

## Mortality of Midland Plant Workers

Soil sampling and analysis carried out over a number of years (1984, 1996, 1998) confirm that the Midland plant site is heavily contaminated with dioxins.

<b>Dow Midland Plant Dioxin Levels (ppt)</b>				
	<u>Year</u>	<u>Dioxin</u>	<u>Range</u>	<u>Average</u>
<b>EPA</b>	1984	TCDD	10 - 36,000	3,090
<b>EPA</b>	1984	TEQ*	43 - 155,400	13,340
<b>DEQ</b>	1996	TEQ	16.5 - 12,900	2,469
<b>DEQ</b>	1998	TEQ	5 - 18,000	3,255
* estimated				

Mathematical modeling of dioxin levels indicates that calculated levels in the Midland plant were extremely high when the hazardous waste incinerators (without adequate air pollution equipment) were in full operation. More information is available on the modeling of dioxin levels in the web site section labeled "Dioxin Levels" or via the following link: [Link to Dioxin Modeling](#)

Modeling Basis	1984 Levels	Max. Total Dioxins	Max. TCDD Levels	Max. TEQ Levels
		(ppt)	(ppt)	(ppt)
Avg. TCDD Level, 1984	3,090 ppt	10,426,280 (10.4 ppm)	11,120	83,900
Max. TCDD Level, 1984	36,000 ppt	81,560,325 (81.6 ppm)	86,987	656,990
<b>DEQ Action Level - Industrial</b>				<b>990 ppt</b>
<b>DEQ Action Level - Commercial</b>				<b>1,400 - 2,900 ppt</b>

Exposure to the high levels of dioxins that were and are present in the soils of the Midland plant should have had an adverse (and quantifiable) impact on the health of the exposed workers. However, published information on the mortality of Midland plant employees is very limited and studies do not specifically address environmental dioxin exposure — the exception being Dow employees in Midland production plants that manufactured products contaminated with dioxins.

For example, it would be expected that that employees in the Environmental Services Department that operated the plant's incinerators, chemical waste ponds and waste water treatment plants might have an elevated mortality from certain types of cancers as the result of their exposure to high levels of dioxins.

Two employees of this department have contracted stomach cancer — one has died and the other is on medical leave. A study of Midland production plant employees exposed to dioxins indicated that a stomach cancer death rate of 2.74 deaths per 1000 employees was experienced while only 1.74 deaths per 1000 employees were expected. (Standardized Mortality Ratio [SMR] = 157.5).

Are the two stomach cancer occurrences normal or abnormal? Without epidemiological studies, it is not possible to know if these cancers are work related or just a coincidence. To the best of my knowledge, Dow has not published any mortality studies on the highly exposed workers in the Environmental Services Department.

### **Dow Mortality Studies**

Data presented data in two comprehensive mortality studies does suggest that general chemical exposure is linked to an elevated overall death rate and to an elevated death rate from certain types of cancers.

It is fairly well recognized that hourly chemical workers experience a higher chemical exposure, as a result of their work activities, than do salaried employees. One Dow study has shown that the higher chemical exposure is linked to a higher death rate.

In 1987, Dow published a mortality study (GG Bond, et al, *Cause-Specific Mortality Among Male Chemical Workers*) that was unique in that it provided mortality data that was divided by pay status — hourly, salaried and salaried non-exempt. This study found that the hourly employees' overall death rate was 82% higher than the death rate of the salaried employees. Hourly workers also experienced a death rate from All Cancers that was 34% higher than that of the salaried workforce.

The study did provide information that links stomach cancer with chemical exposure (and perhaps wide-spread dioxin exposure). Hourly workers experienced higher stomach cancer mortality with duration of employment — employees with more than 20 years of employment experienced a SMR of 123. A Relative Risk of 2.14 (95% CL 1.19 - 3.38) indicates the elevated mortality is statistically significant.

