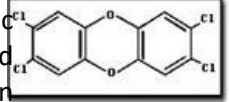


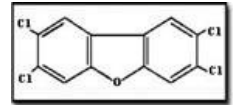
Dioxins & Furans in Fire and Smoke Contamination Investigations

Background

The phrase “dioxins and furans” is a simplified term for a collection of semi-volatile organic compounds with similar structures - polychlorinated dibenzo-p-dioxins (PCDDs), or simply dioxins, and polychlorinated dibenzofurans (PCDFs), or furans. They are formed during combustion processes in the presence of organic compounds and chlorine or bromine.



Dioxins and furans are persistent organic pollutants that remain in the environment for a long time, approximately 10 years, and bioaccumulate in plants and animals. They are extremely toxic and can cause cancer as well as a host of non-cancer conditions.



Problem

There are several tests for particulate and chemical residue from fire and smoke, but few address the critical issue of health. Tests for polycyclic aromatic hydrocarbons (PAHs) do relate to health impacts but the many sources of PAHs limits their usefulness in determining health impacts from fire and smoke specifically.

Most chemical combustion byproducts are very reactive and/or volatile, meaning they will not persist for more than a few hours or possibly days, or do not represent a significant health hazard as individuals, although they may have a substantial effect in aggregate. Therefore, a persistent and unique indicator that also has a significant health impact is necessary to stand in for all the health-related chemical compounds that cannot be measured.

Solution

Combustion is the dominant natural source for dioxins and furans, making dioxins excellent indicators of combustion. However, the presence of dioxins by themselves do not provide sufficient insight into the probable source(s) and persistence of fire and smoke residue. In addition to the background levels of dioxins and furans, there are simply too many dioxin-like chemical compounds to test for all of them effectively.

The development of specific diagnostic ratios by Bryan Vining, PhD (Enthalpy Analytical, LLC-Wilmington) revolutionized how we evaluate the health risk and persistence of chemical residues from fire and smoke. Not only do the diagnostic ratios indicate the source as coming from combustion, their presence in the ranges specified also suggests an increased health risk.

Diagnostic Ratios *	Expected Range
1,3,6,8 TCDD : Total TCDD 1,2,3,4,6,8 HxCDD :	0.1 – 0.5
Total HxCDD 1,3,4,9 TCDF : 2,3,7,8 TCDF	0.4 – 0.8
1,2,6,7 TCDF : 2,3,7,8 TCDF 2,3,4,6/1,2,4,9	0.5 – 2.0
TCDF : 2,3,7,8 TCDF 2,3,4,7/1,2,7,9 TCDF :	0.5 – 2.0
2,3,7,8 TCDF 2,3,4,8 TCDF : 2,3,7,8 TCDF	0.5 – 2.0
1,2,4,6,7,8/1,3,4,6,7,8 HxCDF : Total HxCDF	0.5 – 2.0
	0.5 – 2.0
	0.15 – 0.35

TCDD: tetrachlorodibenzo-p-dioxins HxCDD: hexachlorodibenzo-p-dioxins
TCDF: tetrachlorodibenzofurans HxCDF: hexachlorodibenzofurans

*Developed by Bryan Vining, PhD et al., Enthalpy Analytical-Wilmington

Results & Interpretation

Diagnostic ratios are indicators of the presence of a combustion source. When most of the 8 diagnostic ratios fall within the expected range the dioxins originate from a combustion source. Otherwise, the source of the dioxins is background contamination or industrial process.