Department of Pesticide Regulation

Mary-Ann Warmerdam
Director

M E M O R A N D U M

Arnold Schwarzenegger
Governor

TO: George Farnsworth
Environmental Program Manager I
Worker Health and Safety Branch

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(No. assigned after issuance of memo)

FROM: Harvard R. Fong, CIH
Senior Industrial Hygienist
Worker Health and Safety Branch
(916) 445-4211

[Original signed by H. Fong]

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SUBJECT: RESULTS FROM MONITORING AIR SURROUNDING VENTURA LIFITING BOX FUMIGTION CHAMBER DURING FUMIGATION/AERATION CYCLE

On November 20, 2008, Frank Schneider (Associate Industrial Hygienist), Kevin Solari (Program Specialist), and I initiated a workplace evaluation monitoring of an unusual fumigation facility in Ventura County. The fumigation "chamber" is a large wooden box, measuring 10' by 11' by 6' (3.05 meters by 3.35 meters by 1.83 meters) and enclosing a volume of 660 cubic feet (18.69 cubic meters). The chamber box is attached to a hoist system via a chain drive and is designed to be lifted to allow loading of the area beneath the box. This system, which will be referred to as a lifting box, is used by the operator as a soil fumigation device. Soil trays, each holding as much as 648 cubic inches (10,618 cubic centimeters) are stacked on the loading platform under the lifting box. According to the Ventura County Agricultural Commissioner's (CAC) staff, up to 8.5 cubic yards (6.5 cubic meters) can be treated using the lifting box. After the soil trays have been loaded on the platform, the lifting box is lowered, with the bottom edges of the lifting box fitting into a moat-like channel carved into the concrete. The moat is filled with water to create a liquid seal around the bottom of the lifting box. Methyl bromide (TriCal Methyl Bromide 98% EPA Reg. 8536-19-11220) is then injected into the lifting box via a heat exchanging system and plastic hoses. The entire set up can be seen in Figure One.

In a previous visit, cooperation with the owner/operator of the facility was secured. The Ventura CAC staff agreed to issue a single use permit for the application to be monitored. The permit allowed for the use of up to 6 pounds of methyl bromide in the lifting box. With assistance from the Environmental Monitoring Branch, the CAC calculated a worker buffer zone of 30 feet and an aeration buffer zone of 86 feet.

Monitoring locations for air sampling were established at 10 feet and 30 feet from the lifting box (corresponding to minimal buffer zones of a fumigation chamber during fumigation/aeration), with additional sampling sites at 5 feet that was utilized during the first 15 minutes of aeration (the Short Term Exposure Limit:"STEL"). An additional STEL monitoring site ("Applicator") was added by on-site decision, located by the control switch for the lifting mechanism. Sampling sites consisted of an SKC Personal Air Sampler (either model 222-4 or 222-3, with respective

sampling rates of approximately 0.33 or 0.52 milliliters per count) connected via Tygon® tubing to charcoal sampling tube assemblies (SKC Catalog # 226-38-02). The tube assemblies consisted of a primary tube loaded with 400 milligrams of activated charcoal connected via Tygon® to a secondary (or backup) containing 200 milligrams of charcoal.

Figure One: Lifting Box in raised position.

In most cases, the pump speed controls were adjusted so approximately 7 to 11 liters of air would be sampled during the collection period. In general, the following collection periods were followed during the fumigation/aeration (Table One):

Table One: General Sampling Times

Date	Morning Sampling	Afternoon Sampling
November 20	0900 to 1400 hrs (5 hours)	1400 to 1900 hrs (5 hours)
November 21	0900 to 1400 hrs (5 hours)	1400 to 1900 hrs (5 hours)
November 22	0900 to 1400 hrs (5 hours)	1400 to 1800 hrs (4 hours)

In the case of the "STEL" and "Applicator" samples, these were run at full pump speed, using the pumps with larger displacement (Model 222-3), for 15 minutes during the initiation of the aeration phase. In addition, background samples were run for 4.25, 5 and 10 hours, the last being accidently left on for an extended period, resulting in excess air volume (15 liters) being sampled. Travel blanks were also created by cracking charcoal tubes and then immediately sealing them and placing them in storage.

