Public Health England

Dioxins (2,3,7,8-Tetrachlorodibenzo-*p*-dioxin)

General Information

Key Points

Identity

- The term dioxins refers to a group of 210 compounds with similar chemical structures but greatly varying toxicity
- The most toxic dioxin is 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) and most of the available data refer to this compound

Fire

- Non flammable
- Decomposes when exposed to UV light
- Emits toxic fumes of hydrogen chloride and chlorine when heated to decomposition or on exposure to UV light

Health

- Dioxins are toxic by inhalation or ingestion
- Ingestion of dioxins in humans can lead to adverse effects on the skin, including a severe and persistent acne (chloracne), skin rashes or discolouration and excessive body hair
- Changes in the blood and urine, liver damage or changes in hormone levels may also occur
- Exposure to very high levels of dioxins may cause vomiting, diarrhoea, lung infections and damage to the nervous and immune systems
- TCDD is classified as causing cancer in humans
- TCDD produces a range of toxic effects on reproduction relating to both fertility and developmental toxicity in animals

Environment

- Avoid release into the environment
- Inform Environment Agency of substantial incidents

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2008
Version 1

Background

Dioxins are the general name for a group of 210 compounds of similar structures, which differ due to the amount of chlorine in the molecule and where the chlorine is bound. These compounds, known as polychlorinated dibenzo-dioxins and polychlorinated dibenzofurans, vary greatly in toxicity. Most of these compounds pose no threat to health at the levels commonly found in the environment but 17 of them are of more concern. The most toxic is 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD). Dioxins are non-flammable, colourless solids or crystals at room temperature with no perceptible odour.

Dioxins may be formed during natural processes such as incomplete combustion – for example, during forest fires. Dioxins are not produced commercially, but very small amounts may be formed during the production of some solvents and when chlorinated organic matter and fossil fuels are burnt. Very small amounts may therefore be formed during industrial, domestic and municipal incineration. Small amounts are also released during metal smelting, processing and refining and during the use of chlorine for bleaching of pulp in paper mills.

Dioxins have been detected at low levels in cigarette smoke and motor vehicle emissions.

Dioxins can remain in the environment for a long time and soils and sediments, which are contaminated with dioxins, can release low levels back into the atmosphere. However, dioxins can be broken down following exposure to UV light.

Dioxins have been found to be present in very small amounts in some food products including meat, dairy products and fish.

Dioxins are toxic by ingestion or inhalation. Most non-occupational exposure to dioxins is via ingestion through consumption of food contaminated with dioxins.

The principal adverse health effect of exposure to dioxins is a form of acne known as chloracne. This is a severe skin disease which mainly affects the face and upper body with acne-like spots that may be present many years after exposure. Exposure to high levels of dioxins may also cause rashes, redness, discolouration of the skin and excess body hair. Liver damage has been observed in individuals exposed to high levels of dioxins.

Children exposed to dioxins would be expected to display similar effects to those seen in exposed adults, although appear to be more sensitive than adults. Experiments in animals suggest that TCDD may reduce fertility and causes adverse developmental effects, particularly in the development of the male reproductive system. There is some evidence from mothers being exposed to dioxins due to the accidental release in Seveso, Italy, that the ratio of boys to girls being born was altered, and babies had thyroid problems.

The International Agency for Research on Cancer has classified TCDD as causing cancer in humans. However, it has concluded that it is not possible to classify the other forms of dioxins as to their ability to cause cancer in humans.

Frequently Asked Questions

What are dioxins?

Dioxins is the general name for two groups of 210 compounds with similar structures known as polychlorinated dibenzo-dioxins and polychlorinated dibenzofurans, of which 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) is the most toxic. Dioxins are non-flammable, colourless solids or crystals at room temperature with no perceptible odour. Dioxins are not produced intentionally as they have no commercial use.

How do dioxins get into the environment?

Dioxins may be present naturally during forest fires and may be produced as by-products of industrial processes. Small amounts may also be formed during domestic, municipal and industrial incineration processes or from metal smelting and refining. Dioxins are also found in small quantities in cigarette smoke and vehicle emissions. Dioxins may be present in contaminated soils and sediments where they may remain for a long time without being broken down. Industrial accidents have occurred in the past, such as in Seveso, Italy in 1976 in which high amounts of TCDD were accidentally released into the environment. However, due to strict regulations this is unlikely to occur again.

How will I be exposed to dioxins?

The main way in which people are exposed to dioxins is by eating food contaminated with them. Food such as meat, dairy products and fish may contain dioxins in very small amounts. Dioxins may be inhaled if they are present in the atmosphere but this is a minor way people may be exposed compared to food.

If there are dioxins in the environment will I have any adverse health effects?

The presence of dioxins in the environment does not always lead to exposure. Clearly, in order for it to cause any adverse health effects you must come into contact with it. You may be exposed by breathing, eating, or drinking the substance or by skin contact. Following exposure to any chemical, the adverse health effects you may encounter depend on several factors, including the amount to which you are exposed (dose), the way you are exposed, the duration of exposure, the form of the chemical and if you were exposed to any other chemicals.

Dioxins vary in how poisonous they are from being highly toxic to virtually non-toxic. The most poisonous form of dioxin is TCDD. Many of the other dioxins are many times less toxic.

At the levels which occur in food and the environment, dioxins have no immediate effect on health if you are exposed for a short period of time. The potential risks to health come if you are exposed for a long period of time. Experiments in animals have shown that dioxins can affect the immune and reproductive system. It is therefore important that the intake of dioxins is below that safety limits (tolerable daily intake) and that levels in the environment remain low.

Very high concentrations of dioxins (usually TCDD), compared to normal environmental levels, can cause an acne-like condition known as chloracne. This is a severe skin disease that mainly affects the face and upper body with acne-like spots, which may last several years after the exposure. Chloracne is difficult to cure and can be disfiguring. Exposure to

high levels of dioxins may also cause rashes and redness, discolouration of the skin and an excess of body hair, as well as vomiting, diarrhoea, lung infections and damage to the nervous and immune systems. Liver damage has been observed in individuals exposed to high levels of dioxins. However, these effects have only been seen in cases of deliberate poisoning and, in the past, in people working with chemicals contaminated with dioxins, or following industrial accidents.

Can dioxins cause cancer?

Dioxins can cause cancer in laboratory animals and there is evidence to suggest that exposure to dioxins at work in the past or following industrial accidents has been associated with an increase in the incidence of cancer in humans. The International Agency for Research on Cancer (IARC) has classified TCDD as a chemical which can cause cancer in humans. However, the IARC decided that it was not possible to classify the other forms of dioxins as to their ability to cause cancer in humans.

Do dioxins affect children or damage the unborn child?

Children are expected to be affected by dioxins in the same way as adults, although they may be more sensitive than adults.

Experiments on animals indicate that TCDD may reduce fertility and that exposure during pregnancy may produce adverse effects of the developing offspring. Provided that exposures to dioxins are below the recommended safety limits (tolerable daily intake) there would be no cause for concern.

What should I do if I am exposed to mixtures of dioxins?

It is very unlikely that the general population will be exposed to a level of dioxins high enough to cause adverse health effects.