Formulating with Volarest™ FL

Acrylates/Beheneth-25 Methacrylate Copolymer

Summary

This paper gives guidance to formulators on the use of Volarest FL. It discusses the types of formulations that can be made with the ingredient, the process of addition and method of manufacture as well as compatibilities with commonly used cosmetic ingredients.

1. Introduction

Enhance the consumer experience of your brand by introducing Volarest FL into your emulsion or aqueous-based cosmetic formulation. Volarest FL is a truly unique polymer providing benefits for both the consumer and formulator. Volarest FL delivers controlled, targeted delivery from sprayable emulsions, novel textures that excite the user and the weightless suspension of emollients and beads in low viscosity fluids. Create novel, elegant and visually-appealing cosmetics with Volarest FL.

2. Formulability and Product Information

- **General Information**

Ingredient form	White liquid
Inclusion levels	0.5-2.5% w/w
Formulation types	Sprayable, targeted sprays Aqueous lotions
Applications	Facial Care Body Care Scalp Care Hair Care Sun Care Colour cosmetics
pH tolerance within formulations	6.5 – 12.5
Temperature tolerance	Store between 5°C and 35°C. Volarest FL is frost-sensitive and will not recover on warming. At higher storage temperatures, Volarest FL will dry on the sides of the container and the dried film will form bits in the emulsion that will not re-disperse. It is recommended that part used drums in particular are filtered before use.

- **Method of Addition**

  - Emulsion
    - Volarest FL needs to be added in the water phase
  - Aqueous
    - Add and solubilise the preservative in the water before adding and neutralising Volarest FL to achieve the best clarity.
    - When neutralising, add the based in one go (rather than drop-wise) to avoid any haziness in the water lotion.

- **Compatibility with common cosmetic ingredients**

Volarest FL has been assessed and proven to be compatible with many commonly used cosmetic ingredients such as:

- Emollients
- Actives (including sunscreens)
- Emulsifiers (non-ionic and anionic)
- Preservatives (e.g. Phenoxyethanol or Ethylhexylglycerin)

3. Compatibility

- **Compatibility with Emulsifiers**

Volarest FL can be used as a polymeric emulsifier in formulations containing lower levels of oils, but additional emulsifiers are required to produce stable formulations with oil levels around 10% total oil phase and above. A wide variety of different co-emulsifiers are compatible with Volarest FL. Volarest FL is not compatible with many cationic co-ingredients and it is not recommended that cationic emulsifiers be used in conjunction with this anionic polymer.

Trade Name (INCI Name)	**% w/w**
Non-ionic Surfactants	
Sorbitan Esters	
Span™ 20 (Sorbitan Laurate)	3.00
Span™ 60 (Sorbitan Stearate)	3.00
Span™ 120 (Sorbitan Isostearate)	10.00
Ethoxylated Sorbitan Esters	
Tween™ 20 (Polysorbate 20)	3.00
Tween™ 80 (Polysorbate 80)	3.00
Ethoxylated Fatty Alcohols	
Brij™ L4 (Laureth-4)	10.00
Brij™ S721 (Steareth-21)	3.00
Polyol Esters	
Cithrol™ PG3PR (Polyglyceryl-3 Polyricinoleate)	3.00
Cithrol™ DPHS (PEG-30 Dipolyhydroxystearate)	3.00
Cithrol™ PG321S (Polyglyceryl-3 Diisostearate)	3.00
NatraGem™ E145 NP (Polyglyceryl-4 Laurate/Succinate (and) Aqua)	3.00
Emulsifying Waxes	
Arlacel™ 165 (Glyceryl Stearate (and) PEG-100 Stearate)	3.00
Arlacel™ LC (Sorbitan Stearate (and) Sorbityl Laurate)	3.00
NatraGem™ EW (Glyceryl Stearate (and) Polyglyceryl-6 Palmitate/ Succinate (and) Cetearyl Alcohol)	3.00
Polawax™ NF (Proprietary Product)	1.00
Specialities	
Versaflex™ V-150 (Steareth-100 (and) Steareth-2 (and) Mannan (and) Xanthan Gum)	3.00
Versaflex™ V-175 (Sucrose Palmitate (and) Glyceryl Stearate (and) Glyceryl Stearate Citrate (and) Sucrose (and) Mannan (and) Xanthan Gum)	3.00
Anionic Surfactants	
Crodafos™ CES (Cetearyl Alcohol (and) Dicetyl Phosphate (and) Ceteth-10 Phosphate)	2 – 4.00
Crodafos™ CS20A (Cetearyl Alcohol (and) Ceteth-20 Phosphate (and) Dicetyl Phosphate)	2 – 4.00
Crodafos™ MCK (Potassium Cetyl Phosphate)	2-5.00

