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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

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OFFICE OF
PESTICIDES AND TOXIC SUBSTANCES

JUL 02 1984

MEMORANDUM

SUBJECT: Sulfuryl Fluoride Qualitative Use Assessment

TO: William Miller, Product Manager Team 15
Registration Division (TS-767-C)

The Qualitative Use Assessment (QUA) for Sulfuryl fluoride (SF) is attached. The QUA is rather abbreviated compared to those for more traditional agricultural compounds. This is due to basically one major use (structural fumigation) and a noted lack of available information. Since this use is considered to be exclusively administered by certified commercial applicators, the states evidently do not provide as much information regarding the use of the material relative to less exclusive use situations.

The greater proportion of SF is evidently applied to domestic dwellings. The label for Vikane[®] gas fumigant (Reg. No. 464-236) and the EPA Index entry for sulfuryl fluoride provide the pertinent application information and need not be repeated in the QUA. Please note the Mr. Dave Brassard (Science Support Branch/BUD) has recently drafted amendments and corrections to the Index entry and has also drafted "Auxiliary Documentation For Sulfuryl Fluoride" which discusses the various factors involved in the calculation of estimated dosages for application. This later document also contains several sample calculations for several different sized, hypothetical buildings. Copies of these documents will be forwarded to you upon completion.

The Dow Chemical Company has published a "Fumigation Manual for Use With Vikane Gas Fumigant" which is quite extensive and should be consulted if technical questions arise that cannot be answered from the material provided here.

I'll be happy to try to answer any questions you may have regarding this matter.

M. I. Dow
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Attachment

REGISTRATION STANDARD'S PHASE I
QUALITATIVE USE ASSESSMENT
FOR
SULFURYL FLUORIDE (VIKANE®)

PREPARED BY
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JULY 1984

INTRODUCTION

Sulfuryl fluoride (Vikane[®]) is formulated as a 99 % pressurized gas for insecticidal-rodenticidal fumigation of terrestrial structures, construction materials, surface ships in port, and vehicles (including rail cars, automobiles, buses, and recreational vehicles). There are two registered end-use products and one state registration (CA 5785-3694). The product is packaged in high pressure steel bottles (cylinders) as a liquid. It becomes gaseous upon release and contact with air. Sulfuryl fluoride is toxic to vertebrate and most life forms of invertebrate arthropod pests. Product labels list such pests as rats, mice, several species of cockroaches, carpet beetles, bed bugs, clothes moths, powder post beetles, dry wood and Formosan termites, old house borer, and death watch beetles.

Sulfuryl fluoride is applied by certified, commercial applicators. The greatest majority of the volume is applied to domestic premises and most of that is applied in Florida, southern California and Hawaii.

QUALITATIVE USE ASSESSMENT

Common Name: sulfuryl fluoride

Trade Name: Vikane®

Site Classification: Terrestrial Non-Food

Site Category: Terrestrial Structures including domestic dwellings;
Commercial, Industrial, and Institutional Areas; Surface
Ships in port; and Vehicles

METHOD OF APPLICATION: Sulfuryl fluoride (SF) is admitted to a sealed and/or tarped structure (or commodity) via high pressure (500 psi) hose from a steel "bottle" (cylinder). Theoretically, an applicator should not be exposed since the system is essentially "closed". The SF is a liquid until it is released into the air inside the structure or chamber. The structure is kept sealed for 24 hours then aerated. After a structure is aerated it is entered and monitored with instruments to ensure that all the SF has dissipated before reoccupancy is allowed (N. Goldenberg and J. Grimes; personal communications, 1984).

RATE OF APPLICATION: Most private dwellings are treated with less than 20 lbs of SF (N. Goldenberg; personal communication, 1984).

APPLICATOR CATEGORY: Certified applicators or persons under their direct supervision.

NUMBER OF APPLICATIONS: In portions of Florida, one crew (ca 5 persons) can set up and "shoot" three houses per day, five days per week and nine months per year weather permitting (N. Goldenberg, personal communication, 1984). The excepted months are November, December and January. A second crew opens and aerates the houses 24 hours after treatment. This intensity of treatment schedule is considered highly conservative from a risk point of view and is only expected to occur in very limited geographical areas and involve relatively few persons (estimated number unknown).

DISTRIBUTION OF APPLICATIONS: The main target pests are dry wood termites. They are distributed in the southeastern states, the southern portions of the Gulf Coast states, parts of Arizona and New Mexico and southern California and Hawaii. The largest volume of material is used in Florida, southern California, and Hawaii.

FREQUENCY OF APPLICATION: It is not uncommon for a 30-40 year old structure to become reinfested and be retreated 4-6 times over that time span.

