ENVIRONMENT FRIENDLY PALM-BASED INERT INGREDIENT FOR EW-INSECTICIDE FORMULATIONS

by: ISMAIL, A R; OOI, T L and SALMIAH, A

JUNE 2004

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MPOB TT No. 236

MPOB INFORMATION SERIES ISSN 1511-7871

Insecticides comprise about 18% of the total pesticides marketed in Malaysia in which more than 55% of the insecticides are in the form of solvent-based formulations or emulsifiable concentrates (EC) (MCPA, 2002). In recent trend, the end-users/operators in agriculture sectors increasingly require safer and more convenient pesticide formulations such as water-based emulsion (EW) instead of EC-insecticide formulations respectively (Abdullah and Mohtar, 1993; Tadros, 1995; Ismail *et al.*, 1998).

EW formulations offer many advantages over the conventional solvent-based insecticides (EC) (Tadros, 1995; Ismail *et al.*, 1998; Ismail, 2000; Mulqueen, 2003):

- EW is an aqueous-based formulation, therefore, they produce less medical problems (*e.g.*, skin and eyes irritation) to the operators.
- They are also less phytotoxic to plants.
- EW-insecticide formulations allow adding water-soluble adjuvants to the formulations.
- The formulations are less expensive to produce since mainly water is used instead of oil.

Furthermore, there is a shift from petroleum-based oils to vegetable-based materials such as palm-based surfactants and solvents as inert ingredients in insecticides formulation (Cornish *et al.*, 1993; Srivastava and Prasad, 2000). Some advantages of the vegetable-based materials are:

- Renewable,
- Environment friendly,
- Less flammable (due to higher flash points),
- Cause fewer medical problems and allergies to the end-users/operators.

The paper therefore discusses the *EW-insecticide formulations comprising the environment friendly palm-based inert ingredients for crops protection.*

EMULSIFICATION PROCESS

EW-insecticide formulations were prepared by adding an oil phase, containing blended emulsifiers, palm-based solvent and active ingredients (a.i), and water phase, containing a stabilizer/thickener and water. The mixtures were emulsified as shown in *Figure 1*.

TECHNICAL DESCRIPTION OF INVENTION/INNOVATION

Table 1 shows the physical properties of palm-based solvents and petroleum-based oils (also called as mineral oils). The viscosity and surface tension of palm-based solvents are comparable to the mineral oils, but their flash point values indicate that they are much less flammable than the mineral oils (Ismail *et al.*, 1998).

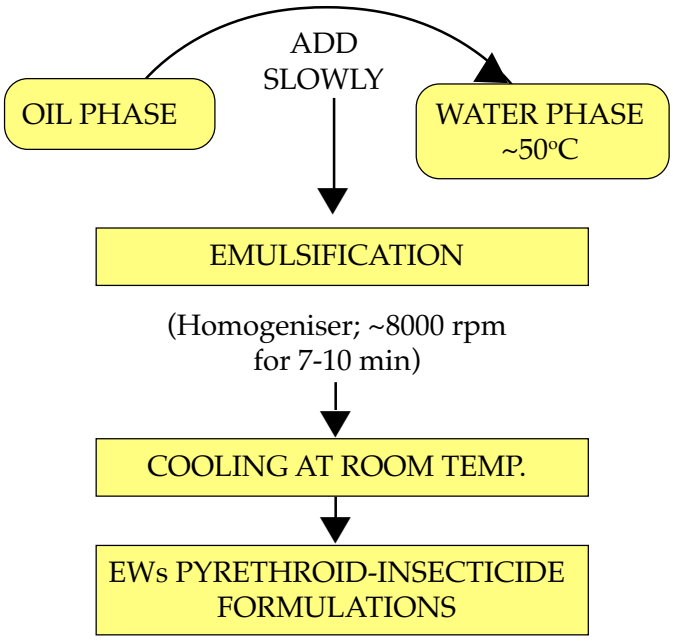

Figure 1. Emulsification process for EW pyrethroid-insecticide formulations

ISSN 1511-7871
9 771511 787001

Malaysian Palm Oil Board, Ministry of Plantation Industries and Commodities, Malaysia
P. O. Box 10620, 50720 Kuala Lumpur, Malaysia. Tel: 03-89259155, 89259775, Website: http://mpob.gov.my Telefax: 03-89259446

Figure 2. Palm-based inert ingredients.

Figure 3. EW-insecticide formulations.

The solubility of some synthetic pyrethroid insecticides was also carried out in palm-based solvents and mineral oils. The results showed that palm-based solvents have good solvency properties for pyrethroid insecticides (Ismail *et al*., 1998).

The EW-insecticide formulations were prepared as in *Figure 1*, and then their physical stability studies were conducted (Ismail, 2002). The accelerated tests showed that the emulsions were stable after standing for one month at 45°C. In addition, the EW-insecticide formulations have been stable for more than a year at ambient temperature. The optimum concentrations for blended emulsifiers, palm-based solvents and a stabilizer/thickener ranged from 3%-5%, 10%-20% and 0.3%-0.5%(w/w) respectively. Concentrations of a.i used were 2.5%, 5% and 10%(w/w). The rheology measurements (*i.e*., thixotropy and yield stress values) confirmed the physical stability of the emulsions.

Table 2 shows the bioefficacy tests that were carried out on major tropical insect pests under laboratory condition at Henkel, Philippines (Henkel Philippines, 2002). The results show that 5% EW-cypermethrin that were prepared in AOTC, MPOB had good performance to kill insects. EW-cypermethrin 5% samples were compared with ATTACT 5R, a commercial EC-insecticide product in Philippines.

