

Dioxin

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Dioxin Key Facts

- Dioxins are called [persistent organic pollutants \(POPs\)](#), meaning they take a long time to break down once they are in the environment.
- Dioxins are [highly toxic and can cause cancer](#), reproductive and developmental problems, damage to the immune system, and can interfere with hormones.
- Dioxins are found throughout the world in the environment, and they accumulate in food chains, concentrating mainly in the fatty tissue of animals.
- More than 90% of typical human exposure is estimated by EPA to be through the intake of animal fats, mainly meat, dairy products, fish, and shellfish.

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What is Dioxin?

Dioxins refers to a group of toxic chemical compounds that share certain chemical structures and biological characteristics (see figure 1). Several hundred of these chemicals exist and are members of three closely related families:

- polychlorinated dibenzo-p-dioxins (PCDDs)
- polychlorinated dibenzofurans (PCDFs)
- certain [polychlorinated biphenyls \(PCBs\)](#)

Although hundreds of PCDDs, PCDFs, and PCBs exist, only some are toxic, those with the chlorine atoms in specific positions. Counting around the carbon rings, those with chlorines at positions 2, 3, 7, and 8 are toxic (see figure 1). The dioxin-like PCBs have both biphenyl rings in the same plane (flat appearance), which allows them to act like dioxins in the body.

PCDDs and PCDFs are not created intentionally but are produced as a result of human activities like the backyard burning of trash. Natural processes like forest fires also produce PCDDs and PCDFs. PCBs are manufactured products, but they are no longer produced in the United States.

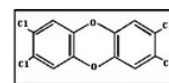
What does dioxin look like?

Pure dioxin looks like white crystalline needles. In the environment, however, it generally is dispersed and attached to soil and dust particles and is invisible to the eye.

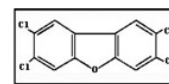
Where does dioxin come from?

Industrial activities: Dioxin is not produced or used commercially in the United States. It is a contaminant formed during the production of some chlorinated organic compounds, including a few herbicides such as Silvex. Over the past decade, EPA and industry have been working together to dramatically reduce the production of dioxin and its release to the environment.

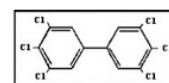
Figure 1: Dioxin chemical structures



2,3,7,8-Tetrachlorodibenzo-p-dioxin



2,3,7,8-Tetrachlorodibenzofuran



3,3',4,4',5,5'-Hexachlorobiphenyl

Most Toxic Dioxin

The most studied and most toxic of all dioxins is **2,3,7,8-**

Although environmental levels of dioxins have decreased in the last 30 years, dioxins are extremely persistent compounds and break down very slowly. In fact, a large part of current exposures to dioxins in the United States is due to releases that occurred decades ago (e.g., pollution, fires).

tetrachlorodibenzo-p-dioxin. In 2012, EPA released an [updated IRIS assessment](#) on this chemical.

Even if all human-generated dioxins were eliminated, low levels of naturally produced dioxins would remain. EPA and its government partners are looking for ways to further reduce dioxins entering the environment and to reduce human exposure to them.

Other ways dioxins are produced:

Burning: Combustion processes such as waste incineration (commercial or municipal) or burning fuels (like wood, coal or oil) form dioxins.

Dioxins are formed as a result of combustion processes such as ... burning fuels like wood, coal or oil.

According to [EPA's 2006 Dioxin Inventory of Sources Report](#) man-made emissions, including backyard and household trash burning, dominated releases in the United States. The report also acknowledges the need for more data on natural sources, such as forest fires, that can form dioxins.

- [Dioxins produced by backyard burning](#)

Bleaching: Chlorine bleaching of pulp and paper and other industrial processes can create small quantities of dioxins in the environment.

Smoking: Cigarette smoke also contains small amounts of dioxins.

Drinking Water: Dioxin can get into drinking water from:

- Air emissions from waste incineration and other combustion, with subsequent deposition to lakes and reservoirs
- Deposition from air to soils that erode into surface waters used for drinking water
- Discharges into water from chemical factories.

Learn more about dioxin in drinking water from this [table of regulated drinking water contaminants](#).

How can dioxin affect my health?

Dioxins are highly toxic and can cause cancer, reproductive and developmental problems, damage to the immune system, and can interfere with hormones.

Related Resources

- [More information about common sources of exposure](#)
- [FDA's Chemical Contaminants: Dioxin](#) [↗](#)
- Questions and answers about dioxin and food safety - Dioxin Related Activities (Feb 2012) (Joint FDA and EPA) is no longer available on the FDA website, see the [USDA Food Safety and Inspection Services Guidelines](#) [↗](#) for the latest information on food safety.