Unfortunately, the study combined Corporate employees, Midland plant employees and Bay City plant employees into a single cohort categories. The Bay City location is primarily a petroleum products and plastics fabrication site, while the Midland plant site produces a wide variety of toxic chemicals and has been (and is still) the location of Dow's hazardous waste tar burners and incinerators. In addition, approximately 45% of the salaried workforce are

are Corporate employees with almost no chemical exposure. The lower mortality of the Corporate employees may mask the higher mortality being exhibited by the Midland plant workers — both hourly and salaried.

The table shown below is a comparison of the health of the hourly and salaried workforces as presented in the 1987 epidemiology study. The comparison only shows the disease categories with a Standardized Mortality Ratio (SMR) that was greater than 100 (higher than the US national average). The hourly workforce has a higher mortality than the salaried workforce in nine (9) out of the eleven (11) disease categories.

For the diseases shown in the table, the hourly workforce has a death rate that is approximately 40% higher than the death rate of the salaried employees.

**Employee Mortality - Dow Chemical, Midland Bay City Sites  
(1940 0 1982)**

	Hourly - SMR	Salaried - SMR
<b><i>Mortality, All Causes</i></b>	<b>95</b>	<b>55</b>
<b><i>Mortality, All Cancers</i></b>	<b>98</b>	<b>73</b>
<b>Cancer of the liver</b>	<b>140</b>	<b>64</b>
<b>Cancer of the lung</b>	<b>104</b>	<b>59</b>
<b>Cancer of the testis</b>	<b>128</b>	<b>29</b>
<b>Cancer of the brain, CNS</b>	<b>118</b>	<b>82</b>
<b>Lymphatic-hemotopoletic cancer</b>	<b>110</b>	<b>104</b>
<b>Lymphosarcoma &amp; reticulosarcoma</b>	<b>104</b>	<b>128</b>
<b>Luekemia-aluekemia</b>	<b>108</b>	<b>119</b>
<b>Cancer of other lymphatic tissues</b>	<b>140*</b>	<b>115</b>
<b>Cancer of Other and Unspecified Sites</b>	<b>141*</b>	<b>100</b>
<b>Diabetes mellitus</b>	<b>101</b>	<b>54</b>
<b>Arteriosclerotic heart disease</b>	<b>102</b>	<b>60</b>
<b>Emphysema</b>	<b>109</b>	<b>54</b>
* Statistically significant		

The 1987 study excluded more than 5,000 workers that had worked in the Bay City Magnesium Foundry. The exclusion was very unusual since the foundry workers clearly met the cohort criteria. A later study reported on the health of the foundry workers and, in general, the mortality experience was very poor. For the foundry workers, deaths from All Causes were significantly elevated (SMR 109, 95% CL 105-113); deaths from All Malignant Neoplasms were elevated and the elevation was also statistically significant (SMR 111, 95% CL 104-118).

The 1987 Dow study also found that the overall death rate for hourly employees increased with years of employment (increased chemical exposure - ?). The same study found that the mortality experience of the salaried workforce actually improved with duration of employment.

**Cancer Mortality - All Cancers  
Standardized Mortality Ratio's - Midland & Bay City Locations (b)  
(1940 - 1982)**

<b>Duration of Employment:</b>	<b><u>&lt; 5 Yrs</u></b>	<b><u>5-19.9 Yrs</u></b>	<b><u>&gt; 20 Yrs</u></b>
<b>SMR, Hourly Employees:</b>	<b>90.9</b>	<b>96.8</b>	<b><u>109.2 (a)</u></b>
<b>SMR, Salaried Employees:</b>	<b>75.7</b>	<b>74.5</b>	<b>72.1</b>

(a) Statistically significant (95% CL 104-135)

(b) Excludes Magnesium Foundry Workers

Unfortunately, the 1987 study combined Midland and Bay City workers into a single cohort. There is some data that suggests that, in certain areas, the mortality of the Midland workers is greater than the US national average.

The Midland plant site has a statistically significant elevation of the very rare cancers that are grouped as Cancers from Other and Unspecified Sites by the International Classification of Diseases. One Dow study addressed this issue by stating, "Among other cancer sites, there was a significant increase in deaths from Other and Unspecified malignant neoplasms. Aside from noting that mortality for the category tends to run somewhat higher at this plant location [Midland] than for the United States population, we can offer no explanation for the finding."

