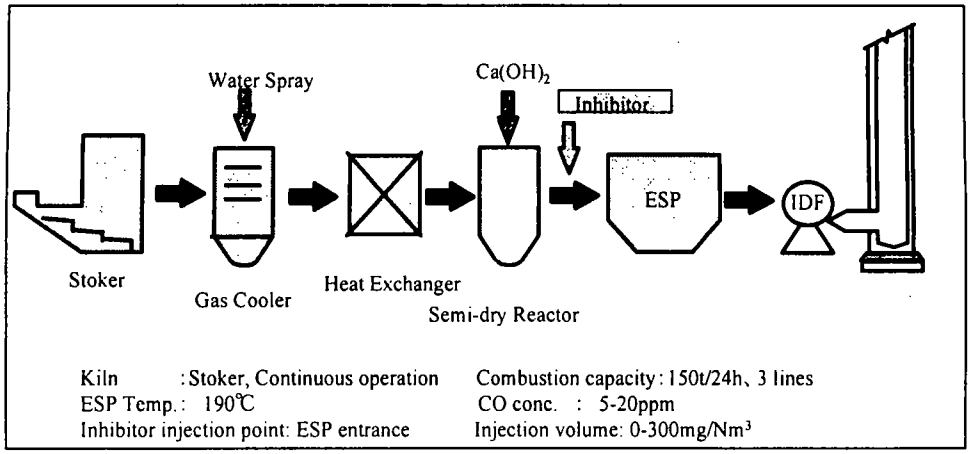

Figure-1. The schematic view of flue gas treatment process in Sakai South Incineration Plant

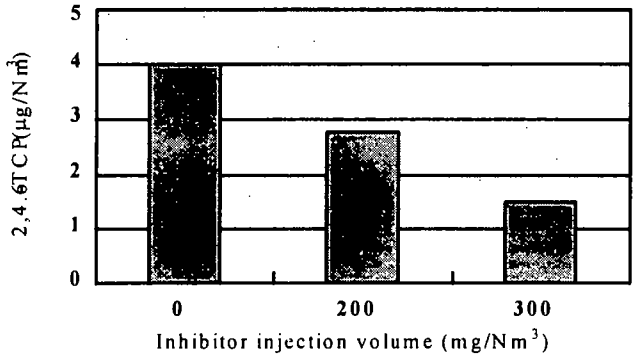

Fig-2. Reduction of 2,4,6-TCP in ESP outlet gas by inhibitor injection

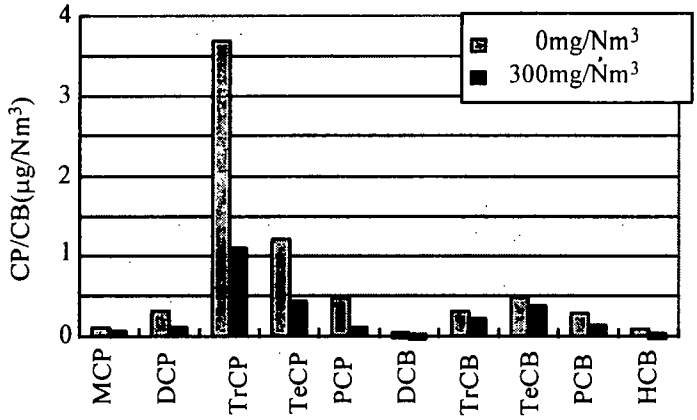

Fig-3. Homologues distribution pattern of chlorophenol and chlorobenzene in ESP outlet gas

Table-1. Dioxins reduction in flue gas and fly ash by inhibitor

Injection volume	ESP outlet gas	ESP fly ash
0mg/Nm^3	0.22ng-TEQ/ Nm^3	0.68ng-TEQ/g
300mg/Nm^3	0.046ng-TEQ/ Nm^3	0.06ng-TEQ/g

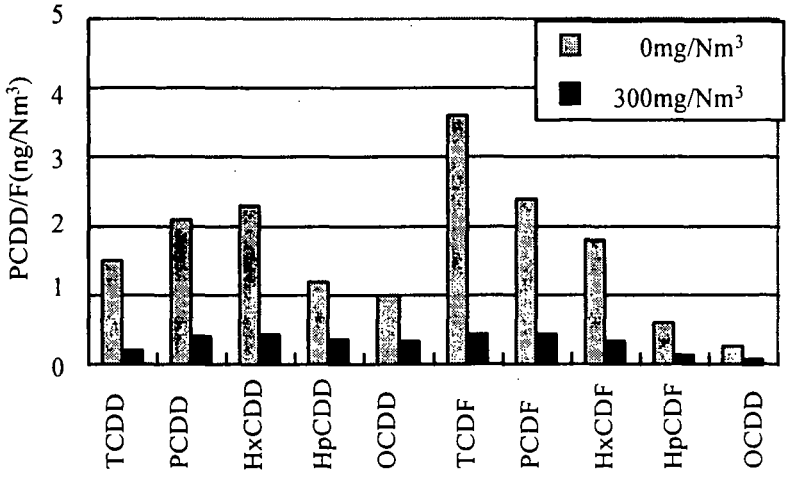

Fig-4. Homologues distribution pattern of dioxins in ESP outlet gas

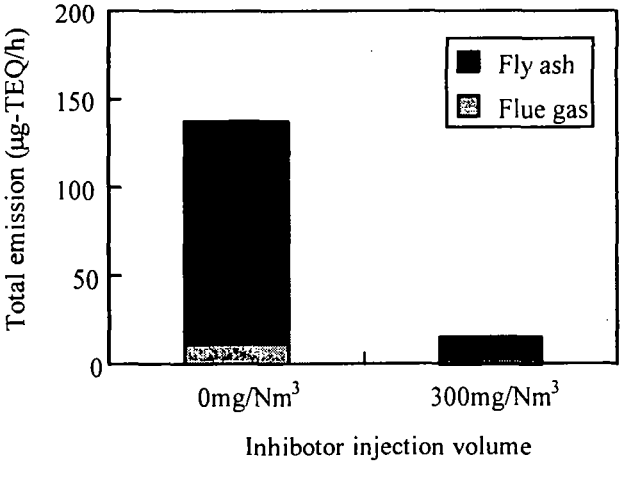

Fig-5. Reduction of total dioxins emission by inhibitor