Environmental surveillance of incinerators: 2006-2009 data on dioxin/furan atmospheric deposition and associated thresholds

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ENVIRONMENTAL SURVEILLANCE OF INCINERATORS: 2006-2009 DATA ON DIOXIN/FURAN ATMOSPHERIC DEPOSITION AND ASSOCIATED THRESHOLDS

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Introduction

Dioxin/furan (PCDD/F) emission into the atmosphere has clearly diminished over about the last 20 years with the closure of non-standard municipal solid waste (MSW) incineration plants and also the installation of more powerful smoke treatment systems in most industrial facilities. In France the reduction between 1990 and 2008 has been -94%, with total industrial emissions in 2008 estimated at 101 g TEQ-NATO[1]. Since 28 November 2005[2], all MSW incinerators have to respect the limitation of 0.1 pg TEQ-$NATO_{89}$/Nm^3 where PCDD/F emission is concerned.

French regulations also impose environmental monitoring in the vicinity of incinerators. This is translated by the introduction of surveillance plans since 2006 and, more particularly, of gauge monitoring to measure total wet and dry atmospheric PCDD/F deposition. Analysis of these data is limited due to of the lack of recent reference values. The currently available references widely used in France are those published by Fiedler[3] in 1996 (based on a 1993 German compilation). Other similar references are also available (1991)[4]. All these reference values, however, should now be considered as obsolete in view of the changes in European emission regulations, including those for MSW incineration plants which are a major source of dioxins.

The collection of environmental monitoring data provides a large number of new data that need to be gathered and suitably processed. The present article summarises all the processed data, describes a treatment method and suggests value ranges and thresholds regarding environmental deposition.

Materials and methods

The approach used in constructing this new French frame of reference on dioxin deposition in the environment is based on four years (2006-2009) of sampling atmospheric deposition with Owen type (dust and precipitation) gauges at 1113 collection points in the vicinity of 49 MSW incineration plants. The standard NF X 43-014 was applied; the gauges measured total wet and dry deposition during period from 1 to 2 months.
When selecting statistically processed TEQ data from the French and German laboratories, preference was given to TEQ calculated according to the NATO 1989 and then WHO 1998 methods that show little divergence on profiles dominated by the OCDD congener with very low TEF, and preferably taking detection limits into account (i.e. nd=DL).
Of the various data-processing methods found in the literature[5,6], the most suitable is that of Lepeltier (1969)[7] applied to deconvoluting the distribution of non-Gaussian populations.

Results and discussion

The compiled data range between <0.01 and 115.5 pg TEQ/m^2/d (Scatterdiagram, Figure 1) and their distribution into 40 classes falls into maximum 5-6 main groups (Figure 1). Comparison with the pg TEQ/m^2/d intervals suggested by Fiedler (1996) in relation to environmental setting (i.e. 5-20 [rural], 20-85 [urban] and up to 1000 near an industrial source) highlights the interest of having lower up-to-date data.

