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(54) **AEROSOL INSECTICIDE AVEC DE L'EAU COMME SOLVANT**
(54) **WATER-SOLVENT-BASED AEROSOL INSECTICIDE**

(57) A water-based or solvent-based, or combinations thereof, aerosol insecticide is provided. Dimethylether (DME) is used both as a solvent and a propellant. The DME holds the ingredients of the aerosol in a homogenous liquid solution while it is in an aerosol bomb. Upon release of the aerosol, the DME flashes off and the remaining ingredients separate into two phases: a liquid phase, and a solid or oil phase having the active insecticidal ingredients.

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WATER-SOLVENT-BASED AEROSOL INSECTICIDE

Abstract of the Disclosure

A water-based or solvent-based, or combinations thereof, aerosol insecticide is provided. Dimethylether (DME) is used both as a solvent and a propellant. The DME holds the ingredients of the aerosol in a homogenous liquid solution while it is in an aerosol bomb. Upon release of the aerosol, the DME flashes off and the remaining ingredients separate into two phases: a liquid phase, and a solid or oil phase having the active insecticidal ingredients.

This invention relates to insecticides, and, in particular, to novel formulations for the efficacious delivery of pesticides, water or solvent based insecticides which will not harm the ozone layer of the atmosphere when released.

Halogenated solvents, such as methylene chloride and 1,1,1-trichloroethane are common carriers, diluents and solvents for aerosol sprays. However, they have been restricted due to health and environmental concerns. To alleviate these concerns, many aerosol manufacturers shifted from solvent-based aerosols to water-based aerosols. Many of these aerosols used water as a carrier, dimethylether (DME) as a propellant, and a solvent. The use of DME as a propellant is well known. See for example U.S. Patent No. 2,358,986 to McGovran et al. Because the insecticide is emulsified in the water, the prior art water-based aerosol insecticides do not have a sustaining good knock-down effect, and when sprayed on a porous surface, such as wood or drywall, the insecticide is significantly absorbed by the surface. As a result, the remaining solvent has a tendency to dilute the insecticide. Thus, consequently, there is not enough insecticide on the surface in sufficient toxic amount to be available for insects to receive in the required amount to effectively kill the same. None of the prior art insecticides disclose a formula wherein the active insecticidal agents are separated from the water or diluent upon release from the aerosol can in order to avoid the problem of dilution, absorbtion and slow knockdown. See for example U.S. Patents No. 2,358,986 to McGovran et al.; No. 4,439,342; No. 4,439,343;

No. 4,439,344, No. 4,483,783; and No, 4,826,674, all to Albanese; No. 4,487,334 to Werding; and, No. 4,381,066 and No. 4,384,661, both to Page et al., No. 4,187,204 to Howard; No. 4,420,575 to Rapaport et al.; No. 4,450,253 to Suk; No. 3,207,386 to Presant et al.; and, No. 4,041,148 and No. 4,139,607, both to Simons et al.

One object of the present invention is to provide an effective, yet environmentally safe insecticide formulation.

Another object of this invention is to provide such an insecticide formulation which has good knock-down and kill capabilities for flying insects.

A further object of this invention is to provide such results that the target insects will be exposed to the undiluted insecticide which will remain on the surface upon which it is sprayed without being absorbed by such surface.

Other objects of this invention will be apparent to those skilled in the art in light of the following description.

In accordance with this invention, generally stated, there is provided solvent-based insecticide formulation contained under pressure in an aerosol can. The formulation comprises a hydrocarbon solvent as a diluent, at least one active insecticidal ingredient which is insoluble in the hydrocarbon solvent diluent when used alone, dimethyl ether (DME) and a co-solvent. The diluent is a hydrocarbon

solvent (for example petroleum distillates) which can include isoparaffinic hydrocarbons, or other solvent or diluents in which the active component is not soluble. The dimethyl ether is a solvent which holds the active ingredient in solution with the hydrocarbon solvent diluent so that the insecticide formulation is maintained as a homogenous liquid solution within the aerosol can. Upon releasing the insecticide formulation, the dimethyl ether flashes and a two phase system forms, one phase comprising the hydrocarbon solvent diluent, and a second phase comprising the active insecticidal ingredient.

