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From the desk of
K. WARREN EASLEY

Cole Webern

X ~~D Wood~~
F Provorny
J R Ortiz

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News Release

FOR FURTHER INFORMATION
Contact: Tom Sinclair or Bob Burt
Phone: (517) 636-9690
Midland, Michigan 48640

FOR IMMEDIATE RELEASE

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DOW REPORTS DIOXINS OCCUR EVERYWHERE
AS RESULT OF NORMAL COMBUSTION PROCESSES

The family of toxic chemicals known as chlorinated dioxins are formed in minute amounts by normal combustion processes that occur everywhere, Dow Chemical scientists reported today. The dioxins include the compounds known as TCDD which are said to be among the most toxic chemicals known to man.

Dow said its research to date has verified the following sources for chlorinated dioxins: refuse incinerators, fossil-fueled powerhouses, gasoline and diesel powered automobiles and trucks, fireplaces, charcoal grills and cigarettes. The company has detected the dioxins in soil samples taken from several cities.

Until now, the dioxins have been viewed as impurities that occur during the manufacture of such chemical products as pesticides and herbicides. The company said there is no need for concern or alarm over the new findings, which Dow considers a key scientific breakthrough.

The discovery and claim that dioxins are ubiquitous, and therefore can be found everywhere, comes after a four month search to explain the presence of 2,3,7,8-TCDD in fish taken from the Tittabawassee River which flows by the Dow plant in Midland. Dow reported finding the TCDD in fish last June and has been on a crash research program to find the source ever since

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Robert R. Bumb, research director of Dow's Michigan Division and head of the task force concerned with the study, explained that new capabilities in analytical chemistry account for the discovery.

"We now think dioxins have been with us since the advent of fire," he reported. "The only thing that's different is our new found ability to detect them in the environment."

Bumb spoke of the "trace chemistries of fire" which produce the dioxins. He said this chemistry, now being understood for the first time, consists of numerous reactions which occur during combustion at very low concentrations in the range of parts per million and lower.

The Dow report said one principal route by which dioxins enter the environment is by way of airborne particulate matter and a second route is by way of waterborne particulate matter. The particulates can come from a wide variety of combustion sources.

"Some thought our pesticide production facilities might be the source of the TCDD. Contrary to that easy assumption, we found the Dow pesticide manufacturing facilities are not measurable sources of the trace levels of dioxins found in the fish taken from the river," Bumb commented.

"It's really been a startling experience for us," Bumb said, "including the fact that much evidence which supports our conclusion is now emerging world wide."

Dow made a report on the findings to state officials this morning and was also sharing its data with the Environmental Protection Agency in Washington.

The need to make an interim report to the State of Michigan prompted today's disclosures. # # #

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Discoveries and Conclusions Excerpted from the Report:

"THE TRACE CHEMISTRIES OF FIRE - A SOURCE OF AND ROUTES FOR THE ENTRY OF CHLORINATED DIOXINS INTO THE ENVIRONMENT"

By

The Chlorinated Dioxin Task Force
The Michigan Division
Dow Chemical U.S.A.

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DISCOVERY

Chlorinated dioxins are ubiquitous. We have concluded their presence is due to the existence of a natural phenomenon, trace chemistries of fire.

Trace chemistries of fire consist of numerous chemical reactions occurring during combustion at very low concentrations, parts per million and lower. The measurable yields of the trace chemical reactions can be as low as 0.0000000001 percent.

The trace chemistries of fire follow two pathways--chemicals reacting at very low yields and low concentration chemicals reacting at high yields.

CONCLUSIONS

The following conclusions are strongly supported:

SOURCES OF CHLORINATED DIOXINS

1. Refuse incinerators and fossil fueled powerhouses are sources of both airborne and waterborne particulates which contain chlorinated dioxins.
2. Gasoline and diesel powered automobiles and trucks are sources of airborne particulates which contain chlorinated dioxins.
3. Fireplaces, charcoal grills, and cigarettes have been identified thus far, as other sources of particulate matter which contain chlorinated dioxins.
4. Michigan Division pesticide production facilities are not measurable sources of the trace levels of chlorinated dioxins found in fish taken from the Tittabawassee River.

CHLORINATED DIOXIN ROUTES TO THE ENVIRONMENT

5. One principal route by which chlorinated dioxins enter the environment is by way of airborne particulate matter.
6. A second route by which chlorinated dioxins enter the environment is by way of waterborne particulate matter.

ADDITIONAL CONCLUSIONS

7. The emission of chlorinated dioxins from combustion sources can be minimized. It is not possible at the present time to eliminate chlorinated dioxins in the combustion process.
8. The quantities previously reported as apparent TCDD and thought to consist exclusively of 2,3,7,8-tetrachlorodibenzo-p-dioxin have been shown in this study to consist of as many as sixteen different isomers of tetrachlorodibenzo-p-dioxin in addition to the 2,3,7,8-isomer.
9. Additional chlorinated compounds were observed in this study and apparently arise from combustion. These compounds include chlorinated dibenzofurans, decachlorobiphenyl, polychlorinated terphenyls and other unknowns.
10. The reductive conditions of combustion favor the formation of the lower chlorinated dioxins while the oxidative conditions found in nature favor the higher chlorinated dioxins.

