



Department of Pesticide Regulation



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MEMORANDUM

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SUBJECT: REVISED EXPOSURES TO METHYL BROMIDE IN KERN COUNTY
BASED ON CORRECTED DATA FOR THE SUMMER 2001 MONITORING
BY THE CALIFORNIA AIR RESOURCES BOARD

This memorandum revises the estimated ambient exposures to methyl bromide in Kern County given in a previous memorandum (Powell, 2002). The estimates were revised to reflect corrections to the monitoring data provided by the California Air Resources Board (ARB) (Cook, 2003). This memorandum gives inhalation exposures as average concentrations of methyl bromide in air for 24-hour, 1-week and 9-week averaging periods, based on the corrected results of the monitoring done by the California Air Resources Board in Kern County between June 30 and August 30, 2001 (ARB, 2002).

Methods

Following the practice of the Worker Health and Safety (WHS) Branch, this memorandum reports arithmetic mean concentrations and tolerance limits estimated using lognormal methods. Lognormality is assumed for environmental contaminants in most cases. The experience of the Department of Pesticide Regulation (DPR) with many large environmental datasets has shown that they are usually well described by the lognormal distribution. In addition, WHS prefers to avoid the inconsistency of using different exposure statistics based on sample characteristics. WHS uses the arithmetic mean concentration because the concentration of interest for exposure assessment is the overall concentration in all of the air that a person could breathe during the averaging period. The arithmetic mean concentration is the best estimate of the average mass of residue per unit of environmental medium; it is equivalent to compositing all of the samples and measuring the concentration of the mixture (Parkhurst, 1998). This is true regardless of the shape of the underlying distribution.

No samples below the detection limit of 0.0018 ppbv (7.1 ng/m³) were reported by ARB. Forty-six samples with flow-rate deviations greater than 25% were excluded from this analysis. Where there were two usable samples for the same day at a site, the arithmetic mean of the values was used. There were seven cases where a site had usable samples for only two days in a week; one where there was only one day, and one site had no usable data for the first monitoring week. The data were not adjusted for recovery (range 102 to 150 % in laboratory, 118 to 152 % in trip and 109 to 152 % in field spikes).

24-hr exposure

For each monitoring site separately, the maximum observed and the 95% tolerance limit for 24-hr concentrations are given. The 95% tolerance limit is the concentration that, with given probability, will be exceeded in 5% of future samples (Hahn and Meeker, 1991). It is calculated using lognormal distribution methods:

$$95\% \text{ tolerance limit} = \exp\{\text{arithmetic mean of log concentrations} + g_{(.90; .95; n)} * (\text{sd of logs})\}.$$

The multiplier g for 90% probability is tabled in Hahn and Meeker (1991).

1-week exposure

For each monitoring site separately, the maximum and the 95% tolerance limit for weekly mean concentrations are given. Each weekly mean is calculated as the arithmetic mean of the 24-hr samples taken at a site during the week (i.e., nonmonitoring days are ignored). The 95% tolerance limit for weekly mean concentrations is calculated using normal distribution methods:

$$95\% \text{ tolerance limit} = \text{arithmetic mean of week means} + g_{(.90; .95; n)} * (\text{sd of week means}).$$

Normal methods are used in this case because sample means from any distribution tend to be normally distributed.

9-week exposure

For each monitoring site separately, average exposure over the 9-week monitoring period is calculated as the arithmetic mean of the weekly means (calculated as above for 1-week exposure).

Results

Twenty-four-hour, 1-week and 9-week concentrations are presented in Table 1 (see below, page 3). Daily concentrations and intermediate calculations are shown in Table 2 (see below, page 5-6).

Table 1. Methyl bromide concentrations (ppbv) in Kern County, June 30 – August 30, 2001, based on monitoring by the California Air Resources Board ^a.

