STATE PEST CONTROL REGULATORY OFFICIALS CONFERENCE (SPECROC)

HISTORICAL RECORD

1965

PRESIDENT:
VICE-PRESIDENT:
SECRETARY:
TREASURER:
LOCATION OF ANNUAL MEETING: New Orleans, LA
DATE: 9/09/65 to 9/11/65

HIGHLIGHTS OF MEETING:
The meeting was held at Monteleone Hotel in New Orleans. The meeting was adjourned early due to the imminent arrival of hurricane Betsy.

States attending were: Alabama, Arkansas, California, Florida, Georgia, Louisiana, Mississippi, North Carolina, Tennessee, South Carolina. Also attending were Dr. Ralph Heal of NPCA, Mr. H. R. Johnston, Forest Service Research Laboratory U. S. Department of Agriculture, Gulfport, Mississippi, Mr. Jack A. Wever of the Veterans Administration, Mr. Paul Adams, Past President of NPCA.

Agenda: Report from Georgia on soil testing; Termites and their resistance to present chemicals; Life expectancy of pest control chemicals; Registered pesticide labels and usage and their relationship to the structural pest control operator; pre-treat and sub-standard job requests; What to do about branch offices; Reciprocity of laws and regulations between states; Value of soil test in checking pco's; Use of chemicals for treating homes with private water supplies; Are pco's using enough chemical for pretreats? What to do about monitoring this activity; and reports from Gulfport (H. R. Johnston), FHA (Neil Connor), VA (Jack Wever), and NPCA (Dr. Ralph Heal).

Historical records contain 1957 technical release on Ethylene Dibromide in subterranean termite control (NPCA)

1963 paper on "Chemicals in Subterranean Termite Control" (NPCA)

1964 paper on "Statement for the Hearing on the Registration of the Economic Poisons, Aldrin, Dieldrin, and Endrin" (NPCA)

1965 paper on "Protecting Individual Water Systems from Termite Toxicants" (NPCA)

1965
Program

STATE PEST CONTROL
REGULATORY OFFICIALS

September
9-11

MONTELEONE HOTEL

NEW ORLEANS, LOUISIANA

SIXTH ANNUAL MEETING

Thursday, September 9

9:00 A.M. - Call to Order

Roll Call

Introductions

Report from Georgia on Soil Testing, discussion on report.
Carl Scott

General Discussion
Suggested Subjects:

Discuss means by which prospective Licensees are examined.

Are termites resistant to present chemicals? Life expectancy of pest control chemicals.

Registered Pesticide Labels and Usage and their Relationship to the (Structural) Pest Control Operator.

Pre-Treat and Sub-Standard job requests.

What to do about Branch Offices?

Reciprocity of laws and regulations between states.

Value of Soil Test in checking PCO's.

Use of chemicals for treating homes with an individual water supply.

"Gimmicks" found to be of greatest value in improving PCO's work.

Are pest control operators putting down the recommended amount of chemical for pretreating? How can this be checked?

ADJOURN FOR LUNCH

1:30 P.M. - Report from U.S. Forest Research Laboratory, Gulfport.
H. R. Johnston

F.H.A. Regulations governing the control of termites.
Neil Connor

V.A. Regulations governing the control of termites.
Jack A. Weber

Report from National Pest Control Association.
Dr. Ralph E. Heal

6:00 P.M. - Social Hour - Orkin Exterminating Co.,Inc.

Friday, September 10

9:00 A.M. - Pest Control Operation
Paul Adams

Continue General Discussion

ADJOURN FOR LUNCH

1:30 P.M. - Executive Session

Saturday, September 11

8:30 A.M. - Depart from hotel for tour of Laboratory at Gulfport, by bus.
Allied Chemical

NOTES

Technical Release

National Pest Control Association INC

A NON-PROFIT MEMBERSHIP ASSOCIATION

THE BUETTNER BUILDING
250 WEST JERSEY STREET
ELIZABETH, N. J. 07202
201-354-3738

NUMBER 7-57

DATE 6/6/57

ETHYLENE DIBROMIDE IN SUBTERRANEAN TERMITE CONTROL

Ethylene dibromide has been found to be valuable as a soil fumigant in the elimination of colonies of subterranean termites under slabs, which would have been difficult or impractical to reach with liquid soil poisons. Limited experience in California over several years indicates that EDB can be used safely in subterranean termite control by the techniques developed in that state and under the conditions of construction, soil, and weather that have been encountered. Two incidents in the East, involving illness of humans, indicate that specific precautions should be observed if EDB is to be used safely in subterranean termite control.

In the development of basic information on this subject, the NPCA staff has found a dearth of experimental data and a considerable divergence of opinion. Recommendations of The Dow Chemical Company accompany this release as Appendix 1. These recommendations emphasize the necessity for thorough aeration of areas to be occupied continuously by humans following the use of EDB as a soil fumigant under or near them. Continuous aeration over a period of days through open doors and windows is indicated as being adequate under weather conditions which permit this. Under inclement weather conditions, or where the treatment is applied under or near a below-grade space (as a basement), Dow recommendations state that the structure should not be released for continuous occupancy until it can be proved that there is less than 5 parts per million EDB air contamination, and that tests should be made every other day for a week to show that this safe level is maintained.

The NPCA staff agrees with The Dow Chemical Company on the need for maintaining safe levels of air contamination when EDB is used. It is our opinion, however, that the difficulties of making the chemical test are such that it would be an impractical recommendation for most termite control firms.

On the basis of the recommendations of the Dow paper, considered in conjunction with reports of field experience to date and calculations of practical exposure hazards, we submit the following recommendations and precautions for use of EDB by our industry in subterranean termite control. It is our opinion that observance of these recommendations will permit further practical evaluation with safety.

(over)

RECOMMENDATIONS AND PRECAUTIONS:

1. Use EDB only where control with accepted soil treatment is impractical. Soil fumigation is not a substitute for the application of liquid chemicals which have residual value. Restrict the use of EDB to those problems where construction and conventional soil treatments are impractical.

2. Avoid overdosing - EDB is not considered to have residual value. Its use can be justified only if its properties of distribution as a soil fumigant provide an advantage. Thus, fewer points of application and lower application rates than for accepted soil treatments should be used.

3. Use EDB only where it can be confined to the soil area by a cover. This is necessary for both safety and effectiveness. Concrete or masonry slabs are adequate cover, but should be made as tight as practically possible. Holes for utility entrances and any large cracks, especially into habitable quarters, should be sealed to the extent possible.

4. Formulations - The presently accepted formulation is a solution of EDB in a base oil such as kerosene or No. 2 fuel oil. Oils lighter than kerosene or other solvents are undesirable, as they may add to the toxicity or fire hazard. Do not use spot or mill fumigant formulations of EDB which contain other fumigants, as carbon tetrachloride or ethylene dichloride.

5. Concentration - Maximum recommended concentration is 15% EDB by weight in the base oil. A product of this concentration may be purchased ready made on the California market. A formulation of this concentration also may be prepared from more concentrated forms of EDB as follows:

   Using 85% EDB soil fumigant formulation
      11 fluid ounces into kerosene to make a total volume of one gallon.

   Using 40% EDB soil fumigant formulation
      37 fluid ounces into kerosene to make one gallon.

   Using undiluted EDB
      7 fluid ounces into kerosene to make one gallon.

6. Rate of Application - Application should not exceed one quart of 15% formulation per 25 square feet of slab area (one quart per hole on five-foot centers). Experience indicates that this dosage will do the job. For restricted area or spot treatments, the application should not exceed one quart per hole unless special checks are made to ensure that the material is being absorbed by the soil. Feed EDB formulations at a rate which permits them to be absorbed by the soil.

7. Seal holes promptly - Immediately after the fumigant has been introduced into a hole, seal it tightly.

8. Ventilate during application - To protect the applicator from EDB vapors make sure that fresh-air movement through enclosed areas is maintained, using a fan if necessary.

9. Ventilate after treatment - Maintain fresh-air movement through confined areas so that detectable concentrations of EDB vapors at any points within the occupiable portion of the structure are removed.

10. Continue ventilation until checks of all likely points of EDB leakage or accumulation indicate the absence of air contamination detectable by the halide leak detector. Do not permit reoccupation of premises if a detectable concentration remains at any point in a habitable room. Maintain aeration by means of an open door or window in each room for several days following treatment if possible. If circumstances make this impossible, do not permit continuous occupancy (as by an infant, an invalid, or an aged person) for a week after a detectable concentration was last observed.

11. Check for the presence of EDB vapors - Use a halide leak detector to reveal any high concentration of EDB vapors that may develop. It can detect a concentration as low as 45 parts per million, if in proper working adjustment. Checks with the leak detector should be used as a guide in application, as a protection against undue exposure of applicators, and to ensure that ventilation after treatment is adequate.

12. Exercise special care with radiant-heat slabs - In addition to the problems which apply to any slab, the slab with radiant heat may have a special hazard at the time the heat is first used after the treatment. EDB gas, absorbed by the soil at temperature prevailing when the slab is cold, can be released rapidly when the heat is turned on and lead to a significant air-contamination problem.

13. Insurance - Your insurance covering extermination operations may not cover operations using 15% EDB in a mineral oil carrier as a sub-slab soil treatment in termite control. Check with your broker to make sure that you are adequately covered before undertaking such operations.

(over)

14. DON'T'S

(a) Don't use EDB near basements or other below-grade areas which can be occupied by humans or pets.

(b) Don't use EDB under or near slabs which contain air ducts - either hot or cold air.

(c) Don't use EDB to treat uncovered soil areas within or under structures.

(d) Don't treat wall voids with EDB formulations.

15. DO'S

(a) Do be cautious in the use of EDB in sub-slab termite control.

(b) Do consider these recommendations as minimum precautions which must be applied with common sense.

(c) Do maintain an experimental attitude, whether you are using EDB for the first time, or if you are an experienced operator using EDB under new conditions.

(d) Do be familiar with the precautions for handling EDB formulations safely and instruct your workmen accordingly. These precautions will be given in detail on the label of the EDB product which you purchase.

METHYL BROMIDE FOR SUBTERRANEAN TERMITE CONTROL

Methyl bromide has also been mentioned for use in sub-slab soil fumigation. It has some theoretical advantages as well as serious limitations. Both should be explored by trained and properly equipped researchers. Until this problem has been fully examined, we strongly recommend against the use of methyl bromide for sub-slab termite control except on an experimental basis by adequately insured fumigators who fully understand the behavior of fumigants in soil and who are equipped to assure positively the safety of persons and property in treated buildings.

PRECAUTIONS FOR THE SAFE HANDLING AND USE OF ETHYLENE DIBROMIDE AND METHYL BROMIDE FOR THE CONTROL OF SUBTERRANEAN TERMITES

By
O. H. Hammer and J. E. Peterson
The Dow Chemical Company

During recent years many words have been written and spoken on the subject of subterranean termite control with the fumigant materials, ethylene dibromide and methyl bromide. Excellent results have been reported from the use of these materials when applied as sub-slab treatments. Ethylene dibromide is being applied also to the soil along masonry foundation walls for termite control. Both fumigants have been reported to have given excellent results in situations where other control measures are impractical.

This discussion does not recommend nor condemn the use of ethylene dibromide or methyl bromide for subterranean termite control. It is an attempt to point out some necessary considerations for the pest control operator who is considering or actually employing these chemicals for this purpose. It is not the purpose here to give details of reported uses nor to evaluate the effectiveness of the materials. Such information is available in the literature and in the files of operators who have had experience with the subject.

