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MEMORANDUM

TO: Chuck Andrews, Branch Chief
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HSM-99017

FROM: Tom Thongsinthusak, Staff Toxicologist [original signed by T. Thongsinthusak]
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DATE: September 15, 1999

SUBJECT: METHYL BROMIDE: RESPONSES TO COMMENTS FROM OEHHA

The following are my responses to comments from the Office of Environmental Health Hazard Assessment (OEHHA) concerning the methyl bromide (MB) exposure assessment document dated January 11, 1999. OEHHA sent Gary Patterson a draft memorandum dated August 24, 1999 and a final memorandum dated September 1, 1999. On July 14, 1999, staff of the Worker Health and Safety Branch responded to some of those comments at the meeting at U.C. Davis.

1. OEHHA contended that dermal exposure is important for those scenarios in which dermal contact is the primary source of exposure, such as for workers who wear respirators in areas with relatively high concentrations of MB (Memorandum page 2 (paragraph 2); attachment pages 1 (paragraph 2) and 4 (paragraph 4)).

Based upon illness reports in the literature, there is the potential for significant dermal exposure of workers who wear self-contained-breathing apparatus (SCBA) in high MB concentration environment and work in the area for extended periods. Zwaveling *et al.* (1987) and Hezemans-Boer (1988) reported skin lesions in six workers eight hours after exposure for 40 minutes to high concentration of MB of approximately 40 g/m^3 or 10,000 ppm during the fumigation of an enclosed building. These workers wore coveralls on top of normal daily clothing, PVC gloves, and work shoes. During the actual fumigation, these workers breathed pressurized air from a portable container through a tight fitting facemask. The skin lesions consisted of sharply demarcated erythema with multiple vesicles and large bullae. The lesions were limited to parts of the skin that were relatively moist and/or subjected to mechanical stress such as the armpits, the groin, the labia, the vulva, the penis, the scrotum, the rima ani, the navel, and the skin under the waistbelt. The mean plasma bromide concentration for samples collected immediately after the exposure and 12 hours after the exposure were 95 ± 15 and $72 \pm 24 \text{ } \mu\text{mol/L}$, respectively. It is possible that MB absorption is increased in this partly lipophilic (sebaceous glands) and partly hydrophilic (sweat glands) environment (Zwaveling *et al.*, 1987). The percentage of dermal absorption could not be determined. Healing of the skin lesions of these workers occurred in 2 weeks. Deschamps and Turpin (1996) reported illnesses of two experienced fumigators who wore a cartridge respirator with activated charcoal. They entered a building where the concentration of MB was 17 g/m^3 .

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Under the very high MB concentration environment, it is likely that the respirator was rapidly saturated with MB. It is for this reason that NIOSH does not recommend any air-purifying respirator for MB.

Dermal absorption of vapors of chemicals other than MB was studied. Four human volunteers (naked excepted shorts) were exposed to styrene vapors in the air within the concentration range of 1,300 to 3,200 mg/m³ for 2 hours (Wieczorek, 1985). These volunteers (3 men and 1 woman aged 25-35) breathed pure air from outside through a respirator. The results showed that dermal absorption of the styrene vapors contributed about 5% to the amount absorbed in the respiratory tract under the same conditions when the subjects did not wear a respirator. Riihimaki and Pfaffli (1978) studied percutaneous absorption of xylene, styrene, toluene, 1,1,1-trichloroethane, and tetrachloroethane vapors employing restricted numbers of human volunteers (n = 2-3 for each kind of vapor). The percutaneous absorption when the volunteers were exposed to moderate air concentrations of 300 and 600 ppm for 3.5 hours were about 0.1 to 2% of the amount estimated to be absorbed from the unprotected respiratory tract.

McDougal *et al.* (1985) studied dermal absorption of dibromomethane (DBM, 500 to 10,000 ppm) and bromochloromethane (BCM, 2,500 to 40,000 ppm) vapors in rats. The percentage of body burden, which was due to penetration of the skin, would be 5.8% for DBM and 4.2% for BCM. The observed permeability constants in rats for styrene, xylene, toluene, perchloroethylene, benzene, halothane, hexane, and isoflurane were estimated to be two to four times greater than the human permeability constants calculated from the available literature data (McDougal *et al.*, 1990). Based upon the difference in absorption of various chemical vapors in rats and humans, the percentage of body burden in humans was assumed to be 1.5 to 2.9% for DBM and 1.1 to 2.1% for BCM.

