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INSECTICIDAL PRODUCT AND PROCESS

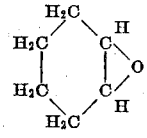
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5 Claims. (Cl. 167—22)

This invention relates to a novel and a more satisfactory insecticide, and to a novel process of fumigating utilizing this insecticidal material. More particularly the invention is concerned with the use of cyclohexene oxide in the destruction of various insects which are frequently encountered in fumigation.

Cyclohexene oxide is normally a liquid having a boiling point at normal atmospheric pressure of about 132° C. It has a relatively high vapor pressure and readily volatilizes if exposed to the atmosphere. However, it is not so volatile as to develop a considerable gas pressure if transported as a liquid in a closed container of comparatively small strength such as a carboy or bottle. Our novel insecticide, cyclohexene oxide, has the following structural formula:—



and is especially valuable for the destruction of various objectionable insects such as the common clothes moth larvae, the granary weevil, the confused flour beetle, aphis or plant lice, cock roaches, and bedbugs.

Ethylene oxide has previously been used as an insecticide but since this compound is a liquid having a relatively low boiling point, about 14° C. at normal atmospheric pressure, difficulties have been met with in handling and transporting it. In commercial practice it is now transported in pressure-resistant cylinders and for this reason it is practically impossible to use for household fumigation as some other materials. Naphthalene and paradichlorbenzene have also been used in household fumigation, particularly for the destruction of the larvae of the common clothes moth. While effective, these compounds impart a very pungent and disagreeable odor to clothes stored in the closets in which these mothicides are employed, which odor does not leave the garments until they have been thoroughly aerated. Moreover, the effective concentration of vapors of paradichlorbenzene and naphthalene necessary to destroy clothes moth larvae when these mothicides are used in an absolutely tight container or closet is relatively high. Government authorities recommend the use of vapor concentrations of paradichlorbenzene and naphthalene as high as 10 pounds per 1000 cubic feet fumigated for satisfactory destruction of the larvae of the clothes moth.

In utilizing cyclohexene oxide as an insecticide or mothicide, the liquid may be sprayed into a space to be fumigated or on the clothes which are to be mothproofed. Similarly, an enclosed space such as a closet, trunk, or storage chest, may be filled with vapors of cyclohexene oxide by spraying some of the liquid into these spaces. Another satisfactory way of utilizing cyclohexene oxide directly in the liquid state, is to leave a quantity of the oxide exposed to the atmosphere in an enclosed space to be fumigated in a relatively shallow dish. As a result of the evaporation of the cyclohexene oxide due to its relatively high vapor pressure, the space will become filled with vapors of the compound. This latter method may be used for fumigating closets, other enclosed spaces for the storage of clothes, granary storage spaces, flour bins, greenhouses, or machines which handle food products and are periodically fumigated to destroy insect life.

Cyclohexene oxide is especially suitable for fumigating machines which are periodically fumigated since insect destruction may be effected without shutting down the operation of the plant. This is because cyclohexene oxide, as distinguished from other fumigants such as hydrocyanic acid or sulfur dioxide, is not highly toxic or noxious to workers operating the other processes carried on in the plant. It has also been found particularly valuable as a mothicide since the odor imparted to the clothes which is not necessarily objectionable or disagreeable in itself and, as contrasted with some other mothicide materials, very rapidly leaves the garments upon exposure to the open air. This rapidly disappearing property of odors resulting from cyclohexene oxide vapor is especially desirable since garments stored in a closet fumigated with this material need be aerated for but a very few minutes and will then be free from noticeable odor.

Since cyclohexene oxide is a liquid it may be more desirable in some circumstances to prepare solid mixtures containing an amount of cyclohexene oxide which will yield vapors of the insecticide in the desired amount to the air present in the space to be fumigated. One very satisfactory way of preparing solid fumigant mixtures containing cyclohexene oxide is to admit a quantity of the liquid cyclohexene oxide with a molten wax such as paraffin, spermaceti wax, carnauba wax or beeswax. In this way a relatively hard solid product can be obtained. A relatively inexpensive paraffin wax is of course the preferred wax with which cyclohexene oxide is to be admixed, because of its low cost and availability.