Application commenced at 0900 hrs on November 20th. After loading the soil trays under the raised lifting box, the applicator lowered the lifting box and filled the moat with water. As he was preparing the lifting box for fumigation, IH staff placed air samplers in the appropriate locations (see Figure Two, diagram not to scale).

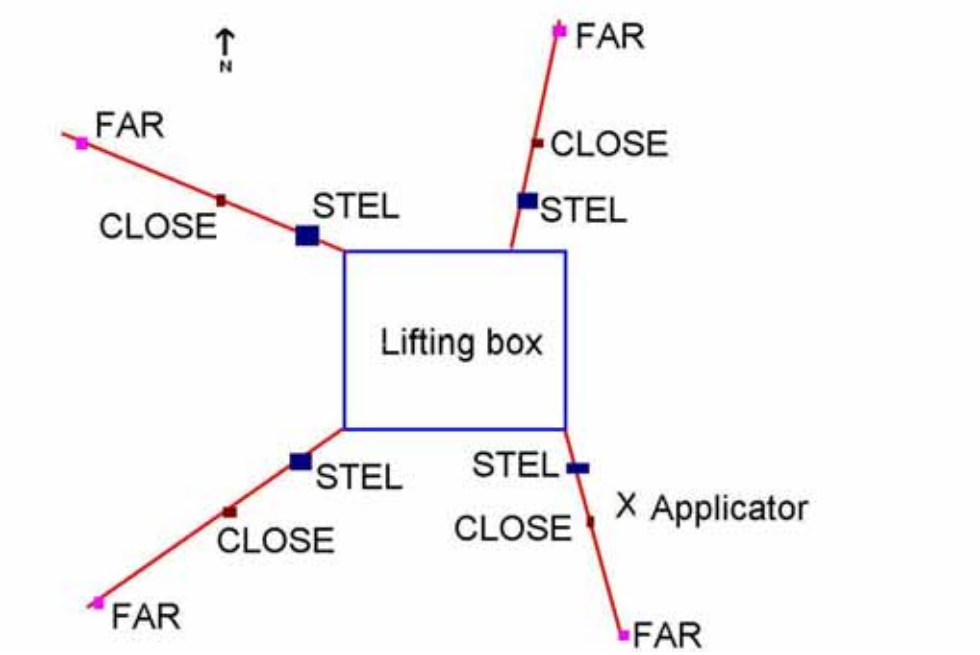


Figure Two: Sampling Sites

Sampling sites designated "STEL" were within 5 feet of the box; those designated "CLOSE" were at approximately 10 feet; those designated "FAR" were at 30 feet. The location of the lifting box control switch sampling site is marked with an "X" and labeled "Applicator".

Once all sampling sites were set, the applicator released the methyl bromide from the tank, through plastic tubing into a heat exchanger (Figure 3) to fully phase-change the pressurized liquid into a gas (boiling point of methyl bromide is 40º F [4.4º C]). From the heat exchanger the gas flowed into the lifting box fumigation chamber.

Figure Three: Heat Exchanger

Sampling pumps were turned on simultaneously to the application. Pumps were run for 5 hours, after which both pump and sampling media were replaced, with sampling continuing for 5 more hours. Collected air sampling tubes would be removed from the pump assembly and the primaries would be removed from the backup tubes. All sampling tubes were capped, stored in a plastic bag (all together) and placed on dry ice.

After completion of all the standard and STEL sampling cycles, the samples (still stored on dry ice) were transported to the Center for Analytical Chemistry (a division of the California Department of Food and Agriculture) in Sacramento. Samples were handed over on November 24, 2008. Results were reported to WH&S on December 18th, 2008.

On receiving the laboratory results, the raw microgram per sample data were converted into parts per million values (ppm), for better comparison to the DPR Guideline value of 630 ppm for an 8-hour work day. The summary results are shown in Table Two. Quality control recovery samples run by the laboratory all were above 75%, and as such, no correction factors were applied to the results.

