ASSESSMENT OF AN ON-LINE CI-MASS SPECTROMETER AS A CONTINUOUS EMISSION MONITOR FOR SEWAGE SLUDGE INCINERATORS

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ABSTRACT

ELI Eco Technologies Inc, tested two sewage sludge incinerators using regulatory methods and a V&F CIMS-500 chemical ionization mass spectrometer. Correlations between dioxins and dibenzofurans from the regulatory MM5 trains and the continous readings from the CIMS-500 for chlorobenzenes and chlorophenols were noted. As well, correlations between chlorinated organics and other volatile organics were obvious under poor combustion conditions.

ELI Eco Technologies Inc. recently completed an extensive survey of organic chemical emissions including VOCs, chlorobenzenes, chlorophenols, chlorinated dioxins and dibenzofurans from two sewage sludge incinerators. The program was funded by the Municipality of Metro Toronto, Environment Ontario, and Environment Canada. Contaminants were measured by regulatory methods (ASME Modified Method 5) and simultaneously with the continuous mass spectrometer. The purpose of the study was to provide regulatory testing and at the same time evaluate the usefulness of the CIMS-500 mass spectrometer in assessing emissions.

Continuous monitoring of emission concentrations at two sewage sludge incinerators with the V&F CIMS-500 mass spectrometer correlated well with data obtained using regulatory methods. The most important difference found between the regulatory method (ASME Modified Method 5) and measurement with the CIMS-500 was that the results were available immediately using the continuous mass spectrometer system, and the higher emissions from one day to the next were noted at the time, when some corrective action could have been taken.

The regulatory method requires triplicate sampling for day-long periods, lengthy delays for lab analysis, and yields only one number per test for each contaminant. With current regulatory testing, it is difficult to establish correlations between incinerator operating conditions and stack emissions, let alone attempt to correct them. Continuous emission

monitoring with the CIMS-500 would make it possible to optimize combustion by measurement of various hydrocarbons, reduce dioxin and dibenzofuran emissions by monitoring chlorobenzene and chlorophenol emissions, and track emissions year-round.

Three days of testing at a sewage sludge incinerator in January 1990 showed chlorinated dioxin and dibenzofuran emissions that can respectively be called low, high and medium, relative to each other. The CIMS-500 data for both chlorobenzene and chlorophenol concentrations correlated well with that trend. Although the mass spectrometer system cannot measure the extremely low concentrations of dioxin and dibenzofuran emissions, it can measure the part per billion levels of chlorophenols that occur in conjunction with dioxins and dibenzofurans, thus providing an indirect measurement of dioxin and dibenzofuran emissions. Figure 1 shows correlations of dioxin and furan concentrations by ASME MM5 versus chlorophenol and chlorobenzene concentrations by CIMS-500. A slightly better correlation results using the chlorobenzene data. Although continuous data is available for the chlorobenzene and chlorophenol concentrations, the correlations are limited by the three data points available from the ASME MM5 trains for dioxins and dibenzofurans.

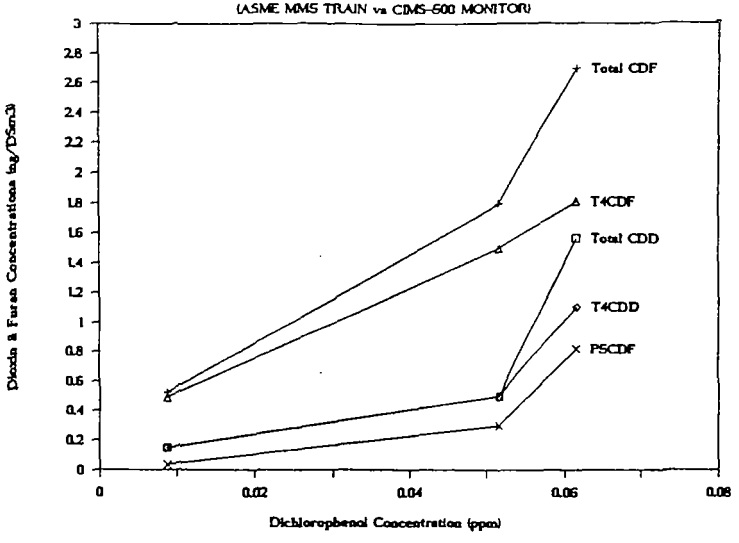
Other correlations were noted between chlorophenol and chlorobenzene concentrations and those for benzene, toluene, xylene, and phenol. These correlations reflect the poor combustion conditions that occurred on the test day with the highest dioxin emissions. The continuous analysis of organic emissions with an installed mass spectrometer system would therefore allow the incinerator operator to optimize combustion using benzene, toluene, and xylene readouts, and further optimize to achieve the lowest dioxin and dibenzofuran emissions by measurement of chlorobenzenes and chlorophenols. As well, a continuous record of emission data would be produced all year, rather than three days per year.

