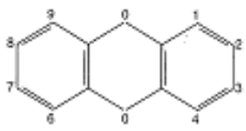
Dioxins in Herbicides – a primer

Most weedkillers for turf are "phenoxy herbicides". They are contaminated with dioxins.
Dioxin in Agent Orange was notorious, but what forms are being spread today?
What are the health effects of today's herbicides? Are Canadians still suffering from previous spraying?

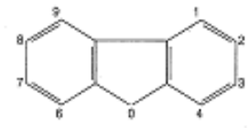
What are Dioxins?

Dibenzo-*para*-dioxins ("dioxins") are toxic chemicals that break down extremely slowly in the environment. They are among the most toxic compounds made by man, and some are targeted for elimination. Dioxins bioaccumulate - they collect in fatty tissue, and become concentrated in animals higher up the food chain. They are almost exclusively man-made, and they are now everywhere in our environment and in people's bodies – even before birth and in mothers' milk. [1,2]

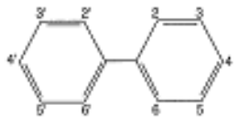
There are 76 different chlorinated dioxins, distinguished by the number (0 to 8) and arrangement of chlorine atoms in the labelled positions around dioxin's three-ring structure. Other chemicals that cause "dioxin-like" health effects include furans and polychlorinated biphenyls (PCBs).



dioxin



furan



biphenyl

Where do dioxins come from?

Dioxins are formed during chemical manufacturing (especially pesticides), chlorination and burning of waste in pulp and paper making, and high temperature processes such as metal sintering and waste incineration.

Why and how are dioxins toxic?

Dioxins that have chlorine atoms in at least the 2,3,7 and 8 positions bind to the "aryl hydrocarbon receptor" (AhR) in cells. This starts off a variety of reactions that affect the immune, reproductive, endocrine and neurological systems. Diseases associated with Agent Orange contamination with 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) include many cancers, diabetes, birth defects, chloracne and neurological problems.[3] There are 17 such dioxins, that are regulated internationally. Virtually all the toxicity literature deals with the strongest-binding one – 2,3,7,8-TCDD.

The other 58 dioxins are not monitored or regulated, but they are toxic as well – although there is little if anything published about them. It is difficult to prepare and test this large number of chemicals, but an entire family of very similar chemicals (polynuclear aromatic hydrocarbons) are biologically active and cause many illnesses.[4] Dioxins also have toxic effects that do not involve the AhR.[5,6,7,8,9] Furthermore, the toxicities (carcinogenicity, neurotoxicity, immunological and reproductive toxicities) that had been associated with 2,4,5-T continue to be reported by independent researchers, in connection with other phenoxy herbicides.[10,11,12,13, 14,15]

What about dioxins in herbicides?

Dioxins are always produced when making phenoxy herbicides. It is just a matter of what kind and how much.

Agent Orange was a mixture of the phenoxy herbicides 2,4,5-T and 2,4-D, used to kill broad leaf plants. Crude manufacturing in the 1950's and 1960's meant that 2,4,5-T was heavily contaminated with 2,3,7,8-TCDD. This was blamed for illnesses and birth defects in the Vietnamese and Vietnam war veterans, as well as in New Brunswick power workers who used "Brushkill". 2,4,5-T was banned world-wide in the late 1970's and early 1980's.

In 1990, Environment Canada identified phenoxy herbicides (such as 2,4-D, mecoprop and dicamba used to kill weeds) as the second-largest chemical source of dioxins contaminating the Canadian environment, after contamination of pentachlorophenol wood preservative. [16] Unlike the wood preservative contaminants, today's phenoxy herbicide dioxins are not among the 17 regulated forms. 2,4-D is contaminated with dioxins with two or three chlorine atoms, rather than four,[17,18] but these are not being examined in the re-assessment of 2,4-D.[19]

How are dioxins regulated and monitored?

The 17 dioxins with four or more chlorine atoms, which are toxic via the AhR, are regulated internationally and are targeted for elimination. In Canada they fall under the Canadian Environmental Protection Act (CEPA), and numerous other acts and regulations at the federal and provincial level, including the Pest Control Products Act. Track 1 Substances under CEPA also include dioxins with 0 and 3 chlorine atoms, but dioxins with 1 and 2 chlorine atoms are not regulated. These additional dioxins are generally not reflected in other statutes.

Only 17 dioxins are measured when using the US Environmental Protection Agency (EPA) method used for analysis – it does not include dioxins with fewer than 4 chlorine atoms. This is the standard method called for by Canadian regulators as well.

Dioxins are reported as "toxic equivalents" (TEQ) – the mass of 2,3,7,8-TCDD that would bind the AhR in an equivalent manner. 2,3,7,8-TCDD binds the AhR most strongly, and is considered the most toxic dioxin. The other 16 are pro-rated according to how strongly they bind the AhR. This method assigns much lower values to the other 16 regulated dioxins, and zero toxicity to the 59 dioxins that do not bind to the AhR. The TEQ is much less than the mass of the regulated dioxins, as seen in reports from Dow Chemical and the Chlorine Council (the EPA recently required reporting of the total mass of the 17 dioxins measured, as well as the TEQ). [20,21]

The TEQ scheme is based on a relatively simple lab test. This easy way to categorize toxicity of a large number of toxic chemicals, including some PCBs and furans, left the majority of similar toxic chemicals unregulated.

Although the 59 other dioxins are not monitored, there is no reason to believe that they are not at least as prevalent. Indeed, since they have escaped the scrutiny of regulatory agencies, manufacturers may not have made efforts to decrease their production. Indeed, there may be an incentive *not* to minimize dioxin contamination, because during manufacturing of phenoxy herbicides there is a trade-off between dioxin contamination and speed of conversion and yield of herbicide. It was the "quick and dirty" war-time manufacturing of Agent Orange that led to high levels of contamination with 2,3,7,8-TCDD.

What does this mean for CFB Gagetown?

Veterans and neighbours of CFB Gagetown are suffering ill health apparently related to spraying of herbicides from the 1950's to the 1980's. Investigations of dioxin contamination by the federal government are only examining water, air, soil, vegetation and sediment. Dioxin levels will be highest in the fat of animals, such as fish, and wildlife (samples of moose and deer could be donated during hunting season). This is the usual way to sample the environment for dioxins, but is not occurring at CFB Gagetown.

The only dioxins being analysed for are the 17 AhR binding ones. The dioxin contaminants of 2,4-D or other herbicides will not be examined.

There are twice as many analyses being done for the herbicides 2,4-D and 2,4,5-T (these would be expected to have degraded decades ago) as there are for dioxins. A large number of "no detection" may be politically expedient, but not informative.

Other toxic, persistent, bioaccumulative substances that should be examined as well include arsenic and hexachlorobenzene, and doubtless others.

Wildlife, and human testing, of blood, fat and breast milk, for the full range of toxic pollutants is called for.

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