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INTERNATIONAL DEVELOPMENTS IN MEASURING DIOXIN AND RELATED CHEMICALS IN A MORE COST EFFECTIVE AND BIOLOGICALLY RELEVANT MANNER

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ABSTRACT

Dioxin and dioxin-like substances represent a collection of a large number of widely dispersed environmental organic chlorinated chemicals, many of which are unusually toxic. These substances and many related non-chlorinated substances primarily arise from the high temperature burning of organic material such as that produced by waste incineration.

Although these substances have been experimentally shown to be able to produce cancer and other serious toxicities, the evidence on their public health significance is still not clear, in considerable measure because the tests required for producing the data needed for public health assessment are so costly. With such inadequate information, the views of the scientific, regulatory, industry, and environmental citizens' communities are often at odds. More cost-effective methods need to be developed so that this perceived public health problem can be given a proper assessment.

The theoretical principles of relatively new methods, which are based on the biological activity of these chemicals, are presented. It will be shown that one such method, which is designed to screen samples which makes use of the central event of toxicity and which is much more cost-effective, possesses the theoretical capability of providing the type of information needed for better public health assessment.

INTRODUCTION:

Dioxins and related trace compounds have always been present throughout our environment, and throughout the world. Soil samples from 1850 show low levels of dioxins which increased slowly until about 1930, reflecting extensive wood and coal burning.. A steady upward ramp is seen until about 1970, reflecting the increased use of chlorine in materials which were burned. After passage of the Clean Air Act, dioxins have been decreasing back toward pre-industrial levels, due to improved control of combustion and installation of emission controls. Combustion of organic matter, inevitably associated with some degree of chlorine, and with the assistance of various catalysts, such as copper and iron, can result in the chlorination of simple organic rings in the form of dioxins and furans. It has been found that good combustion can minimize dioxins [1], and injection of carbon can absorb them.[2] However, poor combustion can produce extremely high levels of these compounds, capable of contaminating the environment to levels of concern, or at least to levels at which they can be measured. The toxic effects of dioxin and dioxin-like compounds on sensitive rodents, have been used to develop internationally accepted factors for the relative toxicity of the various congeners of dioxins, furans, and even some similarly-constructed compounds.

What are dioxins and dioxin-like chemicals?

The most toxic form (congener) is the 2,3,7,8 TCDD, shown in Figure 1. Chlorine is attached at the four corners of the molecule, numbered 2,3 and 7,8. The equivalent form of furans has only one oxygen connecting the two halves. Hexachlorabiphenyl has no oxygen link. The basic molecules can form these congeners:

Polyhalogenated (Cl or Br):

- dibenzo-p-dioxins (75 each)
- dibenzofurans (135 each)
- biphenyls (PCBs) (209 each)
- azo- and azopoxy-benzenes
- chlorinated napthalenes

Non-halogenated: PAHs (1000s)