| Site ^b | N days | Daily | | 1-week | | 9-week | |
|-------------------|--------|------------------|---------------------|----------------------------------|---------------------|----------------------|--|
| | | Maximum 24-hr | 95% tolerance limit | Maximum weekly ^c mean | 95% tolerance limit | Mean of weekly means | |
| | | ----- ppbv ----- | | | | | |
| ARB | 32 | 0.31 | 0.47 | 0.19 | 0.27 | 0.12 | |
| ARV | 25 | 0.22 | 0.25 | 0.12 | 0.16 | 0.07 | |
| | | | (0.26) | (0.13) | (0.18) | (0.08) | |
| CRS | 32 | 33.50 | 25.70 | 12.08 | 14.69 | 2.49 | |
| | | (25.34) | (25.03) | (10.04) | (13.13) | (2.78) | |
| MET | 29 | 0.25 | 0.25 | 0.13 | 0.17 | 0.07 | |
| MVS | 26 | 0.23 | 0.29 | 0.15 | 0.20 | 0.08 | |
| VSD | 27 | 0.23 | 0.31 | 0.15 | 0.20 | 0.08 | |

^a The values in this table are based on the corrected monitoring data (Cook, 2003). Where different, the originally reported values (Powell, 2002) are shown in parentheses.

^b Monitoring sites described in ARB (2002).

^c Each weekly mean is the arithmetic mean of the daily concentrations (*n* ranged 1 - 4) in a calendar week.

Exposure appraisal

The average concentrations presented here are based on limited monitoring data and must be considered as having some degree of uncertainty. The representativeness of the six monitoring sites is unknown. Each site was monitored only 1 - 4 days per week for a relatively short (9-week) period. Weekend days were not monitored. It is unknown whether weekdays and weekends differ systematically in numbers of methyl bromide fumigations.

References

- ARB. 2002. Ambient air monitoring for methyl bromide and 1,3-dichloropropene in Kern County - Summer 2001. Final report dated June 18, Project No. P-01-004. Sacramento, CA: Quality Management Branch, Monitoring and Laboratory Division, Air Resources Board, California Environmental Protection Agency.
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- Hahn, G.J., and Meeker, W.Q. 1991. *Statistical Intervals: A Guide for Practitioners*. New York, John Wiley & Sons, Inc.
- Parkhurst, D.F. 1998. Arithmetic versus geometric means for environmental concentration data. *Environmental Science and Technology News*. Feb. 1.
- Powell, S. 2002. Exposures to methyl bromide in Kern County based on the Summer 2001 monitoring by the California Air Resources Board. HSM-02016. Sacramento, CA: Worker Health and Safety Branch, Department of Pesticide Regulation, California Environmental Protection Agency.
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Table 2. Daily concentrations and intermediate calculations for Kern County sites.