Environmental Laws that Apply to Dioxin

- [Comprehensive Environmental Response, Compensation and Liability Act \(CERCLA\) / Resource Conservation and Recovery Act \(RCRA\)](#)
- [Hazardous Air Pollutants for Hazardous Waste Combustors and Clean Air Act](#)
- [Toxic Substances Control Act \(TSCA\)](#)
- [Emergency Planning and Community Right-to-Know Act \(EPCRA\)](#)
- [Safe Drinking Water Act \(SDWA\)](#)

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) / Resource Conservation and Recovery Act (RCRA)

In 2009, former Administrator Lisa Jackson directed EPA to accelerate work underway to reassess the human health risks from exposures to dioxin. One aspect of this reassessment was developing interim preliminary remediation goals (PRGs) for dioxin in soils.

PRGs are goals for lowering the concentration of specific chemicals in particular media. Media types include soil, sediment,

and water at CERCLA (also known as Superfund) sites, federal facilities, and regulated waste, or RCRA, sites. EPA and responsible parties use PRGs as target concentrations during initial development, analysis, and selection of cleanup options.

PRGs are designed to

- protect human health and the environment
- comply with all applicable, relevant and appropriate regulations (ARARs) for all exposure pathways being addressed.

For more information, see:

- [Risk Assessment for Dioxin at Superfund Sites](#)
- [Summary of the Resource Conservation and Recovery Act](#)
- [Process for Developing Dioxin Cleanup Decisions at Superfund Sites](#)
- [Treatment Standards for Hazardous Wastes Subject to Land Disposal Restrictions](#)

Learn more about the [Superfund clean-up process](#)

Need help on CERCLA/RCRA? Contact the [Superfund helpdesk](#).

Hazardous Air Pollutants for Hazardous Waste Combustors and Clean Air Act

The rule established national emission standards for hazardous air pollutants (like dioxins) for sources that burn hazardous waste. These sources are commercial and onsite incinerators, cement kilns, lightweight aggregate kilns, boilers, and hydrochloric acid production furnaces.

These standards were promulgated pursuant to Section 112 (d) of the Clean Air Act (CAA). That section requires EPA to issue standards reflecting the best performing industry sources, known as the Maximum Achievable Control Technology (MACT).

After EPA issued the 2005 emission standards, the Administrator received four petitions for reconsideration of the National Emissions Standards for Hazardous Air Pollutants (NESHAP) final rule. EPA granted the petitioners' requests for reconsideration and provided the public with an opportunity to comment on a proposed rule to amend the emissions standards. On October 8, 2008 EPA published a rule announcing the final action regarding the eight issues for which EPA granted reconsideration.

More information:

- [Hazardous Waste Combustors: National Emission Standards for Hazardous Air Pollutants \(NESHAP\)](#)
- [Hazardous Waste Combustors Microsoft Access Database Supplemental Documents](#)
- [Hazardous Waste Permitting](#)
- [How Do I Find Hazardous Waste Management Facilities in My Area?](#)
- [Summary of the Clean Air Act](#)

Congress added Section 129 to the CAA in 1990 specifically to address emissions from solid waste combustion. Sections 111 and 129 require EPA to establish New Source Performance Standards (NSPS) for new units. Sections 111(d) and 129 require the Agency to establish Emission Guidelines (EG) for existing units.

Both the NSPS and the EG under section 129 use a MACT-like approach as used under section 112. NSPS are direct federal regulations that apply to new sources. EG do not directly regulate solid waste combustion units. Rather, EG establish requirements for state plans to implement the guidelines. Once approved, the state plans become federally enforceable.

For further information see the [CAA guidelines and standards for waste management](#). Section 129 includes a list of the waste incineration rules.

Toxic Substances Control Act (TSCA)

Under TSCA section 8(e), any person who manufactures (including imports), processes, or distributes in commerce a chemical substance (including, generally, dioxin) or mixture and who obtains information which reasonably supports the conclusion that such substance or mixture presents a substantial risk of injury to health or the environment to immediately inform EPA, except where EPA has been adequately informed of such information.

Under 40 CFR part 766, testing by manufacturers and processors of certain specified chemical substances to ascertain whether those substances may be contaminated with halogenated dibenzodioxins (HDDs)/dibenzofurans (HDFs) is required under TSCA section 4, and under TSCA section 8 manufacturers and processors of certain chemicals are required to report certain information to EPA.

