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Ruminations

A Chlorine Phase-Out: The Real Way to Reduce Dioxin

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*One hundred years ago, the chlorine industry got its start by making a substitute for sour milk: chlorine water replaced the use of sour milk and sunlight for bleaching cotton cloth. (1) Today, the industry is a global colossus, generating some 800 billion pounds of elemental * chlorine per year. (2) Elemental chlorine, which consists of two conjoined atoms of chlorine, is an extremely reactive, acutely toxic substance. It is entirely a technological product, with no reported natural sources. This chlorine is then used in the manufacture of trillions of pounds of products and by-products. According to an American Chemical Society publication, this massive enterprise has been accompanied by "widespread occupational diseases and environmental damage." (3)*

After a century, the industry's legacy of disease and damage has become a global concern. Organizations and institutions ranging from environmental organizations to international commissions and international conventions have come to similar conclusions: the manufacture of elemental chlorine and/or the manufacture of organochlorines must be phased out. (4,5)

Dioxin has been a deciding factor in this process. *(The term "dioxin" is used here to include all polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs).)* Dioxin and similar complex organochlorines are among the unwanted, but unavoidable by-products that are created throughout the industrial chlorine cycle. These chemical contaminants occur during the manufacture of elemental chlorine. They are created when chlorine is used to make chlorinated chemicals, bleached pulp, PVC plastic, etc. They are formed when the wastes from these processes and discarded products are burned in incinerators, cement kilns and industrial boilers and furnaces. And they are formed when the products are burned intentionally (such as gasoline additives) or accidentally (as in building fires). (6)

Chlorine is an essential component of dioxin. Without chlorine, there is no dioxin. In other words, dioxin cannot be created when chlorine-free chemicals are made by and used in chlorine-free processes.

Dioxin on the Rise

Three sets of information offer compelling reasons for a chlorine phase-out. The first, from the Chlorine Institute, is the growth of the US chlorine manufacturing industry over a 90-year period. The second documents an upward trend in the concentrations of polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs) in archived samples of British soil during the same time. (7) The third set of data estimates the annual dioxin fallout in the US. (8)

It may not seem obvious that the first two trends are comparable: one addresses US chlorine production capacity and the other, dioxin levels in British soils. However, commercial chlorine manufacture began almost simultaneously in the US and the UK. (9) Therefore, dioxin trends in British and US soils can be expected to be generally similar.

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A comparison of the rate and timing of the chlorine industry with that of the environmental dioxin burden leads to an important conclusion: the now global spread of dioxin in the environment coincides with the emergence and expansion of the chlorine industry. (10) Several key studies support this conclusion. For example, modern human tissues carry fifty times more dioxin than ancient tissues. (11) This would not be the case if, as some contend, forest fires were "major sources" of dioxin. (12) After all, humans have coexisted with forests and forest fires throughout their history. Likewise, people in agrarian regions burn wood for heating and cooking. Nonetheless the dioxin concentrations in their tissues are far smaller than those of people in industrialized regions. (13) If, as some contend, dioxin has some natural sources, the dioxin from such sources is far outweighed by that of industrial origin. (14)

Dated sediment cores provide more direct evidence that chlorine manufacture and use is the ultimate source of the dioxin in the bodies of the US population and the environment. The scientists who analyzed the sediment noted that

dioxin levels in the core samples rose at the same time as the rapid, post-1940 growth of the chlorine industry. (15)

As mentioned, the third reason for a chlorine phase-out is the annual dioxin fallout in the US. This refers to the United States Environmental Protection Agency's (USEPA's) estimate of the quantity of dioxin falling from the air onto US soils, lakes, rivers and other surfaces. According to USEPA, the annual fallout of PCDDs and PCDFs is equivalent to 25,000 grams per year of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), the most potent of the PCDDs and PCDFs. (16)

This 25,000 grams of TCDD exceeds USEPA's estimated "acceptable" lifetime intake (for cancer effects only) for some 2.3 trillion adults. [This calculation is based on USEPA's estimation that a lifetime intake of 0.006 picograms per kilogram per body weight per day of dioxin is associated with a cancer risk of one in one million, and the Agency's judgment that a lifetime cancer risk due to dioxin exposure of one in one million is acceptable.] (17) In other words, the amount of dioxin falling on the soils, rivers, lakes, forests, vegetation, crops and croplands in the US each year is 380 times greater than the acceptable lifetime intake for the entire population of the planet.

Dioxin fallout on vegetation and surface water probably follows the most direct route into the bodies of the US population. As an example, cows accumulate dioxin deposited on their forage, passing it along to the people who consume their meat, milk, butter, cheese, and meat. Fish accumulate dioxin deposited in rivers, lakes and estuaries and the dioxin collects in the tissues of those who eat the fish.