Preferably, the dimethyl ether is present in the range of 10.0-75.0%, the diluent is present in the range of 25.0-90.0%, and the active insecticidal ingredient is present in the range of 0.01-10.0% all based on weight.

The insecticide formulation also includes a co-solvent to make production of the aerosol easier. The co-solvent is preferably chosen from the group consisting of isopropyl alcohol, 1-methyl-2-pyrrolidinone, and combinations thereof. Obviously, other equivalent co-solvents may work just as effectively. The amount of the co-solvent is preferably up to about 25% by weight based on the formulation.

The natural physical state of the active insecticidal ingredients are generally a solid or an oil when not in solution. If the insecticide is to be used to kill

crawling insects, the active ingredients can be chosen from any group including organophosphates, carbamates, and pyrethroids, such as chlorpyrifos, propoxur, or cypermethrin, as examples. If the insecticide is to combat flying insects the active ingredients are preferably chosen from the group consisting of natural pyrethrum, synthetic pyrethroids, and combinations thereof.

The flying insect insecticide may include synergistic agents. The synergistic agents preferably are chosen from the group consisting of piperonyl butoxide, N-octyl bicycloheptene dicarboximide and combinations thereof, while many other like agents are readily commercially available.

The aerosol may include corrosion inhibitors chosen from any group including oleamide DEA, phosphate esters sodium benzoate and sodium nitrate.

As can be obvious from that as reviewed herein, the concept of this invention is not only to provide a solvent-based insecticide, but an insecticide that may be solvent-based and emplaced within an aerosol can, so as to remain miscible within the solvent within the can, until sprayed. Such is the concept of the invention herein, the mixing of the insecticide with dimethyl ether, and a co-solvent, becomes a homogeneous mixture within the solvent in the can. When sprayed, the dimethyl ether flashes and the solvent separates, leaving the undiluted insecticide on the surface

of the area sprayed or undiluted insecticide suspended in the air.

The use of dimethyl ether (DME) as a propellent has been known for some time. However, it is also a strong polar solvent which has been found to be able to hold active insecticidal ingredients in solution with a diluent while in an aerosol bomb (i.e. in an aerosol can). It has also been found that when the aerosol is released (discharged) the DME flashes off, allowing the insecticidal ingredients and the diluent to separate into two phases the diluent being one phase, the insecticide being the other. This allows the insecticide to return to its natural physical state upon release, i.e., if the insecticide is naturally a crystal, it will crystallize upon release. Because the insecticide is separate from the diluent, it will not be absorbed into the contacted porous surfaces. Therefore, there is more insecticide available for insects to ingest, and the insecticide is thus more effective in application.

The aerosol is preferably made by dissolving the insecticidal agents in the co-solvent, e.g., isopropyl alcohol. The diluent is added next and then DME.

The aerosol could be made without the use of the isopropyl alcohol, which only acts as a co-solvent. However, the use of isopropyl alcohol makes production easier and is thus preferred.

The following examples show various formulations of insecticidal aerosols made in accordance with the above procedure as well as somewhat similar formulations that are outside the scope of the present invention.

Crawling Insect Insecticides

Example I

0.505%	Chlorpyrifos*	insecticide
10.000%	Isopropyl alcohol	co-solvent
0.300%	Oleamide DEA	corrosion inhibitor
59.195%	Deionized water	diluent
30.000%	DME	solvent/propellent

*O,O-diethyl O-(3,5,6-trichloro-2-pyridinyl) phosphorothioate available from Dow Chemical U.S.A. under the trademark Dursban R 99%

Example II

0.505%	Chlorpyrifos	insecticide
4.000%	Isopropyl alcohol	co-solvent
0.300%	Oleamide DEA	corrosion inhibitor
65.195%	Deionized water	diluent
30.000%	DME	solvent/propellent

Example III

1.087%	Propoxur*	insecticide
10.000%	Isopropyl alcohol	co-solvent
0.300%	Oleamide DEA	corrosion inhibitor
58.613%	Deionized water	diluent
30.000%	DME	solvent/propellent

* 2-(1-methylethoxy)phenol methylcarbamate available from the Agricultural Chemicals Division of Mobay Chemical Corporation under the trademark Baygon, technical.