▪ **Compatibility with Emollients**

Volarest FL can be used in conjunction with a wide range of oils, emollient esters and silicones. As Volarest FL has to be used in aqueous solutions then combinations with oil insoluble co-ingredients will be hazy or cloudy. Volarest FL can be used to make flowable dispersions of emollients known as water lotions; these formulations do not contain any emulsifiers and range from clear gels with visible large oil droplets through to hazy formulations caused by the formation of small oil droplets.

The methods for preparation of water lotions are covered later in this guide.
Typically, levels of oil up to around 5% total oil phase can be used to make a water lotion, and above this the formulation will be opaque. Volarest FL can be used as a rheology modifier and polymeric emulsifier for formulations containing up to around 10% total oil phase. The actual levels will depend on the type of oils used. Above around 10% oil additional emulsifiers are required for stable formulations.

Trade Name (INCI Name)	**% w/w**	**Appearance**
Crodamol™ IPIS (Isopropyl Isostearate)	5.00	Translucent - opaque
Crodamol™ ISIS (Isostearyl Isostearate)	5.00	Translucent
Crodamol™ SSA (Decyl Isostearate (and) Isostearyl Isostearate)	5.00	Translucent
Crodamol™ STS (PPG-3 Benzyl Ether Myristate)	5.00	Translucent - opaque
Super Sterol Liquid (C10-30 Cholesterol/Lanosterol Esters)	5.00	Translucent
RevitElix™ (Echium Plantagineum Seed Oil)	10.00	Translucent
Medilan™ (Lanolin)	5.00	Translucent - opaque
Crodamol™ SFX (PPG-3 Benzyl Ether Ethylhexanoate)	5.00	Translucent – opaque
Mineral Oil (Paraffinum Liquidum)	5.00	Translucent – opaque
Crodamol™ GTCC (Caprylic/ Capric Triglycerides)	5.00	Translucent - opaque

▪ **Compatibility with Actives**

Volarest FL can be used in conjunction with a range of different cosmetic grade actives. Actives that have a high level of electrolyte, such as proteins or botanical extracts, may reduce the apparent viscosity of the formulation and higher levels of Volarest FL may be required. Typically, Volarest FL is incompatible with cationic co-ingredients, but there are exceptions to this. Cationic polymers that have a low cationic content and a medium molecular weight can be compatible with Volarest FL, and cationic products that have been shown to be compatible with Volarest FL are shown below.

Trade name (INCI Name)	**% w/w**
MiruStyle™ CP (Polyquaternium-72)	5.00
MiruStyle™ MFP PE (Hydroxypropyltrimonium Hydrolysed Corn Starch)	5.00
Keravis™ PE (Hydrolysed Vegetable Protein PG-Propyl Silanetriol)	5.00

▪ **Compatibility with Preservatives**

Volarest FL is compatible with a range of preservative systems. The preservatives were used at the maximum recommended use levels in each case. Though all these systems shown below are compatible with Volarest FL, some may increase the viscosity upon addition.

Preservative Systems that do not affect the viscosity of aqueous solutions containing Volarest FL	**Preservative Systems that increase the viscosity of aqueous solutions containing Volarest FL**
Microcare BNA (Benzyl Alcohol)	Euxyl PE9010 (Phenoxyethanol (and) Ethylhexylglycerin)
Euxyl K702 (Phenoxyethanol (and) Benzoic Acid (and) Dehydroacetic Acid (and) Ethylhexylglycerin (and) Polyaminopropyl Biguanide)	Phenoxyethanol