The NIOSH, 1991 study also found a statistically significant elevation of these rare cancers among the employees of twelve companies that had been exposed to dioxins following a latency of 20 years or more. (SMR 201, 95% CL 118-316, p < 0.05).

The Dow data and the NIOSH data suggest that exposure to site-wide environmental dioxins may be associated with the increase in these very rare cancers. It should be noted that the Magnesium foundry workers, although with a statistically significant elevation of Mortality from All Causes and Mortality from All Cancers, did not show a reportable increase in these very rare cancers. It is assumed that the foundry workers were not exposed to high levels of dioxins and would not show an elevation of dioxin-related cancers.

**Mesothelioma - Mortality of Dow Chemical Workers**

Malignant mesothelioma, a rare form of cancer, is a disease in which cancer (malignant) cells are found in the sac lining the chest (the pleura), the lining of the abdominal cavity (the peritoneum) or the lining around the heart (the pericardium). Typically, more than 95% of mesothelioma is associated with asbestos exposure. For Dow's Midland and Bay City employees, almost 60% of the mesothelioma may be related to chemical exposure, possibly dioxin exposure.

A Dow mortality study published in 2002, CJ Burns, et al, *Cause-Specific Mortality Among Michigan Employees of a Chemical Company: 1940 to 1994*, reported that 57 cases of mesothelioma had been found in Midland and Bay City employees from 1940 to 1994. An earlier study of the employees of the same locations also reported deaths from mesothelioma, but at a much lower rate.

**Mesothelioma Mortality  
Midland and Bay City Locations**

<u>Time Period</u>	<u>Total</u>	<u>Asbestos Related</u>	<u>Unknown Causes</u>
1940 - 1982	18	17	1
1940 - 1994	57	23 (est)	34 *

\* Includes 3 women with no job-related asbestos exposure

The death rate with mesothelioma from 1982 to 1994 (12 years) is almost a sevenfold increase over the average death rate from 1940 to 1982 (42 years).

The 2002 study was unable to explain the unusual increase in mesothelioma other than to state, "It is difficult to interpret deaths with mesothelioma... However, any observation [death] is considered an excess from expected."

The 2002 study handled the unusually high number of the rare deaths in the following manner, "... the 57 mesothelioma deaths were classified in eight different sites [categories]."

The study went on to indicate which specific categories received the deaths from mesothelioma and the resulting mortality ratios and 95% Confidence Levels were reported for seven out of the eight categories. None of the seven categories had 95% CL's that signified "statistical significance" that would have warranted additional comment and clarification.

However, if the 2002 study had combined the mesothelioma deaths into a single category, the results would have been as shown below. Information from the 1987 Dow study and the NIOSH, 1991 study are shown as comparison.

**Mesothelioma Mortality  
Midland and Bay City Employees  
(1940 to 1994)**

	<u>Obs.</u>	<u>Exp.</u>	<u>SMR</u>
Dow, 2002	57	2.1	2714
Dow, 1987	18	1.8	1000
NIOSH, 1991	2	0.073	2740

Dow has presented information that confirms that more than 60% of the mesothelioma deaths are not related to asbestos exposure. With the wide-spread contamination of the Midland site by dioxins, perhaps mesothelioma is also linked to dioxin exposure, as the NIOSH data suggests.

## **Conclusions**

Even with a quality epidemiology study, it is very difficult to confirm that poor health and early death are the result of chemical exposure. Sometimes, only a hint of the underlying cause and effect can be seen.

Proving that there is a linkage between wide-spread dioxin exposure and adverse health effects is even more difficult if focused epidemiology studies are not available or if a large number of relatively non-exposed workers have been added to the study cohort.

The Midland plant site has been heavily contaminated with high levels of dioxins since the late 1930's. Based on Dow's own mortality studies, the plant employees have a recognized elevation of certain cancers. The health problems are not at issue — the only issue is the cause of the higher mortality.