It does seem desirable however, to point out some of the safety precautions necessary when using ethylene dibromide or methyl bromide. As with other pesticides these materials must be used with knowledge and caution if adverse effects are to be avoided. Several important items to consider and a discussion of each follows.

TYPE OF CONSTRUCTION

Two general types of concrete slab construction seem to lend themselves to the use of these fumigants for the control of subterranean termites.

(a) <u>Surface Slabs</u>: Those structures where the entire top surface of the slab floor is level with or above the surrounding soil surface. In these instances the entire dwelling units or habitable areas are entirely above the ground level. Under such conditions there is little hazard of post-application exposure from the use of either ethylene dibromide or methyl bromide if all floor cracks and other floor openings are carefully sealed.

(b) <u>Sub-Surface Slabs</u>: Those structures where the top surface of slab floors are in part or wholly below the level of the surrounding soil surface. This type of construction is often associated with concrete or masonry walls and foundations. In the absence of positive information, it would seem likely that there is considerably more hazard associated with the fumigation of sub-surface slabs. Additional information with respect to the hazard connected with this use of these fumigants is being obtained. Until such information is available extreme caution must be exercised in the use of these fumigants for this type of construction.

(over)

FORMULATIONS OR MIXTURES

Probably the most commonly used and the safest ethylene dibromide formulation is one containing 15% ethylene dibromide in a light oil such as Stoddard Solvent or No. 2 fuel oil. Other ethylene dibromide formulations containing materials such as ethylene dichloride, carbon tetrachloride or carbon bisulfide should not be used because of the greater toxicological hazards involved.

Methyl bromide used for this purpose should contain two per cent chloropicrin as the odorizing or warning agent. It must be kept in mind that the warning properties of chloropicrin can be relied upon only during the time of application.

PROPER DOSAGE

The proper amount of each of these fumigants to be used can be determined only by a careful appraisal of each area to be fumigated. No helpful statement can be given here except to point out that suggested amounts for the different situations may be found in the literature and that excessive dosages are to be avoided.

SAFE HANDLING AND APPLICATION PRECAUTIONS

All of the safety precautions pertaining to the use of these fumigants should be exercised.

Avoid personal exposure to both the liquid and gaseous forms of these chemicals. Use approved application equipment and appropriate protective devices. Prior to application, make certain that the construction and sealing is such that the fumigant vapors will be confined to the areas under fumigation. Exclusion of the gases from all areas not under actual fumigation is highly important. This is a job that requires understanding, good judgment and sobriety from beginning to end.

METHODS OF DETECTING FUMIGANT VAPORS

Several methods are available for determining the concentration of ethylene dibromide and methyl bromide in air. Each method has distinct advantages and disadvantages which must be recognized. The limitations of the most widely used methods are discussed below.

(a) Odor and/or irritation: For most people a concentration of ethylene dibromide of 25 parts per million or more in the atmosphere is detectable by its odor. Furthermore, concentrations of this material which are hazardous to life upon short exposure have a definite and sickening odor. If the warning given by the odor of ethylene dibromide is heeded, acute overexposure is not likely to occur. On the other hand, concentrations of ethylene dibromide in the atmosphere which may be harmful upon continuous exposure are not detectable by odor.

Methyl bromide alone has little or no odor and is not irritating to the eyes or respiratory tract. When odorized with chloropicrin, warning properties of the mixture are adequate to prevent acute overexposure provided that the mixture is fresh from its original container. After contact with soil, or building materials the warning properties of odorized methyl bromide are no longer reliable.

(b) Halide Leak Detector: A halide leak detector (torch) can be used to estimate the concentration of methyl bromide or ethylene dibromide in air provided that the concentration of the fumigant is not below the sensitivity of the instrument. The lowest concentration of methyl bromide which will cause a change in the appearance of the flame is about 25 parts per million, while the analogous figure for ethylene dibromide is about 45 parts per million. (See attached Table). In order to determine concentrations below these figures or to determine accurately any concentration a chemical method is necessary.

(c) Thermal Conductivity Instruments: Certain instruments such as the Gow-Mac Gas Meter* and the Fumiscope** determine fumigant concentrations by means of thermal conductivity cells through which contaminated air is drawn. While such instruments are valuable for certain applications they are not sensitive enough to be of any value in assessing the health hazard presented by low concentrations of methyl bromide or ethylene dibromide. These instruments simply were not designed to detect and measure accurately concentrations appreciably below 500 parts per million.

(d) Chemical Methods: Several chemical methods are available for the determination of atmospheric concentrations of methyl bromide or ethylene dibromide. They all have the disadvantage that a certain amount of time is required for sampling and for analyzing the samples. These methods however, offer the only practical means of determining concentrations of ethylene dibromide and methyl bromide which may be hazardous upon continuous exposure.

One of the most practical of these methods is described in the December 1956 issue of the American Industrial Hygiene Association Quarterly page 429. The sample is taken by drawing contaminated air through a bed of activated silica gel upon which the fumigant is adsorbed quantitatively. The gel then can be transported to the laboratory for analysis. By using various combinations of flow rate and length of sampling time any concentrations of methyl bromide or ethylene dibromide encountered in fumigation may be accurately determined.

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* Manufactured by Gow-Mac Instrument Company, 100 Kings Road, Madison, New Jersey.

** Manufactured by Robert J. Hassler Company, 994 E. Poppyfield Drive, Altadena, California.

(over)

RELEASE OF FUMIGATED PREMISES FOR SAFE CONTINUOUS OCCUPANCY

Probably the greatest potential hazard from the use of these fumigants exists during and soon after the termination of the desired exposure period. This hazard may result from lack of complete elimination of the fumigant from the habitable area. The cause of atmospheric contamination is most likely seepage through cracks in foundation walls and concrete slab floors. Construction openings for heating, plumbing and other utility equipment as well as improperly sealed holes made for the purpose of applying the fumigant can also be contributing factors. Thorough aeration of the area after fumigation is always necessary. When the fumigant has been applied beneath a surface slab in good weather, open windows and doors of the dwelling will probably assure continuous aeration over a period of days. Under these circumstances, a halide leak detector torch probably is sensitive enough to assure safety.

On the other hand, if the fumigation is conducted during inclement weather or if the slab is below the soil surface, then adequate aeration no longer can be assured by this means.

If the aeration, for one reason or another, will be less than continuous over a period of days, and if it is desirable to inhabit the area more or less continuously, then the absence of fumigant vapors <u>must</u> be assured before such occupancy can be allowed. In order to do this, reliable methods of gas detection must be employed. In checking for the presence of fumigants special attention should be given first to those areas most likely to show excessive amounts of gas such as cracks, resealed holes, etc. This checking can be most easily accomplished with a halide leak detector. If leaks are found, they should be sealed before occupancy is allowed. However, and this is very important, even though no color change is observable in the detector flame this is <u>not</u> sufficient assurance that a hazardous amount of fumigant is not present, that is, less than 5.0 parts per million.

Therefore, prior to allowing such continuous habitation of a fumigated area, positive evidence of concentrations lower than 5 ppm. of either methyl bromide or ethylene dibromide must be provided. Chemical methods of air analysis are the only convenient techniques available to determine fumigant concentrations in this range, and therefore, their use in these circumstances is mandatory. Until evidence to the contrary is forthcoming, the assumption should be made that back seepage of the fumigants into the habitable area may occur and therefore, even after occupancy is shown to be safe and is permitted the area should be checked at two day intervals for a week after fumigation. If the fumigant is detected upon rechecking then the structure should again be thoroughly aerated. In such rechecking, areas such as basement rooms, below-the-soil-surface furnace rooms, storage and utility rooms, tight closets, etc. should receive special attention.

In summary, the hazards associated with the use of ethylene dibromide and methyl bromide in fumigating beneath slabs are not so great as to preclude the use of these materials for this purpose. However, the hazards are great enough so that special precautions must be taken. If the fumigator is careful to avoid skin and eye contact and to avoid breathing these materials both may be applied with safety. However, the PCO must not lose sight of the fact that his responsibility is not ended after the exposure period required for fumigation is complete. He must be absolutely certain that occupants of the fumigated dwelling will not be harmed as a result of his activities. Such certainty is not easily established at times, but the extra effort involved is a small price to pay in relationship to the harm that could be done.

TABLE

CALIBRATION (APPROXIMATE) OF THE PREST-O-LITE® AND BERNZ-O-MATIC® HALIDE LEAK DETECTOR FOR FUMIGANT VAPORS

Description Of Flame	Fumigant (Calculated in p.p.m.) Methyl Bromide	Ethylene Dibromide
Trace of Green at top edge (Blue base)	25 to 60	45
Definite Green (Blue base)	100	75 to 120
Kelly Green	250	190 to 300
Green with blue fringe	500	500
Blue green		700
Blue with a green fringe	1000	1200 to 2000
Blue	1500	3000 and up
Blue with some smoke	2000	
Blue with pink or orange fringe	4000 and up	

Chemicals in Subterranean Termite Control
1963 Revision

This revision has been developed by the Wood Destroying Organisms Committee and Staff of the National Pest Control Association to replace the section, Chemicals in Subterranean Termite Control, pages 35-44 in the original (1951) edition of the Approved Reference Procedures for Subterranean Termite Control.

National Pest Control Association
250 West Jersey Street
Elizabeth, New Jersey

Chemicals in Subterranean Termite Control
1963 Revision

Chemicals are frequently used in three phases of subterranean termite control, the procedures of which will be discussed separately in other sections of these Approved Reference Procedures. Because the same chemical often is used in more than one phase of termite control, the properties of the various chemicals are discussed in this section separately from the discussion of their application in control work.

The chemicals used by termite control workers in termite control work are listed in the table below with an indication of their use by the termite control industry. The application of chemicals in subterranean termite control is discussed under Soil Treating, pages 45-54; Foundation Treating, pages 55-59; and Wood Treating, pages 61-63. Chemicals applied in commercial wood-treating plants are discussed briefly on page 44G.

TABLE 1

CHEMICALS USED IN TERMITE CONTROL BY TERMITE CONTROL WORKERS

	Reference Concentration	Treating Use: Soil	Treating Use: Foundation	Treating Use: Wood	Page
General purpose materials					
Aldrin (actual)	0.5% by wt.	x	x	x	37
Chlordane (technical)	1.0% by wt.	x	x	x	38
Dieldrin (actual)	0.5% by wt.	x	x	x	39
Heptachlor (actual)	0.5% by wt.	x	x	x	40
Lindane	0.8% by wt.	x	x	x	41
Special use materials					
Ethylene dibromide	15% by wt.	x			41
Orthodichlorobenzene	25% by vol.	x	x	x	43
Paradichlorobenzene	100% by wt.	x	x	x	44A
Pentachlorophenol	5% by wt.		x	x	44A
Sodium arsenite	10% by wt.	x	x	x	44C
Trichlorobenzene	25% by vol.	x	x		44D

Note: A number of other chemicals, which have been used or considered for subterranean termite control but are not now recommended, are referred to on page 44E.

(over)

REFERENCE CONCENTRATIONS AND RATES OF APPLICATION

Chemicals for soil treatment are used to establish a barrier which is lethal or repellent to termites. The toxicant should be adequately incorporated in the soil to provide a barrier to all routes of termite entry.

Effective soil treatment requires the dispersion in the soil of a required amount of toxicant. Two interrelated factors are: the amount of chemical and a means of dispersing it in the soil. These factors are controlled by the concentration of the chemical and the rate and uniformity of application. A balance must be maintained between the concentration and volume applied. Neither should be changed without appropriate adjustment of the other.

