



Emulsion for plant protection

Explore the full potential of your emulsions

Supporting our customers to formulate crop protection formulations is what we do. Every day. We are a global company with a broad range of environmentally safe, biodegradable and cost effective solutions. This guide shows how our products can be used to explore the full potential of your emulsions.

Key products for successful emulsions

- **Ethylen® NS-500LQ, Ethylan 992, Ethylan 954LQ**

Ethylen NS-500LQ is a block copolymer. In combination with the alcohol alkoxylate Ethylan 954LQ and the anionic Witconate P1460EH suitable EC formulations based on dimethylamide solvents (Armid) will be achieved. The alcohol alkoxylate Ethylan 992 in combination with Witconate P1460EH is a superior combination for aromatic solvents such as Solvesso.

- **Berol® 9927, Berol 9960, Berol 9968, Berol 9969**

Nonionic / anionic emulsifier blends for standard aromatic solvent based EC formulations. The basic pair consists of Berol 9960 and Berol 9968. Depending on the HLB of the EC the emulsifier ratio needs to be determined by means of a ratio check. Berol 9927 and Berol 9969 can be used in more hydrophobic formulations.

- **Berol 829, Berol 904**

Castor oil ethoxylates with respectively 20 (Berol 829) and 36 moles EO (Berol 904) are standard EC emulsifiers in combination with dodecylbenzenesulphonate salts.

- **Lankropol® KPH70, Phospholan® PE169, Witconate™ P1460EH**

To make an efficient emulsion, nonionic surfactants need to be combined with anionics. Lankropol, Phospholan and Witconate have carefully been selected from 3 different chemistries; sulfosuccinate (Lankropol KPH70), phosphate esters (Phospholan PE169) and dodecylbenzene sulphonate (Witconate P1460EH). Together with Berol's and Ethylan's they are necessary tools to formulate an EC, EW and ME. Lankropol and Phospholan are excellent for ME formulations.



Agrochemical formulation guide for EC, EW and ME

Formulations in this guide have been tested in laboratory scale and comply with the following CIPAC methods:

Emulsion characteristics CIPAC MT3

Emulsification stability CIPAC MT 39 & MT 46.1.3

Emulsifiable concentrates (EC)

While green solvents are gaining market share, emulsifiable concentrates (EC) have reinstated their position as popular agrochemical formulations. Their simple manufacturing process and relatively low cost remains important benefits. In addition, ECs generally have a better biological activity compared to dispersions.

Aromatic solvents continue to be popular solvents in several regions around the world because of their high solvency power and low cost. ECs based on these types of solvent require different emulsifier systems compared to the formulations based on green solvents.

On dilution in water, ECs form a spontaneous emulsion with oil droplets ranging from 1 to 10 µm. Since the active ingredient reaches the target surface in a liquid form, ECs usually result in having a better biological performance compared to dispersions with the active in solid forms.

Preparation

The active ingredient is dissolved in the solvent and the emulsifier system is added while stirring. Typically 5 to 10% emulsifier is used.

Active ingredients	Emulsifier	Solvent	Additional additives
Chlorpyriphos 200 g/l	20 g/l Berol 9960 30 g/l Berol 9968	Solvesso 150ND up to 1 liter	
Fluroxypyr-methyl 288 g/l	27 g/l Ethylan NS-500LQ 50 g/l Ethylan 954LQ 14 g/l Witconate P1460EH	200 g/l Armid FMPC Armid DM10 up to 1 liter	
Cyhalofop-butyl 200 g/l	10g Berol 9968	Solvesso 150 up to 1 liter	20 g/l Adsee AB 615 (adjuvant)
2,4-D ester 660 g/l (a.e.) (Iso octyl ester)	38 g/l Ethylan 992 58 g/l Witconate P1460EH		
Pentoate 500 g/l	30 g/l Berol 9969 20 g/l Agrilan AEC145	Xylene up to 1 liter	
Oxyfluorfen 240 g/l	80 g/l Berol 9927 18 g/l Ethylan NS-500LQ	220 g/l Armid FMPC 350 g/l Cyclohexanone Solvesso 150ND up to 1 liter	

Solvesso is a trade name by ExxonMobile Chemicals



Micro emulsions (ME)

Micro emulsions (ME) are thermodynamically stable liquid formulations with a relatively low concentration of active ingredient. They are suited to formulate actives for application at low dose rates. As such they usually find their way into the home and garden or wood preservation markets.