Euxyl K712 (Sodium Benzoate (and) Potassium Sorbate)	Microcare MTD1 (Methylisothiazolinone (and) Decylene Glycol)
	Microcare PCH (Phenoxyethanol (and) Chlorphenesin)
	Microcare PM2 (Phenoxyethanol (and) Methylparaben and Propylparaben)
	Microcare SMP (Sodium Methylparaben)
	Microcare SPP (Sodium Propylparaben)
	Microcare DB (Dehydroacetic Acid (and) Benzyl Alcohol)
	Paratexin DMD (DMDM Hydantoin)
	Paratexin DPM (Propylene Glycol (and) Diazolidinyl Urea (and) Methylparaben (and) Propylparaben)
	Saliguard COS (Phenoxyethanol (and) Caprylyl Glycol (and) Chlorphenesin)

4. How to make a sprayable emulsion with Volarest FL

▪ Why targeted sprays?

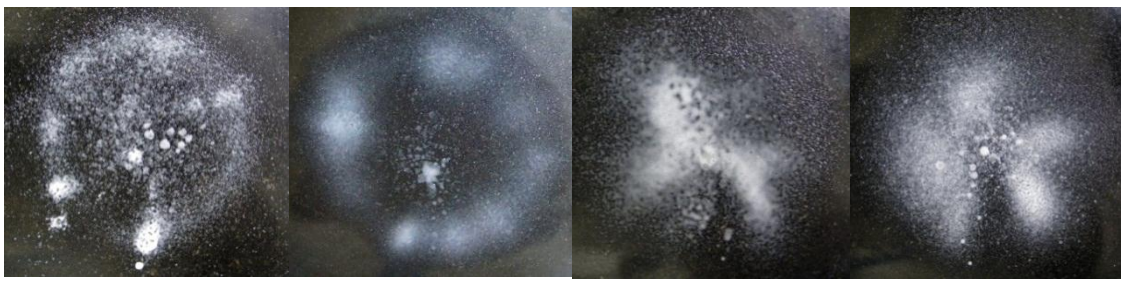
The Personal Care market is evolving to keep up with the ever-changing behaviour of the consumer. As lifestyles become busier, the personal time of the consumer is becoming more precious. This is shifting the industry towards convenient, easy-to-use, multifunctional products.

On-the-go cosmetics are in high demand with consumers now applying products outside of the home. The increase in cosmetic usage on-the-go is driving manufacturers to adapt their products to deliver convenient, easy-to-use solutions. This has been recognised through the sharp rise in sprayable Personal Care products launched into the marketplace, with sun and body care innovations leading this format change.

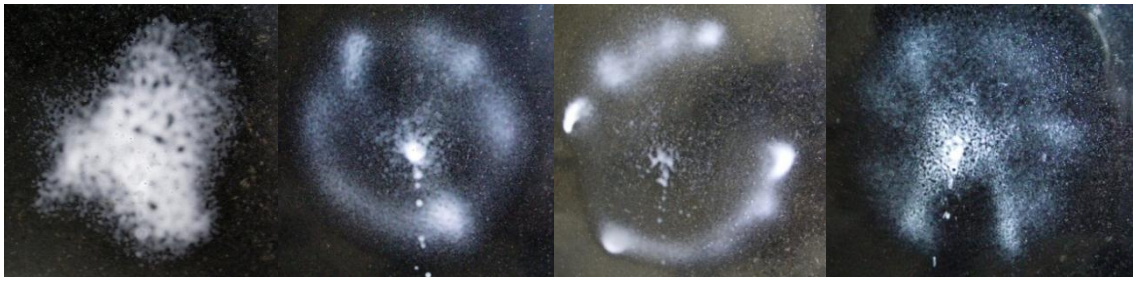
Volarest FL has the right “Fly-Stay” rheology to deliver sprayability from viscous creams. The optimised rheological properties of Volarest FL can be used in a variety of different formulations to provide the ease of use and targeted delivery of emollients and active ingredients onto the skin and hair. This means that highly viscous formulations can be easily sprayed through even the most basic pump spray as fine mists that immediately reform to give a viscous cream that can spread easily.

▪ Delivering ‘Sprays that Stay’ with Volarest FL

Volarest FL can be combined with different emulsifiers to produce stable sprayable emulsions. These emulsifiers will still create stable formulations on their own but will not benefit for the ‘Fly-Stay’ technology of Volarest FL. The table below shows the different spray patterns of a simple emulsion chassis containing different types and levels of various emulsifiers and Volarest FL.