Reference concentrations are listed in Table 1. The related reference rates of application, as discussed in the section on soil treating (page 45) are as follows:

REFERENCE APPLICATION RATES FOR SOIL TOXICANTS

<u>Soil Under Slabs - 1 gal/10 sq. ft.</u>
(see section on soil treating - pages 51-52)

<u>Exposed Soil - 1 gal/10 sq. ft.</u>

<u>Interior of Foundation and Critical Areas - 4 gal/10 lin. ft.</u>

<u>Exterior of Foundation - 4 gal/10 lin. ft. per foot of depth</u>
Treatment is to provide a treated barrier from the footing to the surface of the soil (exterior of slab structures without foundation shall be treated as a foundation 1 foot in depth.)

Reference concentrations as given in Table 1 and reference application rates as given above are recommended to achieve the prolonged period of control that responsible termite control operators provide. Such prolonged control may require the use of greater concentrations under adverse conditions of soil, weather or termite pressure. In some cases soil will not accept liquids at the reference rates of application. When this condition exists, a lesser volume of carrier (water or oil) may be used. For example, 5 gallons of 2% chlordane would be equivalent to 10 gallons of 1% chlordane. The actual amount of the insecticide per linear or square foot of soil should not be reduced and it must be properly distributed to provide an adequate barrier of treated soil.

CHEMICALS APPLIED BY TERMITE-CONTROL OPERATORS

GENERAL PURPOSE MATERIALS

ALDRIN: Aldrin is a chlorinated hydrocarbon which is widely used as a soil poison for termite control. It is used more for pretreat than for corrective work. Its odor is seldom objectionable in pretreat work. It is slightly more volatile than the closely related dieldrin. After aldrin has been in soil for some time, a very small portion of it may be converted to dieldrin. Such conversion is not considered to be of much importance in view of the quantities and location of aldrin as applied for subterranean termite control.

Technical aldrin is a brownish waxy solid that is insoluble in water but soluble in most organic solvents. It has a characteristic odor. Aldrin is sold for termite control as an emulsifiable concentrate containing 2 pounds of actual aldrin per gallon.

Aldrin is absorbed readily through the skin as well as by ingestion or inhalation. It is a central nervous system stimulant which can cause serious injury from a single dose or repeated small exposures. The greatest occupational hazard to the termite control operator is from skin contact; therefore, special care should be taken to avoid contact of aldrin with the skin whenever possible.

Do not allow aldrin to come in contact with the skin or eyes nor to get into the mouth. Clean synthetic rubber gloves and other protective equipment should be used as necessary to prevent contact with concentrates or prolonged exposure to dilute emulsions. Workers should wear clean clothing and should wash thoroughly with soap and water after handling aldrin, especially before eating or smoking. In the event of skin contamination, remove contaminated clothing at once and wash the skin with soapy water. If it splashes in the eyes, flush them with plenty of water and get medical attention. Containers, when empty, must be disposed of safely.

As used in soil treatments for subterranean termite control, aldrin emulsions are not known to be harmful to plants.

In Forest Service tests in Mississippi, 0.5% aldrin (actual) in water emulsion has been under test for 13 years and is still 100% effective. Aldrin at 0.5% concentration applied in oil solution or water emulsion is acceptable for soil treatment (pretreatment) under Section 815-3.8 of the Minimum Property Standards of the Federal Housing Administration.

The approved reference concentration for aldrin is 0.5%.

(over)

CHLORDANE: Chlordane is a chlorinated hydrocarbon that is a widely used and successful soil poison for termite control. In addition to long lasting effectiveness and minimal odor, it has been used successfully in water emulsions with little or no harm to plants.

Technical chlordane is defined as "a commercially produced chemical containing 60-75% of chlordane together with 25-40% of related compounds occurring in the natural manufacturing process which are toxic to insects." It is a brownish liquid which is insoluble in water but readily miscible with most petroleum solvents. The odor of chlordane varies with the formulation, concentration and other factors, but as it is used in termite control, few persons find it objectionable, while others are not aware of it.

Chlordane is readily absorbed through the skin, the lungs or the alimentary tract. It is a central nervous system stimulant which can cause serious injury from a single dose or repeated small exposures.

Chlordane vapor in sufficient concentration can be toxic. However, in tests conducted by the manufacturer under the guidance of the Public Health Service, chlordane was not detectable in the air of three crawl spaces and two slab houses which had received standard preconstruction treatments of chlordane for subterranean termite prevention.

Chlordane sprays or other formulations should not be allowed to come in contact with the skin or eyes, nor to get into the mouth. Clean synthetic rubber gloves and other protective equipment as necessary should be used to prevent contact with concentrates or prolonged exposure to dilute emulsions. Workers should wash thoroughly with soap and water after handling and before eating or smoking and wear clean clothing.

As ordinarily used in subterranean termite control, chlordane emulsions are not harmful to woody plants, and in fact, are recommended for direct application to termite-infested areas of living plants.

In Forest Service tests in Mississippi, 1% chlordane (technical) in water emulsion has been under test for 14 years and is still 100% effective. Chlordane at 1.0% concentration applied in oil solution or water emulsion is acceptable for soil treatment (pretreatment) under Section 815-3.8 of the Minimum Property Standards of the Federal Housing Administration.

The approved reference concentration for chlordane is 1.0%.

DIELDRIN: Dieldrin is a chlorinated hydrocarbon that is widely and successfully used as a soil poison for termite control.

Technical dieldrin is a buff to light tan flaky solid with a rather mild chemical odor. Dieldrin has the lowest vapor pressure of the general purpose chemicals listed in Table 1. It is insoluble in water, but moderately soluble in such materials as xylene.

The dieldrin formulation used for termite control is an emulsifiable concentrate containing 1.5 pounds of dieldrin per gallon. Most formulations have an odor, primarily from the solvent, which may persist a week or more.

Dieldrin is a central nervous system stimulant which can cause serious injury from a single dose or repeated small exposures. It can be absorbed by ingestion, inhalation or skin contact. The greatest occupational hazard to the termite control operator is from skin contact. Injuries have resulted to workers in some foreign countries who failed to observe adequate precautions. In the United States and elsewhere when proper personal protection and hygiene have been observed, there have been few, if any, substantiated cases of illness due to the use of dieldrin. These differences emphasize the need for carefully following precautions supplied with insecticides. Because of the ease with which dieldrin, dry or in formulations, can penetrate the unbroken skin, special care should be taken to avoid contact of dieldrin with the skin whenever possible.

Precautions to be followed in the use of dieldrin include the following: Do not allow it to come in contact with the skin or eyes nor to get into the mouth. Clean synthetic rubber gloves and other protective equipment as necessary should be used to prevent contact with concentrates or prolonged exposure to dilute formulations. Workers should wear clean clothing and should wash thoroughly with soap and water after handling dieldrin and especially before eating or smoking. In the event of accidental contamination of skin or clothes, remove contaminated clothing at once and wash the skin with soapy water. Flush eyes with plenty of water and get medical attention.

As used in subterranean termite control, dieldrin emulsions are not known to be harmful to plants.

In Forest Service tests in Mississippi, 0.5% dieldrin (actual) in water emulsion has been under test for 13 years and is still 100% effective. Dieldrin at 0.5% concentration applied in oil solution or water emulsion is acceptable for soil treatment (pretreatment) under Section 815-3.8 of the Minimum Property Standards of the Federal Housing Administration.

The approved reference concentration for dieldrin is 0.5%.

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HEPTACHLOR: Heptachlor is one of the newer chlorinated hydrocarbon materials to be used for soil poisoning. Its chief distinguishing characteristic is its vapor pressure, which is somewhat higher than that of other general purpose materials used for subterranean termite control. Heptachlor has enough vapor toxicity to be valuable in reaching some soil infestations which are normally rather inaccessible.

After heptachlor has been in soil for some time, a small portion of it may be converted to a more stable material, heptachlor epoxide. As with the conversion of aldrin to dieldrin, this conversion of heptachlor to heptachlor epoxide is probably of minor, if any, significance in structural termite control.

Technical heptachlor is a tan colored, soft, waxy solid composed of about 3/4 actual heptachlor and 1/4 related chemicals. It is practically insoluble in water but readily soluble in a number of common insecticide solvents. The emulsifiable concentrate of heptachlor contains 2 pounds of actual heptachlor per gallon.

Heptachlor has been found to produce signs of poisonings similar to those caused by dieldrin and aldrin. It may enter the body by ingestion, absorption through the skin or by inhalation. Skin contamination is probably the greatest hazard for termite control operators.

Precautions to be followed in the use of heptachlor include the following: Do not allow it to come in contact with the skin or eyes, nor get into the mouth. Clean synthetic rubber gloves and other protective equipment as necessary should be used to prevent contact with concentrates or prolonged exposure to dilute emulsions. Workers should wear clean clothing and should wash thoroughly with soap and water after handling heptachlor especially before eating or smoking. Remove contaminated clothing at once, wash the skin with soapy water, flush the eyes with plenty of water and get medical attention.

As used in subterranean termite control, heptachlor emulsions are not known to be harmful to plants.

Heptachlor has not been tested as long as other chlorinated hydrocarbons for termite control. The Forest Service reports, that in Mississippi heptachlor, as a 0.5% emulsion, has been under test for 10 years and is still 100% effective. Heptachlor at 0.5% concentration and applied in oil solution or water emulsion is acceptable for soil treatment (pretreatment) under Section 815-3.8 of the Minimum Property Standards of the Federal Housing Administration.

The approved reference concentration for heptachlor is 0.5%.

LINDANE: Lindane is a chlorinated hydrocarbon that is used as a soil poison particularly on the West Coast. It is the essentially pure gamma isomer of BHC and does not have the objectionable odor of crude BHC.

Lindane is a white crystalline solid which is moderately volatile and acts by contact, ingestion or action of the vapors. It is fastest acting of the general purpose chemicals but must be applied in an especially thorough manner. This is because termites which receive sub-lethal dosages of lindane, can crawl away, be knocked down and some time later recover and resume normal activity.

Emulsion concentrates containing 20% lindane for dilution in water are widely available.

Lindane can be absorbed by ingestion, inhalation or skin contact. It is a central nervous system stimulant and can cause convulsions. Precautions to be followed in the use of lindane include keeping it from contact with skin, eyes or mouth.

As used in termite control lindane is not known to be harmful to plants.

Forest Service experience with BHC may be applied to the use of lindane at the concentrations described for gamma BHC. In their ground board tests in Mississippi in which 0.8% gamma BHC in water emulsion was used as a soil poison, it was 100% effective for 8 years, 90% effective for 9 years and 70% effective for 10 years. Lindane at 0.8% applied in an oil solution or water emulsion is acceptable for soil treatment (pretreatment) under Section 815-3.8 of the Minimum Property Standards of the Federal Housing Administration.

The approved reference concentration for lindane is 0.8%.

SPECIAL USE MATERIALS

ETHYLENE DIBROMIDE: Ethylene dibromide is a fumigant which is some times used in special cases as a fumigant for eliminative treatment against subterranean termites. It is applied as a 15% solution in oil to areas that cannot be treated in a practical manner with residual insecticides. Its principal use is for the treatment of the inaccessible areas, as under slabs, open porches or other covered or complicated construction features.