MANAGEMENT CONTROL PRACTICES: There are several actions that can be taken to help avoid infestation from drywood termites. The primary objective is to deny access to wood by use of special construction practices and selection of special building materials. Screening of attics and crawl space ventilators can help prevent entry by termite swarms. Dusting attics and enclosed soffits with sorptive dusts such as aero silica gel can help prevent infestation. Although quite expensive, the use of treated lumber (particularly framing lumber and siding lumber) can help repel dry wood termites. In areas of intense termite pressure, investing in treated lumber can often be justified.

PEST BIOLOGY: There are several species of termites in the genera Incisitermes and Cryptotermes that cause most of the damage in the continental U.S. Termites are social insects that live in colonies and in this case within dry wood. Unlike subterranean termites, dry wood termites do not need contact with the soil.

Dry wood termites have 3 life forms or "castes" in their colonies. The castes are reproductives, workers, and soldiers. Individuals of each caste pass through three growth stages, egg, nymph and adult. Colonies or infestations are started by a winged (alate) pair of primary reproductives which have swarmed out of a previous colony. The primary reproductives bore into wood and excavate a small nest gallery. The queen lays a few eggs which are tended by the primary pair of reproductives. When the nymphs emerge, they are also cared for by the king and queen until they are large enough to forage for themselves. The older nymphs and subsequent workers assume care of the colony and feed the primary king and queen. Later, soldiers are produced. Soldiers have enlarged head capsules and large mandibles. Their function is that of protecting the colony, primarily from ants that raid termite nests. It is the worker caste that causes damage to wood from their incessant tunneling for food and to enlarge the nest cavity. As the colony increases in size, the function of the primary pair becomes one of reproduction only. The queen lays eggs on a more or less continual basis. Eventually, secondary reproductives are formed which take the place of primary pair at the time of their demise or, if the colony is really large, they also produce eggs. At some point, usually after several years of colony growth, winged reproductives are formed which swarm and leave the colony to begin the cycle anew.

SULFURYL FLUORIDE REFERENCES

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AUXILIARY DOCUMENTATION FOR SULFURYL FLUORIDE (078003)

- (1) Protection of Food There is a serious discrepancy in the directions for structural fumigation between 464-236 (Dow) and 2749-279 (Aceto Chemical). The Dow label reads "Food, feed, drugs and medicinals (including those items in refrigerators and freezers) must be removed from fumigation site or sealed in highly resistant containers such as" the Aceto label reads "Food and medicinals not in sealed glass or metal containers must be either (a) removed from the building, (b) ..., or (c) placed in refrigerator or freezer with the door cracks sealed completely with masking tape".

I have chosen to include the Dow statement in the entry since Dow is the basic producer and its' statement is the most restrictive of the two.

- (2) Respiratory Protection 464-236 was recently revised to eliminate the use of "gas masks" for respiratory protection. The only respiratory protection now permitted for Vikane is a NIOSH or MSHA approved positive pressure self-contained breathing apparatus (SCBA). However, Dow neglected to remove references to the use of gas masks from the "Fumigation of Ships in Port" section of the label. Another discrepancy involves the Aceto Chemical label which still recommends gas masks for respiratory protection. This label should be amended to agree with the Dow label.
- (3) Dow has put together an excellent technical bulletin exclusively for the use of their product 464-236. It is an excellent reference and gives specific directions for step by step use of the product and is over 100 pages long. The problem here is that this technical bulletin (referred to by Dow as the Vikane Fumigation Manual) is not referenced on the label nor is a stamped (a RD acceptance Stamp) copy included in the registration jacket (only a 1969 Manual can be found here). Previous labeling has referenced the manual in the bottom right hand corner of the label but the current marked-up copy appears to have deleted this reference. At my request, Gary Otakie has requested that Dow put this statement on their next label (currently in revision). I have decided to use the technical bulletin in the compilation of the "index" entry because of its excellent directions for the use of Vikane, and because of previous reference to it on earlier labeling.
- (4) The following pests contained in the technical bulletin, were omitted in the entry because they were not listed on the label and because they were not associated with a specific dosage rate:

False powderpost beetles (Bostrichids)
 Round head borers (Cerambycids)
 Flathead borers (Buprestidae)
 Hide beetle

* Millipedes
 * Spiders
 * Springtails
 * Earwigs

* Firebrats
 * Silverfish
 * Crickets
 * Fleas

* Ants
 * Bees
 * Wasps
 * Booklice

* The above are considered "incidental pests also affected during Vikane Fumigation".

- (5) Dosage Calculation is impossible to make without the Fumiguide B and Fumiguide Y and would be very difficult to make with consultation of the manual. The user has to (1) Measure the volume of the structure (cu. ft); (2) Estimate Half Loss Time (using Fumiguide B or a complex formula included in the manual); (3) determine hours exposure (usually 20-24 hours but can vary with the requirements of a particular job); (4) calculate Vikane concentration (oz/1000 cu. ft.) (using Fumiguide B or Y); (5) calculate actual dosage (concentration X volume X known multiple of reference dosage); and (6) recheck Vikane concentration during fumigation to determine actual Half Loss Time, readjusting the dosage (using Fumiguide Y) if necessary. I am attaching a two page narrative entitled "Vikane Dosage Determination Guidelines" which briefly discusses some of the factors that feed into the dosage equation and gives dosage examples for several fumigation scenarios.