Arlacel LC 3% Volarest FL 1% O/W	Arlacel 165 3% Volarest FL 1% O/W	Brij S721 3% Volarest FL 1% O/W	Crodafos MCK 3% Volarest FL 1% O/W

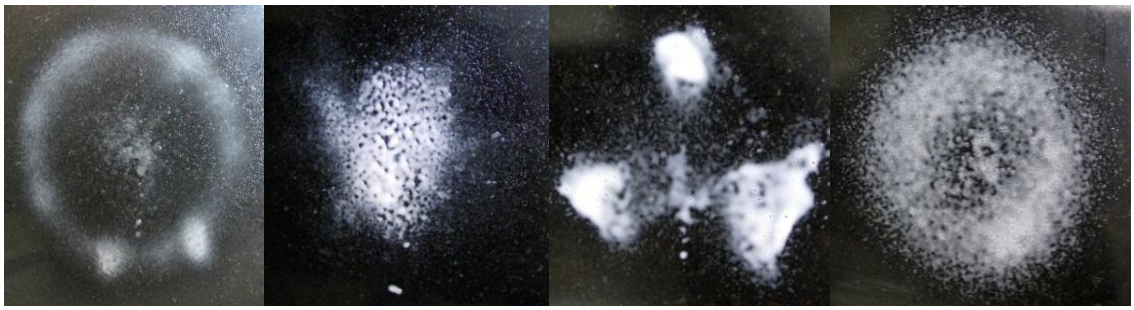


Cithrol PG32IS 3%
Volarest FL 1.5%
W/O

Cithrol DPHS 3%
Volarest FL 1%
W/O

NatraGem E145 2%
Volarest FL 1%
O/W

NatraGem EW 2%
Volarest FL 1%
O/W



Polawax NF 1%
Volarest FL 1%
O/W

Span 60 1.5%
Volarest FL 1%
O/W

Tween 80 3%
Volarest FL 1.5%
O/W

Versaflex V-150 3%
Volarest FL 1%
O/W

Not only does the choice of emulsifier have an effect on the sensory effects of the finished formulations, but also using Volarest FL as the rheology modifier in a formulation can reduce the amount of emulsifier required. This is due to the fact that Volarest FL is a polymeric emulsifier as well as rheology modifier, and this means that any potential irritation from surface active emulsifiers is reduced.

The rheology of Volarest FL means that formulations can be sprayed from a standard spray nozzle, reducing the need for specialist nozzles or pumps. The spray patterns so produces are similar to those produced by aerosol packaging including bag in a can or solvent based systems.

▪ **Sprayable Body Moisturising Cream**

Product (INCI Name)	**Functionality**	**% w/w**
Phase A		
Crodamol™ STS (PPG-3 Benzyl Ether Myristate)	Cushiony emollient	6.0
Crodamol™ ISIS (Isostearyl Isostearate)	Emollient with skin hydration properties	4.0
Crodamol™ PTIS (Pentaerythrityl Tetraisostearate)	Substantive and cushiony emollient	2.0
Phase B		
Water Deionised (Aqua)	-	To 100
Arlacel™ LC (Sorbitan Stearate (and) Sorbityl Laurate)	Emulsifier	3.0
Volarest™ FL (Acrylates/ Beheneth-25 Methacrylate Copolymer)	Rheology modifier	1.0
Phase C		
Phenoxyethanol	Preservative	0.8
Phase D		
Fragrance – Passion Flower & Cassis (Parfum)	Fragrance	0.5
Phase E		
10% Sodium Hydroxide Solution	pH modifier	pH = 6.5-7.0

A comparison of the spray pattern from this formulation compared to the formulation containing Carbomer, at equivalent polymer solids, is shown below. The photographs show the fine mist of viscous cream without splatter.

Volarest FL Carbomer

▪ **Formulating tips**

- When formulating spray formulations containing Volarest FL, standard emulsion processing methods need to be followed, with Volarest FL included in the water phase and neutralised post-homogenisation.

5. How to make a sprayable sunscreen

▪ **Why sprayable sunscreens?**

Sprayable sunscreens have been available on the market for many years but typically are low viscosity formulations that limit the type of co-ingredients that can be included in them. Volarest FL offers high viscosity, targeted delivery of sunscreens with no drip, high SPF performance and improved sensory benefits.

