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DIOXINS - PRIMER AND COMMENTARY

by
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Several thousand people, primarily male teenagers or young adults, subject themselves to potential physical damage, including brain damage and in some cases death, by purposely inhaling solvents and propellants. The street name is "huffing". Over half claim that they would not have "huffed" if they had known it was dangerous.

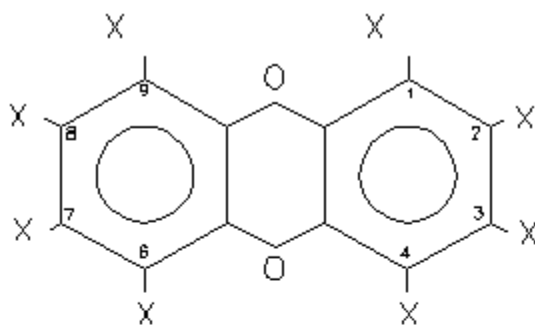
On the other hand, we have people who have an extreme fear of man-made chemicals. In both cases it is a general lack of knowledge that creates the majority of the problem. It would be naive to believe that education alone will prevent some people from abusing their bodies with chemicals or cause others to throw off their fear and sing the praises of chemicals.

We must see chemicals that surround us for what they are: some are good, some are bad, most are benign, and we must use our knowledge to discern the difference. There is no purpose here in discussing the damaging properties of solvents and how harmful the practice of "huffing" certainly is. Anyone who receives Tech Notes is going to be well aware of this. However, it is worthwhile to shed some light on the other end of the spectrum.

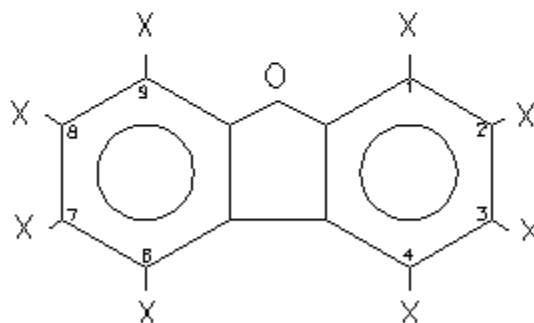
One of the most feared set of compounds are the polychlorinated dibenzodioxins and polychlorinated dibenzofurans (PCDDs and PCDFs), frequently shortened to "dioxins and furans" or merely "dioxins". The use of these short names has led to a certain amount of confusion in the public. As an example, it is common for chlorinated solvent manufacturers to add a chemical stabilizer to their products called, "p-dioxane" (also called: 1,4-dioxane, tetrahydro-1,4-dioxin, tetrahydro-p-dioxin and others). It is not unreasonable for someone without a background in chemistry to think this is the dioxin of story and legend. In this case, p-dioxane is a ring structure comprised of four carbons and two oxygen atoms, with the oxygen atoms located in the para (p) positions; that is, the 1 and 4 positions in the ring. If this compound had only one oxygen, it would be called a "furan". A furan with one oxygen and four carbons in a ring is a compound called tetrahydrofuran (also called butylene oxide, furanidine, hydrofuran and others). This compound is a common solvent used to formulate a glue used to bond PVC pipes together. By definition, a "furan" is "any hetrocyclic ring compound made up of one or more kinds of atoms". By that definition, dioxins are a subset of furans. There are hundreds of compounds that could possess dioxin, dioxane, dioxan, furane or furan in their name. None of which are remotely related to the PCDD's or PCDF's. With so many compounds that have these infamous names, rather than discuss which are not PCDDs or PCDFs perhaps it is better to discuss what PCDDs or PCDFs are.

Rarely does anyone in the media explain what PCDDs or PCDFs are, let alone the toxic equivalency factor (TEF) assigned to each. One would think such important information, needed to understand the risk of "dioxin" emissions, would be carefully and frequently communicated. Sadly, it is not.

A polychlorinated dibenzodioxin is two benzene rings joined together by two oxygen atoms. A polychlorinated dibenzofuran is similar but has only one oxygen atom. These compounds are expressed by the following diagrams.



polychlorinated dibenzodioxin



polychlorinated dibenzofuran

The "X's" can represent either hydrogen or chlorine atoms. If all of the "X's" but one are hydrogen with the one being chlorine, the compound would be called monochlorinated dibenzodioxin (furan). If there were two chlorine atoms, it would be "dichlorinated". If there were three "tri-" and four "tetra-", on through penta (5), hexa (6), hepta (7) and octa (8). In all there are 75 different chlorine/hydrogen combinations of PCDDs and 135 combinations of PCDFs. The number and positions of the chlorines makes a difference in the chemical and toxic properties of individual compounds.

After many years of research, researchers have determined the relative toxicities for the 210 different compounds that make up the PCDDs and PCDFs with the most toxic, 2,3,7,8-tetrachlorodibenzodioxin, being assigned a toxic equivalency factor (TEF) of One (1). The others are assigned values of 0.5, 0.1, 0.05, 0.01, 0.001 or zero. The 210 different compounds breakdown as follows for each TEF.

TEF	Number of Compounds
1	1
0.5	2
0.1	8
0.05	1
0.01	3
0.001	2
zero	193

To calculate the toxic equivalent quantity (TEQ) emitted from a source, the measured quantity of each of these compounds is multiplied by its assigned TEF. Then the results are summed to produce a single TEQ value. It is this TEQ value that is used in calculating the health risk associated with living near a combustion source.

Commentary:

The risk to human health due to dioxin emissions is a source of frequent and heated debate. It is interesting to note that there are 193 of these "most-feared-of-all" compounds (91.9% of the possible 210 compounds) that are considered by researchers to have relative toxicities of zero. If this were not the case, those of us that ate flame-grilled meat, drove in rush hour traffic or sat around a smoky fire would be very ill; but, of course, we're not. The EPA issued their famed dioxin reassessment in June of 1994. Buried in their final conclusion (page 9-87) is the following statement, "...there is currently no clear indication of increased disease in the general population attributable to dioxin-like compounds." The French Academy of Sciences issued a dioxin report as well. The academy's report stated, "PCDD/PCDF...toxicity in man is infrequent and not serious." The report further stated, "no fatal case of poisoning by these products has ever been reported."

As expressed earlier, we must view the chemicals that surround us for what they are: some are good, some are bad, most are benign. It is our knowledge that discerns the difference. It would be interesting to ask these kids that are "huffing", half of which claim they did not know it was dangerous, if they believed inhaling dioxins to be more dangerous than "huffing". Regardless of the answer, we will have lots of educating to do.