

PATENT SPECIFICATION

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(54) USE OF PESTICIDAL COMPOSITIONS FOR THE CONTROL OF MAMMALIAN ECTOPARASITES

see
19.10

(71) We, AFRICAN EXPLOSIVES AND CHEMICAL INDUSTRIES LIMITED, of 40. Fox Street, Johannesburg, Transvaal, a company incorporated in the Republic of South Africa, do hereby declare this invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the use of pesticidal compositions in controlling ectoparasites of mammals other than man. In particular, it relates to the use of non-aqueous, self-emulsifiable, solvent-free, pesticidal compositions containing a substantial quantity of a pesticide as the active ingredient. It also relates to containers of such compositions for such purposes.

In most parts of the world, domesticated mammals including livestock, are subject to infestations by external parasites. The most important class of such parasites are arthropod ectoparasites, especially those belonging to the class Insecta and the order Acarina. These pests include lice, flies, ticks and mites which are often not only injurious to the host-mammals themselves, but are vectors of disease-causing organisms and cause substantial financial losses to livestock farmers. Estimates of the losses caused by the more important pests affecting livestock production are given in a Report issued by the U.S. Department of Agriculture (Agricultural Handbook 291), from which it will be noted that the losses can amount to millions of U.S. dollars per annum.

Among pests of significant economic importance is *Boophilus decoloratus*, a tick mainly affecting cattle and equines in Africa south of the Sahara, which is a vector of a number of diseases including anaplasmosis and babesiosis in cattle. Another tick prevalent in Africa is the "brown ear tick", *Rhipicephalus appendiculatus* Neumann, which is parasitic on cattle, equines, sheep, goats and other mammals. It is the chief vector of East Coast

fever of cattle and is implicated in the transmission of other diseases as well. These are of course many other ectoparasites of domesticated animals among which may be briefly mentioned *Rhipicephalus evertsi* and *Amblyoma lebraem* parasitic on sheep and cattle; *Lucilia cuprina* and *sericata* parasitic on sheep; and *Chrysomya bezziana* (screw worm) parasitic on cattle, sheep and goats. All such ectoparasites are to a greater or lesser extent responsible for economic losses which can take the form of decreased meat, milk, and wool production, damaged hides, general debilitation and even the death in cases of heavily parasitised animals.

At present, the major practical means for controlling such arthropod ectoparasites is by the use of chemicals toxic to these parasites. Among a large variety of such chemicals—or pesticides—which have been used for this purpose are the organo-phosphorus and the organo-chlorine pesticides. These are relatively insoluble in water and are presented for use in the field as dips which are usually in the form of wettable powders or miscible oils (also known as emulsifiable concentrates). The miscible oil formulations contain solvents and emulsifiers and are applied to infested animals as an emulsion in water which is prepared by diluting the formulations to provide the desired concentration of active ingredient. These emulsions are known as washes and are applied to the animals by spraying (spray wash) or by dipping or immersing the animals in the wash (dip wash). Applications of the pesticides in this way reduces or eliminates the infestation and provides some degree of protection against re-infestation.

Dipping in and spraying with emulsion washes is extensively practised in Africa, Europe, the Americas and Australasia. A cattle dipping bath, for example, may hold at least 3,000 gallons of dip wash in which cattle are successively dipped. Each animal removes several gallons of wash from the bath, but most of this returns to the bath via the

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draining pens. An additional amount of the pesticide is, however, selectively absorbed by the hair or skin of the animal which leads to a progressive decrease in the concentration of the wash as more animals are dipped in the same wash. This decrease is known as "stripping", "exhaustion" or "depletion" of the wash, and is undesirable in view of the necessity of continually checking the concentration of the wash and the need for replenishment.

The conventional miscible oil formulations of liquid pesticides used to prepare washes are characterised by the presence of a high solvent content for the active ingredient which may be as much as 80 per cent by weight of the formulation. It is usually in the range of 50 to 70 per cent by weight and rarely falls below 30 to 40 per cent by weight. Another feature of these conventional formulations is the relatively low concentration of the pesticide which rarely exceeds 55 per cent by weight and is usually in the range of 2 to 30 per cent by weight of the composition. Apart from the active ingredient, other substances, termed in the art together with the solvents referred to above as "inerts", are commonly included to reduce the viscosity, to stabilise or to dilute the conventional miscible oil compositions.

The inclusion of a solvent in these conventional miscible oil formulations has been established practice for many years (see for example U.K. Patent Specification No. 1,144,003, page 3, lines 72 to 102). Apart from acting as a solvent for the active ingredient, its inclusion was especially believed to be of value in reducing the rate of "exhaustion" of a dip or spray wash made from a formulation. It was thus shown by Brown, *et al* ("The formulation of Pesticides"; S.C.I. Monograph No. 21, Society of Chemical Industry, 1966, at pages 166 to 172) that the more solvent present in the dip (and hence in the wash), the lower the degree of exhaustion. It was also feared that the omission of a solvent would produce dips which would be more toxic to handle in view of high concentration of the active ingredient. In consequence it has been the invariable practice for many years to include a substantial amount of a solvent in miscible oil formulations.