Because of the dynamic nature of the dosages for sulfuryl fluoride, we have decided to list the basic dosage in the index entry as the reference dosage and list the "known multiple" of this dosage for each target pest.

David W Brassard

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 Science Support Branch
 Benefits and Use Division (TS-768-C)

VIKANE DOSAGE DETERMINATION

GUIDELINES

(refer to Section 4.5 of manual for more details)

- (1) Measure the Structure (cu. ft.) Refer to manual for specific instructions.
- (2) Estimate Half Loss Time (HLT) (Range = 2-27 hours, average = 6-10 hours)
The Half Loss Time is the time it takes for half of the fumigant to leak out of the structure being fumigated. An estimate is calculated using Fumiguide B or Table 13 in the fumigation manual. Both of these methods start with a basic HLT of 12 hours and adjust this figure accordingly depending upon the following factors:
 - a. Tarp or stucco conditions (poor = 0.6, medium = 0.8, excellent = 1)*
 - b. Seal (poor = 0.6, medium = 0.8, excellent = 1)*
 - c. Soil (sand = 0.25, loam = 1, slab = 3)
 - d. Volume (1,000 cu. ft. = 0.4, 27,000 cu. ft. = 1.2, 1,000,000 cu. ft. = 4.0)*
 - e. Wind (0 mph = 1, 6-9 mph = 0.7, 20 + mph = 0.4)*

* adjustment factor to basic HLT

- (3) Determine Hours Exposure (HE) (Range = 2-72 Avg. = 20-24)
The current fumigation manual is somewhat unclear on this determination. The directions say to calculate HE (from the HLT) using fumiguide Y but nowhere in the manual or on Fumiguide Y does it say how to accomplish this. According to an earlier fumigation manual and conversations with professionals in the field, present fumigation practices call for an exposure period of 20-24 hours. This figure can be shortened or lengthened depending on the circumstances surrounding the particular job (e.g. distant job, business can only be closed for a short period, etc.).
- (4) Calculate Vikane Concentration (oz/1000 cu. ft) and Ounce-hours (OH) using:
 - (A) Fumiguide Y sliding scale calculator. Using the example on the calculator when HLT = 10, HE = 20 and F° = 60, align the 20 HE curve (X axis) with 10 HLT on the Y axis in upper window. Then opposite 60°F on temperature scale read 13 oz/1000 cu. ft. on Vikane concentration scale. Also note on Ounce-Hours (OH) scale that 145 Ounce-Hours are required at 60°F.

OR

- (B) Fumiguide B calculator which assumes an exposure time (HE) of 20 to 24 hours and computer dosages 1.33 times higher (than Fumiguide Y) due to HLT estimation with no follow up measurements for actual HLT.
- (5) Calculate Vikane dosage by multiplying the Vikane concentration (e.g. 13 oz) by the number of 1,000 cu. ft. in structure to be fumigated. This is the reference dosage. Then multiply this dosage by the known multiple of the reference dosage for the target pest (e.g. bedbugs = 2, formosan termites = 4, clothes moths = 6, powderpost beetles = 10, drywood termites = 1)
- (6) Compute Actual Half Loss Time (HLT) Fumigate structure. After equilibrium check Vikane concentration (with a gas measuring instrument) and recheck after one or more hours to determine actual HLT (use side B of Fumiguide Y to calculate).
- (7) Recalculate Dosage (if actual HLT is less than estimated HLT) using instructions or Fumiguide Y (side A).
- (8) Examples Using Fumiguide Y and the formulas in the manual I calculated dosages for several fumigation scenarios. In these calculations I made the following assumptions: HE = 20, Temperature = 70°F, Tarp Condition - good; Seal - medium, Soil - loam wind 6-9 mph, and Pest = Drywood termites

	<u>Cubic Feet</u>	<u>Estimated HLT</u>	<u>Vikane Concentration</u>	<u>Total Vikane Used</u>
24' X 30' Bungalow (w/crawl space)	7,560	4.8 hrs.	14.7 oz/1000cu ft	6.95 lbs.
28' X 40' Ranch (w/basement)	20,720	6.65 hrs.	11.4 oz/1000cu ft	14.75 lbs.
28' X 38' Colonial Home (w/basement)	28,196	7.3 hrs.	10.6 oz/1000cu ft	18.7 lbs.
Small Commercial Building	125,000	12.1 hrs.	7.9 oz/1000cu ft	61.7 lbs.
Large Commercial Building	400,000	18.1 hrs.	6.8 oz/1000cu ft	170 lbs.

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