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Dioxins and Dioxin-like Compounds

The terms **dioxins** and **dioxin-like compounds** (DLC ^[1]) commonly refer to a class of highly toxic **compounds** that are environmental pollutants and **persistent organic pollutants** (POPs). The terms usually refers to or is associated with:

Polychlorinated dibenzodioxins (PCDDs), or simply dioxins, technically a derivative of **dibenzodioxin**

Polychlorinated dibenzofurans (PCDFs), or simply furans, technically a derivative of **dibenzofurans**. Whilst they strictly speaking are not dioxins, they have dioxin-like properties

Polychlorinated biphenyls (PCBs), which also strictly speaking are not dioxins, but some have "dioxin-like" properties. They can under certain conditions form the more toxic dibenzodioxins and dibenzofurans through partial oxidation

Finally, it may refer to **Dioxin (chemical)**, the basic chemical unit of the more complex dioxins

Because dioxins refer to such a broad class of compounds, that vary widely in toxicity, the concept of toxic equivalent (TEQ) has been developed to facilitate risk assessment and regulatory control. Toxic equivalent factors (TEFs) exist for selected **congeners** of dioxins, **furans** and PCBs. The reference **congener** is the most toxic dioxin 2,3,7,8-TCDD which per definition has a TEF of one.

Common uses

According to the Agency of Toxic Substances & Disease Registry ^[2]:

*Dioxins are not intentionally produced and have no known use. They are the **by-products** of various industrial processes (i.e., bleaching paper pulp, and chemical and pesticide manufacture) and **combustion** activities (i.e., burning household trash, forest fires, and waste incineration). The defoliant **Agent Orange**, used during the **Vietnam War**, contained dioxins. Dioxins are found at low levels throughout the world in air, **soil**, **water**, **sediment**, and in foods such as meats, dairy, fish, and shellfish. The highest levels of dioxins are usually found in soil, sediment, and in the fatty tissues of animals. Much lower levels are found in air and water.*

*CDDs are not manufactured commercially in the **United States** except on a small scale for use in chemical and toxicological research. They are unique among the large number of organochlorine compounds of environmental interest in that they were never produced intentionally as desired commercial products.*

Sources

What are the sources and routes of exposure for dioxins?

Dioxins are produced as by-products of incomplete combustion and some chemical processes, including natural ones.

General sources of exposure

Dioxins enter the physical environment by release during:

- Combustion
- Metal smelting and refining
- Manufacturing of chlorinated chemicals
- Paper bleaching
- Natural biological and photochemical processes
- Mobilization from environmental reservoirs (e.g., stirred sediments)

Specific sources and routes of exposure

Exposure through diet

The major sources of human exposure (96%) are

- Animal fats found in meats
- Full fat dairy products
- Fatty fish (herring, mackerel, salmon, sardines, trout, tuna)

Exposure through air

Breathing incineration gases released from medical, municipal, and hazardous waste incinerators.

Breathing gases released by industrial processes from paper mills, cement kilns, and metal smelters.

Exposure through occupation

People who perform the following types of work can be exposed to dioxins:

- Production and handling of certain chlorinated phenols (such as 2,4,5-trichlorophenol or pentachlorophenol [PCP])
- Production or handling of chlorinated pesticides, such as 2,4-dichlorophenoxyacetic acid (2,4-D) and other herbicides
- Chlorinated pesticide application
- Pressure treatment of wood with PCP and handling of PCP-treated wood
- Production of chlorinated paper at pulp and paper mills
- Operation of municipal solid waste or hazardous waste incinerators
- Hazardous waste clean-up operations

Accidental exposure

Rare cases of high level exposures through industrial accidents such as occurred in Seveso, Italy.

Exposure from waste sites

Potential chronic low level exposure by living next to a hazardous waste site containing dioxins. Currently, in the United States, there are 126 Superfund sites (with a completed exposure pathway) contaminated with dioxins.

Intentional Toxic Equivalent Factors (ITEF) for the **dioxin** congeners of concern (NATO/CCMS) [3]

(T = tetra, P = penta, Hx = hexa, Hp = hepta, O = octa)

For **furan** isomers [4]

References

1. ^ Dioxins And Dioxin-Like Compounds In The Food Supply: Strategies To De-crease Exposure Food and Nutrition Board (FNB), Institute of Medicine
2. ^ Dioxins -- ToxFAQs™: Chemical Agent Briefing Sheets (CABS)
3. ^ Seveso II directive Annex 1, part 1)
4. ^ <http://www.pacelabs.com/services/analytical-services/specialty-analytical-services/dioxins-furans/dioxin-furan-specific-isomers-toxic-equivalent-factors.html>

External links

<http://www.pacelabs.com/services/analytical-services/specialty-analytical-services/dioxins-furans/dioxin-furan-specific-isomers-toxic-equivalent-factors.html>

Dioxin Homepage