There are several practical limitations to the use of ethylene dibromide as a soil fumigant in termite control. Once dissipated, it leaves no residual deposits to affect termites that may later reach the

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treated area. Movement of the material in soil is very uncertain as it may be affected by such soil factors as: type, texture, temperature, moisture content as well as building construction and weather conditions.

Ethylene dibromide is a heavy, colorless liquid with an odor something like chloroform. It is not flammable nor soluble in water. It is soluble in most organic solvents, and when used for soil treatment for termite control, it is used as a 15% solution in an oil such as kerosene.

Ethylene dibromide is a hazardous material which may be absorbed through the lungs, the intact skin or the gastrointestinal tract. Ethylene dibromide vapors are toxic to man, and precautions must be taken to avoid inhalation of them by workers or occupants of treated buildings. As low as 45 parts per million can be detected by a skillfully used halide leak detector in good order. Some but not all people can smell ethylene dibromide when first entering concentrations as low as 25 parts per million. This concentration is considered safe for workers on ordinary 40 hour per week schedule. Where persons can be exposed continuously, the concentration should be maintained below 5 parts per million. Special equipment and methods are required for reliable analyses of concentrations below 45 parts per million. Treated and adjacent living spaces should not be used until the concentration of ethylene dibromide in air can be maintained below 5 parts per million.

Since ethylene dibromide is hazardous as a gas, precautions must be taken to avoid breathing the vapor during handling and application. The material should be stored in tightly closed containers in a cool location away from dwellings. Any handling of the material should be done in well ventilated areas, preferably out of doors.

Ethylene dibromide also is toxic when absorbed through the skin or when taken internally. It is irritating to the skin, especially if confined on it. Thus, even small amounts spilled on clothing may cause injury to the skin unless the contaminated clothing or shoes are removed immediately.

Avoid breathing vapors of ethylene dibromide. Avoid contact with the skin, eyes and clothing. In case of contact, immediately remove all contaminated clothing, including shoes, and wash the skin with soap and plenty of water; flush the eyes with water for at least 15 minutes and get medical attention. Wash the clothing and air the shoes very thoroughly before re-use.

Ethylene dibromide should be used only where residual materials are impractical, and it should be applied only to the soil areas confined by a cover, such as concrete. Ethylene dibromide must not be used near basements, enclosed porches or other below-grade areas which can be occupied by humans, and pets or under or near slabs which contain air ducts. The maximum recommended concentration is 15% ethylene dibromide by weight in a base oil such as kerosene or No. 2 fuel oil. The rate of application should not exceed 1 quart of 15% formulation per 25 square feet of slab area; that is, one quart per hole on five foot centers. Holes and other opportunities for ethylene dibromide vapor leakage from the treated area should be sealed tightly. Positive ventilation must be maintained during and after the application until the concentration is reduced to and remains at safe levels.

Trees, bushes, etc. may be damaged if ethylene dibromide comes near their roots.

The approved reference concentration for ethylene dibromide is 15%.

ORTHODICHLOROBENZENE: Orthodichlorobenzene is a liquid toxicant of the vaporizing type, the heavy vapor tending to diffuse downward through the soil to a considerable depth. It is sometimes used as a foundation-treating toxicant and to a limited extent for the treatment of wood in place. It may be used for spot treatments of existing slabs.

It is a colorless heavy liquid with an odor somewhat resembling paradichlorobenzene (PDB moth crystals). It is non-inflammable. It is miscible with petroleum oils in all proportions. It is relatively insoluble in water. It may be emulsified with water quite readily.

Orthodichlorobenzene can be used in termite control undiluted or as an emulsion with water, but ordinarily is applied in petroleum oil solution (usually 1 part with 3 parts of fuel oil).

Orthodichlorobenzene or its vapors may irritate skin or sensitive tissues such as the nose or eyes. The vapor in confined areas may act as an anesthetic. Free circulation of air should be provided when it is used. It should be kept from contact with the skin or eyes.

Orthodichlorobenzene will taint the water of wells when it is present, and may render it unfit for use for a considerable period of time. The vapors of orthodichlorobenzene also may contaminate foods.

Orthodichlorobenzene will injure those parts of plant root systems with which it comes in contact. It is not absorbed and translocated within the plant. For this reason contact with a limited

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portion of the plant root system may not be fatal to the entire plant, although a more extensive contact with the roots may have this effect.

Orthodichlorobenzene cannot be expected to provide prolonged protection against subterranean termites. It is not recommended in government bulletins on subterranean termite control. In Forest Service tests in Mississippi in which 25% orthodichlorobenzene was used in No. 2 fuel oil at 4 gallons per 10 cubic feet in stake tests, it was 100% effective for 3 years and 80% effective for 4 years.

The approved reference concentration for orthodichlorobenzene is 25% by volume in oil.

PARADICHLOROBENZENE: Paradichlorobenzene is a white crystalline material commonly sold as moth crystals or PDB. It is used occasionally for wood treatment, as a soil toxicant and in foundation treatment. It is usually applied to the soil as crystals but paradichlorobenzene is readily soluble in oil. It is insoluble in water. The principal use is to control swarming temporarily until full treatment can be made. Also, it may be used as a dry soil toxicant where contamination of water supply could be a factor. Its properties are similar to those of the closely related orthodichlorobenzene.

The approved reference concentration for paradichlorobenzene is 100%.

PENTACHLOROPHENOL: Pentachlorophenol is widely used for the treatment of wood in place, particularly where wood and soil are inseparable or where decay is also a problem. For soil treating and for foundation treating, it has been supplanted by other more useful materials. It is one of the wood preservatives used for the treatment of wood in commercial treating plants. Since pentachlorophenol prevents decay and decreases the acceptability of wood as a termite food, it is frequently used to flush out termite infested wooden members in place.

Pentachlorophenol is a solid, usually in the form of grayish-brown flakes or needle-like crystals. It has a positive chlorphenolic odor. It is only slowly volatile and its vapor does not spread sufficiently or in adequate concentration to give a vapor-toxicant action. Pentachlorophenol is repellent to termites but this effect is not sufficient for prolonged protection. It is non-flammable but oil solutions, as used in termite control, are flammable. It is soluble to a limited extent in petroleum oils, but is insoluble in water. It is usually used as a 5-percent solution in a petroleum oil such as fuel oil. Most fuel oils will dissolve this amount of pentachlorophenol. With lighter oils such as kerosene, it may be soluble only to the extent of 3 percent and an auxiliary solvent such as an aromatic distillate, pine oil or raw linseed oil may have to be added to get 5 percent into solution. The sodium salt which is freely soluble in water is also available but is not usually recommended for termite control.

Pentachlorophenol is commercially available as a ready-to-use 5-percent solution in oil, as a concentrated solution for dilution with oil, and as a gel or mayonnaise-like emulsion for direct application to wood in place. Both oil and gel formulations must be used carefully to avoid oil stains.

Water emulsions or emulsion concentrates of pentachlorophenol in solution can be prepared and are offered commercially in some sections of the country. These forms have certain advantages in ease of handling, reduced fire hazard, and less "oily" odor. They are not nearly as widely used as the oil solutions.

Pentachlorophenol, alone or in solution, can be absorbed by and is irritating to the skin or mucous membranes. It can cause considerable discomfort in the nasal passages, throat and eyes. If left in contact with the skin, it can cause systemic poisoning as well as local irritation and dermatitis. Care should be taken to avoid inhaling it either as small particles of the undiluted compound or as mist droplets of the diluted solution. A respirator with a canister for organic vapors, gloves and goggles should be worn when working with it. Should pentachlorophenol get into ones eyes, water in generous amounts should be used to wash them thoroughly and promptly.

Pentachlorophenol will taint the water of wells and render it unfit for use for a considerable period of time.

This chemical is toxic to plant life with which it comes in contact. Like orthodichlorobenzene it is not absorbed and translocated within the plant. Its injury is limited to the portion of the plant with which it has contact. Extensive contact with the root system of a plant, however, will result in the death of the plant.

Proper commercial treatment of wood with a petroleum oil containing 5-percent pentachlorophenol has provided a high degree of protection against termites and decay fungi. Specifications for pentachlorophenol and for petroleum oil for use with it in commercial wood treating are set up in Standards P8-49 and P9-49 of the American Wood Preservers' Association. Certain treatments with pentachlorophenol and petroleum oil leave the wood in a paintable condition, while treatments applied with other oils may

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interfere with painting. Where painting of treated wood is necessary, the supplier of the treated wood should be required to furnish painting instructions and evidence of satisfactory performance with respect to paintability.

Tests by Forest Service in Mississippi, indicate that when pentachlorophenol is used at 5% strength in fuel oil in ground board tests, it is 100% effective for only 2 years and drops to 50% effectiveness in 3 years. The 1960 USDA Home and Garden Bulletin No. 64, Subterranean Termites, Their Prevention and Control does not list pentachlorophenol among the materials recommended for treatment of soil to prevent termite attack.

The approved reference concentration for pentachlorophenol is 5%.

SODIUM ARSENITE: Sodium arsenite is an inorganic chemical which was formerly used widely as a soil toxicant. Its principal use at present is for soil treating only under slabs where no odor can be tolerated. Furthermore, it is usually limited to industrial or commercial situations. It is commonly applied to termite control as a 10% solution in water.

Sodium arsenite is insoluble in petroleum oils but is freely soluble in water. Excess moisture in soil dissolves the sodium arsenite and eventually washes it away.

It is commercially available either as a dry powder or as a concentrated solution, usually 40% in water.

Sodium arsenite in any of its forms is highly caustic, irritating to the skin, and toxic to warm-blooded animals. Care should be taken not to allow it to come in contact with the skin or eyes. It must not be used near wells or springs that serve as sources of drinking water.

Sodium arsenite is also very toxic to plant life. It is readily absorbed in water solutions by the roots and transferred to other parts of the plant. Because of this, contact of one portion of a root system with sodium arsenite may result in the death of an entire plant, shrub or tree.

Sodium arsenite is no longer recommended in government publications. In soil poison ground board tests in Mississippi, the Forest Service found that 10% sodium arsenite was 100% effective for 3 years and 70% effective for 7 years.

The approved reference concentration for sodium arsenite is 10%.

TRICHLOROBENZENE: Trichlorobenzene is a toxicant of the vaporizing type from which toxic vapors tend to diffuse downward through the soil. It has been used in soil treating, foundation treating and to a limited extent for the treatment of wood in place.

It is a colorless heavy liquid with a strong odor somewhat similar to paradichlorobenzene (PDB moth crystals). It is non-inflammable. It is miscible with petroleum oils in all proportions. It is insoluble in water but may be emulsified with water quite readily.

Trichlorobenzene has been used in termite control undiluted, in petroleum-oil solution (usually No. 2 fuel oil), or as an emulsion with water.

Trichlorobenzene has toxicity and irritant properties similar to orthodichlorobenzene. It or its vapors may irritate the skin or sensitive tissues such as the nasal passage or eyes. Its vapor, if confined, may act as an anaesthetic. Free air circulation should be provided when using it. It should be kept from contact with the skin or eyes.

Trichlorobenzene will taint the water of wells and may render it unfit for use for a considerable period of time. The vapors of trichlorobenzene may also contaminate foods.

Trichlorobenzene is toxic to those parts of plants with which it comes in contact. It is not absorbed and translocated within the plant. Extensive contact with the root system, however, may result in the death of the plant.