CONCLUSION

The water-based insecticide formulations (EWs) offer many advantages to the end-users/operators over the solvent-based insecticide formulations (EC):

- They may cause fewer medical problems and allergies to the end-users/operators, and less phytotoxic to plants.
- Cost of production for EW-insecticides formulation can be less expensive to the EC-insecticides formulation because they replace about 70 to 80% of the oil (solvent) with water.
- Solvents and surfactants derived from palm-based materials have better environment friendly characteristics than the petroleum-based surfactants and mineral oils.
- Palm-based solvents have comparable physical characteristics and good solvency properties for

TABLE 1. PHYSICAL PROPERTIES OF PALM-BASED SOLVENTS AND MINERAL OILS

Palm-based solvents/ mineral oils	Physical properties Viscosity (cP), 25°C	Surface tension (mNm^{-1}), 25°C	Flash points (°C)
POME 1[a]	9.7	29.7	170
POME 2[b`]	5.3	32.0	170
POME 3[c]	5.6	31.8	170
POME 4[d]	3.4	30.6	130
Solvesso 150[e]	1.5	31.5	66
Xylene[f]	0.74	29.7	28

Note: [a], [b], [c], [d] are palm-based solvents, and [e], [f] are mineral oils.
cP= centipoise, a unit for viscosity.
mNm^{-1}= miliNewton per meter, a unit for surface tension.

TABLE 2. EFFECT OF ATTACT 5R (EC) AND CYPERMETHRIN 5% (EW) AGAINST MAJOR TROPICAL INSECT PESTS UNDER LABORATORY CONDITION AT HENKEL, PHILIPPINES (72 HAT)

Treatment	Conc. (ppm)	Major Tropical Insect Pests: NEPHNI	NEPHIM	NILALU	SOGAFU	MITES	ANAPCO
ATTACT 5R (EC)	30	50	70	30	20	0	60
	100	100	80	70	40	0	90
	300	100	100	100	100	86	100
	500	100	100	100	100	93	100
CYPERMET-RIN 5%(EW)	30	70	100	50	30	0	50
	100	100	100	100	100	0	80
	300	100	100	100	100	60	100
	500	100	100	100	100	96	100

Note: Nephni= N. nigropictus
Nephim= N. virescens
Nilalu= N. lugens
Sogafu= S. furcifera
Mites= T. kanzawai
Anapco= orchid thrips

active ingredients (a.i) derived from pyrethroid. In addition, palm-based solvents have higher flash points than the mineral oils. Thus, they are less flammable than mineral oils.

- The bioefficacy tests confirmed that the EW-pyrethroid insecticide formulations have comparable efficacy to the conventional EC-pyrethroid insecticide formulations.

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ATTACHMENT

EW (Concentrated Emulsions, Oil in Water Emulsions or Aqua flows)

Introduction

These formulations are developed using liquid or low melting point active ingredients that are not water soluble and where it is desirable to reduce the levels (or eliminate) of hazardous solvents used in typical Emulsifiable Concentrate formulations.

Problems in formulation are traditionally those of long-term stability of the formulation causing creaming or settlement and this can be due to both the particle-size of the emulsion droplets or the emulsification process.

General

COGNIS has developed two approaches to this problem.

1. For high value actives the use of PHASE INVERSION TEMPERATURE mechanism enables highly stable, low particle size emulsions to be produced. There is an equipment requirement and information on this is available from your Cognis contact.

2. For suitable actives, the use of biodegradable and emulsifiable methyl esters are recommended. These act as solvents and adjuvants so increase efficacy. They have low vapour pressure and very high flash points. Emulsification is via non-alkyl phenol ethoxylate emulsifiers, so low toxicity formulations are formed. The limitation is that the active ingredient must be soluble in the methyl ester based product but this includes most synthetic pyrethroids.

Typical Formulations:

Active (*e.g* Cypermethrin or Fenvalerate)	10 parts by weight
Cognis AGNIQUE blend	18- 20 parts by weight
Blend above together adding liquid active to the AGNIQUE. (warm the active if necessary).	
Xanthan gum	0.3-0.5 parts by weight
Water plus preservative	To 100 parts by weight

Pre blend the water phase

Add the oil phase slowly to the water phase with stirring after heating to approximately 45°-50°. Emulsify using high shear mixer starting at 1000 r.p.m and going up to 8000 r.p.m then gradually reduce shear rate. Allow to cool. Low solids formulations at 5%-15% of active ingredient are very economic via this method.

Cognis Products:

1. For phase inversion temperatures these will vary depending on the active ingredient and in general will be specific to customer requirements.

2. AGNIQUE BL 7001.
   This is for use with such as 5% active cypermethrin with recommended starting point formulation as follows.

Active ingredient (as 100% pure)	5% w/w
AGNIQUE BL 7001	14 to 15% w/w
Thickener (Xanthan Gum)	0.3-0.5% w/w
Water plus preservative	to 100%

A preservative is suggested depending on water quality used but also to protect the thickener, which is susceptible to bacterial degradation.

3. AGNIQUE BL 7002.
   This is for use at 10% active with pyrethroid actives such as cypermethrin, es fenvalerate *etc*. Others can be evaluated on request.

Active ingredient (as 100%)	10% w/w
AGNIQUE BL 7002	18-20% w/w
Thickener.(Xanthan Gum)	0.3-0.5% w/w
Water plus preservative	to 100%

Please note that other liquid actives can be evaluated on request.

For more information kindly contact:

Director-General
MPOB
P. O. Box 10620
50720 Kuala Lumpur, Malaysia.
Tel: 03-89259155, 89259775,
Website: http://mpob.gov.my
Telefax: 03-89259446