▪ **Compatibility with sunscreen actives**

Volarest FL is compatible with a wide range of different organic and inorganic sunscreens as shown in the table below.

Inorganic UV filters	**Organic UV filters**
Trade Name (INCI Name)	**INCI Name**
Solaveil™ XT-300 (Titanium Dioxide (and) Caprylic/Capric Triglyceride (and) Polyhydroxystearic Acid (and) Stearic Acid (and) Alumina)	Benzophenone-3
Solaveil™ XT-100 (Titanium Dioxide (and) C12-15 Alkyl Benzoate (and) Polyhydroxystearic Acid (and) Stearic Acid (and) Alumina)	Butyl Methoxydibenzoylmethane
Solaveil™ ST-100 (C12-15 Alkyl Benzoate (and) Titanium Dioxide (and) Polyglyceryl-3 Polyricinoleate (and) Silica (and) Stearic Acid (and) Aminopropyl Triethoxysilane)	Ethylhexyl Methoxycinnamate
Solaveil™ CT-100 (C12-15 Alkyl Benzoate (and) Titanium Dioxide (and) Aluminum Stearate (and) Polyhydroxystearic Acid (and) Alumina)	Ethylhexyl Salicylate
Solaveil™ XT-40W (Titanium Dioxide (and) Aqua (and) Polyglyceryl-2 Caprate (and) Sucrose Stearate (and) Simmondsia Chinensis (Jojoba) Seed Oil (and) Stearic Acid (and) Alumina (and) Glyceryl Caprylate (and) Squalane)	Homomenthyl Salicylate

Inorganic UV filters	Organic UV filters
Trade Name (INCI Name)	**INCI Name**
Solaveil™ CT-10W (Aqua (&) Titanium Dioxide (&) Isodeceth-6 (&) Oleth-10 (&) Aluminum Stearate (&) Alumina (&) Propylene Glycol (&) Diazolidinyl Urea (&) Methyl Paraben (&) Propyl Paraben (&) Simethicone)	Octocrylene
Solaveil™ CT-12W (Aqua (and) Titanium Dioxide (and) Oleth-10 (and) Isodeceth-6 (and) Aluminium Stearate (and) Alumina (and) Simethicone (and) Phenoxyethanol)	Tinosorb M (Methylene Bis-Benzotriazolyl Tetramethylbutylphenol (and) Aqua (and) Decyl Glucoside (and) Propylene Glycol (and) Xanthan Gum)
	Tinosorb S (Bis-Ethylhexyloxyphenol Methoxyphenyl Triazine)
	Uvinul A Plus (Diethylamino Hydroxybenzoyl Hexyl Benzoate)

- **"Into the Sun" High Protection Spray SPF 50+**

This formulation demonstrates the versatility and capability of Volarest FL in creating sprayable sunscreens with a wide compatibility of UV filters and delivering excellent sensorial and non-whitening effects on the skin.

Product (INCI Name)	Functionality	% w/w
Phase A		
Crodamol™ AB [C 12-15 Alkyl Benzoate]	Emollient	8.00
Eusolex OCR [Octocrylene]	Organic UVB filter	9.00
Eusolex 9020 [Butyl Methoxydibenzoylmethane]	Organic UVA filter	5.00
Eusolex OS [Ethylhexyl Salicylate]	Organic UVB filter	4.00
Xiameter PMX-245 [Cyclopentasiloxane]	Emollient	1.00
Titriplex III (Disodium EDTA)	Chelating Agent	0.02
Arlacel™ 165 [Glyceryl Stearate (and) PEG-100 Stearate]	Emulsifier	1.50
Span™ 60 [Sorbitan Stearate]	Co-emulsifier	1.00
Phase B		
Water Deionised (Aqua)	-	To 100
Pricerine™ 9091 [Glycerin]	Humectant	3.00
Crodafos™ MCK [Potassium Cetyl Phosphate]	Emulsifier	3.00
Volarest™ FL [Acrylates/ Beheneth-25 Methacrylate Copolymer]	Rheology modifier	0.75
Phase C		
SolPerForm™ 100 [Aqua (and) Hydrolyzed Wheat Protein/PVP Crosspolymer]	SPF Booster	2.00
Euxyl PE9010 [Phenoxyethanol (and) Ethylhexylglycerin]	Preservative	0.80
10% Sodium Hydroxide Solution	pH modifier	0.65
Phase D		
Solaveil™ CT-12W [Aqua (and) Titanium Dioxide (and) Oleth-10 (and) Isodeceth-6 (and) Aluminium Stearate (and) Alumina (and) Simethicone (and) Phenoxyethanol]	Inorganic UVB/UVA filter	13.50
10% Citric acid solution	pH modifier	To pH 6.80