Tests by the Forest Service in Mississippi, indicate that when trichlorobenzene is used at 25% by volume in No. 2 fuel oil at the rate of 3-3/4 gallons per 10 cubic feet of soil in stake tests, it was 100% effective for 4 years and 70% effective for 7 years. Trichlorobenzene at 1 part to 3 parts of oil was one of the materials which was listed as acceptable for soil treatment in Section 815-3.8 of the Minimum Property Standards of the Federal Housing Administration. Trichlorobenzene is not listed among the chemicals to use for soil treatment in USDA Home and Garden Bulletin No. 64, Subterranean Termites, Their Prevention and Control in Buildings. It is more expensive than several of the materials commonly recommended.

The approved reference concentration for trichlorobenzene is 25% by volume in oil.

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OTHER MATERIALS FORMERLY USED IN SUBTERRANEAN TERMITE CONTROL OR PRESENTLY USED TO A LIMITED EXTENT FOR SPECIAL PURPOSES

BETANAPHTHOL: Betanaphthol is very seldom used as a termite toxicant except as an ingredient of proprietary combinations.

BHC: BHC, or benzene hexachloride, is seldom used as a termite control chemical. It has a persistent musty odor that limits its acceptability. Also, this compound provides shorter protection than other widely available materials. The principal active ingredient of BHC is the gamma isomer, which when essentially pure, is called lindane. BHC is applied for termite control as an emulsion or oil solution containing 0.8% gamma isomer.

COAL-TAR CREOSOTE: Coal-tar creosote is not used extensively by the termite control operator in any of his operations because of its objectionable odor, poor penetrating ability and poor lasting qualities as a soil toxicant. It is used extensively, but primarily to prevent decay, by commercial wood-treating plants, for the treatment of structural materials.

Coal-tar creosote is a black or brownish oil made by distilling coal tar. It is relatively insoluble in water. It is relatively non-volatile although it has a strong odor which is unpleasant to many people and is usually considered objectionable in dwellings. Many foodstuffs also are sensitive to creosote odors. It is soluble in coal tar and in petroleum oils and is often diluted with these materials for commercial application as a wood preservative. Its penetration in soil is improved somewhat by applying it as a kerosene solution.

Wood treated with coal-tar creosote is very dark in color. Usually, it cannot be painted satisfactorily.

Coal-tar creosote is irritating to the skin of the face and hands of many individuals. The use of wood treated with it, however, presents no serious toxicity hazard either to workmen handling it or man or livestock occupying structures in which the wood is used.

Proper commercial treatment of structural wood with coal-tar creosote provides excellent protection against termites and decay fungi as well as considerable resistance to attack by marine borers. Recommended treating practice with coal-tar creosote and solutions of it are given in Federal Specifications TT-W-571 and Recommended Practice R3 of the American Wood Preservers' Association. Specifications for coal-tar creosote and solutions of it are given in the current editions of Federal Specifications TT-W-556, TT-W-566, and TT-W-568, and in Specifications P1, P2, and P4, of the American Wood Preservers' Association.

In Forest Service tests of coal-tar creosote as a soil poison in ground board tests in Mississippi, 50% creosote in No. 2 fuel oil was 90% effective for 1 year and 50% effective for 2 years. Tests at the University of Georgia showed that subterranean termites readily build tubes over wood recently pressure treated with coal-tar creosote.

DDT (DICHLORO-DIPHENYL-TRICHLOROETHANE): DDT was the first of the chlorinated hydrocarbon insecticides to be used as a soil poison, but its effectiveness at reasonable dosage is shorter-lived than other more economical soil toxicants. Consequently, DDT is little used by the termite control industry.

DINITROPHENOL: Dinitrophenol is very seldom used as a termite toxicant except as an ingredient of proprietary combinations.

METHYL BROMIDE: Methyl bromide is a well-known fumigant that has been mentioned for use in sub-slab soil fumigation. It is more hazardous and more difficult to handle under these circumstances than ethylene dibromide. Present knowledge does not permit recommendations for the safe use of methyl bromide in sub-slab termite control.

NITROCHLORTOLUENE: Nitrochlortoluene (DuPont NC) was used as a soil toxicant and in foundation treating. It is a low-melting, crystalline material with a distinct objectionable odor.

Nitrochlortoluene is commonly used as a solution (approximately 20 percent) in petroleum oil such as fuel oil or as a water emulsion of a solution in petroleum oil.

The toxic properties of this compound have not been fully explored. Precautions should be taken to avoid skin contamination when treating with this chemical.

Nitrochlortoluene is toxic to plant life and may produce plant injury if the roots come in contact with it.

In Forest Service tests in Mississippi, when 20% nitrochlortoluene was used in No. 2 fuel oil at the rate of 2-1/2 gallons per 10 cubic feet of soil in stake tests, it was 100% effective for 3 years and 70% effective for 4 years.

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SODIUM ARSENATE: Sodium arsenate is very seldom used as a termite toxicant except as an ingredient of proprietary combinations.

SODIUM FLUORIDE: Sodium fluoride is very seldom used as a termite toxicant except as an ingredient of proprietary combinations.

CHEMICALS APPLIED IN COMMERCIAL WOOD-TREATING PLANTS

Several chemicals are available which impart effective resistance to termite attack when structural wood is adequately impregnated with them. For proper impregnation it is essential that one of the processes used in commercial wood-treating plants be used. Spraying or brushing of structural wood with these chemicals is not considered a treatment adequate to impart appreciable resistance to termite attack. As proper wood impregnation is not a normal activity of the termite-control operator, this section is limited to a brief listing of chemical treatments which may be available in structural wood to be purchased and sources of further information on the subject.

Commercial wood preservatives are of two general classes, oils or oil-borne materials and water-borne materials.

The oils and oil-borne preservatives are, in general, more resistant to leaching than the water-borne preservatives and are preferred for use where the wood is subjected to conditions favorable to leaching. Commonly used materials of this group are: coal-tar creosote and its solutions, pentachlorophenol and copper napthenate.

The water-borne preservatives are employed principally where the treated wood will not be in contact with the ground or with water and where the treated wood requires painting. Some common water-borne preservatives are Celcure, Chemonite, copperized chromated zinc chloride, Wolman salt (Tanalith), zinc chloride, and zinc meta arsenite.

A particularly useful source of reference is "A Guide to Wood Preservatives and Preservative Treatments," available for $1.00 per copy as Bulletin 44 from the Northeastern Wood Utilization Council, P. O. Box 1577, New Haven, Connecticut. The Forest Products Laboratory of the USDA at Madison, Wisconsin, has a free report, "List of Publications on Wood Preservation," Report No. 704.

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DINITROPHENOL: Dinitrophenol is very seldom used as a termite toxicant except as an ingredient of proprietary combinations.

METHYL BROMIDE: Methyl bromide is a well-known fumigant that has been mentioned for use in sub-slab soil fumigation. It is more hazardous and more difficult to handle under these circumstances than ethylene dibromide. Present knowledge does not permit recommendations for the safe use of methyl bromide in sub-slab termite control.

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Nitrochlortoluene is commonly used as a solution (approximately 20 percent) in petroleum oil such as fuel oil or as a water emulsion of a solution in petroleum oil.

The toxic properties of this compound have not been fully explored. Precautions should be taken to avoid skin contamination when treating with this chemical.

Nitrochlortoluene is toxic to plant life and may produce plant injury if the roots come in contact with it.

In Forest Service tests in Mississippi, when 20% nitrochlortoluene was used in No. 2 fuel oil at the rate of 2-1/2 gallons per 10 cubic feet of soil in stake tests, it was 100% effective for 3 years and 70% effective for 4 years.

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A particularly useful source of reference is "A Guide to Wood Preservatives and Preservative Treatments," available for $1.00 per copy as Bulletin 44 from the Northeastern Wood Utilization Council, P. O. Box 1577, New Haven, Connecticut. The Forest Products Laboratory of the USDA at Madison, Wisconsin, has a free report, "List of Publications on Wood Preservation," Report No. 704.

GENERAL PRECAUTIONS IN THE USE OF CHEMICALS

TOXICITY

Most termite-control chemicals are toxic to man. Containers of them or their solutions should be clearly labelled. They should be stored where children or pets cannot get at them. They should be used only with strict observation of the precautions recommended by the manufacturer. The recommendations above concerning storage apply equally to diluted solutions as well as to the basic chemicals and concentrates. Containers which have been used for termite-control chemicals should not be used for other purposes. They require careful storage and handling until disposed of safely.

In handling chemicals used in subterranean termite control, care should be taken to avoid contact with the skin, eyes or membranes of the nose and mouth. Some of the special use materials may be caustic. The general purpose insecticides ordinarily do not cause skin irritation, although the solvents in which they are formulated will cause skin to become dry, red and sore. Whether they irritate or not, insecticide formulations should be kept off the skin. The general use materials are all capable of passing through the skin and are stored in body fat.

Children and pets should be excluded from underareas of structures treated for termite control. Screens, notices and verbal warnings are all useful in preventing the repeated exposures which can occur if children or pets are allowed to rest or play on the treated soil.

Protection of termite control workers from exposure to chemicals requires constant attention and planning. Avoid spillage on the skin in handling or applying solutions of the chemicals. Avoid breathing dusts of dry powders, or mists of solutions or emulsions. Protective equipment, such as gloves (water-proof or oil-proof, depending upon the solvent or carrier used), goggles and respirators, should be provided and used whenever these exposure hazards are present. Too often these protective devices, especially respirators, are used only for the immediate comfort of the operator without consideration of the hazard from repeated exposure to toxic chemicals. Always provide the maximum ventilation possible when working with termite chemicals in enclosed areas.

Repeated exposure to some termite-control chemicals may produce chronic poisoning. Such poisoning may reach relatively serious proportions without preliminary warning, and the cause of the trouble may be overlooked entirely or may be very hard to

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diagnose. Operators should use particular care to avoid repeated inhalation or skin absorption of poisonous chemicals. This is important in the case of the individual who is assigned to daily use of irritating or cumulative chemicals. Prevention is the best treatment for a poisoning case.

Sodium arsenite, being water soluble and highly toxic to man and animals, should not be used where it can contaminate sources of drinking water. For full discussion see chapter on "Soil Treating" under "Hazards To Be Avoided."

All termite control chemicals present some hazard of toxicity to plant life. This phase of the problem is covered in the chapter on "Soil Treating" under "Hazards To Be Avoided."

FIRE HAZARD: Oil solutions of toxicants present a fire hazard. Solvents more inflammable than insecticide base oil (deodorized kerosene) should not be used. The specification for insecticide base oil is that it should not have a flash point of less than 125° F. by the Tagliabue closed-cup test. Any petroleum solvent, however, regardless of high or low flash point, presents a degree of fire hazard, particularly when present as a mist. Avoid open flames, pilot lights, smoking or electric sparks when applying oil-based preparations in a confined space. It is a wise precaution to use explosion-proof motors, sockets, and switches on your electrical equipment. At least bulbs of extension lights should be of the heavy duty type and adequately protected by a cage. The mist of spray should be kept off lighted electric bulbs. Nozzles on application equipment should be chosen to minimize the amount of mist produced by the application procedure. The maximum amount of ventilation possible should be provided during application.

ODORS: Certain of the termite-control chemicals and their solvents have strong odors. These should not be used near food-storage places. Judgment should be exercised in using these in indoor locations, particularly in areas such as basement apartments and cellars where ventilation is restricted.

