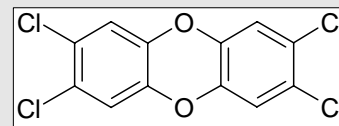


Dioxins



2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD)

Introduction

Dioxins is a general term for polychlorinated dibenzo-*p*-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and dioxin-like polychlorinated biphenyls (PCBs), which share similar chemical and toxicological properties with 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD), the reference compound for dioxin-like toxicity. Trace amounts of dioxins are unintentionally formed during the manufacture of chlorinated compounds, such as phenols, phenoxy acids and polychlorinated biphenyls as well as during various combustion processes such as refuse incineration and the manufacture of iron and steel. Vehicle exhaust fumes and chlorine bleaching of paper were previously significant sources of dioxins. In order to assess the total effect of all dioxin-like compounds present in different environmental matrices, the toxic equivalent factor (TEF) system has been established. All congeners included in the TEF system have received a potency factor relating it to the toxicity of TCDD. The TEFs together with congener concentrations can be used to calculate the total toxic equivalency (TEQ) of a mixture or environmental sample, which is equivalent to the TCDD concentration producing the same toxicity.

Human exposure

Humans are exposed to dioxins mainly via food, with the highest levels found in fatty food of animal origin such as fish, milk, and meat. The developing fetus is exposed to dioxins via placental transfer and the infant via the mother's milk. The average daily intake of dioxins in the EU is estimated to be 1.3-3.0 pg TEQ/kg body weight for adults, 2.5-4.5 pg/kg body weight for infants and small children, and considerably higher for breast-fed infants. The levels of dioxins in fish and in mother's milk have decreased since the 1970s, but the decrease rate has declined in recent years and current environmental levels are in some matrices higher than in the 1990s.

Health hazards

Cancer, immune deficiency, and disturbed reproduction and development have been observed in several species after long-term exposure to low doses of TCDD. Various types of studies have shown that fetuses are particularly vulnerable. Diabetes, cardio-vascular disease, and osteoporosis are suspected to have a connection with early life exposure to dioxins. A lowest observed adverse effect level (LOAEL, the highest dose tested in animals that did not give rise to any adverse health effects) of 40 ng/kg body weight (maternal steady state body burden) for reproductive effects in male offspring has been established for TCDD based on animal studies. In human epidemiological studies, an association between exposure to low levels of dioxins and effects on the immune system and behavioural changes have been observed. TCDD is also classified as a human carcinogen by the International Agency for Research on Cancer (IARC).

Health based guidance values

EU's Scientific Committee on Food (SCF) has set the tolerable daily intake (TDI) for dioxins (PCDDs and PCDFs) and dioxin-like PCBs to 2 pg WHO-TEQ/kg body weight and day.

Human Health Risks

A considerable proportion of the European population has an average dietary intake of dioxins and dioxin-like PCBs exceeding the TDI and could therefore be considered of risk for negative health effects. The margins between exposure levels in animal studies causing adverse effects and exposure levels in human fetuses and infants are small. Also, the knowledge about early life exposure and negative health effects later in life is insufficient, leading to uncertainties when assessing the health risks.

Bans and restrictions

The European Union has proposed legislative measures to reduce the contamination levels in the environment and in foodstuffs. The Council of the European Union has approved a regulation determining maximum values for dioxins in certain foods. The regulation allows a time-limited exception for the sale of fish from the Baltic Sea that exceed the maximum level, valid within Sweden and Finland until 2011. The exception is associated with annual monitoring of levels and the use of dietary recommendations. Dioxins are listed in the two POP conventions (POP = persistent organic pollutant), the Stockholm Convention and CLRTAP (Convention on Long-range Transboundary Air Pollution).

References

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