Because the DME flashes upon release from the aerosol can, chlorpyrifos and propoxur, which are both solid, crystalline insecticides, recrystallize immediately upon release from the aerosol bomb. As they are not held in solution or dissolved in the water after release, the insecticide will remain on the surface upon which it is sprayed. It will not be absorbed into the surface to any appreciable extent. Thus, there is more crystalized insecticide readily available for insects to ingest or otherwise contact.

Flying Insect Insecticide

Example IV

1.250%	Pyrethrum, technical	insecticide
0.278%	d-trans Allethrin	pyrethroid insecticide
1.000%	MGK-264*	synergist
1.000%	Piperonyl Butoxide	synergist
18.000%	Isopropyl alcohol	co-solvent
0.300%	Oleamide DEA	corrosion inhibitor
33.172%	Deionized water	diluent
45.000%	DME	solvent/propellent

* MGK-264: McLaughlin Gormley King Co. trademark for N-octyl bicycloheptene dicarboximide

Example V

1.183	Resmethrin*	pyrethroid insecticide
1.000	M-Pyrol**	co-solvent
10.000%	Isopropyl alcohol	co-solvent
0.250%	Oleamide DEA	corrosion inhibitor
42.567%	Deionized water	diluent
45.000%	DME	solvent/propellent

* (5-Benzyl-3-furyl)methyl-2,2-dimethyl-3-(2-methylpropenyl) cyclopropanecarboxylate, available from S.B. Penick and Company under the Trademark SBP-1382.
** Trademark of GAF Chemicals Corp for N-methylpyrrolidinone.

Example IV includes synergistic agents to help increase the efficacy of the insecticides. In both Example IV and V, the insecticides and synergistic agents are all liquid oils, except that Resmethrin crystals are present as the insecticide. Upon dispensing, they form a highly atomized fog. The crawling insect formulae (Examples I - III) have a lower percentage of DME than the flying insect formulae. The lower percentage of DME in the crawling insect formulae reduces the amount of atomization. A high degree of atomization is not required for crawling insects because it is not desirable to spray a large area. It is preferable to concentrate the insecticide in the immediate area of the insect to be sprayed, or in proximity therewith.

Example VI

3.080%	Orthene Tech, 97%	insecticide
10.000%	Isopropyl alcohol	co-solvent
36.920%	Isopar L*	diluent
50.000%	DME	solvent/propellant

* A trademark of Exxon Company U.S.A., a division of Exxon Corporation for a hydrotreated heavy naptha, petroleum consisting primarily of C_{11}-C_{13} isoparaffinic hydrocarbons.

In this example, Isopar L, an isoparaffin petroleum distillate operates in the same manner as the water in the preceeding examples. The combination of the

co-solvents, and the solvent/propellant, together make a homogeneous mixture within the can, in order to sustain the dilution of the mixture within the container, until sprayed.

Numerous variations, within the scope of the appended claims, will be apparent to those skilled in the art in light of the foregoing description.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A solvent-based aerosol insecticide formulation to be sprayed, which is a homogeneous liquid solution contained under pressure in a aerosol can and consists essentially of:

(a) 0.01-10% by weight of at least one active insecticidal ingredient that is a solid or an oil in its natural physical state and is selected from the group consisting of organophosphates, carbamates and pyrethroids,

(b) 25.0-90.0% by weight of a hydrocarbon solvent as a diluent,

(c) 10.0-75.0% by weight of dimethyl ether (DME) as a propellant as well as a solvent, and

(d) up to 25% by weight of a co-solvent,

wherein:

the active insecticidal ingredient is insoluble in the hydrocarbon solvent diluent when used alone, but the dimethyl ether holds the active insecticidal ingredient within the homogeneous liquid solution; and

upon releasing the insecticidal formulation out of the aerosol can, the dimethyl ether flashes and a two phase system forms, one phase comprising the hydrocarbon solvent and a second phase comprising the active insecticidal ingredient in its natural physical state that is a solid or an oil.

