

Community Update



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A newsletter with the latest information on the dioxin/furan situation



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The Right Actions at the Right Time

This issue of our Community Update is devoted mainly to recent science associated with dioxins and furans. Dow strongly believes that the only way to find real solutions to this situation is by knowing the facts. That is exactly why Dow supports the research discussed below that is under way now.

This analytical work is important because dioxins and furans are perhaps the most frequently studied compounds, yet the findings about their toxicity – especially in humans – are inconclusive. Despite the claims of some, the overwhelming weight of scientific evidence does not support the fact that dioxin/furan exposure

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Dow Releases Results of Current Worker Study Blood Levels Elevated, Still Below CDC Level for Cancer Concern

Dow recently released results of its most current worker study. In this current study, researchers measured the blood dioxin levels of workers who were employed in departments where high dioxin exposure could have occurred.

The study shows workers in plants that produced chlorophenol had an average blood serum level of dioxin of 68 parts per trillion (ppt) TEQ[†] (toxic equivalency quotient). Chlorophenol is an ingredient used to make pesticides and herbicides. A control group of workers who did not work in the chlorophenol plant had an average of 33 ppt TEQ blood serum level of dioxin.

No Indication of Health Effects

“Given these new study findings, we are more confident than ever about our health conclusions that, other than chloracne among highly exposed workers, we find little indication of any health effect related to dioxin exposure in our chlorophenol workers,” said Dow Medical Director, Dr. Mike Carson.

This conclusion is based on extensive health studies of Dow workers, and on advice used by the Centers for Disease Control (CDC), which states:

“In occupationally exposed workers, an increased incidence of cancer has been associated with ... dioxin levels of 495 to 31,800 ppt [of 2,3,7,8-TCDD] ...”¹

No worker in the Dow study had these high levels of dioxin in their

blood. The range for Dow employees was 2 to 176 ppt TCDD.

People More Resistant

The CDC also states: “Although dioxin is extremely toxic in some animals, humans appear to be more resistant to its toxicologic effects than most animals in which it has been tested. The primary clinical health effects that have been observed in humans exposed to high levels of dioxin through occupational or accidental exposures have been chloracne and transient mild hepatotoxicity. Various types of cancer and non-cancer health effects also have been associated with exposure to dioxin in some studies. However, study results have been inconsistent in demonstrating these effects.”¹

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The Right Action at the Right Time

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at low levels is cause for serious concern.

Studying Worker Health. Dow has monitored the health of its workers for decades and since 1980 has conducted 17 studies of workers in Midland. (See related story about the results of Dow's most current worker study, page 1.) Each study has been peer reviewed and published in scientific journals.

The Dow workers studied represent one of the largest groups at a single location ever examined for health effects from potential dioxin exposure. Additionally, these workers have been followed since 1940, making them the longest-followed population in the world for examination of dioxin health effects.

To date, the studies show that Dow workers with high levels of dioxin exposure do have an increased risk of chloracne, a skin condition known to be caused by such exposure. However, other than chloracne, no other increased risk of disease, including cancer, was found related to dioxin exposures. These results are consistent with recent observations published by the U.S. Agency for Toxic Substances and Disease Registry and the national Centers for Disease Control.

U of M Exposure Study. Since the key to potential health effects is exposure, and not simply the presence of dioxins and furans in the soil, the regional comparison study being performed by Dr. David Garabrant and the University of Michigan will be important. (See related story, page 7.)

This comparison will provide critical data about the relationship between the presence of dioxins and furans in the local soil versus what is present in

people's blood. In other words, it will help to determine if dioxin is being ingested and causing actual exposure.

Ecological Risk Assessment.

Another study, an ecological risk assessment of wildlife downstream of Midland on the Tittabawassee River, is being conducted by a team from Michigan State University.

This study will compare levels of dioxins in animals to data in computerized models to determine the validity of the models. The study will also examine the diet of key wildlife species, measure the dioxin levels of their food and monitor their health. Phase 1 of the study will be used as the basis for a full ecological risk assessment, expected to begin in 2005.

Bioavailability Study. Dow also is conducting a pilot bioavailability study. Bioavailability refers to the ability of the human body to absorb any compound. This study will help find out how much dioxin can be absorbed into the body if it is attached to soil. Since dioxins firmly bond to soil particles and are not readily absorbed into the bloodstream, it is important to understand this process.



The MDEQ currently assumes that 50 percent of the dioxin on soil that has been ingested can be absorbed into the body. A study conducted by Dow and published in peer-reviewed scientific literature suggests that the level of absorption may be as low as 25 percent on average. What's more, a German study found the level to be as low as 15 percent. Findings from these two studies may indicate residents have a much lower potential for exposure to dioxin based on their ingestion of soil.