It has now been surprisingly found, contrary to established opinion and accepted practice in making miscible oil formulations of liquid pesticides, that it is not necessary to include a solvent; that a satisfactory dip can be made without the inclusion of such solvents; that the presence of a solvent in substantial amounts can have deleterious effects on mammals; and that dip washes made from such solvent-free dips have improved biological effects and do not exhaust to a substantially greater extent than dips made from conven-

tional formulations containing a solvent.

Accordingly the present invention provides a method for the control of arthropod ectoparasites of a mammal other than man comprising the application to the mammal of an effective amount of an aqueous emulsion prepared by the emulsification in water of a self-emulsifiable, substantially solvent-free (as hereinafter defined), non-aqueous, pesticidal composition comprising at least one liquid pesticide suitable for controlling the ectoparasite and an emulsifier, which composition has a total pesticide content of from 65 to 95 per cent by weight of the composition. There is also provided by this invention a container marked with indications of suitability of its contents for use in the control of arthropod ectoparasites of a mammal, the said contents being a composition as defined above; a container associated with written indications of the suitability of its contents for the control of arthropod ectoparasites of a mammal, the said contents being a composition as defined above; and a container marked with instructions to dilute its contents with water to prepare an emulsion wash and to apply said wash to a mammal for controlling infestations of arthropod ectoparasites, the said contents being a composition as defined above.

A pesticide for use in the compositions may be any pesticide which is liquid at normal ambient temperatures, and which is suitable for the control of arthropod ectoparasites of mammals. Organo-phosphorus pesticides of the phosphate and phosphorothionate ester type are especially preferred and include such chemicals as chlorfenvinphos (2 - chloro - 1-(2,4 - dichlorophenyl) vinyl diethyl phosphate), ethion (O,O,O',O' - tetraethyl S,S' - methyl-enediphosphorodithioate), dioxathion [2,3 - p-dioxanedithiol S,S - bis(O,O - diethyl phosphorodithionate)], 'Diazinon' (Trade Mark) (O,O - diethyl O - 2 - isopropyl - 4 - methyl-6 - pyrimidyl phosphorothionate), dichlorfenthion (O,O - diethyl O - 2,4 - dichlorophenyl phosphorothionate), carbophenthion (O,O - diethyl S - (p - chlorophenylthio) methyl phosphorodithioate), bromophos ethyl (O,O - diethyl O - 4 - bromo - 2,5 - dichlorophenyl phosphorothionate), folithion (O,O - dimethyl O - (3 - methyl - 4 - nitrophenyl) phosphorothionate), dibrom (O,O - dimethyl O - 1,2 - dibromo - 2,2 - dichloroethyl phosphate), and fenthion (dimethyl 3 - methyl - 4 - methylthiophenyl phosphorothionate). Mixtures of two or more of these pesticides may, if desired, be included in the compositions. A solid pesticide may also be included in solution in the compositions in addition to one or more liquid pesticides, and 'Dursban' (Trade Mark) (O,O - diethyl O - 3,5,6 - trichloro - 2 - pyridylphosphorothionate) is usefully included in combination with bromophos ethyl. Other solid pesticides which may be used include fenchlorphos (O,O - dimethyl O -

(2,4,5-trichlorophenyl) methyl phosphorothionate. This composition is suitable for use in the control of arthropod ectoparasites of a mammal, the said contents being a composition as defined above; and a container marked with instructions to dilute its contents with water to prepare an emulsion wash and to apply said wash to a mammal for controlling infestations of arthropod ectoparasites, the said contents being a composition as defined above.

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(2,4,5 - trichlorophenyl) phosphorothionate) and 'Imidan' (Trade Mark) (N - mercapto-methyl) - phthalimido S - (O,O - dimethyl phosphorodithioate)).