We have found that a mixture containing 65% of paraffin and 35% cyclohexene oxide, these percentages being by weight, forms a very satisfactory solid product. If a larger quantity of cyclohexene oxide is used with paraffin, such as a 50% concentration, the resulting wax is likely to be soft and viscous rather than a hard solid. We therefore prefer to employ a mixture of 65% paraffin and 35% cyclohexene oxide in our novel insecticide which mixture will provide a relatively high concentration of vapor when using but a relatively small amount of the solvent. When using other and relatively harder waxes such as carnauba wax or spermaceti wax a larger amount of cyclohexene oxide can be admixed with the molten wax and still obtain a solid and relatively hard product. If desired, small amounts of porous substances such as kieselguhr, diatomaceous earth, or bentonite may be mixed with the wax—cyclohexene oxide mixture. When using these solid products for the destruction of insects the solid may be made up into the form of small balls or flakes similar to the naphthalene and paradichlorbenzene mothicides now sold for household use. Small amounts of the solid may be placed in the pockets or folds of the garment or exposed to the atmosphere in food product machines or other enclosed places wherein insect life is to be exterminated. If the very rapid evolution of fumigant vapors from cyclohexene oxide is desired, a small amount of the solid mixture of wax and cyclohexene oxide may be rapidly volatilized by placing it upon a heated plate; or, if desired, the liquid may be rapidly volatilized from any heated surface. For example, a hot iron or a brick which has previously been heated may be used as the vaporization surface for volatilizing cyclohexene oxide or for obtaining a rapid evolution of the vapors of the novel fumigant from the wax—cyclohexene oxide solid. By the rapid evolution of vapors very rapid destruction of insects in the enclosed space fumigated may be obtained. Under some circumstances equally rapid evolution can be obtained by spraying or atomizing cyclohexene oxide as a liquid into the enclosed space.

In the various experiments undertaken, the toxicity of cyclohexene oxide vapors for various insects such as larvae of the common clothes moth, the granary weevil, the confused flour beetle, aphis or plant lice, cockroaches and bedbugs, has been very carefully determined. These insects are those most frequently encountered in household, greenhouse and industrial fumigations. For killing the clothes moth larvae, the concentration of vapors of cyclohexene oxide in the enclosed space fumigated should range from 0.5 to 2.0 pounds per one thousand cubic feet of space. When the lower concentration is used substantially all the larvae are killed in a period of about two days. When using concentrations as high as 1.5 to 2.0 pounds of cyclohexene oxide vapor per thousand cubic feet of closet space, the larvae are entirely destroyed in periods of time as short as six hours or less.

When combating the granary weevil, which is one of the most difficult insects to exterminate among those which are encountered frequently in industrial fumigation, amounts of the order of 3.0 to 4.0 pounds of cyclohexene oxide vapor per thousand cubic feet of space fumigated, are desirable. Aphis or plant lice, may be killed with amounts as low as 0.5 pound of cyclohexene oxide per thousand cubic feet of space, while the confused flour beetle will ordinarily require about 2.0 pounds per thousand cubic feet for rapid and efficient destruction. For killing cockroaches and bedbugs amounts of the order of 2.0 pounds per thousand cubic feet are also satisfactory. It may be mentioned that when cyclohexene oxide is used solely as a repellant, i. e., merely for repelling rather than destroying any of the other insects mentioned, the amount of cyclohexene oxide present as vapor in the enclosed space fumigated may be somewhat less than 0.5 pound per one thousand cubic feet.

Cyclohexene oxide is especially valuable for fumigating flour mills, cereal mills and macaroni factories and the rolls, conveyors, elevator legs, and sifters of these factories. Many types of insects are encountered in such industrial insect destruction problems. Many factory machines such as shredders, conveyors or molding machines are fumigated regularly at frequent intervals, often while workmen are present in the plant operating other machines. Cyclohexene oxide, by reason of its not unpleasant odor and relatively low order of toxicity, as well as its relatively high vapor pressure, is especially valuable for such use. It lends itself readily to fumigating, either by the drip method or by the enclosed space method, i. e., either by dripping the fumigant or insecticide periodically into the open and uncovered machine or by enclosing the machine so that it is separated from the other space in the workroom and then fumigating the machine by volatilizing cyclohexene oxide in the space thus enclosed. For these purposes either liquid cyclohexene oxide or the solid mixtures described may be utilized.

The various details and amounts herein specified are to be considered as illustrative and not restrictive, the scope of our invention being determined by the appended claims. Various changes might be made in the specific proportions or amounts of cyclohexene oxide or cyclohexene oxide—wax mixtures used without departing from the scope of the invention.

We claim:

1. An insecticide comprising cyclohexene oxide.

2. A mothicide and moth repellent comprising cyclohexene oxide.

3. An insecticide comprising a solid mixture of cyclohexene oxide and a wax.

4. An insecticide comprising a solid mixture comprising approximately 35% of cyclohexene oxide and 65% of paraffin.

5. An insecticide comprising a solid mixture of cyclohexene oxide and a wax selected from the group which consists of paraffin wax, carnauba wax, and spermaceti wax.

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