The University of Missouri, with funding from Dow, is performing the research. A final report is expected in 2005.

Dow Will Continue to Pursue Science. While Dow continues to pursue a science-based approach, we also support corrective actions that are based on a well informed decision-making process. We continue to seek solutions that are protective of human health and the environment, while also considering the economic and social well being of the community.

There is a lot at stake for everyone involved, and Dow will take the right actions at the right time to ensure the most effective result. We are working hard, in cooperation with the Lt. Governor's Office, other regulatory agencies, and local elected officials and citizens, to determine the proper course of action. It is not easy or simple, but to do less would be a disservice to the community that has been our home for more than 100 years.

We continue to welcome your feedback and comments as we work through this issue. Thank you for your ongoing interest and support.

Estimating Risk with Models vs. Real Data

Regulatory agencies often use models when they talk about risks from dioxins or other chemicals in the environment. Models are simply estimates based on a set of assumptions.

In everyday life, we frequently use models, or make estimates. For example, the host of a barbecue may decide how many hot dogs to buy by estimating the number of people that will attend and how many hot dogs each person will eat. The host then adds a few extra “to be on the safe side.”

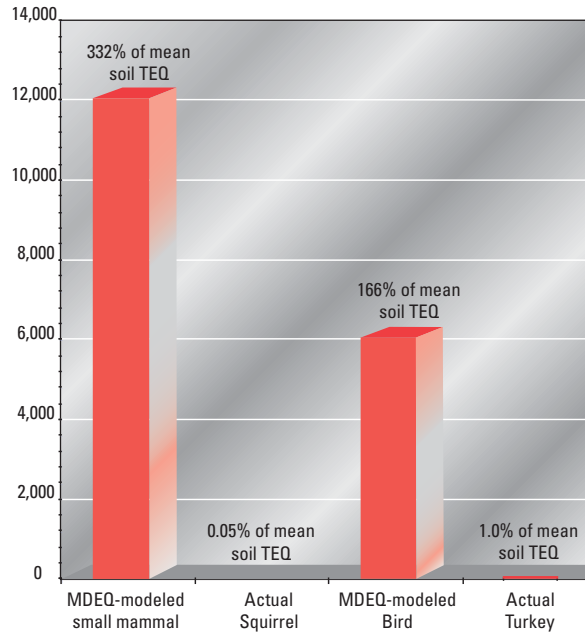
Modeling and Risk Assessment

Similarly, in risk assessment, regulatory agencies use default, or standard, estimates of individual factors like how much soil a person might accidentally swallow or have on skin each day, how much dioxin is absorbed, and the amount of risk to human health.

A model may include many factors that are each estimated, and the estimates are usually designed “to be on the safe side” – in other words, to overestimate rather than underestimate exposure and risk. As more factors are included, the total overestimate of actual exposure and risk can increase substantially.

As with any estimate, the accuracy of the model depends upon the accuracy of the assumptions used in the model.

Comparison of Models vs. Actual Data in Tittabawassee River Wildlife



The chart shows a comparison between the estimated level of dioxins and furans in local wild game, versus the actual, measured levels in turkeys and squirrel that were identified during a Wild Game Study recently conducted by Dow. Note that the actual levels are hundreds of times lower than the model estimates.

In risk assessment, having a lot of detailed information can improve the estimate of potential risks. Because the standard, or default, assumptions are usually designed to be on the “safe side,” revising those assumptions based on real information often results in a reduced estimate of risk.

Studies Will Clarify Models

Several studies help in our understanding of the validity of the models being used to assess potential risk of exposure to dioxins and furans. Dow’s recent study of the levels of dioxins in wild game such as deer, turkey, and squirrels from the flood plain area

is one example. As the chart demonstrates, the actual measured levels in turkeys and squirrel were hundreds of times lower than the model estimates from MDEQ.

Such data, while expensive to generate, reduces the overestimation of exposure and risk from standard models. It also improves the estimates of potential risk and provides a better basis for making decisions about the need for and type of corrective action.

CDC Study Shows Average Blood Levels Are Related to Age

A study² published recently by the Centers for Disease Control (CDC) shows a relationship between age and the amount of dioxin in the blood.

The purpose of the research was to identify the typical amount of dioxin in the blood of an average resident of the United States, by various ages. A second purpose was to explore the link between age and the amount of dioxin in the blood of people who live in the United States.