Table Two: Summary Results From Air Sampling Lifting Box Fumigation

Sampling Period			Methyl Bromide Concentration	
Date/Time	**Location**	**Activity**	**Average PPM**	**Maximum PPM**
11/20 0900 to 1400	*Close*[1]	*Fumigation*	*0.072*[2]	*0.118*
11/20 0900 to 1400	*Far*[3]	*Fumigation*	*0.022*	*0.033*
11/20 1400 to 1900	*Close*	*Fumigation*	*0.070*	*0.100*
11/20 1400 to 1900	*Far*	*Fumigation*	*0.052*	*0.022*
11/21 0900 to 1400	Close	Fumigation	0.043	0.082
11/21 0900 to 1400	Far	Fumigation	0.029	0.052
11/21 1400 to 1900	Close	Fumigation	0.223	0.285
11/21 1400 to 1900	Far	Fumigation	0.063	0.082
11/22 0900 to 0915	*STEL*[4]	*Aeration*	*0.361*	*1.050*
11/22 0900 to 0915	*Applicator*[5]	*Aeration*	*Not Applicable*	*1.013*
11/22 0900 to 1400	*Close*	*Aeration*	*0.032*	*0.057*
11/22 0900 to 1400	*Far*	*Aeration*	*0.025*	*0.074*
11/22 1400 to 1800	*Close*	*Aeration*	*0.019*	*0.041*
11/22 1400 to 1800	*Far*	*Aeration*	*0.009*	*0.014*

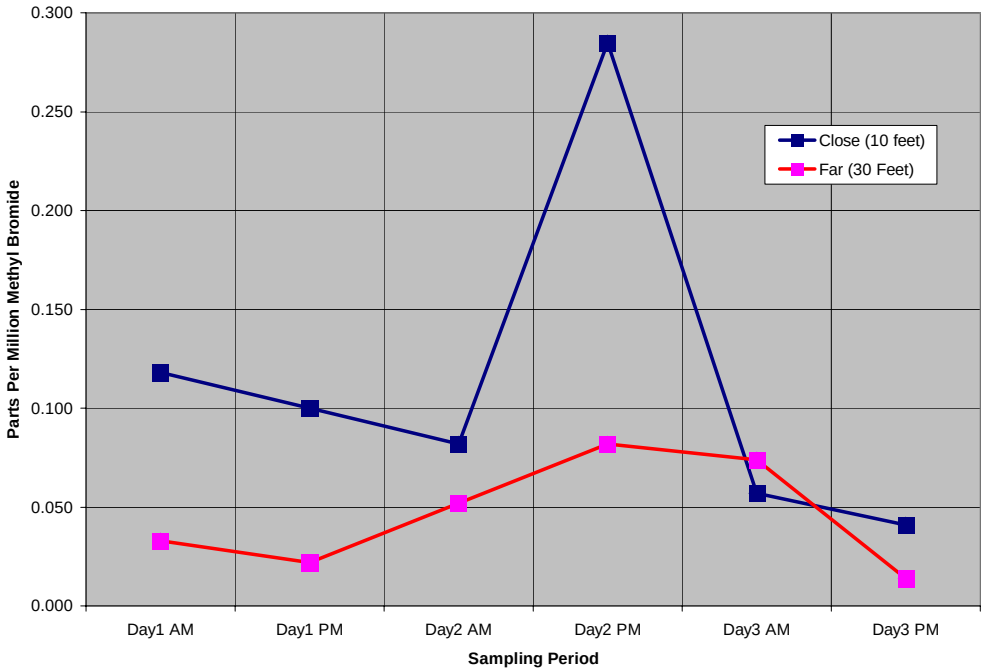
[1]10 feet from chamber [2]sampler error, only 3 samples taken [3]30 feet from chamber
[4]5 feet from chamber [5]Located at power switch for lifter motor

The complete raw data spreadsheet, including all laboratory results, sampling volumes and sampler site location (N, E, S, W) is found as Attachment One of this document.

