

## Dioxins

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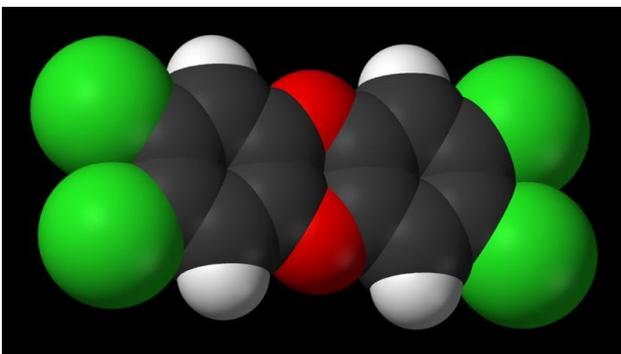
Widespread pollutants, never intentionally made by humanity

'Dioxins' are a group of chemical compounds that are *unintentional* by-products of certain industrial, non-industrial and natural processes, often related to combustion. They are persistent organic pollutants with the many different types of dioxin varying greatly in toxicity, from harmless to very toxic. One of these dioxin compounds, called 'TCDD', is the best studied but most toxic form of dioxin.

### A family of 210 compounds

This large product family consists of no less than 75 dioxins and 135 closely related compounds called 'furans'. The abbreviation of the chemical name is PCDD for the dioxins, PCDF for furans. They are found throughout the world in the environment at very low concentrations. Due to this fact, we all have some 'background exposure' at levels not expected to affect human health.

Dioxin and furan molecules are composed of carbon, oxygen, hydrogen and chlorine atoms, the latter two occurring in variable numbers.



*The most toxic dioxin is 2,3,7,8-TCDD or 2,3,7,8-tetrachlorodibenzo-para-dioxin. The numbers refer to those carbon atoms (black) to which chlorine atoms (green) are attached*

### Dioxin is not deliberately produced

Dioxins and furans are *not* 'produced' on purpose by humans as they do not have any useful function. Dioxins are *generated* in many combustion processes. In nature for example they result from volcanic eruptions, forest fires and are even produced by some fungi. Incomplete combustion (like in wood

stoves or badly managed waste incineration) can emit significant quantities of dioxins. In fact, the US Environmental Protection Agency estimates that the sum of all 'uncontrolled combustion' (natural or due to 'unintentional' human activity) is by far the largest source of dioxins (about 57%). Dioxins also form in cigarette and cigar smoke.

Dioxins and furans can also be emitted in limited quantities by industrial processes including smelting, the production of steel and non-ferrous metals (copper, nickel, magnesium etc.), the manufacturing of some pesticides and some reactions with chlorinated substances.

According to national emissions inventories in European countries such as Germany, the UK, the Netherlands and Sweden, the chemical industry is not a major source of dioxins/furans. In Germany, the chemical industry is not even mentioned by the authorities in their [list of dioxin sources](#).

### Properties of dioxins

Because they have a melting point of about 320°C, dioxins are solid at ambient temperature. However, in combustion processes, dioxin molecules can be released and dispersed in air.

Dioxins are practically insoluble in water, but are soluble in oils and fats. As a consequence, they readily adsorb and accumulate in organic matter, sediments, suspended solids, fly ash, soot and the fatty tissues of organisms. Dioxins is not found at significant levels in water, except adsorbed onto solid particles in suspension.

### How can we be exposed to dioxins?

As dioxins are soluble in fats, more than 90% of human exposure to dioxins is via food, mainly meat and dairy products, fish and shellfish.

When accidents in the food chain occur, a secondary contamination of the food supply can take place. In 1999 for instance, high levels of dioxins were found in poultry and eggs in Belgium. The cause was traced to animal feed that was contaminated with non-edible, industrial oil containing dioxins. This should, of course, be strictly avoided.

Other sources can be gases from uncontrolled combustion sources or cigarette smoke.

Very low levels of dioxins have been detected in ambient air. Some attaches to particulates and eventually settle in sediments, soils, grass or crops.

### Effects of dioxins on human health

Only 17 of the 210 dioxin-family compounds have been reported to have toxic effects. Their toxicity level is compared to the most toxic dioxin, 2,3,7,8-TCDD and often [expressed as TEF](#) (Toxic Equivalency Factor).

**Short-term exposure** of humans to high levels of dioxins may result in skin lesions, such as chloracne and patch darkening of the skin, and altered liver function.

**Long-term exposure** is linked to impairment of the immune system, the nervous system, the endocrine system (hormone system) and reproductive functions. Chronic exposure of animals to dioxins has resulted in several types of cancer.

The dioxin family was evaluated by the World Health Organisation (WHO) and its International Agency for Research on Cancer (IARC) in 1997. Based on animal data and on human evidence, 2,3,7,8-TCDD was classified as 'known human carcinogen, category 1'. However, TCDD does not affect genetic material, and there is a level of exposure below which cancer risk would be negligible.

(Source: [WHO Fact Sheet N° 225, May 2010](#)).

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Because dioxins are also soluble in milk fat, the debate has been going on for many years whether breast-feeding of infants is safe. Indeed, their daily intake during the (relatively short) breast-feeding period could be higher than the WHO daily safety level for a lifetime. Nevertheless, WHO's position is that at current exposure levels, known benefits of breast-feeding outweigh any potential risks.

### How can we limit exposure?

Trimming fat from meat and consuming low fat dairy products may decrease exposure to dioxin compounds. Also, a balanced and varied diet, including adequate amounts of fruit, vegetables and cereals will help to avoid excessive exposure from a single source. These measures are probably most relevant for pregnant women in order to reduce exposure of the developing foetus and when breast-feeding infants.

All EU countries have food contamination monitoring systems. These ensure that safety limits are not exceeded. Also, good controls and practices during food production, processing, distribution and sale are essential to the production of safe food.

In industry and waste incineration, strict control of the processes is necessary to reduce the formation of dioxins. Incineration of potentially contaminating material (like medical waste and hazardous waste) should only be done at temperatures above 850°C in facilities equipped with proper exhaust gas treatment.

### Euro Chlor position

- Euro Chlor supports further research to understand and quantify the effects of dioxins on human health.
- We favour the development of new processes and technologies to minimise the formation and emission of dioxin into the environment from industrial activities.
- Even though human exposure to dioxins is very low and unlikely to pose risks, we believe that raising the standards and environmental controls on incineration and production processes represent a positive step towards the further protection of public health.

Much more about chlorine on [www.eurochlor.org](http://www.eurochlor.org).

Chlorine chemistry applications: [www.chlorinethings.eu](http://www.chlorinethings.eu)