Age Affects Background Levels

Results showed, on average, that the presence of all dioxin compounds combined increases as age increases. The highest levels were observed among people 60 and over. In this age group, the average toxic equivalency quotient (TEQ) was 36.1 ppt. The range for this group was a minimum of 3.4 with a maximum of 146.4 ppt.

In comparison, the average TEQ for someone aged 15 to 29 was 6.4 ppt. This age group had a minimum of 0.0 ppt and a maximum of 53.9 ppt. The table below shows results for all age groups.

According to the CDC study, *“Overall, this research shows that consideration of age-specific reference*

Age Range	Mean	Minimum	Maximum
15-29	6.4	0.0	53.9
30-44	11.8	0.2	50.4
45-59	16.9	0.8	55.4
60+	36.1	3.4	146.4



levels is more appropriate than a single estimate for the entire population. In addition, this compilation of 588 participants with no known dioxin exposure provides a reasonable estimate of the most recent age-specific reference levels available to date in the U.S.”

CDC Recommends Age Considerations

“This CDC data is important for understanding the connection between age and dioxin levels in the blood,” said Dow Toxicologist Bob Budinsky. “Since everyone has dioxin in their



“Overall, this research shows that consideration of age-specific reference levels is more appropriate than a single estimate for the entire population.”

Centers for Disease Control



blood, and dioxin breaks down very slowly, the study suggests it is most appropriate to assign guidelines by age.”

The study also shows that the range of dioxin levels in blood for all age groups can vary considerably and still be within what the CDC would consider to be “background” levels for residents of the U.S.

Study participants had no known exposure to combined dioxin-like compounds (referred to as TEQ, for toxicity equivalency) other than typical dietary and environmental exposure. All samples were analyzed at the dioxin laboratory of the Centers for Disease Control and Prevention.

For more information, go to www.cdc.gov.

²Patterson, DG, et. al., Age Specific Dioxin TEQ Reference Range, Organohalogen Compounds, Vol. 66, 2004:pp2878-2883.

Dow Helps with Park Renewal Projects

Dow is working in cooperation with Saginaw area officials to help improve two Tittabawassee River parks and at the same time take steps to minimize potential exposure to dioxins and furans.

Dow and parks officials recently received permit approval for improvement projects at Imerman and Freeland Festival parks. The work is part of the corrective action process by Dow and was proposed as an interim response activity (IRA).

Imerman Park: Riverbank Stabilization Project

An eroding riverbank and an unstable fishing platform are the focus of improvements at Imerman Park.

Workers will begin by reshaping the riverbank and adding erosion

protection. The project also calls for improving the fishing platform, adding handicap accessibility and stabilizing the pavilion.

Freeland Festival Park: Stone Wall and 2-Tiered Walking Platform

A stone wall that directs park guests to a two-tiered walking platform are the main improvements planned for Freeland Festival Park. A natural stone wall, to be built along the riverbank, will limit access to exposed soils and encourage users to travel along a wood walkway. The new, two-tiered walking platform will be handicap accessible, will provide two access points for fishing and offers more space for viewing the river.



Current Worker Study *(continued from page 1)*

Other key findings of the study are as follows:

- Some tradesmen who had plant-wide responsibilities, such as pipefitters and mechanics, also had dioxin levels above non-chlorophenol workers.
- Workers with past chloracne had higher blood dioxin levels – five times higher on average than other workers employed in the chlorophenol departments.
- Dioxin exposure estimates used in the previous studies of Dow workers accurately predicted actual, measured dioxin levels.

Testing Estimates of Exposure

The purpose of the study was to determine the accuracy of Dow's estimates of past exposures to dioxins used in our previous studies, and to determine if we could improve these exposure estimates.

This study was not a health study but only tested blood dioxin levels. However, the results are important to help us better interpret past and future health studies conducted on Dow workers.

Results of the study were presented in October at the International Symposium on Epidemiology and Occupational Health in Melbourne, Australia. Dow also met with local health department officials, and has briefed the Michigan Department of Community Health and the Michigan Department of Environmental Quality on the research.

¹ATSDR. Health Consultation: Exposure Investigation Report, Calcasieu Estuary, Lake Charles, Calcasieu Parish, Louisiana, 2000.

[†]TEQ stands for toxic equivalency quotient. It is a model used to estimate the combined risk of 17 dioxin and furan compounds.

Technology Update: New Data Compares Toxicity of Dioxin-like Compounds

Those who have followed the dioxin and furan issue may understand that the term “dioxin” is used to describe a group of chemical compounds (which includes furans) that share similar chemical structures and biological characteristics.

There are several hundred dioxin and furan compounds, which are collectively referred to as dioxins. Of those, 17 are considered more toxic than the others. The most potent of these is 2,3,7,8-TCDD.