- 5 The pesticide content of a composition is conveniently not less than 75 per cent by weight of the composition, and the preferred content will vary with the nature of the pesticide chosen, and the nature and quantity of the remaining ingredients.
- 10 The emulsifier for inclusion in a composition may be any emulsifier which is miscible with the liquid insecticide and provides a satisfactory emulsion of the composition in water. The emulsifier may constitute the sole additional ingredient with the pesticide and thus make up the balance of 5 per cent to 35 per cent by weight of the composition, or further ingredients may be included, as described below. The preferred emulsifiers are non-ionic or anionic surface active agents having emulsifying and dispersing properties, and a blend (or mixture) of these two types is especially useful for compositions of the invention.
- 15 Suitable non-ionic surface active agents include polyalkylene glycol ethers, and condensation products of alkyl phenols, aliphatic alcohols, aliphatic amines or fatty acids with ethylene oxide. Conveniently the emulsifier may be a condensation product of nonyl phenol with 5 to 25 mols. of ethylene oxide, mixed with a polyalkylene glycol. Anionic surface active agents which may be used include calcium salts of alkylbenzene sulphonics, naphthalene sulphonics acid, and salts of lauryl sulphate.
- 20 Although the compositions of the invention are non-aqueous in character, that is to say, they contain no added water, it is commonly found that surface active agents usually employed in the manufacture of pesticidal compositions contain up to about 3 per cent by weight of water. Compositions containing such surface active agents are therefore also included within the scope of the present invention.
- 25 Further substances may be included in compositions of the present invention, in addition to the pesticide and emulsifier, in order to supplement the activity of the composition or to modify its properties. Such substances should be miscible with the remaining ingredients of the composition and include bactericides, bacteriostats, fungicides, corrosion inhibitors, perfumes, diluents and viscosity reducing agents.
- 30 Although it is a main object of the present invention to provide compositions not containing any solvent for the purpose of solubilising the pesticide ingredients, such solvents may be included in compositions of the invention in an amount not exceeding 10 per cent and preferably not more than 5 per cent by weight of the composition for the purpose of reduc-
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ing viscosity or adjusting the concentration of the pesticide to provide a desired concentration in a wash on dilution. In this specification "solvent" means a free-flowing organic liquid of low viscosity which is readily miscible with the remaining ingredients of a composition, and includes such substances as hydrocarbon solvents, for example alkyl benzenes, alkyl naphthalenes, xylene, paraffins, aliphatic alcohols, and others commonly employed in solubilising the active ingredient of pesticidal compositions. The inclusion of a small amount of such a solvent as described herein may be useful in preventing the crystallisation of the pesticide in a composition if it should be stored in low temperature climatic conditions. It will therefore be understood that a composition described herein is termed "substantially solvent-free" if its solvent content does not exceed 10 per cent by weight of the composition.

A stabiliser for the pesticide may also be included in an amount of from 0.5 to 5 per cent by weight of the composition. Suitable stabilisers for organo-phosphorus compounds include propylene oxide, epichlorohydrin and alkanolamines such as triethanolamine.

The compositions of the present invention may be made by intimately admixing the ingredients thereof to produce a uniform composition. If a solid pesticide is included, then this should be first dissolved in the liquid pesticide. If an anionic and non-ionic emulsifier mixture is used, this should be first prepared before the addition of the pesticides.

A wash for the spraying or dipping of infested animals is prepared by adding the composition to water, and dispersing it until an aqueous emulsion of uniform composition is produced. It is preferred, however, to 'pre-cream' the composition, namely to mix the composition with the same amount of water, stirring continuously, to make a highly concentrated emulsion. The stirring is continued and water added to form a thin cream, and this is then added to the remaining quantity of water, with stirring, to provide the desired concentration of pesticide in the wash. It is preferred that in the wash, the particles of the emulsion should be less than 1 μ . The optimum concentration of active ingredient in the wash will of course depend upon the nature of the pesticide and its intended use. In general a range of concentration from 0.005% w/v to 0.5% w/v may be used, although most pesticides may be used at a concentration of 0.005% to 0.2% w/v.

The washes made from compositions of this invention may be applied to infested animals by conventional methods, and may be done by dipping the animals in a bath of the wash or spraying the animals with the wash.

The following examples are given to illustrate suitable compositions of the invention and the results obtained in using these com-

positions in laboratory and field trials, but without limiting the scope of the invention in any way.

Examples 1 to 4 are examples of suitable compositions prepared according to the invention. The ingredients are given in percentages by weight of the total composition in each example.

The remaining examples illustrate the use of the compositions and the results obtained from tests using these compositions.

EXAMPLE 1.

A composition was prepared from the following ingredients:—

15	Chlorfenvinphos (technical grade)	87.20
	Calcium dodecyl benzene sulphonate (anionic emulsifier; technical grade 70% w/w)	3.84
20	A non-ionic emulsifier blend: (a mixture of polyalkylene glycol ether; and a condensate of nonyl-phenyl with 10 to 20 mol. ethylene oxide)	8.96

The polyalkylene glycol was melted by gentle heat and mixed with the remaining emulsifiers. The resulting mixture was then added to the insecticide and stirred until an homogeneous composition was obtained. The composition was filled into a container, the latter sealed and marked with instructions to dilute its contents with water and to apply the resulting emulsion wash to a mammal for controlling an infestation of an arthropod ectoparasite.

EXAMPLE 2.

A composition was prepared from the following ingredients, filled into a container, and the latter sealed and marked in the manner described in Example 1:—

40	Dioxathion (technical grade)	82.64
	Calcium dodecyl benzene sulphonate (anionic emulsifier; technical grade 70% w/w)	5.20
45	A non-ionic emulsifier blend: (a mixture of polyalkylene glycol ether; and a condensate of nonyl-phenol with 10 to 20 mol. ethylene oxide)	12.16

EXAMPLE 3.

A composition was prepared in the manner described in Example 1 from the following ingredients:—

50	Chlorfenvinphos (technical grade)	40.24
	Dioxathion (technical grade)	40.24
55	Calcium dodecyl benzene sulphonate (anionic emulsifier; technical grade 70% w/w)	5.90
60	A non-ionic emulsifier blend: (a mixture of polyalkylene glycol ether; and a condensate of nonyl phenol with 10 to 20 mol. ethylene oxide)	13.62

The composition was filled into a container, and the latter sealed and marked in the manner described in Example 1.

EXAMPLE 4.

