

DOW EPIDEMIOLOGY STUDY

TITLE: *Cancer risk for chemical workers exposed to 2,3,7,8-tetrachlorodibenzo-p-dioxin*

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This Dow study is an update of four prior Dow studies that examined the mortality of approximately 2187 male chemical production workers that were exposed to varying levels of dioxins/furans while employed at Dow's Midland production site.

I believe that Bodner, 2002 and the underlying studies contain some factual errors which bring into question the accuracy of the conclusions.

1. Bodner, 2002 states, "... a cohort of 2187 male chemical production workers previously exposed to substantial levels of dioxins." This statement seems to apply that all 2187 employees were heavily exposed.

However, neither Bodner, 2002 nor the original studies ever really indicate how many employees were exposed to "substantial" levels. Another Dow study that Bodner, 2002 cites, Bond, Sept 1989, indicates that approximately 270 to 369 employees had very low TCDD exposure levels.

Bodner, 2002 also updated Ott, May 1987 that followed the mortality of the same 2192 employees from 1940 to 1982. Based on data supplied in Ott, May 1987, 220 employees that worked in the Ronnel and Erbon plants had zero TCDD exposure.

Another Dow study, Ramlow, 1995¹, indicates that out of 770 employees involved in the manufacture of Pentachlorophenol, approximately 392 employees had very low or low exposure to TCDD.

Bond, Sept 1989 also indicates that 1319 employees had very low exposure levels to hexa- to octochlorinated dioxins (H/OCDD).

Dow has gone to great lengths to develop a dioxin exposure intensity and dioxin cumulative dose methodology. Unfortunately, the company never revealed how many employees were actually or were actually not exposed to certain levels of TCDD or to certain levels of H/OCDD. Without this information, it is very difficult to agree with Dow's conclusions on the health risks of dioxin exposure.

2. There seems to be some confusion on the part of Dow as to how many workers were actually exposed to dioxins, whatever the variety. Most of the studies indicate that 2187 to 2192 employees were exposed to varying levels of dioxins.

One study, Bond, Sept 1989, which doesn't get a lot of mention broke down dioxin exposure into a variety of categories. However, each category totals 1963 employees, not 2187 to 2192. Since the authors of this report were also co-authors of the other Dow dioxin studies, it's hard to believe that they would have made this magnitude of mistake. Perhaps, Bond, Sept 1989, didn't include the 220 Ronnel/Erbon employees that had zero TCDD exposure. Adding 1963 + 220 equals 2183 employees, which is very close to the 2187 to 2192 being reported by other Dow reports.

I'm so confused. Perhaps, Dow is also.

3. The Bodner, 2002 report states, "Our study highlights... the lack of consistency across dioxin studies." Actually, this statement may slightly in error.

One of the more consistent findings across a number of Dow mortality studies is a statistically elevated mortality from "Cancers of Other and Unspecified Sites".

Mortality studies utilize the International Classification of Diseases to analyze and present deaths associated with approximately 999 disease classifications, including a wide variety of cancers. However, some cancers are so rare that they do not warrant a separation classification. These rare cancers are lumped into the category "Cancers of Other and Unspecified Sites." The National Institute of Occupational Safety and Health (NIOSH) which conducted an extensive study of 5,172 US chemical workers exposed to dioxins (Dow's 2,187 or so employees were included in the NIOSH study) had this to say about this category, "Mortality was significantly higher than expected in the category of

unspecified sites, which included those of rare sites not included in a category of the life-table analysis...”

The NIOSH finding was probably not a surprise to Dow since they had observed the same statistically significant elevation. In fact one of the studies that Bodner, 2002 updated had this to say about the category, “Among other cancer sites, there was a significant increase in deaths due to other and unspecified malignant neoplasms (12 observed v. 4.6 expected) [SMR 261]. Review of the death certificates and other available information did not provide additional insights as to the origin of the tumors. Nor did the internal analyses identify any significant work area or dioxin-related associations. 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.”

Table 1 is a summary of the findings from various epidemiology studies on these rare cancers.