Since it is quite resistant to physical and biological degradation, dioxin deposited in soils and sediments is stored there until wind, rain, and various organisms bring it into circulation in the food web. Once within the food web, some portion of the dioxin will eventually make its way into human tissues.

Even if all chlorine production and use were brought to an immediate halt, industrially-produced dioxin would still be circulating in the environment centuries from now. Estimates of the half-life of dioxin range from 9 to 15 years in surface soil and 25 to 100 years in the subsurface.(18) [Half-life is the time required for 50 percent of a substance to be transformed into other substances by physical, chemical and biological means.] With decay taking place so slowly, dioxin concentrations build up quickly in the environment. For example, if the half-life of dioxin in soils and the subsurface were only ten years, an annual deposition rate of 25,000 grams of TCDD would lead to the

accumulation in soils and sediments, over a ten-year period, of more than 200,000 grams of TCDD.

Despite its general dilution in the environment, the dioxin burden in the bodies of US population has already reached levels where, according to USEPA, certain effects may be occurring in some segments of the populations, such as nursing infants and those whose diets are high in native fish. (19)

A Natural Defense

Does the occurrence in nature of a chemical or class of chemicals mitigate the effects of these same or similar chemicals when they are mass-produced by industry? Among those who have publicly adopted such a stance are Gordon Gribble, Philip Abelson and Elizabeth Weisburger (20,21,22,23,24,25). These scientists point to the occurrence in nature of some organochlorines as justification for industry's mass production and dispersal of organochlorines. Following this rationale, the occurrence in nature of the toxin for botulism would be sufficient reason to permit its mass production and dispersal.

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The irrationality of this argument is exemplified by the issue of stratospheric ozone depletion. Ozone depleting chemicals, some of which are organochlorines, have been created by natural processes for millennia. Their creation has taken place at a rate such that depletion of the ozone layer has been balanced by its regeneration. Now, however, scientists have determined that industrially produced organochlorines have destroyed that balance: ozone destruction now exceeds regeneration. (26)

Worldwide, governments and industries have responded with both mandatory and voluntary agreements to phase-out industrial production of the most potent ozone-depleting organochlorines. (27) Their objective is to ensure that industrial activities do not disrupt the natural balance of the stratospheric ozone layer.

Volumes of scientific studies attest to the number and variety of ways in which dioxin and dioxin-like chemicals disrupt the physiological balance in more complex organisms such as rats, birds, humans and similar species at even the lowest exposures. (28) For most species, including humans, this physiological

balance is most vulnerable from conception to birth. During this period, even slight disturbances may cause irreversible abnormalities in entire systems, including the brain and nervous system, immune system, and reproductive system.

Protecting the physiological balance of humans and other species is no less important than safeguarding the balance of the stratospheric ozone layer. In both cases, the threat of catastrophic imbalance can be traced to one root source: the mass production and use of elemental chlorine.

Yes, it is exciting to learn that some organisms produce organochlorines. It is fascinating that volcanoes may produce trace quantities of CFCs, and perhaps even PCBs. (29) And the identification of natural sources of dioxin is of interest. Some of these reported findings may be accurate and, in some cases, they may be the products of laboratory error or, in the case of identifying forest fires as dioxin sources, the failure to determine contributions from deposited and airborne organochlorines of industrial origin. (30,31) In any event, the occurrence of organochlorines in nature does nothing to stop the impairment of the health and reproductive capabilities of humans and other species by those organochlorines produced by the chlorine industry and its satellite industries.

Conclusion

Representatives of the chlorine industry are using suggestions that some dioxin may occur naturally to make the astounding claim that very little dioxin comes from pollution. In June, 1995, the *Wall Street Journal*carried an article by Katherine Kelley in which she claims that incinerators and pulp and paper mills account for only 3% of dioxin emissions while "other and natural sources" make up 82%. (32) This claim flies in the face of scientific knowledge: dioxin concentration in soil, sediment and human tissue is far higher now than before the mass production and use of chlorine began.

A chlorine phase-out is not a new concept. It is certainly not a new thought to industry, as shown by the following statements appearing in a 1989 publication released jointly by Europe's largest chemical manufacturers, waste treatment industries and the Commission of the European Communities:

To judge the role of halogenated organic substances, or rather organic chlorine compounds as industrial chemicals, we cannot see them isolated from the role of chlorine as a whole. ... [O]ne might argue that the only fundamental solution for the environmental problems caused by organo-halogenated products and

their waste is to drastically reduce their produc-tion and restrict their use to closed systems. (33)

A clearer acknowledgment of the problem can hardly be articulated, nor can its solution be more obviously inferred. The chlorine industry is the problem; a chlorine phase-out is the solution.

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