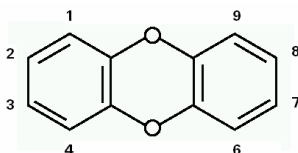


*newsletter***POPs****Dioxins and Furanes**

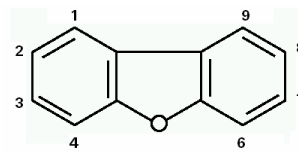
The risk posed to human health by dioxins and furanes has been an issue since the 1980s. Despite measures being taken to reduce concentrations of these toxic substances in the environment and in foodstuffs, a large part of the population still exceeds the maximum daily intake (WHO guide value). For this reason, the EU is planning to specify target values for foodstuffs and animal feeds by 31.12.2004.

**POPs**  
**Dioxins (PCDDs),**  
**Furanes (PCDFs)**

Dioxins and furanes are generic terms for the group of 75 polychlorinated dibenzo-*p*-dioxins (PCDDs) and the group of 135 polychlorinated dibenzofuranes (PCDFs). These numbers are derived from the varying degrees of chlorination of the eight possible positions in the dibenzo-*p*-dioxin or dibenzofurane molecule. Of toxicological interest are only those which show a typical bond of Cl atoms at positions 2, 3, 7 and 8 in the hydrocarbon ring, for only these are able to accumulate in the organisms of mammals. Of interest, therefore, are 7 PCDDs and 10 PCDFs. The most well-known and toxic of the compounds in this class is the 2,3,7,8-tetrachlordibenzo-*p*-dioxin (2,3,7,8-TCDD or "Seveso Dioxin"). A dose of just 1 µg per kg bodyweight is fatal in humans.



Basic structure: Dibenzo-*p*-dioxin (Dioxin)



Dibenzofurane (Furane)

PCDDs and PCDFs belong to the group of poisonous chemicals known as persistent organic pollutants (POPs). They are non-degradable and can accumulate in living creatures (bioaccumulation). Because they are dispersed via the air or water, they are globally present in the environment.

*Literature:* apropos Dioxins, AssTech 1992.

**Usage,**  
**formation**

Dioxins and furanes are not manufactured for a specific purpose. Low-concentration mixtures of different dioxins and furanes are created as the unwanted by-products of various thermal processes involving chlorine, eg in aluminium production, or during the recycling of copper from old wires, cables, and printed circuit boards. Dioxins occur also during the manufacture of certain herbicides or disinfectants, and from the chlorine bleaching process of paper. Considerable amounts of dioxins and furanes are produced when materials containing chlorine are burned (waste incineration), in particular when the

combustion process involves polychlorinated biphenyls (PCBs) as used eg in transformer oils (usage prohibited in Germany since 1978). Moreover, these compounds are produced in everyday combustion processes and are therefore present in, eg car exhaust fumes and cigarette smoke.

### **Toxicity**

People who have suffered considerable exposure to dioxins, either as a result of an accident (eg Seveso, 1976) or via prolonged contact at the workplace often suffer from an illness called chlorine acne - a serious and chronic skin disease. Other, less specific symptoms include liver damage, insomnia, sickness and headaches. Several types of cancer are linked to accident-related dioxin exposure and contact at the workplace (primarily 2,3,7,8-TCDD – rated as carcinogenic for humans as per WHO, February 1997). Although dioxin is a known carcinogenic agent in humans, cancer per se is not regarded as a critical consequence of exposure when it comes to defining tolerable intake levels. The critical effects include neurological changes in behaviour, endometriosis, and suppression of the immune system. Numerous toxicological effects have been observed in plants and animals exposed to dioxins in the wild. These include both chronic and acute symptoms, notably a reduction in reproductivity, along with growth disorders, immunotoxicity and carcinogenicity. However, a clear link between exposure to dioxins and such effects is often difficult to establish. Cases of poisoning can be treated only symptomatically as there is no known antidote. And there are currently no therapeutic options available to combat the long retention period of the substance in the body (half-life of 5–10 years).

### **Human health burden**

Low-key exposure over time (chronic exposure) has a greater impact on human health than a single major exposure resulting from an accident. Thanks to their persistence, dioxins and furanes can accumulate in nature. The mean daily intake of PCDDs in humans in the industrialised nations is several picogrammes of TEQ (toxicological equivalent;  $1 \text{ pg} = 10^{-12} \text{ g}$ ) per kg of bodyweight per day. The maximum acceptable daily intake is of a similar order. Expert opinion varies greatly here. According to the Federal Health Office in Germany (BGA) a daily intake of up to  $1 \text{ pg}$  dioxin per kilogramme bodyweight (=  $1 \text{ pg/kg KG d}$ ) is provisionally acceptable (= general guide value). By contrast, the Environmental Protection Agency in the USA (EPA) puts the tolerable daily intake at just  $0.008 \text{ pg/kg KG d}$  of dioxin.

Around 99% of the overall burden to human health stems from foodstuffs. As dioxins are lipophilic, the highest concentrations are found in milk, milk products, meat and fish. Due to the accumulation of dioxins in human breast milk (Beck et al., bulletin of the Federal Health Office 12/91:564-568), breast-fed babies are a section of the population at particular risk. Since babies and infants absorb more milk relative to their body-weight than adults, the daily impact on their systems can be many times higher.

## Significance

Thanks to numerous legal provisions (ban on additives in petrol, production ban for PCBs and PCPs, etc.), the number of dioxin impacts stemming from the chemicals industry and, in particular, from the sub-sector of chlorinated chemicals has been reduced significantly. That said, the industry must be regarded as the cause of many cases of pre-existing pollution. Today, the prime cause of dioxin-related environmental pollution is incomplete combustion (primarily in industrial, commercial and domestic processes). Although the burden on the environment posed by PCDDs and PCDFs has been reduced considerably over the last 20 years, maximum values are still recorded in individual cases, eg the trigger values for animal feeds of 1.2 ng WHO-TEQ / kg for animal fat. It is for this reason that the international community is striving to reduce further the burden by introducing guide, trigger and remediation values. These will apply especially to animal feeds, regarded as a particularly serious source of impairment. The target values correspond to concentrations of dioxins and dioxin-related PCBs in foods and animal feeds. Exposure of the majority of the population to such concentrations must not exceed the tolerable daily intake set down by the Scientific Committee on Food (SFC). These are to be defined on an EU-wide basis by 31.12.2004.

## Persistent Organic Pollutants

In 2001 the United Nations Environment Programme (UNEP) declared 12 substances as being persistent organic pollutants (POPs). Apart from a few exceptions, all of them were banned. They include:

- Pesticides: aldrin, chlordane, DDT (apart from in certain countries, where used to combat the anopheles mosquito that is known to spread malaria); dieldrin, endrin, heptachlor, hexachlorobenzene, mirex, toxaphene
- Industrial chemicals: polychlorinated biphenyls (PCBs, still permitted in circulation in some countries until 2025, provided that leakage is ruled out);
- By-products: polychlorinated dibenzodioxines and furanes (PCDDs, PCDFs)

The list of POPs is, however, not yet complete and numerous substances may be added according to future procedures defined by the convention.

## Information for the underwriter

The key relevance lies in the field of liability underwriting. POPs such as PCDDs and PCDFs are a many-facetted problem when it comes to assessing the impact to human health and the environment. There are two main standpoints here, namely that which applies the precautionary principle, and the other that is oriented more towards establishing causality. When assessing environmental or product liability risks, we therefore recommend that exposure to POPs is examined carefully. This applies all the more to risks in the chemicals industry and waste incineration in terms of existing pollution and emissions, and to manufacturers of animal feeds in terms of the new limiting values affecting products.

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