DISCUSSION

Samples were gathered from the stacks of refuse incinerators, chemical tar burners, and fossil fueled power plants; and the mufflers of automobiles and trucks, the chimneys of fireplaces, the smoke from cigarettes, and charcoal broiled steaks.

Chlorinated dioxins were found in every sample of particulate matter taken from the air emissions of a wide variety of commercial and domestic combustion processes.

In explaining these surprising results the following facts must be recognized as very significant:

1. Refuse and fossil fuels are an extremely complex mixture of many chemical elements and compounds. An enormous number of these chemical elements and compounds are present in refuse and fossil fuels at low concentrations.

2. Conditions in a flame favor the occurrence of every conceivable type of chemical reaction.

3. Chemical reactions which occur at part per million and part per billion levels have gone unreported because the measurement techniques to study them have not been available.

4. Modern analytical techniques are so incredibly sensitive and specific that results of chemical reactions occurring with very low yields, 0.0000000001 percent, can now be identified and determined. Therefore, it can be shown that chemicals at part per billion levels can produce measurable amounts of other chemicals.

5. Combustion processes must be greater than 99.9 percent efficient in order to insure the reduction of the concentration of a chemical from 1 part per million to 1 part per billion. Common combustion processes are not nearly this efficient.

I. BUILDING BLOCKS FOR CHLORINATED DIOXINS

Refuse and fossil fuels are extremely complex mixtures of many chemicals and compounds, some of which are present at low concentration

The chlorine content of various materials used as fuels for combustion has been examined by a committee sponsored by the National Academy of Sciences (5). Table I summarizes the result of that survey.

TABLE I

CHLORINE CONTENT OF FUELS

Fuel	Chlorine, ppm
Coal	1300 (mean)
Refuse	2500 (average)
Paper	300-1600
Leaded Gasoline	300
Unleaded Gasoline	1-6
Fuel Oil	*

*No data were available for the chlorine content in fuel oil. However, measurements indicated that 500 pounds of hydrogen chloride would be produced per day per 100,000 persons whose homes were heated by oil-fired furnaces.

The National Academy of Sciences estimated that "311 ppm of chlorine, mostly hydrogen chloride, is in flue gas from burning normal base refuse". Some of this chlorine is found on the fly ash accompanying the flue gas.

Fly ash from an Amsterdam, The Netherlands, municipal incinerator was examined for chlorinated aliphatic and aromatic hydrocarbons by Lahaniatis et al.(20). More than 77 gas chromatographic peaks, representing concentrations of from 5 to 250 ppb, were obtained using an electron capture detector. Further examination by mass spectrometry provided identification of 27 of these peaks and empirical formulas for 22 more.

Lasiewicz et al. (21) reported the following concentrations of solid and gaseous products in emissions from oil-fired heating and power plants.

TABLE II

PRODUCTS FROM OIL-FIRED HEATING AND POWER PLANTS

PRODUCTS	CONCENTRATION, PERCENT
Sulfur dioxide	1.-6.
Sulfuric Acid	1.-6.
Carbon monoxide	0.1 -0.2
Nitrogen oxides	0.5-1.
Dust	0.2-1.
Vanadium compounds	0.005-0.01
Nickel oxide	0.001-0.003
Soot, Carbon black, and Organic Compounds	0.1-0.5

Particles emitted from coal-fired boilers were shown by Kobayashi et al.(18) to contain 3,880-38,700 ppm vanadium, 1,810-98,500 ppm nickel, 1,440-19,200 ppm iron, and about 270 ppm manganese.

From these various analyses it becomes clear that the myriad of initial pyrolysis products formed during combustion are jumbled at low concentrations in a sea of chemical reactivity including pyrolysis, oxidation, reduction, and acidolysis.

These reactions are influenced by the physical and chemical state of the particulates which contain metallic compounds that serve as catalysts. Within this sea of chemical reactivity, ions, electrons, free radicals, free atoms, and molecules form, combine, and decompose. The process is repeated time and time again.

Up to now, the behavior of this chemical potpourri has been studied only in terms of the major products of combustion- water and carbon dioxide- and those generally described as minor- carbon monoxide, hydrogen chloride (5), sulfur oxides (10), nitrogen oxides (4), however, at ultratrace levels, parts per billion, the number of compounds which may possibly form on particulate matter approaches or exceeds that presently known to man.

This infinitely complex situation is further complicated by the use of water to quench or scrub the combustion gases. Donaldson (9) points out that water treated for domestic consumption contains about 1000 parts per billion of organic chemicals. Commonly used waters often contain higher amounts of organic chemicals. When the chemicals in scrubber waters come in contact with the gaseous reacting chemicals, many more trace chemicals may form.

One trace level combustion product, benzo(a)pyrene (3), has been studied in some detail. To some extent, it can be used as a model compound for trace studies. Like chlorinated dioxins it is found on particulate matter. It is formed in higher concentrations during inefficient burning. It has a high melting point. It readily photodegrades in solution. It is highly stable on particulates and has a very low solubility in water.

The best estimates (3) showed that in 1971, 600 tons of benzo(a)pyrene were produced in the United States by refuse burning, 500 tons by heat and power generation, 200 tons by coke production, and 20 tons by automobiles and trucks.

Modern scientific instruments and highly skilled analytical scientists now make it possible for the first time to study the effects of the trace chemistries of fire.

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