Furans Most Prevalent

The current data show that 95 percent of the dioxins and furans measured by the Michigan Department of Environmental Quality (MDEQ) in floodplain soils and river sediment are actually various types of congeners, or furans.

Less than 2 percent are actually dioxin in the form of 2,3,7,8-TCDD which is the only congener that is classified as a human carcinogen and for which most of the toxicological data are available.

When dioxins are measured in the environment, such as in flood plain soils, each concentration of every congener is multiplied by a formula in order to convert it into a 2,3,7,8-TCDD equivalent.

This establishes the toxic equivalency quotient (TEQ) as if only 2,3,7,8-TCDD were present and constituted the entire dioxin picture. This assumes that the mixture of the 17 dioxin and furan compounds behaves in a manner similar to 2,3,7,8-TCDD. As previously described, the floodplain



TEQ is made up mostly of two furan compounds: 2,4,7,8-PCDF (also known as 4-PCDF) and 2,3,7,8-TCDF.

Study Finds Furans Are Less Potent

A new cancer study³ on laboratory animals, recently completed by the U.S. National Toxicology Program, shows that the furan congener 4-PCDF (which makes up about 50 percent of the TEQ in the Tittabawassee River area) is much less potent in laboratory animals than originally thought.

Using the NTP study findings to adjust this one value in the TEQ equation will reduce the TEQ level in the floodplain soils, on average, by about 50 percent of current estimates. This study was presented in September during an international conference on dioxins, held each year.

The other important congener in the floodplain, 2,3,7,8-TCDF, comprises 25 to 30 percent of the TEQ in the floodplain.

Overall, these TEQ values are critical for understanding potential dioxin exposure in the Tittabawassee River area, especially considering most of the compounds in the floodplain are actually furans, and not the more potent laboratory animal carcinogen, 2,3,7,8-TCDD.

³NTP Technical Report on the Toxicology and Carcinogenesis, Studies of 2,3,4,7,8-Pentachlorodibenzofuran (PeCDF) in Female Harlan Sprague-Dawley Rats. (CAS No. 57117-31-4) (Gavage Studies)

Regional Exposure Study Underway

Data gathering has begun on a study to compare dioxins and furans for two populations: residents who live in Midland and the Tittabawassee River area, and people who live in a community with similar demographics but no known exposure to dioxins and furans.

The study will look at the level of dioxins and furans in residents' blood. It is being conducted by Dr. David H. Garabrant, professor of occupational medicine and epidemiology at the University of Michigan (U-M). Dow awarded a grant to U-M for the study.

This data will help clarify whether there is a link between dioxins in soil/house dust and in human blood. If dioxin levels are not elevated in residents' blood, it would indicate there is no increased health risk for area residents. If levels are elevated, additional health studies would be appropriate, to determine if there is a correlation with dioxin exposure.

The results also will provide another point of tangible data on which to base decisions about corrective action in Midland and the Tittabawassee River area. Go to <http://umdiioxin.org> for additional information.

About the Research:

Study size:

350 residents from the Tittabawassee River area and Midland

350 residents from Calhoun and Jackson counties

Purpose:

To study blood levels of dioxin and explore soil and dust samples of residents, to determine if there is a connection between dioxin in soils and in blood.

Advisory Boards:

A 4-member Scientific Advisory Board will oversee the work. The Board is responsible for reporting results and includes:

- Linda Birnbaum, PhD, toxicologist, Environmental Protection Agency

- Paolo Boffetta, MD, epidemiologist, International Agency for Research on Cancer
- David Kleinbaum, PhD, statistician, Emory University
- Ronald Hites, PhD, environmental scientist, Indiana University.

A separate, local community advisory panel has been established to provide input.

Dow will not participate on either the Scientific or Community Advisory Panels.

Expected Completion Dates:

Data gathering completed by late 2006

Results published in 2007





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Related Web Sites

Visit these web sites for related information about dioxins and furans:

Agency for Toxic Substances and
Disease Registry (ATSDR):

<http://www.atsdr.cdc.gov/>

Michigan Department of
Environmental Quality (MDEQ):

<http://www.michigan.gov/deq>

Michigan Department of Agriculture:

<http://www.michigan.gov/mda>

Michigan Department of Community
Health (MDCH):

<http://www.michigan.gov/mdch>

University of Michigan Dioxin
Exposure Study:

<http://umdioxin.org>

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Your input is essential. We want to hear from you.

There are several ways you may contact us:

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Go to www.dowmidmichigan.com for more information

Fax your questions to 989-636-8897