A composition was prepared from the following ingredients:—

	O,O - diethyl O - 3,5,6 - trichloro - 2-pyridylphosphorothionate (technical grade)	15.0
	Bromophos ethyl (technical grade)	70.0
	"Toximul" MP8 (Trade Mark)	15.0

The solid insecticide (the pyridylphosphorothionate ester) was dissolved in the liquid insecticide (bromophos ethyl). The emulsifier was added to the mixture and the product stirred to give a homogeneous composition.

"Toximul" MP8 is a liquid sulphonate non-ionic blend emulsifier available from Stepan Chemical Co., Illinois, U.S.A.

The composition was filled into a container, the latter sealed and marked as described in Example 1.

EXAMPLE 5.

The biological activity of the compositions according to the invention against cattle tick larvae was determined by the method described by R. D. Shaw in the Bulletin of Entomological Research, Vol. 56, Part 3, June 1966. The larvae were of the organo-phosphorus-resistant strain (Berlin strain) of *Boophilus decoloratus*. The results were obtained in terms of the larval LC 50 (%), that is, the lowest concentration of active ingredient giving a 50 per cent mortality of the larvae. The results are shown in Table 1 together with the results obtained using conventional miscible oil formulations containing the same active ingredients. These conventional formulations contained the following ingredients:—

Dioxathion miscible oil formulation		% w/w	
	Dioxathion (technical grade)	29.6	
	Anionic emulsifier	4.9	
	Blend of two non-ionic emulsifiers	4.9	105
	Organic solvent (containing a high proportion of aromatic hydrocarbon)	60.6	
Chlorfenvinphos miscible oil formulation		% w/w	
	Chlorfenvinphos (technical grade)	27.9	110
	Anionic emulsifier	2.8	
	Blend of two non-ionic emulsifiers	6.5	
	Organic solvent (containing a high proportion of aromatic hydrocarbons)	62.8	
Dioxathion / chlorfenvinphos miscible oil formulation		% w/w	
	Dioxathion (technical grade)	14.1	
	Chlorfenvinphos (technical grade)	14.1	
	Anionic emulsifier	2.8	
	Blend of two non-ionic emulsifiers	6.5	120
	Stabilizer (based on propylene oxide)	0.8	
	Organic solvent (containing a high proportion of aromatic hydrocarbons)	61.6	

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61.6

TABLE 1

Formulation or composition	LC 50 (%)
Composition of Example 1	0.0027
Chlorfenvinphos miscible oil formulation	0.0030
Composition of Example 2	0.0011
Dioxathion miscible oil formulation	0.0028
Composition of Example 3	0.0022
Dioxathion/chlorfenvinphos miscible oil formulation	0.0028

These results show that the compositions of the invention have greater pesticidal activity than the corresponding conventional miscible oil formulations containing a solvent.

EXAMPLE 6.

The biological efficacy of the dioxathion composition of Example 2 was compared with that of a conventional miscible oil formulation of dioxathion (described in Example 5) in field trials with cattle. The method used was that described by J. A. F. Baker and G. E. Thompson in the Journal of the South African Veterinary Medical Association, Vol. 37, No. 3, 1966, pp. 367—372, against *Rhipicephalus appendiculatus* (Brown Ear Tick). The composition and the formulation were each diluted with water to prepare washes containing 0.05% w/v of active ingredient.

The results of these trials are represented in Figure 1.

The number of ticks is the average number per animal. Each figure was obtained from a group of 3 animals. Treatment of the animals was at weekly intervals and on treatment days, tick numbers were counted before each treatment.

These results show that the counts on the animals treated with the composition of Example 2 are consistently lower than the counts on the animals treated with the conventional miscible oil formulation.

Statistical analysis of variance on these data showed that the control of ticks using the composition of Example 2 was significantly better than the control with the conventional miscible oil formulation.

EXAMPLE 7

A further comparative field trial with cattle, using the dioxanthion composition of Example 2 and a conventional miscible oil formulation of dioxathion described in Example 5, was conducted. The method used was that described in Example 6 to test control of the ectoparasite *Rhipicephalus evertsi* (Neumann) (Red Tick). The composition and the formulation were each diluted with water to prepare washes containing 0.5% w/v of active ingredient.

The animals, divided into two groups of three animals, were treated on day 0 and day 7, total adult tick counts being made just prior to treatment.

In this trial, short interval counts were carried out on days 3, 4, 5, 6 and 7 after the first treatment and on days 10, 11, 12 and 14 after the second treatment (on day 7).

The results are represented in Figure 2, which is a comparative scale, the number of ticks at each count representing a percentage of the number of tickets counted on day 0. These results show that the conventional miscible oil formulation exerted a residual effect until the fourth and the tenth day, but thereafter a steady attachment of ticks took place. On the group treated with the composition of the invention, tick attachment was depressed until the sixth and twelfth day, with the result that successful tick attachment on the seventh day was much less than when the conventional formulation was used. This trial clearly indicates that tick infestations can be controlled and eradicated sooner if the composition of the invention is used instead of the conventional miscible oil formulation.