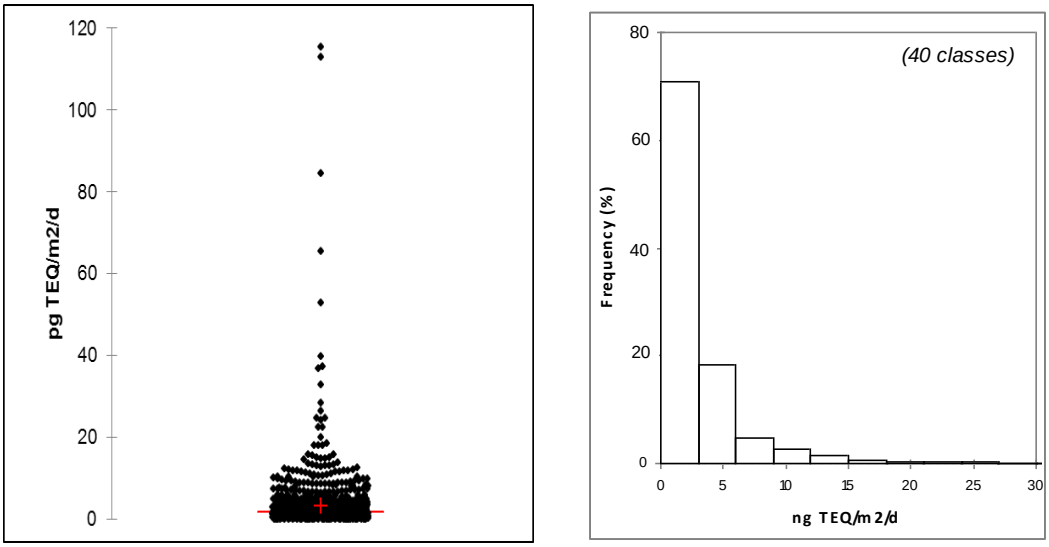

Figure 1 – TEQ dioxin/furan deposition data: scatter diagram (left) and distribution (right)

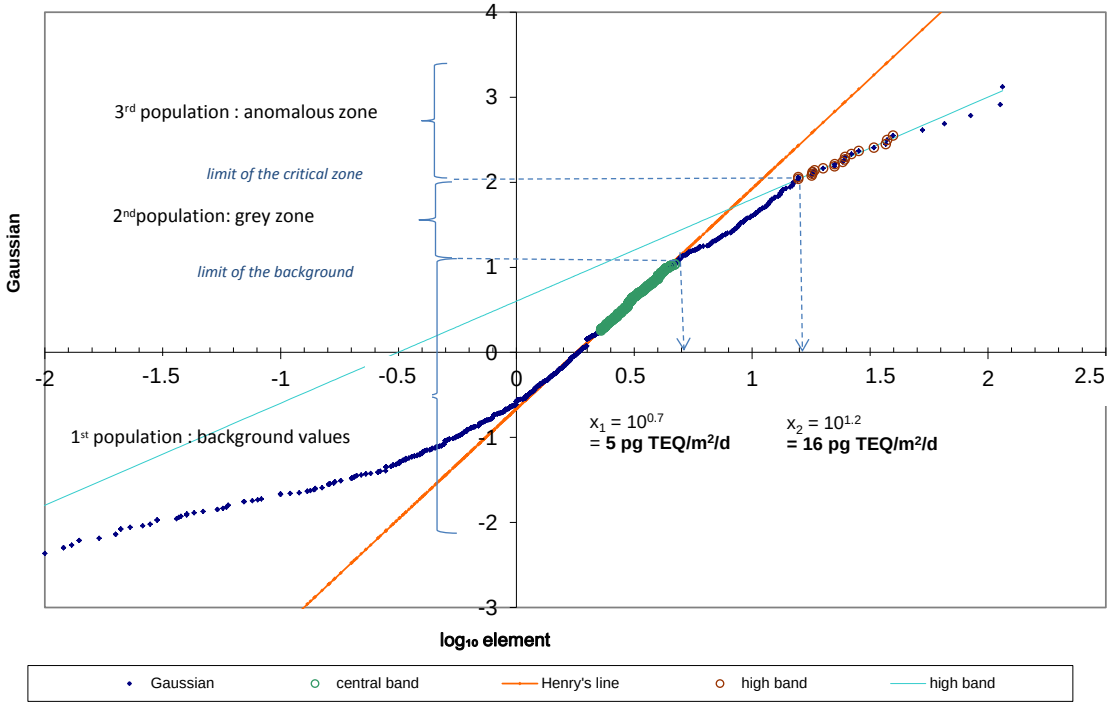

Figure 2 – TEQ deposition data treatment: graphical representation of Henry's line method[5,6,7].

Applying the Lepeltier method (Figure 2), data can be deconvoluted in three populations limited by inflexion points- of the curve the function reverses the Gaussian one applied to the logarithm of the distribution of the population-: two log normal population and one smaller population -around 2% of the values- with a very large value distribution. Up to 85% of the data population is lower than 5 pg/m²/d; these data can be considered as urban and industrial background values of atmospheric deposition. Then the 85-98%

population are in the 5-16 pg/m²/d interval, which can be considered as values more impacted by human activities. Finally 2% of the population gives values >16 pg/m²/d, which can be considered as an anthropic signature in relation with a nearby emission source. The limiting values of 5 and 16 pg TEQ/m²/d concern TEQ data assigned to population quartiles; they are consistent with the points distribution (Figure 1).