PROPERTY DAMAGE: Solutions or emulsions containing toxicants may stain floors, walls, wallpaper, or plaster if used carelessly. Materials spilled should be flushed away or picked up on absorbent material promptly to avoid damage to floors. Absorbents suggested are kieselguhr (diatomaceous earth) for water-based materials and sawdust for oil solutions. If an odor persists after the solution has been removed, this may be taken care of by covering the spot with burlap and sprinkling a layer of activated charcoal on it.

APPLICATION EQUIPMENT: In addition to adequate protective garments and equipment, the operator should ensure that his application equipment is in good condition. Leaky or weak gaskets, hoses, or packings can be the cause of personal irritation, discomfort, and even injury to the operator. They also contribute to a variety of property damage problems such as stains on floors and injury to lawns and plants.

If spraying or injecting at levels above the shoulder of the operator, a tight-fitting shield on the rod leading to the nozzle often saves a wet elbow.

As a safety measure, a clean towel slipped through the belt at the hip often saves much discomfort when a pressure hose breaks or a gasket gives way. It is easier to reach for a towel than grope for help when you have chemicals in your face.

A wide variety of electrically powered tools are used in termite control, both in connection with mechanical alterations and with application of chemicals. The locations in which the tools are used often place the operator in contact with damp ground, and the operator himself may be damp with perspiration. Both of these conditions characteristic of termite work increase the hazard of shock over that which would be associated with the same tools under dry conditions and to such an extent that fatality might ensue. Electric shock may emanate from any of several flaws which may be present or develop in equipment, such as a winding defect or simply a misplaced wire.

The measure of protection which can be taken is to ensure adequate grounding of the power equipment. The better modern equipment is provided with a three-conductor cable, one line of which is connected to ground the chassis of the tool. Unfortunately, most outlets from which termite-control operators will draw current are not equipped to permit grounding at the outlet box. It is usually necessary for the operator to provide his own ground and a wire to reach to it from his tool or the attached ground line. A water pipe is an adequate ground except in those relatively rare instances where pipe joints are connected with insulating materials or where lines are connected to mains of nonconducting materials. A ground rod driven into moist soil also may be used. Such rods may be pipes or rods of iron or steel or nonferrous materials or alloys. They should have a clean metal surface, and the National Safety Council recommends that they be driven into the ground to a depth of 8 feet. Where it is not possible to reach this depth the electrodes should be buried in a horizontal trench. The ground wire should be no smaller than No. 18 for tools protected by fuses whose capacity does not exceed 15 amperes.

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Even when electrical equipment is well grounded, it is extremely important that the power cable be well maintained. Otherwise, an operator coming in contact with a defective cable would receive full current to the ground.

STATEMENT FOR THE HEARING ON THE REGISTRATION OF THE ECONOMIC POISONS, ALDRIN, DIELDRIN AND ENDRIN APRIL 16, 1964, IN MEMPHIS, TENNESSEE

Ralph E. Heal, Executive Secretary
National Pest Control Association, Inc.
250 W. Jersey St., Elizabeth, New Jersey

I am Ralph E. Heal, Executive Secretary of the National Pest Control Association. I reside at 535 Madison Avenue, Elizabeth, New Jersey. The statement which I present today is made in my capacity as chief administrator of the Association, and is made on behalf of the members of the Association. The National Pest Control Association is a voluntary non-profit trade association, having as members more than 1,000 structural pest control firms throughout the United States. It is the only national association representing this industry. Twenty-eight state or local pest control associations are Affiliates of the National Pest Control Association. Each member firm offers pest control service to the public for hire. It is upon this industry that the public depends to a major degree for the control of pests of houses, apartment buildings, theatres, stores, warehouses, restaurants, and food-processing plants. The pests for which our members most commonly provide control service are termites, rats and mice, cockroaches, ants, silverfish, and pests of foods or stored products. The members of our Association, with members of Affiliated State Associations, do approximately 75% of the structural pest control work done in the United States.

The structural pest control industry makes extensive use in its service work of two of the three chemicals that are the subject of this hearing - aldrin and dieldrin. At the present time, there does not appear to be any need for endrin in the work of pest control operators.

Although none of the uses of dieldrin or aldrin by the structural pest control industry are in the production of crops, the registration of these pesticides for the uses of our industry is in the hands of the Division of Pesticides Regulation, Agricultural Research Service, U. S. Department of Agriculture, and our industry wishes to place on record at this hearing the importance of the uses for which we consider these pesticides necessary.

Aldrin is not used for the control of pests indoors by our industry. Dieldrin is used as a residual insecticide for the control of household pests according to the recommendations currently acceptable for registration. While dieldrin is useful for the control of some household pests, useful alternate pesticides from other groups of chemicals are available to our industry. Thus, we can make no special plea for the retention of dieldrin as an acceptable residual pesticide for household use.

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The greatest use of aldrin and dieldrin by our industry is as soil toxicants for the control of subterranean termites. It is for this use that our industry requests your recognition of their value in the public interest, and requests your careful consideration before any action which might result in the cancellation of their registration for this use.

Subterranean termites are a serious pest throughout much of the area of the United States. They do serious damage to homes and other structures. The expansion of our suburban dwelling areas into former forest areas increases their importance day by day. Eighty-four percent of our members do termite control work.

To give you some idea of the importance of subterranean termites to the people of the United States, I cite data available for termite work in four states that are representative of the southern half, or more, of our country. The state of Georgia reports over 34,000 termite control jobs done in one year, 1962-63 - one job for every 1,200 people in the state every year. Oklahoma, in 1963, reports 16,145 corrective termite control jobs and an additional 6,793 homes treated in the process of construction to prevent future termite attack. California, in 1962, reported 240,926 inspections made for termites, with 112,177 infestations of subterranean termites found. In Tennessee, it is estimated that 30,000 to 35,000 termite jobs are done each year, with last year showing a 20% increase over the previous year. The cost of subterranean termite control service alone in Tennessee is estimated at approximately a dollar per resident per year.

Control of subterranean termites is accomplished most frequently by the application of toxicants to establish a barrier in the soil under and adjacent to the structure. Soil treatment is the most commonly used, most positively effective, most economical termite control measure, and the only measure that is practicable with slab-on-ground construction. In support of this statement, I quote from the 1958 Addendum to the Report of the Building Research Advisory Board to the Federal Housing Administration, National Academy of Sciences - National Research Council Publication 448, page 15(a): "Soil treatment was considered in the original report as a practical and acceptable protective measure in locations where inspection was not possible, but protection was needed. It was recommended as the most suitable measure at the present time for slab-on-ground construction. The possibility of termite entry through cracks in the slab and access through unsealed vertical penetrations, i.e., around pipes, conduits, ducts, etc., is such as to establish soil poisoning as the most effective method for such construction."

The chemicals which have been proved to be most effective and safe as soil toxicants for protection against termites are all chlorinated hydrocarbon insecticides of the type described currently as "persistent." In termite control, persistence becomes a desirable attribute. The chemicals are placed into the soil quite precisely, and they stay there in effective concentration unless physically disturbed for many years. We are advised from tests of the U. S. Department of Agriculture that these toxicants applied on the surface of open soil at prescribed rates in Mississippi test plots have remained 100% effective in protecting against termite attack for 14 years, having resisted the leaching effect of annual rainfall of 70 inches per year throughout this period, more than 80 feet of rainfall over their 14 years of exposure. Practical control applications are even less susceptible to movement from their point of application. The major part of the treatment is under the structure, and thus protected from leaching rains. The applications outside of the structure are deposited as an impregnation of the soil adjacent to the foundation wall from grade to footing. They are applied as water emulsions, but on the breaking of the emulsion in the soil mass, the materials are retained in essentially a non-reemulsifiable form and resistant to leaching.

The four pesticides recommended for termite control at the present time are aldrin, dieldrin, chlordane, and heptachlor. Our industry does not feel that we can consider chlordane or heptachlor as available alternates for aldrin and dieldrin, because they are related chlorinated hydrocarbons. Should the evidence develop that aldrin and dieldrin are too hazardous for this usage, we are confident that parallel investigation would undoubtedly find parallel evidence to support the same conclusion with respect to chlordane and heptachlor.

Our industry has made wide use of one or more of these soil toxicants in subterranean termite control over the past fourteen years with a remarkable record of safety. Our workmen use these chemicals regularly in their daily work. We have not been able to detect an industrial health problem in our industry. We have cooperated with the U. S. Public Health Service in a health survey of our personnel. This survey, made under the direction of Dr. Wayland J. Hayes, Jr., Medical Director, Chief, Toxicology Section of the Communicable Disease Center, was reported by him at our Association's Convention in 1962. In summary he stated, "In essence, the survey failed to reveal any significant increase in disease, or any peculiar distribution of disease, or any unknown or different sort of disease among these people." We understand that the report of this study is currently in press.

To place on record a rather complete discussion of the chemicals available for control of subterranean termites, I would like to introduce as a part of my statement the 1963 Revision of a Section of the Approved Reference Procedures for Subterranean Termite Control, published by National Pest Control Association, the Section headed "Chemicals in Subterranean Termite Control, 1963 Revision," 20 pages numbered 35 to 44K inclusive.

This section discusses the available termite toxicants and their relative effectiveness. Aldrin, dieldrin, chlordane and heptachlor

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are listed as four of the five general-purpose materials. The fifth toxicant listed is lindane, another chlorinated hydrocarbon, which gave an appreciably lesser term of protection in the tests of the U. S. Department of Agriculture.

This section lists the possible alternative chemicals for use as soil toxicants in termite control. We have a choice between one of a group of chlorinated hydrocarbons of lesser effectiveness, or sodium arsenite. Of the chlorinated hydrocarbons of lesser effectiveness, pentachlorophenol is the best, and it failed to meet the requirement of five years effective protection in tests of the U. S. Department of Agriculture. The others - orthodichlorobenzene, paradichlorobenzene, and trichlorobenzene - have been proved by experience to be less desirable than pentachlorophenol. The alternate of sodium arsenite is equally undesirable. This chemical is caustic, irritating to the skin, and toxic to warmblooded animals. It is extremely toxic to plant life, and is translocated within the living plant. Thus, contact with a single root of a tree can result in the death of the entire tree. It is water soluble, and is more susceptible to leaching movement than our currently recommended chlorinated hydrocarbons.

None of the alternate soil toxicants will give the protection that today's incidence of termites demands, and none, by our present knowledge, presents a lesser toxicological hazard to either man or the plant life around his home.

From time to time, measures other than soil treating have been recommended for protection against termites. One such recommendation has been the installation of termite shields. The recommendations say that termite shields, properly installed, will drive the termites into the open should they build their tubes over them. On inspection, the homeowner then will know that he has termites, and will know at least one place at which he should make an application of soil toxicant to keep the termites from building over the shield again. The same situation applies with solid concrete foundations, and reinforced concrete caps on masonry foundations. And none of these are effective with slab-on-ground construction, where termites may gain access through any crack in the slab, at any expansion joist, or around any utility entrance.

It has been recommended that the use of some minimum amount of pressure-treated lumber in the construction of a house will provide protection against termite attack. This undoubtedly is true. This, however, is not a practical solution to the problem of termites invading an existing home. Nor is it known how much of a new home must be constructed in this way to obtain effective protection. Current recommendations seem to make this practice equally impractical for new construction.