| Date | Week | Monitoring site ^a | | | | | | ARB | ARV | CRS | MET | MVS | VSD |
|-----------|------------------|-------------------------------|--------------|---------------|--------------|--------------|--------------|----------|-------|-------|-------|-------|-------|
| | | ARB | ARV | CRS | MET | MVS | VSD | | | | | | |
| | | ppbv (corrected by ARB 12-03) | | | | | | ln(ppbv) | | | | | |
| 30-Jun-01 | 1 | 0.037 | 0.027 | 0.263 | | | | -3.30 | -3.62 | -1.34 | | | |
| 1-Jul-01 | 1 | 0.029 | | 0.114 | 0.022 | 0.023 | | -3.53 | | -2.18 | -3.81 | -3.76 | |
| 2-Jul-01 | 1 | 0.314 | | 0.070 | 0.021 | | | -1.16 | | -2.66 | -3.88 | | |
| | 1 Average | 0.127 | 0.027 | 0.149 | 0.021 | 0.023 | | | | | | | |
| 6-Jul-01 | 2 | 0.0250 | 0.0486 | 0.0614 | 0.0344 | | | -3.69 | -3.02 | -2.79 | -3.37 | | |
| 7-Jul-01 | 2 | 0.0199 | 0.0205 | 0.0249 | 0.0221 | | 0.0200 | -3.92 | -3.89 | -3.69 | -3.81 | | -3.91 |
| 8-Jul-01 | 2 | 0.0195 | 0.0211 | 0.0233 | 0.0216 | 0.0207 | 0.0211 | -3.94 | -3.86 | -3.76 | -3.83 | -3.88 | -3.86 |
| | 2 Average | 0.021 | 0.030 | 0.037 | 0.026 | 0.021 | 0.021 | | | | | | |
| 13-Jul-01 | 3 | 0.1516 | 0.1263 | 25.1235 | 0.0583 | | 0.1327 | -1.89 | -2.07 | 3.22 | -2.84 | | -2.02 |
| 14-Jul-01 | 3 | 0.0664 | | 1.4582 | | | 0.0363 | -2.71 | | 0.38 | | | -3.32 |
| 15-Jul-01 | 3 | 0.0425 | 0.0269 | 0.2113 | 0.0240 | 0.0289 | 0.0300 | -3.16 | -3.61 | -1.55 | -3.73 | -3.55 | -3.51 |
| 16-Jul-01 | 3 | 0.1531 | 0.0646 | | 0.0379 | 0.1306 | 0.0436 | -1.88 | -2.74 | | -3.27 | -2.04 | -3.13 |
| | 3 Average | 0.103 | 0.073 | 8.931 | 0.040 | 0.080 | 0.061 | | | | | | |
| 21-Jul-01 | 4 | 0.1577 | 0.2147 | 0.9200 | 0.1522 | 0.1711 | 0.2282 | -1.85 | -1.54 | -0.08 | -1.88 | -1.77 | -1.48 |
| 22-Jul-01 | 4 | 0.0428 | 0.0501 | 8.2095 | 0.0497 | 0.0433 | 0.0634 | -3.15 | -2.99 | 2.11 | -3.00 | -3.14 | -2.76 |
| 23-Jul-01 | 4 | 0.1142 | | 0.5128 | | 0.0906 | 0.0621 | -2.17 | | -0.67 | | -2.40 | -2.78 |
| 24-Jul-01 | 4 | 0.0394 | 0.0350 | 0.3597 | 0.0288 | 0.0468 | 0.0394 | -3.23 | -3.35 | -1.02 | -3.55 | -3.06 | -3.23 |
| | 4 Average | 0.089 | 0.100 | 2.500 | 0.077 | 0.088 | 0.098 | | | | | | |
| 29-Jul-01 | 5 | 0.0505 | 0.0256 | 0.6588 | 0.0260 | 0.0277 | 0.0219 | -2.98 | -3.66 | -0.42 | -3.65 | -3.59 | -3.82 |
| 30-Jul-01 | 5 | 0.1057 | 0.0515 | 0.0743 | 0.0281 | 0.0398 | 0.0558 | -2.25 | -2.97 | -2.60 | -3.57 | -3.22 | -2.89 |
| 31-Jul-01 | 5 | 0.0381 | 0.0417 | 0.7056 | 0.0386 | 0.0367 | 0.0404 | -3.27 | -3.18 | -0.35 | -3.26 | -3.31 | -3.21 |
| 1-Aug-01 | 5 | 0.0669 | 0.0323 | 0.0564 | 0.0326 | 0.0390 | 0.0343 | -2.70 | -3.43 | -2.88 | -3.42 | -3.25 | -3.37 |
| | 5 Average | 0.065 | 0.038 | 0.374 | 0.031 | 0.036 | 0.038 | | | | | | |
| 6-Aug-01 | 6 | 0.2941 | 0.2189 | 33.5010 | 0.2455 | 0.2276 | 0.2137 | -1.22 | -1.52 | 3.51 | -1.40 | -1.48 | -1.54 |
| 7-Aug-01 | 6 | 0.2270 | | 4.3815 | 0.1157 | 0.1582 | | -1.48 | | 1.48 | -2.16 | -1.84 | |
| 8-Aug-01 | 6 | 0.1173 | 0.0968 | 9.8433 | 0.0901 | | 0.0949 | -2.14 | -2.34 | 2.29 | -2.41 | | -2.36 |
| 9-Aug-01 | 6 | 0.1182 | 0.0556 | 0.5905 | 0.0602 | 0.0645 | 0.0621 | -2.14 | -2.89 | -0.53 | -2.81 | -2.74 | -2.78 |
| | 6 Average | 0.189 | 0.124 | 12.079 | 0.128 | 0.150 | 0.124 | | | | | | |

Continued

Table 2. Continued.