More information:

- [Summary of the Toxic Substances Control Act](#)
- [TSCA section 8\(e\) Substantial Risk Notifications](#)
- [40 CFR Part 766 - Dibenzo-para-dioxins/dibenzofurans](#) [↗](#)
- Need help on TSCA questions? Contact the [TSCA hotline](#) by email at tsc hotline@epamail.epa.gov or phone 202-554-1404.

Additional Resources:

- [Technologies for Cleaning Up Contaminated Sites](#)
- [Remediation Technologies for Cleaning up Contaminated Sites](#)
- [Greener Cleanups](#)
 - [A Citizen's Guide to Greener Cleanups](#) (2012)
 - [A Citizen's Guide to Incineration](#) (2012)
- [How Do I Find Hazardous Waste Management Facilities in My Area?](#)

Emergency Planning and Community Right-to-Know Act (EPCRA)

Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) requires certain facilities manufacturing, processing or otherwise using listed chemicals to report their environmental releases of such chemicals annually. The list of reportable chemicals, known as the EPCRA section 313 list and also referred to as the Toxics Release Inventory, or TRI list, was originally identified in the statute and was comprised of more than 300 individual chemicals and 20 chemical categories.

More information:

- [Summary of the Emergency Planning and Community Right-to-Know Act](#)
- [Toxics Release Inventory \(TRI\) program](#)
- [Emergency Planning and Community Right-to-Know Act Section 313 Guidance for Reporting Toxic Chemicals within the Dioxin and Dioxin-like Compounds Category](#)
- [Dioxin and Dioxin-like Compounds Toxic Equivalency \(TEQ\) Information](#)
- Need help on TEQ's? Contact the [TRI Information Center](#).

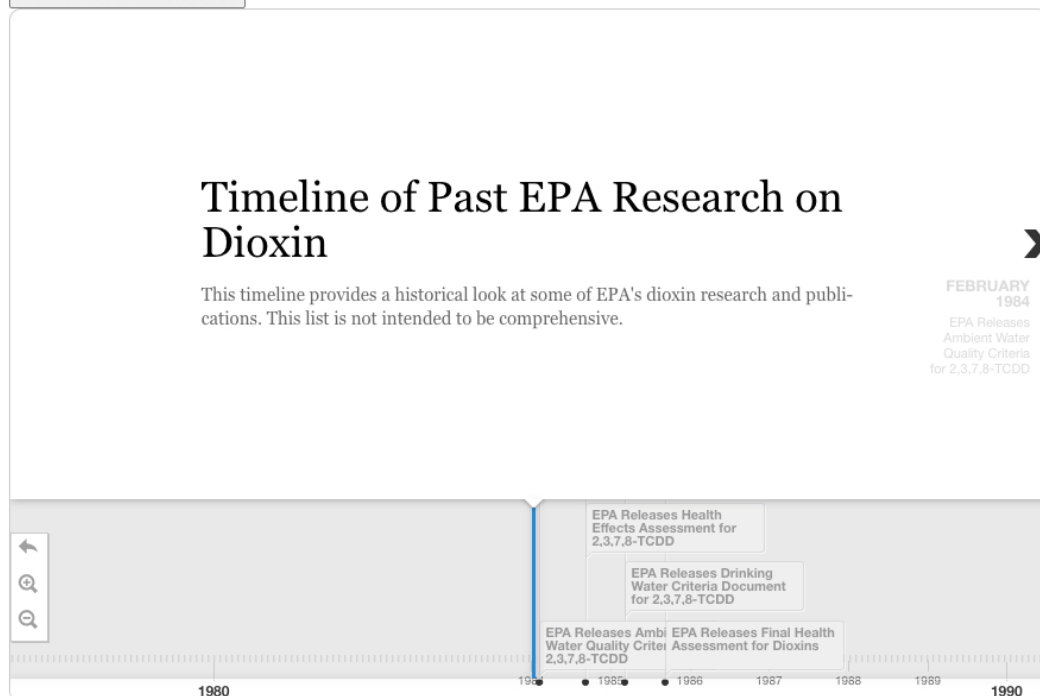
Safe Drinking Water Act (SDWA)

Under the Safe Drinking Water Act (SDWA), EPA has established a maximum contaminant level for dioxin in drinking water. Learn more about how EPA regulates contaminants under the SDWA and the drinking water regulations for dioxin on these pages:

- [Regulating Public Water Systems and Contaminants Under the Safe Drinking Water Act](#)
- [Basic Information about Dioxin \(2,3,7,8-TCDD\) in Drinking Water](#)
- [Pulp, Paper and Paperboard Effluent Guidelines](#)
- Need help with safe drinking water? visit the [contact us about your drinking water](#) website.

History of Dioxin

[View the list of milestones](#)



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