It is the representation of our Association that soil treatment is an essential step in subterranean termite control as practices today for almost all construction, and especially for newer construction, whether it be dwelling, public building, or industrial building. The soil toxicants that may be considered as alternates for aldrin, dieldrin, chlordane, or heptachlor are markedly less efficient. If reliance were placed on available alternates, the period of effective protection to be anticipated would be reduced to the range of three to five years from the currently anticipated 10 to 15 years. None of the alternates offer the advantage of any reduction of potential toxicological hazard. The cancellation of the registrations of aldrin and dieldrin would impose a great financial burden on the public. While a great part of this burden would be increased need for the services of our industry, we cannot, with clear conscience, recommend the elimination of more efficient pesticides without valid proof of a real hazard. We urge a careful objective and scientific investigation to establish the realities of hazard from these pesticides before action is taken to limit their applications further.

PROTECTING INDIVIDUAL WATER SYSTEMS FROM TERMITE TOXICANTS

Termite control treatments must not contaminate water. This statement discusses some of the problems related to termite control for buildings having nearby individual water supply systems.

If a risk of water contamination exists, the termite control operator should consider:

First - can mechanical alteration protect the structure at a cost that is economically feasible. If so, this method should be applied following guidelines of the ARP.

Second - that chemical treatment, if required, must utilize restricted spot treatment. In the interest of safety, chemical treatments should be so conservative that long term guarantees need not be granted. Reinspections should be made at frequent intervals.

The following practices can be used to reduce the amount of toxicant applied and to control its deposit in the soil.

1. Treat only those areas where infestation exists or there is serious threat of infestation.

2. Measure carefully each application of chemical. Never pump until flooding occurs or the liquid comes out some other hole or place.

3. In slabs, use more holes and apply a proportionately smaller, measured treatment per hole.

4. In foundation treating, apply only a limited amount of chemical per unit of void space. Do not permit run off.

5. In treating soil outside foundations, trench fully and treat the backfill with measured quantities of toxicant. The best control of the insecticide and its distribution in the exterior barrier is achieved by using a treated backfill (See ARP p. 47)

Other topics reviewed are:

1. Potential water contamination problems.

2. Useful alternate procedures of termite control which can be used when a hazard is recognized.

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3. Decontamination of water and water systems.

4. Testing water for freedom from insecticides.

Protection of water supplies from contamination by pesticides is a responsibility that pest control operators must constantly bear in mind. The presence over a period of time of even minute amounts of pesticides in water could be hazardous to users. Where modern plumbing and municipal water supply systems are in use, there is seldom any problem of water contamination. Special alertness to the need to avoid any possibility of water contamination is required in developing recommendations and in treating buildings in the vicinity of wells, cisterns or spring-fed individual water supply systems.

Inspectors should be alert to the problem and question householders about the type and location of the source of water. They should be impressed with their responsibility to check the accuracy of such information. Old cisterns, old wells that have not been properly filled or unusual fill problems about a structure are all potential sources of trouble.

Contamination of wells seems to occur most often because liquid materials applied to the surface or along the foundation find their way into water courses leading to the wells. Wells that are so easily contaminated by chemicals are just as susceptible to biological contamination. They are usually deficient in one or more of the features listed below for safe wells.

Construction of Safe Wells

Recommendations for location and construction of wells to reduce chances of biological and chemical pollution will be found in the Extracts from FHA's Minimum Property Standards given in Appendix I, and the recommended rules for well location and construction in Appendix II.

Comments on Stability of Termite Toxicants in Soil

Modern termite toxicants of the chlorinated hydrocarbon group are nearly insoluble in water. Once they have been deposited in the soil, it is understood that the chemicals are very firmly held by the soil particles. Apparently such materials as chlordane, dieldrin, aldrin, heptachlor and lindane resist leaching.

Water soluble materials such as sodium arsenite probably are much less resistant to leaching and should not be used if there is any question about the water supply.

The stability of insecticides in soil is the subject of current investigations in several laboratories. One such lab with special responsibility regarding termite toxicants is the Wood Products Insect Laboratory at Gulfport, Mississippi. Mr. H. R. Johnston, project leader, notes that their studies are still inadequate for definitive answers, but he offers the following comments:

> "The best evidence we have that insecticidal emulsions applied to soil for termite control cease to be emulsified and remain where they are applied is in our field tests. In these tests, insecticides applied in the form of water emulsions are still present in the soil in a sufficient quantity to control termites after a period of 14-15 years. During this 15-year period, approximatly 90 feet of rain has fallen on the experimental plots. The fact that some of the insecticide still remains where it was applied, however, does not preclude the possibility that some of it has moved.
>
> "Variations in soil moisture, particle size, etc., probably affect stability, but we have no data on this point."

Alternate Treatments

Termite control must be conducted with special care where there are wells that do not meet the standards referred to above or where other special hazards to water supply systems exist. Alternate methods of successful control using limited amounts of, or no, insecticides generally require more labor and are more expensive. Some alternate methods are described below.

Mechanical Alteration

If analysis of all available information about the structure and its water supply indicates that there is risk in the use of chemicals, consideration should be given to mechanical alterations which would prevent entry of termites or cause them to expose any routes of entry to the wooden part of the structure.

Mechanical alterations are described in considerable detail in NPCA's Approved Reference Procedures for Subterranean Termite Control.

This publication should be consulted for its general discussion of mechanical alteration, pages 7-34 and also suggested alterations for most elements of construction.

A good grade of coal tar pitch (as used for roofing) is recommended by USDA for filling expansion joints, mortar joints and the like. Unfortunately, coal tar pitch cracks when cold and may be unsatisfactory

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in the colder parts of the country. As an alternative to pitch, USDA recommends use of a bituminous rubberoid compound. An example of such a compound is a sealer for storage batteries sold as item No. RR1950 by the H. H. Robertson Company, 2407 Farmer's Bank Building, Pittsburgh, Pennsylvania.

Foundation Treatment

Foundation treatment, that is, application of chemicals into void spaces within foundation walls, posts and piers is discussed in the ARP on pages 55-59 and procedures are recommended for most elements of construction.

The 1963 revision of the section of the ARP on Chemicals in Subterranean Termite Control should also be consulted. It gives the current general purpose materials and special purpose materials and indicates which are used in foundation treating. Reference application rates for application to the interior of foundation is given as 4 gallons per 10 lineal feet. Treatments applied to foundations should be carefully measured. The rate noted above should not be exceeded and lesser amounts should be used where void spaces to be treated are small and where risk of water contamination is of concern.

Soil Treating

Soil treating in the vicinity of wells must be very conservative, if done at all. Do not apply insecticides to soil that drains toward a well. In any case, great care must be taken that the soil toxicant stays where it is placed and that it is placed only where it is required. Backfills may be porous and may lead to improperly filled plumbing trenches. Consequently, excessive treatment and flooding should be avoided. Rodding also may be hazardous, as treatment by this method reaches backfill areas which are unknown.

Treated backfills have been used by the termite control industry for many years for special situations. This technique is seldom used today, but it does have a record of successful and safe use in the past, especially for treating near water supplies. The subject of treated backfills is discussed on page 47 of the ARP.

> Note: Maintaining records of pesticide usage is good practice in all pest control. It is especially important where there is risk of water contamination. There should be a permanent record of the name, concentration and volume of the toxicant used as well as where and why it was applied.

Decontamination of Water Systems

Water systems are occasionally subject to accidental contamination. Prompt action is required to re-establish a pure water supply.

The chlorinated hydrocarbons used in termite control are very stable materials. It is not practical to try to break them down into harmless materials or to counteract them in the plumbing. Therefore, they have to be flushed out of pipes and other parts of water systems. Wells should be pumped out, allowed to fill and emptied again. This process should be repeated for 24 hours or longer. All the water in plumbing systems should be changed with clean water at least three or four times. The water in the last change should be allowed to stand in the plumbing for several hours before it is tested.

Testing Water for Pesticides

Testing for the presence of insecticides in water can be done in many ways including tasting, smelling, biological tests as with fish and chemical analyses. Guidance or assistance in the conduct of tests may be available from extension or experiment station chemists or entomologists, public health officials or water supply officials.

Taste and odor are neither specific nor reliable but often provide the first evidence of contamination. It appears that hot water is much more likely to be the source of off-odors than cold water. Probably both the odors and tastes associated with water contamination by chlorinated hydrocarbons come from the solvents and emulsifiers and not from the insecticide themselves.

Fish are extremely sensitive to insecticides in water. Over a period of several hours they may be affected by concentrations of chlorinated hydrocarbons of only a few parts per billion. Consequently, they can be used as indicators of extremely small concentrations of chlorinated hydrocarbons.

Goldfish or guppies are readily available in pet stores and are convenient to use in checking water for freedom from significant amounts of chlorinated hydrocarbon insecticides. Five or more gallons of the suspected water should be used in a clean container. The water should be allowed to reach room temperature before the fish are introduced. If fish survive more than 24 hours, it is clear evidence that the water contains no significant amount of materials like chlordane, dieldrin, aldrin, or heptachlor. On the other hand, if the fish die it is not proof that the water in hazardous--but it indicates that further investigation is needed. Fish are sensitive to many factors in their environment, any one of which may be injurious. Therefore, it is well to have a control

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lot of fish in some water from a clean source (as the pet store). The control fish and water should be handled in the same way as the test lots. Use identical containers and keep both lots of fish together throughout the test.

Chemical Analysis for Pesticides

Analysis of water for specific pesticide content may be justified if there is uncertainty concerning its safety or if litigation is likely. Advice concerning such analyses and laboratories qualified to perform them should be sought from chemical manufacturers or the State Chemist. Commercial laboratories should make analyses down to the order of one part per million parts of water. A few special labs can detect much smaller concentrations. The USPHS laboratory at the Taft Center in Cincinnati reports that they have the capability of identifying fantastically small quantities of insecticides--fractions of a part per billion.

Filtering Water with Carbon

As a last resort, it may be practical to reduce substantially the amount of insecticide in water by means of a special filter containing activated carbon.

In a test at the Taft Engineering Center, more than 99% of several common pesticides were removed from water which was pumped through a bed of activated carbon at the rate of half a gallon perminute per cubic foot of carbon. The carbon also removes emulsifiers, solvents and their odors.

> "An adsorption filter consists of a bed of 'activated' carbon that is supported by a bed of sand and gravel. The bed is housed in a galvanized steel tank, and the water passes downward under pressure. The 'activated' carbon simply absorbs the objectionable tastes, odors, color, and detergents. Periodically the carbon filter must be backwashed in order to expand the bed and to remove any filtered suspended matter. Also the filter should be constructed so that it can be inspected periodically and so that the carbon bed can be replaced when it becomes exhausted. Since the adsorption capacity of the carbon is extremely high, the bed should last for several years. The bed becomes exhausted, however, when the objectionable taste or odor condition returns to the water. Adsorption filter carbon has the appearance of black granules with the approximate size of coarse sand and a screen size of 20 to 50 mesh."*

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*Quoted from--Water from Home Wells-Problems and Treatments by S. D. Faust, N. J. Agricultural Experiment Station, Circular 594.

The filter should be installed between the well and the storage tank. Firms specializing in water softening or conditioning should be able to supply an adequate carbon filter and should know when such a filter requires backwashing.

Additional References on Wells and Well Water

Individual Water Supply Systems, U. S. Public Health Service Publication No. 24, U. S. Government Printing Office, Washington 25, D. C. 20 cents.

Wells, Department of the Air Force Manual 85-23, U. S. Government Printing Office, Washington 25, D. C.

Ground Water Supplies--Disinfection of Wells, Engineering Bulletin No. 0585, Oklahoma State Department of Health, Stillwater, Oklahoma.

Robeck, G. G., Dostal, K. A. et al, 1965 Effectiveness of Water Treatment Processes in Pesticide Removal. Journal, American Water Works Association 57:2, 181-199.

