THE DG ENV EUROPEAN DIOXIN EMISSION INVENTORY- STAGE II: EMISSIONS OF DIOXINS FROM CO-INCINERATION OF HEALTH-CARE RISK WASTE AND MUNICIPAL SOLID WASTE

Jørgen Vikelsøe, Peter Blinksbjerg[1] and Allan Astrup Jensen[1]

National Environmental Research Institute, P.O. 358, DK-4000 Roskilde, Denmark
[1]dk-TEKNIK Energy & Environment, 15 Gladsaxe Moellevej, DK-2860 Soeborg, Denmark

Introduction

In the late 1980's forty-seven small hospital incinerators in Denmark annually incinerated about 17.000 tons of waste, including 2000 tons health-care risk waste (HCW) from hospitals. The flue gas concentration of ΣPCDD/PCDF ranged up to 3000 ng/Nm^3 (≈ 50 ng I-TEQ/Nm^3). The average emission per ton of waste was 53 mg/t ΣPCDD/PCDF (≈ 0,8 mg I-TEQ/t), 40 times greater than the emission from incineration of municipal solid waste (MSW) in large incinerators (MSWIs), estimated to 1.3 mg ΣPCDD/PCDF/t (≈ 0,02 mg I-TEQ/t). The total Danish annual emission from hospital incinerator was estimated to 900 g ΣPCDD/PCDF/y (≈ 14 g I-TEQ/y) compared to about 2200 g ΣPCDD/PCDF/y (≈ 34 g I-TEQ/y) from the larger MSWIs. [1, 2]

Thus the hospital incinerators were by then contributing substantially to the Danish dioxin emission. It was not clear whether the large dioxin emission was caused by the HCW composition or by the operation and construction of the small incinerators. Since then most HCW has instead been *co-incinerated* in large MSWIs together with MSW. In 1995 and 1996 respectively 7800 tons and 5700 tons HCW was co-incinerated[3] with an estimated annual emission of 5 g I-TEQ/y[4]. This co-incineration has never, to our knowledge, been experimentally studied. Hence, the present investigation was initiated, as a part of a follow-up of the European Dioxin Inventory Project.[5, 6]

Methods and Materials

Experimental

The co-incineration was investigated at a MSWI of traditional design (Fig. 1) burning app. 35000 tons of MSW and app. 7000 tons of HCW annually. Nominal capacity: 3 MW of electrical power, 9 MJ/s of district heating (≈ 80% heat recovery of fuel energy). The HCW is contained in disposable cardboard boxes closed at the hospitals, fed automatically into the plant together with MSW chippings. Dioxin sampling in chimney downstream the dry flue gas cleaning system during normal operation, limestone being injected into the chalk reactor.

The co-incineration experiment (3 tests) was performed after some months of continuos co-incineration. Then the HCW-feeding was stopped and followed by 60 hours of feeding of MSW alone (≈ 25 times the retention time of the waste in the MSWI), finally the MSW-alone experiment performed (3 tests). All operating conditions were the same in both experiments.

Analytical

Isokinetic sampling of about 3.5 Nm^3 by filter-condenser method. Soxhlet extraction in toluene, clean-up on silica /NaOH, silica /H_2SO_4, Al_2O_3, analysis by GC/HR-MS. Procedures according to CEN standard EN 1948 (part 1 to 3)[7].

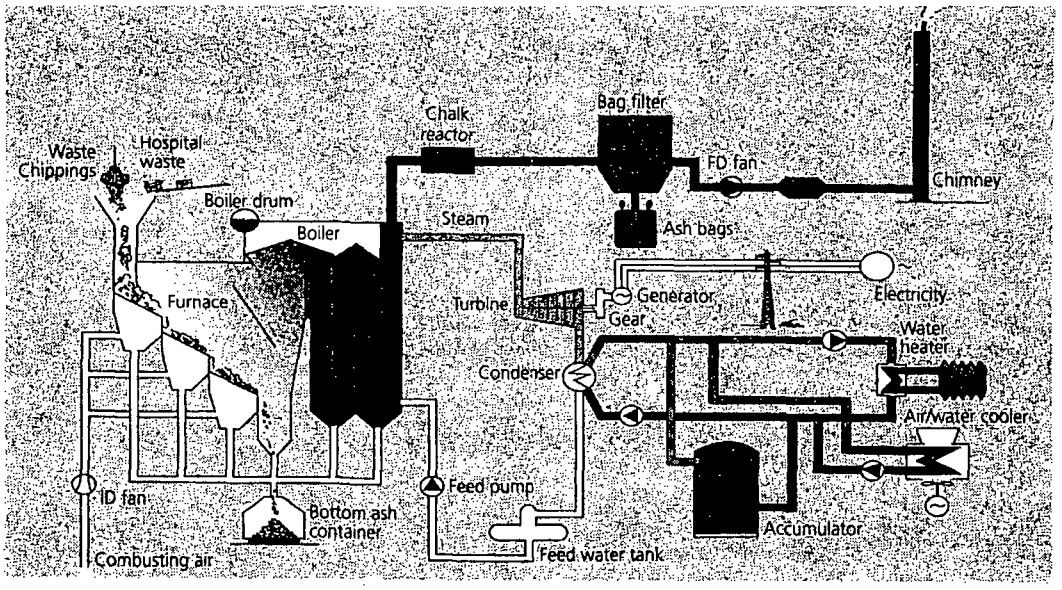

Fig. 1. Outline of MSWI elements.

