Toward Biological or Physico-chemical Screening for Dioxins ?

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Abstract

Since few years, significant advances have been observed in the field of dioxin analysis. Many reports have been published concerning evolution in, not only sample preparation but also in the way in which resulting extracts are analyzed. The combined use of new extraction and clean-up techniques as well as last developments in the area of mass spectrometry made it possible. However, most of the analytical procedures still include labor intensive sample preparation steps as well as high-cost equipment such as high resolution mass spectrometers (HRMS) only available in some well specialized laboratories and the overall process is both time and resource consuming. For these reasons, it is currently not yet possible to enlarge the analyses to sufficient number of samples in acceptable cost allowing early detection of contamination problems. In order to edge their way toward high sample throughput capabilities, analysis protocols have to be simplified. Efforts are then now more focused on development of alternative methods.

As potential tools for screening method, biological assays (based on antibodies or cells response) attracted lot of attention during last few years with the emergence of a battery of bio and immuno-assays. However, since the assays can also be activated by other chemicals present in the mixture in often higher concentration than analytes of interest, the sample preparation steps are still required to reduce the risks of false positives and they become the bottleneck of the procedure. These steps can often require several days of tedious work including delicate solvents exchanges due to the need of performing the assays in aqueous-type media. In addition, depending on the considered assay, cross-reactivities (based on 2,3,7,8-TCDD) can be significantly different from a given TEF scale. Knowing that final TEQ estimation for many matrices mainly rest on the relative contribution of few congeners, these disparities regarding to the TEF can introduce uncertainties on the estimation.

On the side of the development of these biological methods, advances in physico-chemical analysis tools have also reach an interesting level. This is worthwhile to evaluate their capabilities in term of screening for dioxins on a selected congeners basis. The approach suggested here rests on the screening out of negative samples, before expensive GC-HRMS analysis, using quantification of some selected representative congeners isolated by automated clean-up and analyzed by GC-QISTMS or FGC-TOFMS.

This strategy can be seen as a cost effective “dioxin-dedicated” physico-chemical screening method complementary to a powerful biological tool capable of estimating the total toxicity of complex mixtures of large numbers of different halogenated aromatic hydrocarbons contained in samples.