| Date | Week | Monitoring site ^a | | | | | | ARB | ARV | CRS | MET | MVS | VSD |
|-------------------------------|------|-------------------------------|--------------|---------------|--------------|--------------|--------------|--|-------------|--------------|-------------|-------------|-------------|
| | | ARB | ARV | CRS | MET | MVS | VSD | | | | | | |
| | | ppbv (corrected by ARB 12-03) | | | | | | ln(ppbv) | | | | | |
| 14-Aug-01 | 7 | 0.1781 | 0.0911 | 0.1161 | 0.1267 | 0.1630 | 0.1435 | -1.73 | -2.40 | -2.15 | -2.07 | -1.81 | -1.94 |
| 15-Aug-01 | 7 | 0.2387 | | 0.9435 | 0.1651 | 0.1511 | 0.2331 | -1.43 | | -0.06 | -1.80 | -1.89 | -1.46 |
| 16-Aug-01 | 7 | 0.1508 | | 0.6438 | 0.0670 | 0.1079 | 0.0972 | -1.89 | | -0.44 | -2.70 | -2.23 | -2.33 |
| 17-Aug-01 | 7 | | 0.1180 | 0.6152 | 0.1330 | 0.1101 | 0.1128 | | -2.14 | -0.49 | -2.02 | -2.21 | -2.18 |
| 7 Average | | 0.189 | 0.105 | 0.580 | 0.123 | 0.133 | 0.147 | | | | | | |
| 22-Aug-01 | 8 | 0.1996 | 0.0985 | 5.7363 | 0.0725 | 0.0868 | 0.1043 | -1.61 | -2.32 | 1.75 | -2.62 | -2.44 | -2.26 |
| 23-Aug-01 | 8 | 0.1331 | 0.1254 | 1.7730 | 0.1925 | 0.1147 | 0.1432 | -2.02 | -2.08 | 0.57 | -1.65 | -2.17 | -1.94 |
| 24-Aug-01 | 8 | 0.0836 | 0.0538 | 0.1469 | 0.0361 | 0.0657 | 0.0552 | -2.48 | -2.92 | -1.92 | -3.32 | -2.72 | -2.90 |
| 25-Aug-01 | 8 | 0.0571 | 0.0611 | 0.1740 | 0.0475 | 0.0551 | 0.0660 | -2.86 | -2.79 | -1.75 | -3.05 | -2.90 | -2.72 |
| 8 Average | | 0.118 | 0.085 | 1.958 | 0.087 | 0.081 | 0.092 | | | | | | |
| 28-Aug-01 | 9 | 0.0793 | | 0.0949 | | 0.0726 | | -2.53 | | -2.36 | | -2.62 | |
| 29-Aug-01 | 9 | 0.3140 | 0.0778 | 0.7147 | 0.0774 | 0.1004 | 0.1213 | -1.16 | -2.55 | -0.34 | -2.56 | -2.30 | -2.11 |
| 30-Aug-01 | 9 | 0.0806 | 0.0765 | 0.1316 | 0.0576 | 0.0751 | 0.0722 | -2.52 | -2.57 | -2.03 | -2.85 | -2.59 | -2.63 |
| 9 Average | | 0.158 | 0.077 | 0.314 | 0.067 | 0.083 | 0.097 | | | | | | |
| Mean of week means | | 0.118 | 0.073 | 2.991 | 0.067 | 0.077 | 0.085 | Overall means of logs | | | | | |
| SD of week means | | 0.056 | 0.035 | 4.413 | 0.040 | 0.045 | 0.042 | -2.44 | -2.82 | -0.71 | -2.91 | -2.65 | -2.68 |
| Max of week means | | 0.189 | 0.124 | 12.079 | 0.128 | 0.150 | 0.147 | Overall SDs of logs | | | | | |
| n weeks | | 9 | 9 | 9 | 9 | 9 | 8 | 0.81 | 0.67 | 1.90 | 0.74 | 0.67 | 0.72 |
| 95th %ile of week means | | 0.222 | 0.138 | 11.198 | 0.142 | 0.161 | 0.165 | n days | | | | | |
| 90% tol limit on 95th% | | 0.266 | 0.165 | 14.687 | 0.174 | 0.197 | 0.201 | 32 | 25 | 32 | 29 | 26 | 27 |
| Max of days | | 0.314 | 0.219 | 33.5 | 0.246 | 0.228 | 0.233 | 95th %ile of days: | | | | | |
| | | | | | | | | 0.35 | 0.19 | 12.37 | 0.19 | 0.22 | 0.23 |
| | | | | | | | | 90% tol limit on 95th%ile of days | | | | | |
| | | | | | | | | 0.47 | 0.25 | 25.70 | 0.25 | 0.29 | 0.31 |

^a Monitoring sites described in ARB (2002).