In conclusion, the dermal absorption of MB can be significant based upon reported illnesses of individuals with SCBA exposed to high concentration of MB for extended periods. Dermal exposures of other gases in humans such as styrene, xylene, styrene, toluene, 1,1,1-trichloroethane, tetrachloroethane, dibromomethane, and bromochloromethane can be in the range of 0.1-5% of the unprotected respiratory exposure. However, there is no chemical-specific dermal absorption study for MB; we cannot meaningfully estimate dermal exposure at this time.

2. Chloropicrin exposure assessment (Memorandum page 2 (paragraph 4); attachment page 2 (paragraph 2)).

Currently, chloropicrin exposure assessment has not been initiated. This chemical has been placed in a high priority list under the Birth Defect Prevention Act of 1984 (SB 950). I assume that the exposure assessment may be initiated depending on the priority of the Department's risk assessment.

3. *Adjustment of MB exposure estimates for recovery deficiencies (Memorandum page 2 (paragraph 5); attachment page 4 (paragraph 2)).*

Most estimates in the MB exposure document (January 11, 1999) were adjusted for the percentages of recoveries of 69% (majority), 71.4%, 88%, and 74-125%. I did not adjust the exposure estimates obtained from two studies – fumigation of dried fruits and tree nuts, and a brewery facility because the submitted reports did not provide information on the recovery study.

Based upon a recent public notice from Paul Helliker, the Director of the Department of Pesticide Regulation (DPR), I will assume that I have to adjust the air monitoring data to reflect the percentage recovery of 50%. This percentage recovery was obtained from a recovery study conducted by Biermann and Barry (1999).

4. *In several instances a default estimate of 210 ppb has been used in the exposure assessment calculation because of its designation as a "regulatory limit under permit conditions." OEHHA recommended that risk estimates should also be calculated based on actual or estimated exposure (Attachment page 5 (paragraph 4)).*

There was no actual measurement for MB acute exposure on day one after a 72-hour active aeration period for fumigated houses. Residents were assumed to be exposed to a target level of 210 ppb (24-h TWA). This is a conservative exposure level because MB air concentrations of fumigated houses are likely to be lower than 210 ppb according to the following calculation.

Human exposure potential to MB in recently fumigated houses:

Ideal gas law $C_1V_1 = C_2V_2$, or $C_2 = (V_1/V_2) C_1$

Active ventilation (e.g., 3,000 ft³/min) period = 3 days

MB levels in wall voids (V_1) (e.g., electrical sockets) = 3 ppm (C_1)

Exposure potential to reoccupants (C_2) in fumigated houses (V_2):

$$\begin{aligned} \text{WV/DV (or } V_1/V_2) &= 0.056 \pm 0.004 \text{ (Johnson, 1992)} \\ C_2 &= 0.056 \times 3,000 \text{ ppb} \\ &= \underline{168 \text{ ppb}} \end{aligned}$$

(WV, wall volume; DV, dwelling volume)

The same default of 210 ppb was also used for exposure of residents who live near fumigated fields and commodity fumigation facilities. Therefore, MOEs for acute exposure cannot be calculated based on actual or estimated exposure for residents.

5. *A quantitative discussion of the variability should be provided in the exposure appraisal section (Attachment page 5 (paragraph 3)).*

Information on some of the variables, such as the use of repeated estimates from one location, lack of recovery study and standards, missing application rates, or limited data on frequency and duration of exposure, is intended to be qualitative in nature. It is difficult to judge quantitatively how these variables might affect MOE. For example, if the application rate was not mentioned, the rate could be at the maximum application rate. Hence, this variable would have no effect on MOE. Furthermore, we do not know if more data on frequency and duration of exposure would

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affect MOE and to what extent. I think that we do not have sufficient background information to assign numbers to those variables. If we do so, it will cause some uncertainty concerning those assigned numbers.

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cc: Gary Patterson
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(MB-MSW/HS-99017)