1102 INDIVIDUAL WATER SUPPLY SYSTEM

1102–1 OBJECTIVE

To provide an individual water supply system which will assure (a) an adequate supply of safe and palatable water, (b) reasonable, durable and economic operation and maintenance, and (c) be located and constructed to avoid contamination by any existing sewage-disposal system.

1102–2 QUANTITY AND QUALITY

1102–2.1 The system should be capable of delivering a sustained flow of 5 gallons per minute. A test of at least 4 hours duration, after the well is developed to determine the yield and maximum drawdown of the well should be conducted.

1102–2.2 Water quality shall meet the chemical and bacteriological requirements of the health authority having jurisdiction. In addition to being safe and palatable, it shall not be excessively corrosive or contain substances which would make it unfit for domestic uses. If the local health department having jurisdiction does not have chemical and physical standards the "U. S. Public Health Service Drinking Water Standards" may be used. A chemical analysis may be required by either the health authority or the FHA field office.

1102–2.3 After installation, the system shall be chlorinated in accordance with the recommendations of the health authority having jurisdiction. A bacteriological examination of a water sample collected by a representative of the health authority or FHA shall be made when required by the health authority or the FHA field office.

1102–3 LOCATION

1102–3.1 A well located within the foundation walls of a dwelling is not acceptable except in arctic and sub-arctic regions.

1102–3.2 A source of supply which comes from any formation which may be polluted or contaminated or is fissured or creviced or which is less than 20 feet below the natural ground surface is not acceptable.

1102–3.3 Wells shall be located at least the distances from sources of pollution shown in Table 11–1. These distances may be increased by either the health authority having jurisdiction or the FHA field office when site conditions warrant.

TABLE 11–1
Minimum Safe Distances

Source of pollution	Minimum distance (feet)
Septic tank	50
Absorption field	100
Seepage pit	100
Absorption bed	100
Sewer lines with permanent watertight joints	10
Other sewer lines	50
Other	[1]

[1] Recommendation of Health Authority.

1102–3.4 Wells shall be located at least 10 feet from property lines.

1102–4 MATERIALS

1102–4.1 Pipe, pipe fittings and similar materials shall comply with the National Plumbing Code, ASA–A 40.8.

1102–4.2 Linings for bored wells.
Linings shall be of concrete, reinforced concrete, vitrified clay, or other strong and durable materials adequate to maintain the opening and withstand the loads imposed.

1102–5 WELL CONSTRUCTION

1102–5.1 The well shall be constructed to allow the pump to be easily placed and to function properly.

1102–5.2 All wells shall be constructed with watertight casing from a point several feet below the water level in the well at the time of maximum drawdown or from an impervious strata if one exists above the water-bearing formation to a safe elevation (at least 12 inches) above the concrete slab at the ground surface or with offset wells to a safe elevation (at least 12 inches) above the pump room floor. See Detail 81.

1102–5.3 The casing shall be of sound, durable watertight material capable of sustaining the loads imposed.

1102–5.4 The space between the outside of the casing and the wall of the well hole shall be suitably closed or sealed to prevent surface or subsurface pollution entering the well through casing joints or flowing down the outside of the casing and into the well at the lower end.

1102–5.5 The surface of the ground above and around the well shall be graded to drain surface water away from the well.

1102–5.6 The well casing shall not be used to convey water except under positive pressure. A separate drop pipe shall be used for the suction line.

1102–5.7 When sand or silt is encountered in the water-bearing formation the well shall either be gravel packed, or a strainer or screen with properly sized openings shall be installed and fastened to the well piping to permit removal for repair or replacement. The well shall be developed, pumped, or bailed until the water pumped from the well is free from sand.

1102–5.8 The upper opening of the casing shall be sealed to prevent the entrance of surface water.

1102–5.9 Where a breather is provided for the well, the breather installation shall be watertight and shall extend above the highest probable level that surface water may rise. The open end of the breather shall be screened and be located and turned so that dust, insects or other objects cannot enter the well.

1102–5.10 Where openings are provided in the casing, cap, or concrete cover for the entrance of pipes, pump or manholes, such openings shall be made watertight by appropriate seals.

1102–5.11 For examples of well construction. See Details 81 and 82.

1102–6 PUMP AND EQUIPMENT

1102–6.1 Pump capacity shall not exceed the capacity of the well. It shall be capable of delivering the volume of water required in 1102–2.1 under normal operating pressure within the living unit.

1102–6.2 Mount pump securely on a suitable foundation to avoid objectionable noises or vibrations. When mounted on the well casing, the well casing shall be supported to prevent vibration or movement.

1102–6.3 Locate pump and equipment where they will not be subject to flooding and the installation will be pollution and frost proof.

1102–6.4 Motor, drop-pipe, foot valve, cylinder, storage tank, pressure switch, etc., shall be installed in accordance with the manufacturer's recommendations.

1102–6.5 Suction Lines

a. Terminate below maximum drawdown of the water in the well.

b. Encase if located below finish grade.

c. Locate at least the same distance from sources of pollution as indicated in Table 11–1.

1102–7 STORAGE TANKS

1102–7.1 Provide a pressure tank having a minimum capacity of 42 gallons.

1102–7.2 Tanks shall be watertight, sound, not subject to excessive corrosion and capable of withstanding loads imposed. Tank material and any protective coatings used shall not impart undesirable tastes or odors to the water.

1102–7.3 Tanks shall be equipped with a suitable pressure relief valve. A clean-out plug shall be located at the lowest point.

1103 INDIVIDUAL SEWAGE-DISPOSAL SYSTEM

1103–1 OBJECTIVE

To provide an adequate and safe sewage-disposal installation which is located and constructed so to avoid contaminating any existing or future water source or water supply.

1103–2 GENERAL

1103–2.1 The individual sewage-disposal system shall consist of a house sewer, a septic tank, and acceptable absorption system (subsurface absorption field, seepage pit or pits, or subsurface absorption bed).

1103–2.2 Where unusual conditions exist other methods of disposal may be employed provided they are acceptable to the health authority having jurisdiction and the FHA field office.

1103–3 LOCATION AND INSTALLATION

1103–3.1 Location and installation of the sewage-disposal system shall be such that, with reasonable maintenance, it will function in a sanitary manner and will not create a nuisance, health hazard or endanger the safety of any domestic water supply. Consideration shall be given to the size and shape of the lot, slope of natural and finished grade, depth of ground water, proximity of existing or future water supplies, and possible expansion of the system.

1103–3.2 The system shall not be located closer to any water supply than the minimum distance shown in Table 11–2.

Appendix II

PRECAUTIONARY MEASURES FOR IMPROVED WATER QUALITY*

Basic rules to consider in the location and construction of a new water well to reduce chances for biological or chemical pollution, are:

(a) Locate well on ground high enough to prevent surface drainage from entering the well. Extending the casing above the natural ground surface and building an earth mound around the casing provide protection against surface water. A sloping concrete platform should be poured over the mound and around the casing.

(b) Locate well at least 75 to 100 feet from sources of pollution. Greater distances are recommended in coarse-grained or gravelly subsoils.

(c) Install a sanitary well seal between any pipes extending downward in the well and the well casing for protection against entrance of rodents, insects, and other foreign materials.

(d) Provide a grout seal around the outside of the casing to protect against low-quality water present in the upper horizons draining downward into an aquifer of more desirable water.

(e) Disinfect the water and all parts of the equipment with which the water comes in contact by pouring a chlorine solution into the well.

(f) Fill and cover all abandoned wells in the immediate vicinity to prevent direct entrance of pollutants from ground surface.

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*Extracted from:

Water Quality on Minnesota Farms by E. R. Allred, Professor, Department of Agricultural Engineering, Minnesota Agricultural Experiment Station - Minnesota Farm and Home Science 21, No. 3, pp. 9-11, Spring, 1964.

NATIONAL PEST CONTROL ASSOCIATION

National Pest Control Association INC

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REFERENCE STANDARDS FOR PRECONSTRUCTION SOIL TREATMENT FOR PROTECTION AGAINST SUBTERRANEAN TERMITES*

Chemicals may be used as a soil treatment to establish a barrier which is lethal or repellent to subterranean termites. The toxicant must be applied with such thoroughness and uniformity that it provides a barrier in all routes of termite entry. Precautions to be observed in handling concentrated chemical formulations and in the application of diluted materials are given in the "Approved Reference Procedures for Subterranean Termite Control" of the National Pest Control Association. Applications according to the following reference concentrations and reference application rates will achieve a prolonged period of protection that is customarily guaranteed by pest control firms.

Effective soil treatment requires the dispersion in the soil of a required amount of toxicant. Two interrelated factors are: the amount of chemical and a means of dispersing it in the soil. These factors are controlled by the concentration of the chemical and the rate and uniformity of application. A balance must be maintained between the concentration and volume applied. Neither should be changed without appropriate adjustment of the other.

Four termite toxicants are recognized as the most effective and long lasting of those tested to date. These four toxicants may be regarded as being equal in effectiveness and longevity when applied at comparable dosages at their respective recommended concentrations. It is recommended that any of the four be applied as an emulsion in water.

The toxicants and recommended reference concentrations for each are:

Aldrin (actual)	0.5% by weight
Chlordane (technical)	1.0% by weight
Dieldrin (actual)	0.5% by weight
Heptachlor (actual)	0.5% by weight

Combinations of these toxicants are acceptable as long as they are proportioned to provide the equivalent of the full reference concentration. For example, one half of the reference concentration of one toxicant could be combined with one half of the reference concentration of another to provide a full reference concentration.

Reference application rates for soil toxicants are as follows:

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(over)

For slab-on ground construction

(a) one gallon per 10 square feet as an overall treatment under the slab and under attached porches.

(b) four gallons per 10 linear feet to critical areas under the slab, such as along the inside of foundation walls and both sides of interior partition foundation walls, or around utility services or other features that will penetrate the slab.

(c) four gallons per 10 linear feet along the outside of the foundation.

(d) two gallons per 10 linear feet in the voids of all unit masonry foundation walls or piers.

For crawl-space construction

(a) four gallons per 10 linear feet to critical areas under the house, such as along the inside of foundation walls, along both sides of interior partition foundation walls, around piers and around utility service entrance.

(b) four gallons to 10 linear feet along the outside of foundation walls including that part which will be under platforms or porches.

(c) two gallons per 10 linear feet in the voids of all unit masonry foundation walls or piers.

For basement construction

(a) one gallon per 10 square feet as an overall treatment under the basement slab.

(b) four gallons per 10 linear feet to critical areas within the basement area such as along the inside of foundation walls, along both sides of partition foundation walls, around piers, and around the entrance of any utility service or other feature that will penetrate the basement slab.

(c) four gallons per 10 linear feet along the outside of foundation walls where the foundation is of poured concrete or where the footing for masonry foundations is 30 inches or less below grade level, including that part that will be under platforms or porches.

Eight gallons per 10 linear feet where the footing for masonry foundations is more than 30 inches below grade level.

(d) two gallons per 10 linear feet in the voids of all unit masonry foundation walls or piers.

In some cases soil will not accept liquids at the reference rates of application. When the condition exists, a lesser volume of carrier, with an equivalently greater concentration of toxicant, may be used. For example, 5 gallons of 2% chlordane would be equivalent to 10 gallons of 1% chlordane. The actual amount of the insecticide per linear or square foot of soil should not be reduced and it must be properly distributed to provide an adequate barrier of treated soil.