INVESTIGATION ON INTEGRATION OF DIOXINS ABATEMENT TECHNOLOGY

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Abstract

Recently MSW incineration plants in Japan have been provided with more advanced air pollution control device and equipment, to reduce Dioxins concentration in exhaust gas leaving stack. Although the more advanced systems result in increasing factors to be controlled, which are usually in trading off relation, and, therefore, have to be optimized in the balance for the purpose of proper operation/maintenance.

We have been aiming to improve safety in incineration plant operation/maintenance, through development of such integrated system for increasing control factors according to evolving installations, as Dioxins monitors, i.e. continuous analyzer, which provide the information to be directly utilized for better operation/maintenance. In order to predict Dioxins, alternative substances in place of them have been employed. Chlorobenzenes and TOX(Total Organic Halogen Compound) were focused on and investigated, as chemical substances to be monitored easily in seconds or minutes. And we have been intending to establish how to manage incineration plants into optimum operation of under accumulated data obtained in long term of operation.

This report is a summary of the results in the first fiscal year and plans in coming two years of the investigations, to be conducted with research grand of the Ministry of Health, Labor and Welfare (Kousei kagaku kenkyuhi in Japanese) for 3 years starting from FY 2000.

Introduction

Although eager efforts have globally been done for the high speed continuous analysis of Dioxins (DXNs), time required for analysis is still stagnated at 2 to 3 weeks judging from the current papers, that is apart from a target of desired time resolution of several ten minutes. There are reports on semi-continuous monitoring systems employing Chlorobenzenes(CBzs) and TOX by Kawamoto et al., and on better co-relation to DXNs of Pentachlorobenzene(PeCBz) among CBzs. On the other hand, Takeda et al. have reported developing high speed monitoring system of Trichlorophenol(TCP) as a alternative substance with good co-relation to DXNs, which is achieved through corona discharge and mass spectrometry.

However, neither existing examinations report any result undertaken in extremely low level of DXNs concentration, nor any investigation under long term of test duration enough to prove the correspondence to various qualities of waste stemming from four seasons or various units operation modes etc. Considering such a present status of many investigations, we have decided realization of high speed monitoring system of alternative substances, i.e. CBzs and TOX, and

tried to develop on-line DXNs control system by means of EDC method, Photo Ionization Mass Spectrometry and TOX analyzer. At the same time, the current levels of transition of DXNs generation and emission shall be clarified on line through analyzing low level of concentrations of CBzs and TOX fully automatically, under variation of waste qualities during long term of tests throughout the year.

1. Purpose

Strict control of DXNs emission has promoted an incentive to monitoring DXNs concentration year by year. On the other hand, the more difficult operation practices are caused by the more control factors in operation and the more optimum management of units operation, which are trading off each other, and consequently, development of a comprehensive automatic control system for DXNs abatement can be the solution, and break through of the objections of analysis speed and cost shall be main theme to be solved, which current analysis systems have never solved.

On high-speed analysis system of DXNs, there are two approaches studied: direct analysis of DXNs and indirect one that is based on prediction from measurement of alternative substances to DXNs. We decided to adopt and to investigate the latter, which is easier to be commercialized, because the former is still in stage of possibility of realization. We have been aiming at a comprehensive automatic control system of DXNs concentration by means of finding the most adequate alternative substance(s) with good co-relation to DXNs, laying stress on response to coming strict regulation into extremely low emission level of DXNs, and we adopted CBZs and TOX, which can be useful ones of precursors of DXNs and recognized in good co-relation to them.

2. Method

The investigation was conducted as follows:

① Development of high speed of continuous analyzer for the alternative substances in high temperature flue gases, by means of Laser Ionization Mass Spectrometry

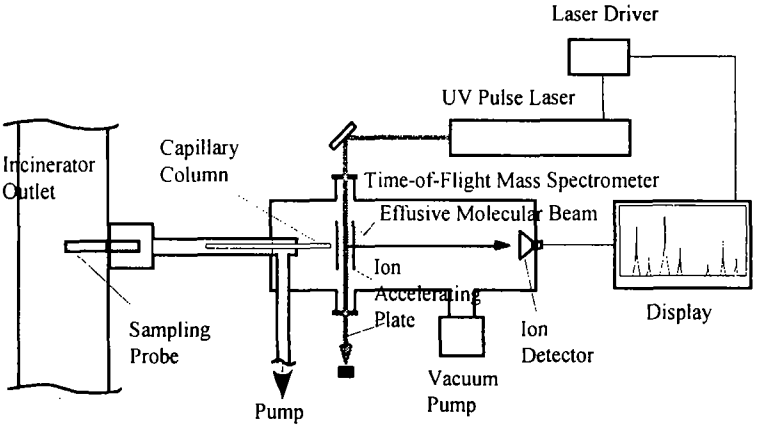


Fig. 1 Laser-Ionization TOF-Mass Spectrometry

② Verification for commercialization of ECD method through long term of continuous operation in a running incinerator