During sampling periods, a Kestrel 4000 hand-held weather station was used to measure temperature and relative humidity during the time staff were present at the site. Morning temperatures were in the mid to upper-teens (15º C to 19º C), whereas afternoon temperatures ranged from low to high 20s (20º C to 28º C). Relative humidity ranged from 24% to 58%, and should not have had an effect on the ability of the charcoal tubes to absorb methyl bromide. Though wind speed was not a parameter measurement required by protocol, some recordings were taken. This data, along with staff perceptions, indicate that a breeze (<3mph/5 kph) was present during most periods staff were on site.

In graphing the results of Table Two, the maximum value was used for plotting data, since this diminishes the effect that shifting wind directions may have on the overall exposure recorded by each sampling site. Therefore maximum values were plotted, separating “Close” and “Far” data.

Figure Three: Variation in Maximum Methyl Bromide Concentrations Over Time



The spike in concentration in the afternoon of Day 2 is puzzling. Since there was not 24 hour surveillance on the site, any unusual transient condition may have occurred. According to the site manager, unauthorized movement of the lifting box is unlikely, since power is cut to the switch after the lifting box is lowered and not reconnected until time to raise the box. It may be that after 36 hours, methyl bromide begins to penetrate the wood of the box, or that temperature-induced expansion/contraction of box occurred, resulting in leakage, or that the moat water level lowered sufficiently to allow some gas escape. Even this high concentration, recorded by the "Close" monitoring, was only 0.285 ppm, which is very near to the DPR Guideline value of 0.210 ppm for 24 hours. It would appear that during fumigation, the worker buffer zone may be collapsed to 10 feet, with an adequate margin-of-safety for workers in the vicinity.

The initial aeration STEL samples ranged from 0.013 ppm to 1.05 ppm, while the "Applicator" sample was 1.013 ppm. These results do not fully characterize the first minute of exposure, when the lifting box was raised, and a potentially large parcel of methyl bromide passed the sampling sites.

All but one of the blanks (travel and background) were reported as non-detected (<2 ug/sample ≈ 0.008 ppm). However, one of the background blanks, collected in the staging area of study (about 100 feet from the lifting box) did have a positive result of 0.008 ppm, right at the edge of

the limit of quantification. This sample was drawn during the morning of the second day of fumigation, just before the afternoon spike that occurred on that day.

When the entire data set of "Close/Far" and STEL samples is viewed in terms of directionality, there does appear to be some environmental effect on distribution of the methyl bromide as it leaves the confines of the lifting box. Instead of a relatively equal distribution of gas, as one would expect in a homogeneous point source in an enclosed space, air movement from winds appears to skew gas distribution, with concentration differences as high as 16X (e.g. Day 2 Morning: North Close Sample = 0.005; East Close Sample = 0.082).

After reviewing the results, I believe the following recommendations should be considered for any further fumigations done using this lifting box system:

- Buffer zones should be collapsed to minimal size: 10 foot for fumigation, 30 foot for aeration. This only applies if the application rate is 6 pounds or less. Applications greater than 6 pounds will require recalculated buffer zones, with a minimum 30 foot application buffer and 86 foot aeration buffer.

- Because the control switch is within the aeration buffer zone, it should be moved outside of this zone.

- After one day of aeration (24 hours), access to the fumigated soil does not require SCBA or testing of the air for methyl bromide. However, this only applies if the lifting box is lifted to its maximum upward travel during initial aeration (as it was in this monitoring) and remains lifted. If the box is not fully lifted, or is lowered during the first day of aeration, air testing and SCBA are required.

These recommendations are void if there are substantial changes to the application procedures used during this study (e.g. higher rates [>6 lbs]; shorter fumigation time [<48 hours]; shorter aeration time [<24 hours]; modifications or lack of maintenance to the lifting box, etc.).

cc: Mr. Henry Gonzalez, Ventura County Agricultural Commissioner (CAC)
Ms. Ellen Kragh, Agricultural Biologist, Ventura CAC
Mr. Jahan Motakef, Sr. Environmental Scientist, Enforcement Branch, Southern Regional Office
Mr. Frank Schneider, Associate Industrial Hygienist, WHS Branch
Mr. Kevin Solari, Program Specialist, WHS Branch