



Department of Pesticide Regulation



Paul E. Helliker
Director

MEMORANDUM

Gray Davis
Governor
Winston H. Hickox
Secretary, California
Environmental
Protection Agency

TO: Joseph Frank, Senior Toxicologist
Worker Health and Safety Branch **HSM-02036**

FROM: Sally Powell, Senior Environmental Research Scientist *[original signed by S. Powell]*
Worker Health and Safety Branch
445-4248

DATE: September 17, 2002

SUBJECT: EXPOSURES TO 1,3-DICHLOROPROPENE IN KERN COUNTY BASED ON
THE SUMMER 2000 MONITORING BY THE CALIFORNIA AIR
RESOURCES BOARD

This memorandum gives inhalation exposures as average concentrations of 1,3-dichloropropene (1,3-D) in air for 24-hour, 1-week and 7-week averaging periods, based on monitoring done by the California Air Resources Board in Kern County in Summer 2000 (ARB, 2000). This memorandum replaces HSM-02025, which erroneously used the limits of detection (LOD) and limits of quantitation (LOQ) from the year 2001 monitoring. Because one-half the LOD is substituted for nondetects, and the mid-point of the LOD and LOQ is substituted for values below the LOQ, correcting these limits resulted in small changes in the 95 percent tolerance limits for days and weeks. In addition, several data points were inadvertently omitted from part of the analysis reported in HSM-02025. Replacing the missing data points had a large impact on the 95 percent tolerance limits for days at the CRS site, because one of the omitted days had an extremely high measured concentration.

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. DPR's experience 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.

Of 194 samples, 92 were below the limits of detection for both cis-1,3-D (LOD = 0.002 ppbv) and trans-1,3-D (LOD = 0.003 ppbv); 72 samples contained quantifiable amounts of both cis- and trans-1,3-D (the limits of quantitation (LOQ) were 0.009 and 0.013 ppbv, respectively). Before cis- and trans- concentrations were summed to get total 1,3-D for each sample, one-half the LOD was substituted for an isomer below the LOD, and the midpoint between the LOD and LOQ was substituted for an isomer below the LOQ.

Twenty-seven samples with flow-rate deviations greater than 25% were excluded from the analysis. When there were two samples taken at a site on the same day, the arithmetic mean of the two values was used. There were eight instances in which a site had usable samples for only two days in a week, and one other in which there was only one sample. The data were not adjusted for recovery (average 127% in 4 laboratory spikes, 104% in 4 trip spikes and 114% in 3 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.

7-week exposure

For each monitoring site separately, average exposure over the 7-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 7-week concentrations are presented in Table 1. Daily concentrations and intermediate calculations are shown in Table 2.

Table 1. 1,3-dichloropropene concentrations (ppbv) in Kern County, 19 July – 31 August 2000, based on monitoring by the California Air Resources Board.

Site ^a	N days	Daily		1-week		7-week
		Maximum 24-hr	95% tolerance limit	Maximum weekly ^b mean	95% tolerance limit	Mean of weekly means
----- ppbv -----						
ARB	23	1.39	2.52	0.65	1.00	0.21
CRS	22	28.25	11.90	18.82	23.25	2.83
MET	23	9.22	1.58	3.08	3.83	0.56
MVS	24	7.98	4.17	2.28	2.82	0.39
SHA	25	0.89	1.67	0.35	0.59	0.12
VSD	24	3.19	1.95	1.11	1.75	0.35

^a Monitoring sites described in ARB (2000).

^b Each weekly mean is the arithmetic mean of the 24-hr samples (*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 1 - 4 days per week for a relatively short (7-week) period. Weekend days were not monitored. It is unknown whether weekdays and weekends differ systematically in numbers of 1,3-D fumigations.

References

- ARB. 2000. Ambient air monitoring for methyl bromide and 1,3-dichloropropene in Kern County - Summer 2000. Project no. C00-028. Testing Section, Engineering and Certification Branch, Monitoring and Laboratory Division, Air Resources Board, California EPA. Sacramento, CA. December 27, 2000.
- 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.

cc: Ruby Reed
 Randy Segawa
 Bruce Johnson

Table 2. Daily concentrations and intermediate calculations for Kern County sites.