This sunscreen formulation was compared to one containing Xanthan Gum. The images below show the spray patterns of the two formulations. The Volarest FL formulation gives a wider spread of coalesced fine particles on the vertical card, whereas the formulation containing Xanthan Gum was a thicker cohesive stream that continued to flow on the vertical surface.

Volarest FL Xanthan Gum

▪ **Formulating tips**

- Certain inorganic UV filters can interact with the polymer structuring and impact the sprayability of the formulation e.g. when formulating with Solaveil CT-100 the viscous dispersion thickens the formulation and affects the sprayability.

- When using water based inorganic filters in Volarest FL formulations, the addition process has to be changed slightly to get a stable formulation. Water based filters (such as Solaveil CT-12W, CT-10W, XT-40W) should be added in the final step after neutralisation and thickening of the formulation.

- Oil based inorganic filters and organic filters can be used as in the standard method without any changes to the addition process.

- To achieve a stable high SPF 50/50+ formulation with Volarest FL, a combination of emulsifiers are required due to the high levels of inorganic and organic UV filters and oils to solubilise the sunscreens, as is expected with traditional high SPF formulations.

- For mid-low SPF (30 or less) systems containing Volarest FL only a single emulsifier is required to get a stable sprayable formulation.

- The recommended level of Volarest FL in sun sprays is 0.75%-1%. As with standard emulsions containing Volarest FL, the type, level and ratio of emulsifier(s) to Volarest FL needs to be optimised to achieve the required stability and sprayability.

6. How to make a water lotion

▪ What is a water lotion?

A water lotion is a formulation that contains suspended, non-emulsified oil droplets in a clear gel. This type of formulation provides effective cleansing or moisturising characteristics from a light formulation. Volarest FL is ideal for use in this type of formulation as the high zero shear viscosity allows the creation of flowable low to medium viscosity formulations.

▪ Instant Skin Smoothing Serum

This formulation has been created to demonstrate the creation of the larger droplets.

Product (INCI Name)	**Functionality**	**% w/w**
Phase A		
Water Deionised [Aqua]	Solvent	To 100
Volarest™FL [Acrylates/ Beheneth-25 Methacrylate Copolymer]	Rheology Modifier	1.80
Paratexin DMD [DMDM Hydantoin]	Preservative	0.10
10% Sodium Hydroxide Solution	Base	0.67
Phase B		
Dow Corning 9040 Silicone Elastomer Blend [Cyclopentasiloxane (and) Dimethicone Crosspolymer]	Silicone	4.00
Xiameter PMX-1501 Fluid [Cyclopentasiloxane (and) Dimethiconol]	Silicone	0.50
Xiameter PMX-200 Silicone Fluid 350 cS [Dimethicone]	Silicone	0.50
Unicert Violet K7014-J [CI60725]	Colour	0.006

▪ **Creating a water lotion (formulating tips)**

Water lotions can be formulated with up to around 5% oil content and between 1.5% and 2.2% Volarest FL. The size of the oil droplet depends on the viscosity and polarity of the oil used, with larger droplets being formed with high viscosity, low polarity oil components such as silicone elastomers or **Supermol™ L** (Pentaerythrityl Isostearate/Caprate/Caprylate/Adipate).

Please find below the method of manufacture.

- Approximately half fill a bottle with the pre-mixed clear gel (Phase A)
- Syringe 2ml of the pre-blended oil phase (Phase B) under the surface of the gel in the bottle
- Fill the remaining half of the sample bottle to the top with the pre-mixed clear gel (Phase A)
- Firmly secure the bottle with the cap and shake to disperse the oil phase (Phase B) in droplets within the gel. Repeat if necessary to match the approved benchmark.
- ***A video has created showing this process. For more details please speck to your sales representative.***