These new data give thresholds than can be used in air quality surveillance. Being aware of these data when monitoring surveillance plans should make it possible to investigate anomalous situations where dioxin/furan deposition is more than 16 pg TEQ/m^2/d. After confirming the measurement (for example at several points downwind during a same visit), a new gauge and/or emission control should be considered, as well as a detailed study of the congener distribution (profiles) to try and assess the potential source(s) and suggest actions where appropriate. Between 5-16 pg TEQ/m^2/d data are also to be discussed with respect to the potential surrounding emissions. Below 5 no additional study is required.

Profiles

The plot of a few data profiles with values varying from 2 to 65 pg TEQ-NATO/m^2/d (Figure 3) confirms the prevalence of the most chlorinated congener of dioxins, as it is known from elsewhere. The differences noted for 2-3 congeners cannot be completely explained at this stage; reduction of the OCDD part, which is often evoked for high TEQ values, is confirmed only for TEQ 65.5 and not for the already high values of 18 and 37 pg TEQ-NATO/m^2/d.

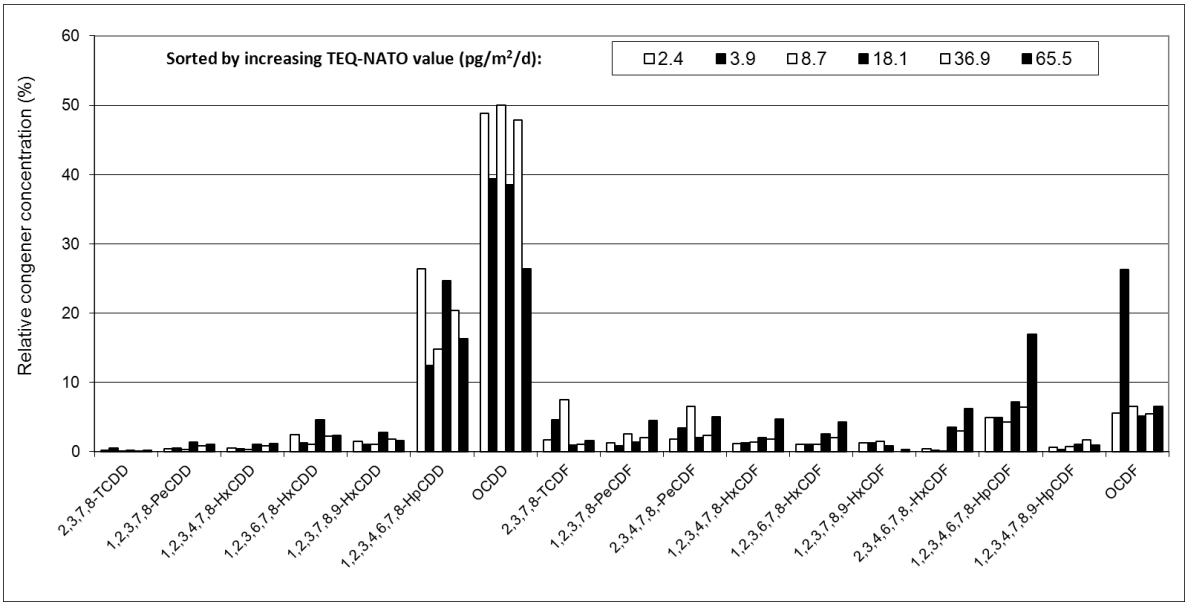

Figure 3 – Example of profiles sorted by increased TEQ values (six analyes)

Conclusion

In a context of installations complying with current regulations, which means low emission values from industrial plants, this article presents a compilation of recent data (2006-2009) obtained from French MSW incinerator surveillance plans with respect to atmospheric dioxin/furan deposition. Two thresholds are provided that could be used in air quality surveillance as discussed above: 5 and 16 pg TEQ/m^2/d.

Finally one can insist on the interest of integrated monitoring method such as Owen gauges to measure atmospheric pollution over a long period and detect anomalous situations; not always detectable during spot analysis at the source.

Acknowledgements:
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References:
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