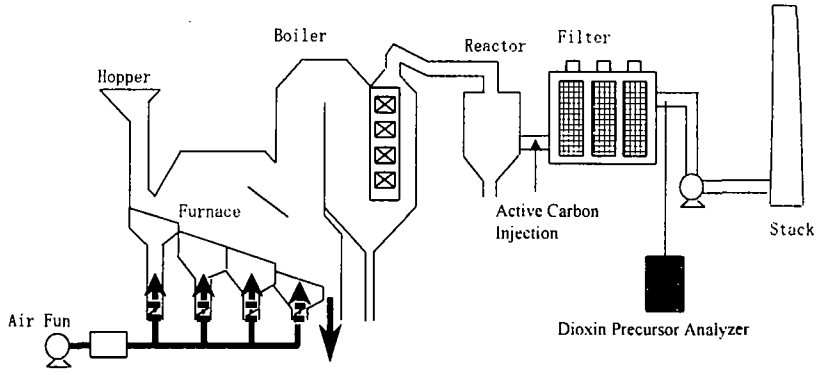


Fig. 2 Incineration flow and the position of Dioxin Precursor Analyzer

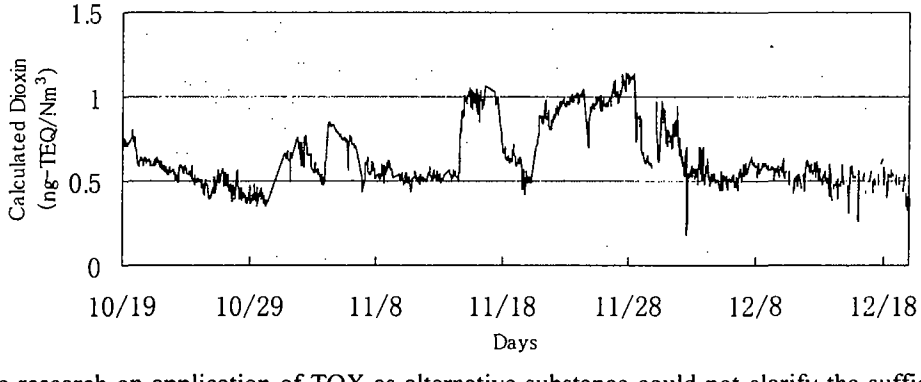
③ Proving propriety of characteristics of TOX required for predicting DXNs concentration in exhaust gas

3. Results

The results of investigation in 2000 fiscal year are summarized as follows.

① Laser Ionization Mass Spectrometry for PeCBz as an alternative substance suggests feasibility of the real time measurement, leaving some themes to be further improved.

② The results by ECD method, with a target of 1ng-TEQ/Nm^3 of DXNs and in 50 minutes/cycle, proved that TCBz shows enough good co-relation to DXNs to be adopted as an alternative substance at such a low level of concentration ranging from 0.04 to 12 μ g/Nm^3 of CBzs, under practical 70 days operation of a unit in service. It showed particularly good co-relation to DXNs with Trichlorobenzene(TCBz), which is feasible to be adopted as alternative substance to DXNs looking for continuous monitoring.



③ The research on application of TOX as alternative substance could not clarify the sufficiently good co-relation to DXNs concentration ranging from less than 0.01 to 0.5 ng-TEQ/Nm^3,

showing just a certain coincidence with existing data in higher concentration level. CBz and Chlorophenols(CPs), which are components of TOX, play little role to contribute to substitute DXNs, that means a possible uncertainty of adequate alternative substance depending on the type of incinerators and their operating conditions.

4. Themes to be carried out

The main themes to be carried out in coming two years are as follows.

1) Investigation on the prediction method of DXNs concentration through high-speed analysis employing alternative substances to DXNs

We are planning to investigate a prediction method of DXNs concentration, focusing on CBzs and TOX as alternative substances, which have the good co-relation to DXNs concentration.

The themes are itemized:

① Improvement of reliability of measurement of CBzs etc. by Laser Ionization Mass Spectrometry in a laboratory.

② Further accumulation of site operation data on DXNs and alternative substances, simultaneously obtained by means of ECD method at extremely low level of DXNs concentration, to verify the usefulness of CBzs as alternative substances to DXNs.

③ TOX method shall be applied also for the exhaust gas from a gasification slagging combustion plant and development of continuous measurement apparatus .

2) Research on the transition of DXNs and the alternatives in long-term operation

Continuous monitoring of CBzs etc. during long term shall be conducted through ECD method and Photo Ionization Mass Spectrometry , that may clarify effects of climates, waste quality and plant operation modes on DXNs and the alternative substances.

3) Investigation on comprehensive integration for the related factors to manage MSW incinerators into proper operation reducing DXNs emission.

We will approach to a final target that is establishment of optimum incinerator operation practices, through extraction and integration of control parameters on abatement of DXNs generation and emission.

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