EXAMPLE 8

This example describes another comparative field trial with cattle, which was directed to eliminate the possibility that one group of animals is more susceptible to infestation than another group. The trial was conducted against the same tick as in Example 6 and using the method of Example 6. The same formulation and composition of dioxathion were used, and these were diluted in water to provide a concentration of the active ingredient in each wash of 0.05 per cent w/v. The results are represented in Figure 3.

The "number of ticks" refers to the number of engorged female ticks on the ears counted before treatment. The treatment groups were interchanged after three weekly treatments. These results showed that, after three treatments, the group treated with the composition of the invention was significantly less infested than the group treated with the conventional miscible oil formulation. After the count on day 21, the groups were interchanged and, after two further treatments, the composition of the present invention again achieved superior results as compared with the conventional miscible oil formulation.

EXAMPLE 9.

Laboratory tests to determine the dermal irritancy of compositions of the invention, as compared with conventional miscible oil formulations, were carried out according to a method using rabbits and described by J. H. Draize (in "The Appraisal of the Safety of Chemicals in Foods, Drugs and Cosmetics", pp. 46 to 48; Published in 1969 by Association of Food and Drug Officials of the United States of America, Editorial Office, 2411 N. Charles Street, Baltimore, U.S.A.).

The compositions and formulations were all diluted to one volume of dip in twenty volumes of water, which gave a higher active

ingredient content for the emulsions prepared from compositions of the invention.

The results of these tests are given in Table II. Sample A is the Dioxathion conventional miscible oil formulation, B is the Chlorfenvinphos conventional miscible oil formu-

lation, and C is the mixed Dioxathion/chlorfenvinphos conventional miscible oil formulation, all of which are described in Example 5. D is the composition of Example 2, E is the composition of Example 1 and F is the composition of Example 3.

TABLE II

		Sample					
		A	B	C	D	E	F
Non-abraded	Total score	0	2	0	0	0	0
	Average	0	0.3	0	0	0	0
Abraded	Total score	9	10	11	8	6	3
	Average	1.5	1.7	1.8	1.3	1.0	0.5
Abraded and non-abraded	Total score	9	12	11	8	6	3
	Average	0.75	1.0	0.91	0.66	0.5	0.25

These results show that on non-abraded skin there is no apparent difference between the compositions and the formulations. On abraded skin the results clearly show the lower irritancy of the compositions of the invention, particularly since the active ingredient content was about three times that of the conventional formulations.

EXAMPLE 10.

A field trial was conducted to compare the reactions of cattle to spray washes prepared from the compositions of the invention and the conventional miscible oil formulations presently in use.

Spraying was used since experience has shown that the reactions of cattle to the application of ixodidical washes can be gauged as well after spraying as after dipping.

The materials used were:—

- A: the Dioxathion/chlorfenvinphos composition of Example 3
- 35 B: the mixed Dioxathion/chlorfenvinphos conventional miscible oil formulation described in Example 5
- C: a formulation containing the solvents and emulsifiers of B without active ingredient.

The standard strength spray washes prepared from A and B contained 0.03 per cent w/v of active ingredient, while those prepared from C contained the same concentration of the solvents and the emulsifiers as for the spray wash prepared from B.

Eighteen mature Jersey cows in milk were divided into nine groups of two. The groups were hand sprayed with the washes prepared from A, B and C at the standard strength, double strength and fourth times standard strength.

A panel of three observers was appointed as judges to record the reactions of the cattle to the spray treatments. The comparative test was based on a points system in which Nil indicated no reaction; 3+ indicated pronounced reaction (such as profuse salivation, restlessness, head shaking and foot movement); and 2+ and 1+ indicated intermediate reactions. The judges were unaware of the order of application to the animals of the different spray washes, the contents of the washes, and their strength.

The results of these trials are given in Table III.

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TABLE III

Spray wash and Strength	Group	Marks of Judges			Accumulative Score
		1	2	3	
A—Standard	1	Nil	Nil	Nil	Nil
B—Standard	2	1 +	Nil	1 +	2 +
C—Standard	3	Nil	Nil	Nil	Nil
C—double	4	Nil	Nil	Nil	Nil
C—four times	5	2 +	3 +	3 +	8 +
B—double	6	2 +	2 +	2 +	6 +
A—double	7	1 +	Nil	Nil	1 +
A—four times	8	Nil	Nil	Nil	Nil
B—four times	9	3 +	3 +	3 +	9 +

These results showed that the spray washes prepared from compositions of the invention had substantially no irritant effect on the cattle, even when used at four times the normally recommended concentration, while those made from the conventional formulations produced substantial irritation.

EXAMPLE 11

A further field trial with cattle was conducted by mechanical spraying methods to determine comparative irritancy, using the materials A, B and C of Example 10 to prepare the spray washes.

The active ingredient concentration of the washes prepared from A and B was 0.04 per cent w/v, and the wash prepared from C contained the same amount of solvents and emulsifiers as the wash prepared from B.

Two observers were appointed as judges to record the reactions of the cattle on the same scoring scale as given in Example 10.

156 Head of cattle were sprayed each time in the same order of herds. The order, in which the formulations were sprayed, was B, then C followed by A.

The results are given in Table IV.