Micro emulsions contain the following components:

- Oil phase, can be liquid active ingredient or an active dissolved in a solvent
- Water phase, can also contain an active
- Emulsifiers

A co-surfactant may be required to reduce the interfacial tension between water and oil. Typical cosurfactants are alcohols, such as hexanol or butanol, but could also be a surfactant. Micro emulsions can be a small-scale version of emulsions with a droplet size typically around 10 nm. This is about 100 times smaller than the typical emulsion droplet size.

Micro emulsions can also be a more dynamic system with micro domains of oil and water. In contrast to an ordinary emulsion, where the droplets slowly coalesce and the phases eventually separate, the highly dynamic oil droplets/domains in a micro emulsions are stable and phase separation never occurs. Because of the small droplet sizes micro emulsions are transparent formulations.

Preparation

Make a W/O emulsion by mixing active ingredient(s), emulsifiers and organic solvent (if necessary) and add approximately 4% water slowly under low shear mixing to a homogeneous mixture at about 40 to 50°C. By adding more water a phase inversion will occur from W/O to O/W.

Active ingredient(s) must be in liquid or semisolid (low melting point) state and insoluble and chemically stable in water. Solid active(s) can be dissolved in a minimum quantity of solvent..

Active ingredients	Emulsifier	Stabilizer
Chlorpyriphos 190 g/l	200 g/l Lankropol KPH70 300 g/l Berol 829	100 g/l Solvesso 100 Water up to 1 liter
Cypermethrin 350 g/l	200 g/l Agrilan AEC145 170 g/l Phospholan PE169	90 g/l Armid FMPC 110 g/l EGDA Water up to 1 liter
Indoxacarb 50 g/l	120 g/l Agrilan AEC145 80 g/l Phospholan PE169	110 g/l EGDA Armid FMPC up to 1 liter

EGDA = Ethylene Glycol Diacetate

Emulsions in water (EW)

The emulsion in water (EW) technology is generally used to formulate liquid or low melting point active ingredients. The major benefit of EWs is that water can be used as the continuous phase resulting in a lower tox profile and high flash point formulations.

Preparation

The emulsification can be spontaneous or low to high shear mixing may be required.

- Mixture 1: Dissolve the active(s) in solvent(s) if needed. Add emulsifiers under gentle stirring.
- Mixture 2: blend water, antifoam and antifreeze
- Add mixture 2 slowly and under moderate shear into mixture 1. Increase shear.
- A phase inversion will occur during this process (from W/O to O/W). Continue stirring and observe/measure droplet size until desired size is achieved (typically around 1 µm).
- Add thickener to obtain desired viscosity (typically 500 -2000 mPa.s)
- Add biocide and fine tune the active content

Active ingredients	Emulsifier	Stabilizer	Solvent	Additional additives
Tebuconazole 250 g/l	80 g/l Berol 904 20 g/l Witconate P1460EH	5 g/l Agrilan 789	450 g/l Water 200 g/l Armid DM10	Thickener 1-3% Biocide 0.1-0.2% Antifoam 0.1-0.2%
Chlorpyrifos 450 g/l	20 g/l Ethylan 324 20 g/l Ethylan 992 20 g/l Agrilan AEC145 5 g/l Ethylan NS-500LQ		100 g/l Armid DM10 100 g/l Solvesso 150 30 g/l MEG Water up to 1 liter	Biocide 1 g/l Antifoam 1 g/l

MEG = Mono Ethylene Glycol

Nouryon

Nouryon is a global, specialty chemicals leader. Markets and consumers worldwide rely on our essential solutions to manufacture everyday products, such as personal care, cleaning goods, paints and coatings, agriculture and food, pharmaceuticals, and building products. Furthermore, the dedication of more than 7,900 employees with a shared commitment to our customers, business growth, safety, sustainability and innovation has resulted in a consistently strong financial performance. We operate in over 80 countries around the world with a portfolio of industry-leading brands. Visit our website and follow us @Nouryon and on LinkedIn.

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