Results and Discussion

The average and standard deviation of the results of each experiment are shown in Fig. 2.

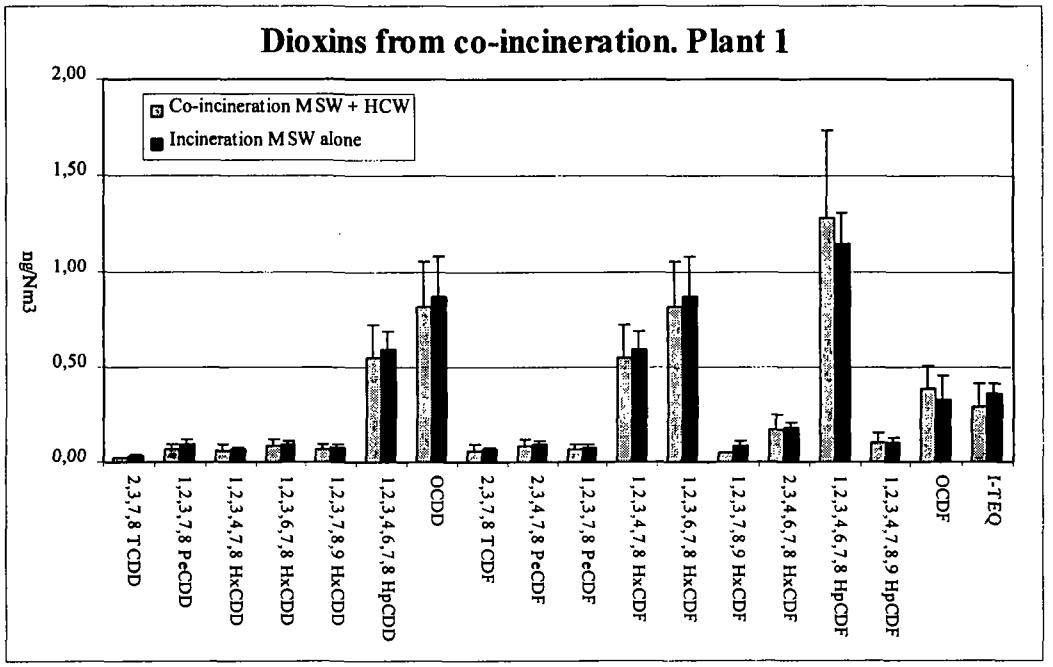

Fig. 2. Results of co-incineration experiment (HCW and MSW) and MSW-alone incineration experiment. Average and standard deviation of the three tests in each experiment.

All congeners are of comparable concentration for the two experiments, and no significant differences were found by t-test for most congeners and for I-TEQ. The emission of dioxin per ton of waste is shown in Table 1. Also in this case, no significant differences between the experiments were found. Because cleaned flue gasses were sampled, the results are valid for the atmospheric emission, not for the dioxin formation.

Table 1. Mass flow of MSW and HCW. Emission of I-TEQ per ton waste

Experiment		MSW/HCW	MSW
MSW burned	ton	35,4	43
HCW burned	ton	7,6	0
I-TEQ emitted	ng	29709	38188
I-TEQ / waste	**ng/ton**	**691**	**888**

In Fig. 3 the results for the MSW-alone experiment are compared with another plant of similar size and design not used for co-incineration (Plant 2), normalised with the I-TEQ set to 100% ("congener profile"). The same laboratory (NERI) has performed the analysis.