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TABLE IV

Spray wash	Marks of the Judges		Accumulative Score
	1	2	
A	Very slight salivation in 2 animals, with 9 others showing mild salivary dribbles	Very slight salivation in 2 animals, with 7 others showing an occasional dribble	
	$\frac{1}{2} +$	$\frac{1}{2} +$	1 +
B	Salivation seen in 26 animals	Salivation seen in 26 animals	
	2 +	2 +	4 +
C	Definite salivation in 3 animals, slight but detectable salivation in 13 others	Definite salivation in 3 animals, slight but detectable salivation in 15 others	
	1 +	1 +	2 +

Again, these results clearly show that the compositions according to the invention have less undesirable effects on cattle than the conventional miscible oil formulations containing solvent. It is significant that the washes made from composition of the invention are even better in this respect than the washes prepared from the material containing no active ingredient but the same amount of solvent as in the conventional miscible oil formulation.

The foregoing Examples show that the use of washes prepared from the compositions of the invention has definite advantages over the use of washes prepared from the conventional miscible oil formulations used at present. Of particular importance are the enhanced biological activity and residual effectiveness of washes. This enhancement will enable farmers to obtain a higher initial kill, to destroy an infestation more rapidly, and to permit a reduction in the number of applications of pesticide in the infestive season. This is of major importance in a country beset with ectoparasite control problems, for example cattle ticks, in which any marginal improvement can provide a substantial overall saving in the use of a pesticide.

The reduced irritation of the washes made from compositions of the invention is of practical importance especially in the spraying or dipping of large animals. Irritated animals emerging from a dipping bath or spray race into the draining pens are known to damage or destroy the pens, and injure themselves and adjacent animals, thus also making them more susceptible to infections.

These advantages in the use of washes made from dioxathion and mixed dioxathion/chlorfenvinphos compositions of the invention are surprisingly achieved without any substantial difference in the exhaustion rate of the washes as compared to washes made from conventional miscible oil formulations. Further advantages lie in the compositions themselves, such as the reduction in cost of packaging and transport per unit weight of the active ingredient. Limited experiments with a dioxathion composition of the invention also show that it was not more toxic dermally to mammals than a conventional miscible oil formulation containing a substantially lower concentration of the active ingredient, suggesting that the compositions of the invention are not more dangerous to handle than the conventional formulations. With the elimination of the solvent it is also possible to pack the compositions in plastic containers, for example polythene, which are slowly permeated by the conventional miscible oil formulations at a rate depending upon the nature and thickness of the wall of the container.

In vivo tests with the compositions of the invention and with the conventional miscible formulations have also shown that, with washes of equal concentration of an organophosphorus pesticide, there was no significant difference in inhibition of blood cholinesterase activity in sheep and cattle sprayed with the washes. Blood cholinesterase activity is used as a measure of the toxicity of organophosphorus compounds, and these tests indicate that the mammalian toxicity of the washes prepared from compositions of the in-

vention were not more toxic than those made from conventional formulations.

- Tests by the South African Wool Textile Research Institute, in which wool and mohair were dipped in chlorfenvinphos emulsion washes, also showed that with the compositions of the invention the effects on wool were similar to those with the conventional formulations, except that sample discolouration tended to be slightly less with the compositions of the invention.