2. The insecticide formulation of claim 1, wherein the hydrocarbon solvent diluent is comprised of an isoparaffinic hydrocarbon.

3. The insecticidal formulation of claim 1 or 2, wherein the hydrocarbon solvent diluent has 11 to 13 carbon atoms.

4. The insecticide formulation of any one of claims 1 to 3, the co-solvent is chosen from the group consisting of isopropyl alcohol, 1-methyl-2-pyrrolidinone, and a combination thereof.

5. The insecticide formulation of any one of claims 1 to 3, wherein the co-solvent is isopropyl alcohol and flashes together with the dimethyl ether upon releasing the insecticidal formulation.

6. The insecticide formulation of any one of claims 1 to 5, wherein the active insecticidal ingredient is chosen from the group consisting of natural pyrethrum, synthetic pyrethroids, and combinations thereof.

7. The insecticide formulation of claim 6, which comprises a synergistic agent chosen from the group consisting of piperonyl butoxide, N-octyl bicycloheptene dicarboximide and combinations thereof.

8. The insecticide formulation of any one of claims 1 to 5, wherein the active insecticidal ingredient is acephate.

9. A method of producing the aerosol insecticide formulation as defined in any one of claims 1 to 6 or claim 8, which comprises:

placing the active insecticidal ingredient and the co-solvent in the aerosol can;

adding the hydrocarbon solvent diluent to the insecticidal ingredient and the co-solvent; and

adding the dimethyl ether under pressure to the active insecticidal ingredient, the co-solvent and the hydrocarbon solvent diluent to form a homogenous liquid solution.

10. A solvent-based aerosol insecticidal composition to be sprayed upon an insect that is embodied in a homogenous liquid solution contained under pressure in an aerosol can, which solution becomes a two-phase system upon release from the aerosol can, the insecticidal composition being produced by a method comprising:

placing in the aerosol can at least one active insecticidal ingredient selected from the group consisting of organophosphates and a co-solvent which dissolves the insecticidal ingredient and maintains the insecticidal ingredient in solution while it is contained in the aerosol can;

adding a diluent to the insecticidal ingredient and co-solvent, the insecticidal ingredient being insoluble in the diluent, the diluent being a hydrocarbon solvent; and

adding dimethyl ether as a propellent and a solvent under pressure, the dimethyl ether holding the insecticidal ingredient, the co-solvent and the diluent in a homogeneous liquid solution within the aerosol can and the insecticidal ingredient is a solid or an oil when not in solution;

wherein upon releasing the aerosol insecticide, the dimethyl ether and co-solvent present flash, and the two-phase system forms, one phase comprising the diluent which separates, and a second phase comprising the insecticidal ingredient, the insecticidal ingredient returning to its solid or oil state when it separates from the diluent; and

wherein the insecticidal composition consists essentially of the organophosphate active insecticidal ingredient in the range of 0.01%-10.0% the co-solvent in the range of up to 25% the diluent in the range of 25.0%-90.0% and dimethyl ether in the range of 10.0%-75.0%.

11. The insecticidal composition of claim 10, wherein the co-solvent is selected from the group consisting of isopropyl alcohol, 1-methyl-2-pyrrolidone, and combinations thereof.

12. The insecticidal composition of claim 10 wherein the co-solvent is isopropyl alcohol.

13. The insecticidal composition of claim 10, 11 or 12 wherein the insecticidal ingredient is acephate.

14. The insecticidal composition of claim 10, 11, 12 or 13 wherein the diluent is an isoparaffinic hydrocarbon.

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