Department of Pesticide Regulation

Brian R. Leahy
Director

M E M O R A N D U M

Edmund G. Brown Jr.
Governor

TO: Sheryl Beauvais, Ph.D.
Senior Toxicologist
Worker Health and Safety Branch

HSM-13012
(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 SAMPLING FOR PHOSGENE USING SALAD DEVICES CHARGED WITH CHLOROPICRIN AND POSITIONED ON NON-ABSORBENT SURFACE

We have continued research into the question of in-field conversion of chloropicrin (PIC) to phosgene (carbonyl chloride). In the earlier iterations of this study, soil moisture and subsequent excess humidity in the static air-limiting accumulation domes (SALAD) appeared to interfere with the ability to detect phosgene in the units. Therefore the units were placed on plastic tables which had been covered with plastic/paper tablecloth cover, plastic side up. This not only removed a source of excess humidity (other than the ambient humidity of the enclosed air), it also removed soil as a potential absorptive sink for both the PIC and the phosgene.

As with the two previous iterations of this study (Health and Safety Memorandum 12004: http://www.cdpr.ca.gov/docs/whs/memo/hsm12004.pdf) a known amount of PIC (approximately 1.5 ml) was added to each dome. This would ensure that PIC was definitely within the SALAD and available for photolytic conversion and was based on the amount added in the previous test done on soil (SALAD II). The first SALAD test (SALAD I) has used much larger amounts (from 25 to 40 ml) and was plagued by the "rebleaching" effect of excessive chlorine-containing test agent overwhelming the pretreatment reagents and entering the indicator tube immediately behind whatever reactants had been formed in the pretreatment section. The unreacted chlorine material bleaches out the dyestuff formed in the indicator tube, yielding a false negative reading. SALAD II, on the other hand, using lower levels (2 ml PIC per dome) had detectable levels of PIC, but these were rapidly reduced, mostly likely from the extremely high humidity trapped within the dome and absorption onto the soil surface. Results for SALAD I and II were inconclusive.

SALAD III, conducted on the non-absorptive table, was done loading the units with approximately 1.5 milliliters of PIC (roughly duplicating the dosage levels of SALAD II-). However, no allowance had been made for the non-absorptive properties of the dry dome siting on a plastic surface compared to SALAD II's absorptive soil surface and high humidity. Once again, the rebleaching effect occurred and all attempts to reduce the concentration (primarily partial purging of the domes and introduction of fresh air) were not successful and SALAD III terminated.

In an effort to prevent further experiment failures, and to better quantify the amount of PIC necessary to be detectable and plentiful, yet not cause a rebleach, the actual volume of the domes was measured using water as the volumetric medium. The volume of the SALAD unit is 38 liters (0.038 cubic meters). To ensure at least an amount at the maximum detection level of the colorimetric tubes (16 ppm or 4 grams), approximately 3 microliters (calculated using a PIC density of 1.66 grams/cubic centimeter) would be sufficient to add to each unit. A 250 microliter plunger pipette was used to charge the domes in SALAD IV.

On August 5th, at 0745 hours, three SALAD units were charged with approximately 3 ± 1 microliters of PIC. Once again, the units were located such that they were in direct sun for about 6 hours per day (see Photo One).

Photo One: Deployed SALAD IV units

A temperature reading, taken at 1515 hours and using an infrared thermometer, indicated the three unit's temperature as 112° F (44° C). At 1910 hours, PIC samples were drawn from all three units. All three were at greater than 16 ppm, with no rebleaching effect.

The following day (August 6th), temperature readings at 1615 hours indicated temperature as 99°F (37° C). Samples drawn for both PIC and phosgene, at 1730 hours, had values shown in Table One.

	Unit One	Unit Two	Unit Three
PIC	9 ppm	4 ppm	12 ppm
Phosgene	0.75 ppm	0.25 ppm	1 ppm

Table One: Detected levels at 1730 hours on August 6th

The next day (August 7th), dome temperature readings at 1715 hours were 90°F (32°C). PIC and phosgene samples drawn at 1715 hours had values shown in Table Two.

	Unit One	Unit Two	Unit Three
PIC	3 ppm	1 ppm	2.5 ppm
Phosgene	0.35 ppm	<0.02 ppm	0.5 ppm

Table Two: Detected levels at 1735 hours on August 7th

SALAD IV was terminated after this sampling.

Units One and Three showed close agreement in ratios of PIC to phosgene and close in absolute values. The lower values in Unit Two may be explained by the location of the unit on the table. Unit Two was situated over the folding seam of the table, which may have allowed gasses to permeate through the table covering and out into the general air.

SALAD IV shows that PIC conversion to phosgene can occur in non-laboratory conditions, though this does not prove that detectable field-condition conversion could occur under the SALAD device. Likewise, the nature of the SALAD environment (confined accumulation) will tend to result in concentrations that may not be consistent with concentrations in a free air exchange environment, and subject to high humidity conditions as found under gas-retaining films (i.e. totally impervious film [TIF] used as a field tarpaulin). Further work with the SALAD may be useful in assessing its utility under field conditions and the utility of the information gathered for your data requirements.

Related HSMs:

HSM-12004 - Results from Dome Sampling for Phosgene Using High Initial Concentrations Of Chloropicrin (Extreme Conditions) In A Field Environment

HSM-13011 - Results From Sampling For Phosgene Using Salad Devices Positioned On Tarped Bedded Field Treated With Chloropicrin And 1,3-Dichloropropene

cc: Nino Yanga, Environmental Program Manager I, WHS