WHAT WE CLAIM IS:—

1. A method for the control of arthropod ectoparasites of a mammal other than man comprising the application to the mammal of an effective amount of an aqueous pesticidal emulsion prepared by the emulsification in water of a self-emulsifiable, substantially solvent-free (as hereinbefore defined), non-aqueous, pesticidal composition comprising at least one liquid pesticide suitable for controlling the ectoparasites and an emulsifier, which composition has a total pesticide content of from 65 to 95 per cent by weight of the composition.
2. A method as claimed in claim 1 wherein the pesticide is present in an amount of from 75 to 95 per cent by weight of the composition.
3. A method as claimed in either of claim 1 or 2 wherein the pesticide is an organo-phosphorus pesticide.
4. A method as claimed in claim 3 wherein the organo-phosphorus pesticide is a phosphate ester.
5. A method as claimed in claim 4, wherein the phosphate ester is 2-chloro-1-(2,4-dichlorophenyl) vinyl diethyl phosphate.
6. A method as claimed in claim 3 wherein the organo-phosphorus compound is a phosphorothionate ester.
7. A method as claimed in claim 6 wherein the phosphorothionate ester is *O,O*-diethyl *O*-4-bromo-2,5-dichlorophenyl phosphorothionate.
8. A method as claimed in claim 6 wherein the phosphorothionate ester is 2,3-*p*-dioxanedithiol *S,S*-bis(*O,O*-diethyl phosphorodithionate).
9. A method as claimed in claim 6 wherein the phosphorothionate ester is *O,O*-diethyl *O*-2-isopropyl-4-methyl-6-pyrimidyl phosphorothionate.
10. A method as claimed in any of claims 1 to 3 wherein the pesticide is a mixture of two liquid pesticides.
11. A method as claimed in claim 10 wherein the two pesticides are 2-chloro-1-(2,4-dichlorophenyl) vinyl diethyl phosphate and 2,3-*p*-dioxanedithiol *S,S*-bis(*O,O*-diethyl phosphorodithionate).
12. A method as claimed in any of claims 1 to 3 containing in addition a solid pesticide dissolved in the composition.
13. A method as claimed in claim 12 wherein the liquid pesticide is *O,O*-diethyl *O*-4-bromo-2,5-dichlorophenyl phosphorothionate and the solid pesticide is *O,O*-diethyl *O*-3,5,6-trichloro-2-pyridylphosphorothionate.
14. A method as claimed in any preceding claim wherein the emulsifier includes a non-ionic surface active agent.
15. A method as claimed in claim 14 wherein the non-ionic surface active agent is a condensation product of ethylene oxide with an alkyl phenol, an aliphatic alcohol, an aliphatic amine, or with a fatty acid.
16. A method as claimed in claim 15 wherein the surface active agent contain 5 to 25 mols. of ethylene oxide.
17. A method as claimed in claim 14 wherein the non-ionic surface active agent is a polyalkylene glycol ether.
18. A method as claimed in claim 14 wherein the non-ionic surface active agent is a mixture of a polyalkylene glycol ether and a condensation product of an alkyl phenol with ethylene oxide.
19. A method as claimed in any of claims 1 to 18 wherein the emulsifier is a mixture of a non-ionic surface active agent and an anionic surface active agent.
20. A method as claimed in claim 19 wherein the anionic surface active agent is a calcium salt of an alkylbenzene sulphonic acid or naphthalene sulphonic acid.
21. A method as claimed in any of claims 1 to 20 wherein the composition is wholly free from added solvent.
22. A method as claimed in any of claims 1 to 20 wherein there is present in the composition a low viscosity organic solvent in an amount not exceeding 10 per cent by weight of the composition.
23. A method as claimed in claim 22 wherein the solvent does not exceed 5 per cent by weight of the composition.
24. A method as claimed in any of claims 1 to 20 and 22 and 23 which additionally includes a bactericide or a bacteriostat.
25. A method as claimed in any of claims 1 to 20 and 22 to 24 which additionally contains a stabiliser.
26. A method as claimed in claim 25 wherein the stabiliser is propylene oxide, epichlorhydrin, or an alkanolamine.
27. A method as claimed in claim 26 wherein the stabiliser is present in an amount of from 0.5 to 5.0 per cent by weight of the composition.
28. A method as claimed in any preceding claim which comprises the steps: preparing an emulsion wash in water of the composition, and applying the emulsion wash to infested mammals by dipping or spraying.
29. A method as claimed in claim 28 which includes the step of pre-creaming the composition before the preparation of the final emulsion wash.

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vention were not more toxic than those made from conventional formulations.

Tests by the South African Wool Textile Research Institute, in which wool and mohair were dipped in chlorfenvinphos emulsion washes, also showed that with the compositions of the invention the effects on wool were similar to those with the conventional formulations, except that sample discolouration tended to be slightly less with the compositions of the invention.

WHAT WE CLAIM IS:—

1. A method for the control of arthropod ectoparasites of a mammal other than man comprising the application to the mammal of an effective amount of an aqueous pesticidal emulsion prepared by the emulsification in water of a self-emulsifiable, substantially solvent-free (as hereinbefore defined), non-aqueous, pesticidal composition comprising at least one liquid pesticide suitable for controlling the ectoparasites and an emulsifier, which composition has a total pesticide content of from 65 to 95 per cent by weight of the composition.
2. A method as claimed in claim 1 wherein the pesticide is present in an amount of from 75 to 95 per cent by weight of the composition.
3. A method as claimed in either of claim 1 or 2 wherein the pesticide is an organo-phosphorus pesticide.
4. A method as claimed in claim 3 wherein the organo-phosphorus pesticide is a phosphate ester.
5. A method as claimed in claim 4, wherein the phosphate ester is 2-chloro-1-(2,4-dichlorophenyl) vinyl diethyl phosphate.
6. A method as claimed in claim 3 wherein the organo-phosphorus compound is a phosphorothionate ester.
7. A method as claimed in claim 6 wherein the phosphorothionate ester is O,O-diethyl O-4-bromo-2,5-dichlorophenyl phosphorothionate.
8. A method as claimed in claim 6 wherein the phosphorothionate ester is 2,3-p-dioxanedithiol S,S-bis(O,O-diethyl phosphorodithionate).
9. A method as claimed in claim 6 wherein the phosphorothionate ester is O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidyl phosphorothionate.
10. A method as claimed in any of claims 1 to 3 wherein the pesticide is a mixture of two liquid pesticides.
11. A method as claimed in claim 10 wherein the two pesticides are 2-chloro-1-(2,4-dichlorophenyl) vinyl diethyl phosphate and 2,3-p-dioxanedithiol S,S-bis(O,O-diethyl phosphorodithionate).
12. A method as claimed in any of claims 1 to 3 containing in addition a solid pesticide dissolved in the composition.
13. A method as claimed in claim 12

wherein the liquid pesticide is O,O-diethyl O-4-bromo-2,5-dichlorophenyl phosphorothionate and the solid pesticide is O,O-diethyl O-3,5,6-trichloro-2-pyridylphosphorothionate.