Table 1
Mortality From Rare and Unspecified Cancers

| <u>Study</u> | <u>Obs.</u> | <u>Exp.</u> | <u>SMR</u> | <u>95% CL</u> |
|---------------------------------------|-------------|-------------|------------|---------------|
| NIOSH, 1991 ² , >20 yrs. | 18 | 9 | 201 | 118-316 |
| Dow, Bond, 1987 ³ | 169 | 125 | 135 | 115-157 |
| Dow, Bond, 1987 ³ , hourly | 126 | 89.5 | 141 | 117-168 |
| Dow, Cook, 1986 ⁴ | 9 | 3.7 | 243 | 111-462 |
| Dow, Ott, 1987 ⁵ | 12 | 4.6 | 261 | 135-456 |
| Dow, Bond, 1987 ⁶ | 8 | 4.2 | 192 | 82-375 |
| Dow, Ramlow, 1995 ⁷ | 6 | 3.8 | 158 | 58-344 |
| Dow, Bodner, 2002 | NR | NR | NR | NR |

NR = Not Reported

Out of the seven studies that reported mortality data for Rare and Unspecified Sites, five studies indicated that the increase in mortality was statistically significant (Lower 95% CL > 100). It would be interesting if the Dow update on some employees had provided some additional information on this category.

Dow is certainly perplexed by these deaths, “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.”

It's fairly well recognized that dioxin levels are very high in Dow Midland plant, and that, based on the dioxin levels being found in the Midland community, being downwind of the chemical waste incinerators might not be healthy for exposed Midland plant workers. Perhaps, unrecognized (or at least, unmeasured) dioxin exposures are the underlying reason for the elevated rates of rare cancers being found in Midland plant workers.

4. The issue of Soft Tissue Sarcoma (STS) was discussed in the Bodner, 2002 update. Bodner, 2002 had this to say about STS, “The previous update of the Dow cohort, STS was cited as the underlying cause on death certificates of two subjects, but no additional cases were ascertained in the current update. Although there was a single case of STS among workers with chloracne, this case was in fact confirmed by pathologists to be a renal clear cell carcinoma.”

Now this single case of an error in STS classification has been mentioned in a number of studies that Dow conducted on the mortality of the dioxin-exposed workers. At least, Bodner, 2002 didn't remind the readers that the Armed Forces Institute of Pathology reclassified the STS. However, only one Dow study (Ott, 1987⁵) reported this information when discussing STS, “Parenthetically, a second member of the group who worked in the Trichlorophenol Production area during the 1963 to 1964 chloracne incident did develop a histologically confirmed soft tissue sarcoma [STS], it, a malignant fibrous histiocytoma. He died in 1983 and thus was not in the scope for the purposes of this study.”

This issue of Soft Tissue Sarcoma's (STS) seems to be a point of contention for Dow epidemiologists, or at least, a point of disagreement as to whether they should be reported at all.

Table 2
Dow Chemical - Soft Tissue Sarcoma (STS)

| <u>Study</u> | <u>Time Period</u> | <u>Obs.</u> | <u>Exp.</u> | <u>SMR</u> | <u>95% CL</u> | |
|-------------------------------|--------------------|-------------------|------------------------------|------------|---------------|---------------|
| Dow, Bodner, 2002 | 1940-1994 | 18 | 11.8 | 153 | 90-240 | Midland Plant |
| Dow, Burns, 2002 ⁸ | 1940-1994 | NR | NR | NR | NR | (1) |
| | | NR = Not Reported | (1) Midland, Bay City plants | | | |
| Dow, Bodner, 2002 | 1940-1994 | 2 | 0.1 | 2180 | 2700-80200 | (2) |

(2) Very high dioxin exposure sub-cohort.

It very unusual that Dow, Burns, 2002 did not report the 18 cases of STS that were noted in the Bodner, 2002 update. Both studies encompassed the same period and the same Midland plant cohort. A cancer category with 18 observed deaths must be large enough to report since Burns, 2002 did report on Cancer of Testes and Other Genital Organs with 15 observed deaths.

Bodner, 2002 did state, "Nevertheless, reclassification of few cases of an uncommon cancer could have a profound impact on the overall STS risk estimates among dioxin exposed persons." This statement is true. However, Bodner, 2002 did not reclassify any of the cases of an uncommon cancer and was silent on the statistically significant elevation of STS in the high dioxin exposure cohort. No doubt, an oversight or sufficient to only report the unpleasant numbers, no need to dwell on a possible sore point within the company.