Figure 2 shows the continuous monitoring of benzene, toluene and xylene, with dichlorophenol (DCP), trichlorophenol (TCP) and tetrachlorophenol (TeCP) on the first graph, and with chlorobenzene (CB), dichlorobenzene (DCB) and trichlorobenzene (TCB) on the second graph. Note that the benzene, toluene and xylene concentrations are shown 10 times reduced. It is quite obvious from this graph that there are correlations between the compounds that were measured. Note that the feed to the incinerator was off at 12:10 and at a reduced rate at 13:30. Bringing the system back on line probably contributed to the high results obtained. Breaks in the continuous monitoring correspond to instrument calibration periods.

In summary, continuous emission monitoring using the CIMS-500 mass spectrometer has been successful in comparison with ASME MM5 sample train measurement and should be useful in optimizing combustion conditions, mininizing emissions of chlorinated dioxins and dibenzofurans, and providing continuous emission data for incinerators.

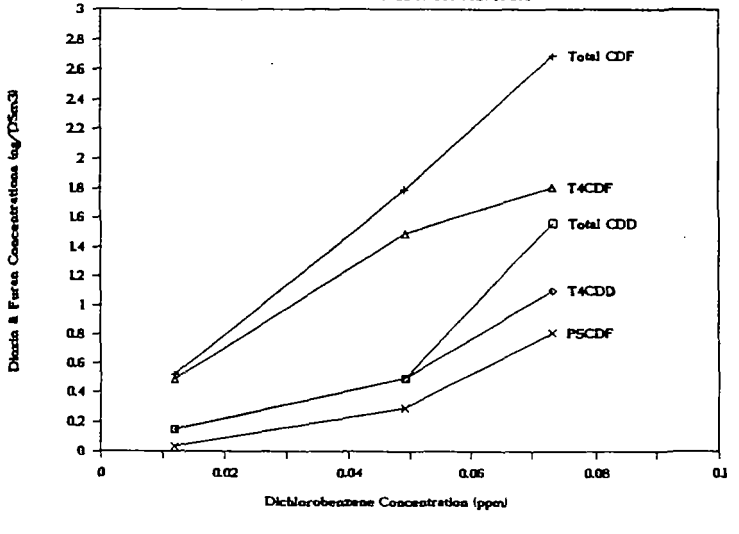
DIOXINS & FURANS vs DICHLOROPHENOL

(ASME MM5 TRAIN vs CIMS-500 MONITOR)

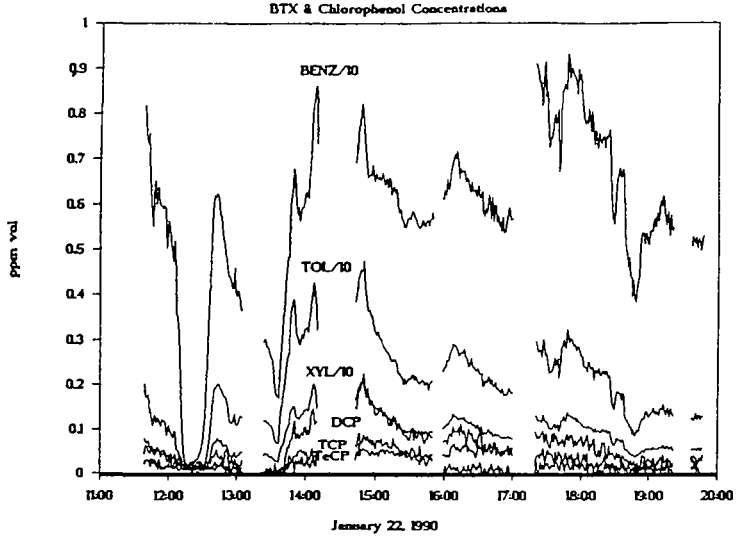


DIOXINS & FURANS vs DICHLOROBENZENE

(ASME MM5 TRAIN vs CIMS-500 MONITOR)



SEWAGE SLUDGE INCINERATOR CIMS-500 DATA



SEWAGE SLUDGE INCINERATOR CIMS-500 DATA