14. A method as claimed in any preceding claim wherein the emulsifier includes a non-ionic surface active agent.

15. A method as claimed in claim 14 wherein the non-ionic surface active agent is a condensation product of ethylene oxide with an alkyl phenol, an aliphatic alcohol, an aliphatic amine, or with a fatty acid.

16. A method as claimed in claim 15 wherein the surface active agent contains 5 to 25 mols. of ethylene oxide.

17. A method as claimed in claim 14 wherein the non-ionic surface active agent is a polyalkylene glycol ether.

18. A method as claimed in claim 14 wherein the non-ionic surface active agent is a mixture of a polyalkylene glycol ether and a condensation product of an alkyl phenol with ethylene oxide.

19. A method as claimed in any of claims 1 to 18 wherein the emulsifier is a mixture of a non-ionic surface active agent and an anionic surface active agent.

20. A method as claimed in claim 19 wherein the anionic surface active agent is a calcium salt of an alkylbenzene sulphonic acid or naphthalene sulphonic acid.

21. A method as claimed in any of claims 1 to 20 wherein the composition is wholly free from added solvent.

22. A method as claimed in any of claims 1 to 20 wherein there is present in the composition a low viscosity organic solvent in an amount not exceeding 10 per cent by weight of the composition.

23. A method as claimed in claim 22 wherein the solvent does not exceed 5 per cent by weight of the composition.

24. A method as claimed in any of claims 1 to 20 and 22 and 23 which additionally includes a bactericide or a bacteriostat.

25. A method as claimed in any of claims 1 to 20 and 22 to 24 which additionally contains a stabiliser.

26. A method as claimed in claim 25 wherein the stabiliser is propylene oxide, epichlorhydrin, or an alkanolamine.

27. A method as claimed in claim 26 wherein the stabiliser is present in an amount of from 0.5 to 5.0 per cent by weight of the composition.

28. A method as claimed in any preceding claim which comprises the steps: preparing an emulsion wash in water of the composition, and applying the emulsion wash to infested mammals by dipping or spraying.

29. A method as claimed in claim 28 which includes the step of pre-creaming the composition before the preparation of the final emulsion wash.



30. A method as claimed in any preceding claim wherein the total concentration of pesticide in the emulsion wash is 0.005 per cent to 0.5% w/v.
- 5 31. A method as claimed in any of claims 1 to 29 wherein the concentration of pesticide in the emulsion wash is 0.005 per cent to 0.20% w/v.
- 10 32. A method as claimed in any of claims 1 to 31 which comprises the control of cattle ectoparasites.
33. A method as claimed in any of claims 1 to 31 which comprises the control of sheep ectoparasites.
- 15 34. A method for the control of arthropod ectoparasites of a mammal other than man which comprises the application to the mammal of an aqueous emulsion wash prepared from a self-emulsifiable, substantially solvent-free (as hereinbefore defined), non-aqueous, pesti-
- 20 cidal composition substantially as hereinbefore described.
35. A container marked with indications of suitability of its contents for use in the control of arthropod ectoparasites of a mammal, the said contents comprising a self-emulsifiable, substantially solvent-free (as hereinbefore defined), non-aqueous, pesticidal composition in which there is present at least one liquid pesticide suitable for controlling the ectoparasites and an emulsifier, which composition has a total pesticide content of from 65 to 95 per cent by weight of the composition.
- 30 36. A container marked with instructions to dilute its contents with water to prepare an emulsion wash and to apply the said wash to a mammal for controlling infestations of arthropod ectoparasites, the said contents comprising a self-emulsifiable, substantially solvent-free (as hereinbefore defined), non-aqueous, pesticidal composition in which there is
- present at least one liquid pesticide suitable for controlling the ectoparasites and an emulsifier, which composition has a total pesticide content of from 65 to 95 per cent by weight of the composition.
37. A container as claimed in either of claims 35 or 36 wherein its contents comprise a composition as defined in any of claims 2 to 27.
38. A container as claimed in either of claims 35 or 36 wherein the organophosphorus pesticide is at least one pesticide selected from:
- 2 - chloro - 1 - (2,4 - dichlorophenyl)vinyl diethyl phosphate;
- 2,3 - *p* - dioxanedithiol *S,S* - bis(*O,O* - diethyl phosphorodithionate);
- O,O* - diethyl *O* - 4 - bromo - 2,5 - dichlorophenyl phosphorothionate; and
- O,O* - diethyl *O* - 2 - isopropyl - 4 - methyl-6 - pyrimidyl phosphorothionate.
39. A container associated with written indications of the suitability of its contents for the control of ectoparasites of a mammal, the said contents comprising a self-emulsifiable, substantially solvent-free (as hereinbefore defined), non-aqueous, pesticidal composition in which there is present at least one liquid pesticide suitable for controlling the ectoparasites and an emulsifier, which composition has a total pesticide content of from 65 to 95 per cent by weight of the composition.
40. A container as claimed in claim 39 wherein its contents comprise a composition as defined in any of claims 2 to 27.
41. A container of a composition substantially as hereinbefore described in Examples 1, 2, 3 or 4.

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