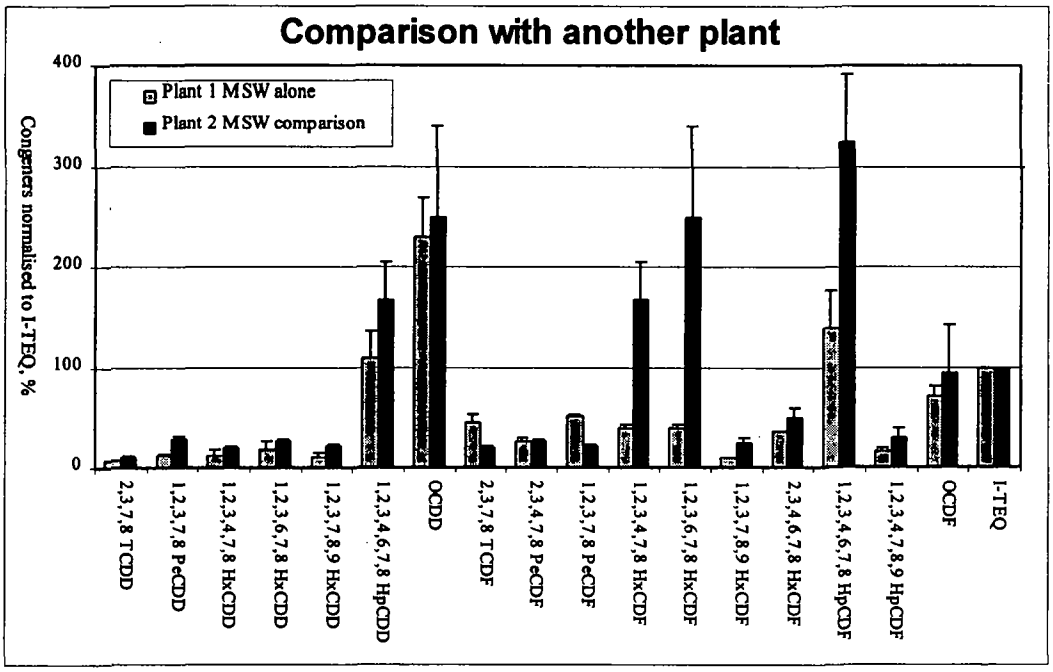

Fig. 3. Congener profiles (concentrations normalised to I-TEQ) from MSW- alone experiment in Plant 1, compared to incineration of MSW in plant 2 not used for co-incineration.

Plant 1 emits 0,4 ng I-TEQ /Nm^3, plant 2 only 0.08 ng I-TEQ /Nm^3. Most pronounced deviations seen are: Higher values of TeCDF and PeCDF for Plant 1, higher values for HxCDF and HpCDF for Plant 2. The inter-plant deviations are highly statistical significant by a t-test and are

significantly larger than the deviation between the co-incineration and MSW-incineration experiments in Plant 1. The two plants are located in different parts of Denmark, leading to different composition of the MSW. Further, the operating conditions are different.

Conclusion

In the same MSWI plant, incineration of HCW does not lead to elevated concentrations levels of dioxin in the cleaned flue gas compared to incineration of MSW alone. The variation between different plants is more pronounced than the variation caused by introduction of co-incineration in the same plant. The importance for the total annual Danish atmospheric dioxin emission of co-incineration of HCW seems lesser than the influence of other factors such as plant size, design, operation, waste composition and flue gas cleaning.

Acknowledgements

EU Part of the work presented here was carried out on behalf of Landesumweltamt Nordrhein-Westfalen (LUA NRW), Germany, within Stage II of the DG Environment European Dioxin Emission Inventory project. The Final Report on Stage II will be available by spring 2001 from LUA NRW and DG Environment
(contact: BIRGIT.VAN-TONGELEN@cec.eu.int). Financial contribution by the European Commission DG Environment is gratefully acknowledged.
The authors further wish to thank the operators and owners of the plant investigated for co-operation and financial contribution. The skilful technical assistance of Elsebeth Johansen, which performed the analytical work, is gratefully acknowledged.

References

1. Warnøe K., Manscher O. H., Heidam N. Z., Vikelsøe J., Pritzl G., Blinksbjerg P., Pallesen L., Madsen H. and Nielsen P. R. (1989). Dioxinemission ved affaldsforbrænding, Miljøprojekt nr. 117, Danish Environmental Protection Agency, Copenhagen.
2. Manscher O. H., Heidam N. Z., Vikelsøe J., Nielsen P. R., Blinksbjerg P., Madsen H., Pallesen L. and Tiernan T. O. The Danish Incinerator Dioxin Study, part 1. Chemosphere 20, 1779-1784 (1990).
3. Affaldsstatistik 1996. Orientering fra Miljøstyrelsen no. 13, Danish Environmental Protection Agency, Copenhagen 1997.
4. Jensen, A. A. (1997). Dioxins. Working Report No. 50. Danish Environmental Protection Agency, Copenhagen.
5. Quass U., Fermann M. and Bröker G. (1997). Identification of relevant industrial sources of dioxions and furans in Europe. Final report of the DG Environment European Dioxin Emission Inventory project -Stage I. LUA-Materialen 43, 936 pp. Price 50 DM/25.56 EURO. Available from LUA Nordrhein-Westfalen, PO Box 10 23 63, D-45023 Essen, Germany. Email-contact: michael.fermann@essen.lua.nrw.de.
6. Quass U., Fermann M. and Bröker G. (2000). The DG ENV European Dioxin Emission Inventory - Stage II: Concept, Scope, Experiences. To be presented at Dioxin 2000.
7. Stationary source emissions – Determination of the mass concentration of PCDD/PCDFs. European Standard EN 1948 (1-3). CEN 1996.