Date	Week	Site ppb						Site ln(ppb)					
		ARB	CRS	MET	MVS	SHA	VSD	ARB	CRS	MET	MVS	SHA	VSD
07/19/00	1	0.55107	28.2526	0.00226	0.04969	0.36140	0.00556	-0.596	3.3412	-6.093	-3.002	-1.0178	-5.192
07/20/00	1	0.74759	9.39029	0.41011	0.31663	0.34046	1.96413	-0.291	2.2397	-0.891	-1.15	-1.0775	0.675
	1 Average	0.64933	18.8214	0.20619	0.18316	0.35093	0.98484						
07/24/00	2	0.36559		0.00887		0.08551	3.18832	-1.006		-4.725		-2.4592	1.1595
07/25/00	2	0.22869	0.23792			0.89047		-1.475	-1.436			-0.116	
07/26/00	2		0.19992	0.00688	0.09906	0.17908	0.05703		-1.61	-4.979	-2.312	-1.7199	-2.864
07/27/00	2	0.35830	1.00059	9.21856	0.04078	0.25841	0.08380	-1.026	0.0006	2.2212	-3.2	-1.3532	-2.479
	2 Average	0.31752	0.47948	3.07811	0.06992	0.35337	1.10972						
07/31/00	3		0.02092		0.11527	0.14087			-3.867		-2.16	-1.9599	
08/01/00	3	1.39214	0.01349	0.59205	0.43777	0.20641	0.49614	0.3308	-4.306	-0.524	-0.826	-1.5779	-0.701
08/02/00	3	0.05995	0.00226	0.58221	0.02121	0.00788	0.01349	-2.814	-6.093	-0.541	-3.853	-4.844	-4.306
08/03/00	3	0.01349	0.00226		0.07641	0.00226	0.01349	-4.306	-6.093		-2.572	-6.0932	-4.306
	3 Average	0.48853	0.00973	0.58713	0.16266	0.08935	0.17437						
08/07/00	4	0.00226	0.00226	0.00887	7.98192	0.00226	0.00226	-6.093	-6.093	-4.725	2.0772	-6.0932	-6.093
08/08/00	4	0.03536	0.00226	0.01349	0.44576		0.01349	-3.342	-6.093	-4.306	-0.808		-4.306
08/09/00	4	0.01655	0.00226	0.01349	0.43823	0.00226	0.57254	-4.101	-6.093	-4.306	-0.825	-6.0932	-0.558
08/10/00	4	0.01983	0.00226	0.00226	0.27127	0.00226	0.02475	-3.921	-6.093	-6.093	-1.305	-6.0932	-3.699
	4 Average	0.01850	0.00226	0.00953	2.28430	0.00226	0.15326						
08/14/00	5	0.00226	0.48332	0.00226	0.00887	0.09937	0.00887	-6.093	-0.727	-6.093	-4.725	-2.309	-4.725
08/15/00	5	0.00226		0.00887	0.01349	0.05082	0.00688	-6.093		-4.725	-4.306	-2.9794	-4.979
08/16/00	5	0.00226		0.00226	0.00688	0.00887	0.00688	-6.093		-6.093	-4.979	-4.7254	-4.979
08/17/00	5	0.01349		0.00226	0.00226	0.00226	0.00226	-4.306		-6.093	-6.093	-6.0932	-6.093
	5 Average	0.00507	0.48332	0.00391	0.00788	0.04033	0.00622						
08/21/00	6	0.00226	0.03109	0.00226	0.00226	0.00226	0.00226	-6.093	-3.471	-6.093	-6.093	-6.0932	-6.093
08/22/00	6	0.00226	0.00226	0.00226	0.00226	0.00226	0.00226	-6.093	-6.093	-6.093	-6.093	-6.0932	-6.093
08/23/00	6	0.00226	0.00226	0.00226	0.00226	0.00226	0.00226	-6.093	-6.093	-6.093	-6.093	-6.0932	-6.093
08/24/00	6		0.00226	0.00226	0.00226	0.00226	0.00226		-6.093	-6.093	-6.093	-6.0932	-6.093
	6 Average	0.00226	0.00947	0.00226	0.00226	0.00226	0.00226						

continued

Table 2. Continued.

Date	Week	Site ppb					
		ARB	CRS	MET	MVS	SHA	VSD
08/28/00	7	0.00226	0.00226	0.00226	0.00226	0.00226	0.00226
08/29/00	7	0.00226	0.00226	0.00226	0.00226	0.00226	0.00226
08/30/00	7	0.00226	0.00226	0.00226	0.00226	0.00226	0.00226
08/31/00	7	0.00226	0.00226	0.00226	0.00226	0.00226	0.00226
7 Average		0.00226	0.00226	0.00226	0.00226	0.00226	0.00226
Grand Average		0.16639	1.80270	0.47360	0.43098	0.10636	0.26992
Mean of week means		0.212	2.830	0.556	0.387	0.120	0.348
SD of week means		0.273	7.055	1.133	0.840	0.162	0.485
Max of week means		0.649	18.821	3.078	2.284	0.353	1.110
n weeks		7	7	7	7	7	7
95th %ile of week means		0.742	16.539	2.757	2.019	0.434	1.289
90% tol limit on 95th%		1.002	23.248	3.834	2.818	0.588	1.750
Max of days		1.39	28.25	9.22	7.98	0.89	3.19

Site	ln(ppb)					
	ARB	CRS	MET	MVS	SHA	VSD
	-6.093	-6.093	-6.093	-6.093	-6.0932	-6.093
	-6.093	-6.093	-6.093	-6.093	-6.0932	-6.093
	-6.093	-6.093	-6.093	-6.093	-6.0932	-6.093
	-6.093	-6.093	-6.093	-6.093	-6.0932	-6.093

mn	-4.08	-4.05	-4.64	-3.70	-4.21	-4.26
sd	2.32	3.00	2.36	2.39	2.22	2.30
n	23	22	23	24	25	24

95th %ile of days (ppb)

0.906	3.054	0.557	1.488	0.658	0.724
2.525	11.902	1.582	4.172	1.674	1.949
90% tol limit on 95th%ile of days (ppb)					