Hospital and Municipal Solid Waste Incinerators: Correlation between the PVC Present in Waste Feed and Emitted Organic Micropollutants

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Experiments and Results

A 17 months analytical campaign was conduced in two incinerators treating both municipal (MSW) and hospital solid waste (HSW) to investigate influence of chlorine containing plastics on dioxins and other related pollutant emissions.

The two plants (A and B), with the pollutant sampling points, are shown in fig. 1 and 2. Both plants are equipped with a post-combustion chamber that should comply with the following operative conditions fixed by Italian regulations:
- free oxygen in wet fumes: $\geq$ 6% in volume
- average speed of gases at the entrance section of the chamber: $\geq$ 10 m/s
- contact time: $\geq$ 2s
- temperature: > 950 °C
- combustion efficiency as $CO_2/(CO+CO_2)$: > 0.999.

For each one of the two plants 44 samples have been taken, half just downstream the boiler and half simultaneously at the stack. Forty samples were taken with the plants normally working, four taken while adding PVC to the waste, in order to increase the chlorine content of the waste feed from 1 to 2% in weight.

Analysed pollutants were, among others, HCl, PCDDs, PCDFs, PAHs and PCBs.

The sampling train (fig. 3) was designed to distinguish the concentrations of micropollutants in all phases: particulate, condensable and incondensable.

Average waste feed in the two plants during the tests is reported in fig. 4. PVC was added to a waste consisting of municipal solid waste only, suspending - during the tests - HSW flow. As it can be noticed in fig. 4, the chlorine percentage is four times higher in HSW than in MSW.

Emission data, expressed in weight of pollutant per ton of waste, are summarized in tables I and II.

Table I: pollutants produced and emitted by plant A

		BOILER			STACK		
		MSW+HSW		MSW+PVC	MSW+HSW		MSW+PVC
		Average	Max		Average	Max	
HCl	kg/t	10.5	29.7	23.6-24.2	1.2	4.2	6.3-7.4
PAHs	mg/t	8.8	28.7	2.8-20.2	7.0	9.1	1.8-5.2
PCDDs	µg/t	1.2	24.5	<0.1-17.5	<0.1	0.3	<0.1
PCDFs	µg/t	8.7	174.9	<0.1-105	<0.1	4.6	<0.1-70
PCBs	mg/t	3.5	55.6	<0.1	1.7	17.6	<0.1

Conclusions

As expected, HCl production increases with PVC addition in both plants. Sometimes, the same MSW-HSW mix contains a chlorine percentage higher than 2%, as shown in table I by the maximum value of HCl produced per ton of feed waste. Nevertheless, in plant A PCDDs and PCDFs production is very low as an effect of thermodynamic combustion conditions: high temperature and long contact time in post-combustion chamber. Higher production of organic micropollutants in plant B is probably due to the smaller volume of post-combustion chamber. Another reason could be the higher temperature of the flue gases leaving the boiler (350 °C in plant B versus 235 °C in plant A).

In both plants, the PCDDs and PCDFs congeners found always had five or more chlorine atoms.

The PVC specially fed did not seem to be influent on PCDDs and PCDFs production and emission, probably because of the high normal chlorine content of MSW-HSW mix.

An interesting result of research is the distribution of micropollutants among different phases, as shown in fig. 5. More than fifty percent was present as incondensable. This enphasizes the necessity of energetic combustion conditions that have to be realized in order to minimize micropollutant production, because of the difficulty to remove incondensable pollutants in the emission control devices.

Fig. 5: micropollutant distribution among emission phases