

## Emulsifiers & Surfactants

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Emulsifiers are used to make creams and lotions and these are the most important product forms in skin and sun care. Hitherto emulsifiers that met natural claims were limited as this restricts the use of ethoxylated compounds but the list is now growing as ingredient suppliers recognise the need. This feature will look at emulsifiers with the focus on those that gain Ecocert and/or COSMOS approval for natural cosmetics.

The winner of Innovation Zone Best Ingredient Award at in-cosmetics 2014 was Emulium Mellifera [INCI: Polyglyceryl-6 distearate, jojoba esters, polyglyceryl-3 beeswax, cetyl alcohol] from **Gattefossé**. According to the manufacturers Emulium Mellifera is created from natural ingredients using green chemistry to give a non-ionic oil-in-water (O/W) emulsifier.

Emulium Mellifera is said to be the first ingredient to auto-adapt to the environment so that in cold or dry conditions, it creates a soft, comfortable film of protection on the skin but in hot and humid conditions it stabilises the sensory properties, leaving the skin less heavy and less greasy with a lower perceptible film. It also has moisturising properties and improves skin tone and firmness.

**Vantage** (formerly Lipo Chemicals) recently launched the Lipomulse Eco range of PEG-free emulsifiers. There is one high HLB [Lipomulse Eco H, INCI: Poly(glycerin/propanediol) stearate] and two low HLB products, [Lipomulse Eco L, INCI: Propanediol stearate and Lipomulse Eco L2, INCI: Polypropanediol stearate] in the range. They can be combined to provide different viscosities depending on the choice of low HLB emulsifier used. Their chemistry is based on propanediol made from the fermentation of a renewable resource and they form very stable liquid crystal emulsions with excellent skin feel.

**The Innovation Company** supply a number of natural-based emulsifiers for both O/W and W/O emulsions. They are recommended for emulsions targeted at dry and sensitive skin types due to their minimal impact on skin's lipids and their function as a barrier against moisture loss and protection against external irritants. For example Biomethics LHS, [INCI: Sucrose stearate, hydrogenated lecithin, Limnanthes alba meadowfoam) seed oil, xanthan gum, tocopherol], is a high HLB O/W emulsifier and Biomethics CPS, [INCI: Solanum tuberosum starch, meadowfoam seed oil, squalane, hydrogenated meadowfoam seed oil, xanthan gum, hydrogenated lecithin, tocopheryl acetate], is a low HLB W/O emulsifier.

Biomethics Emulsifiers can be used in all types of emulsions either as primary emulsifiers or combined together with other surface-active ingredients. In sun care formulations they are compatible with both physical and chemical UV-filters and can boost the SPF results. Due to

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their structure, they provide an even application to sun care products with titanium dioxide, inhibiting agglomeration. They can also be used in foundations and other colour care emulsions and are recommended particularly for formulations designed for dry and sensitive skin types and when high moisture retention is required.

**Cremer Care** is the supplier of three naturally derived non-ionic emulsifiers based on citrate chemistry. Imwitor 372 P, [INCI: Glyceryl stearate citrate], is a partially neutralised ester of monoglycerides and diglycerides of plant derived, saturated edible fatty acids with citric acid. Imwitor 375, [INCI: Glyceryl citrate/lactate/linoleate/oleate], is a partially neutralised ester of mono- and diglycerides of unsaturated edible fatty acids with citric acid and lactic acid and Imwitor 600 is an ester from polyglycerin and plant derived castor oil fatty acids to provide a W/O emulsifier. Imwitor 600 [INCI: Polyglyceryl-3 polyricinoleate] is suitable for all kinds of W/O emulsions, providing a pleasant non greasy skin feel.

Olive oil has been used throughout history for its precious cosmetic properties, as they are very close to skin lipids. Widely preferred to other vegetable oils for its high level (75%) of mono-unsaturated fatty acids, it exhibits well-known properties of integration with the body physiology. When its lipidic chains are chemically combined with hydrophilic molecules functional ingredients suitable for cosmetic formulations can be created. Another interesting property of olive is its unsaponifiable fraction (0.6-1.5%), which remains unchanged in the finished material. Its antioxidant power, as well as its emollient effects contribute to skin protection.

**Kalichem Italia** produces emulsifiers based on a combination of olive oil and vegetal proteins, derived from wheat and oat. The principal material in Olivoil Emulsifier is olive oil hydrolyzed wheat protein, a lipo-protein with a fatty amide structure, showing high interfacial activity. It is obtained by condensation of one amino group of proteins and the carboxyl group of fatty acids of olive oil. Olivoil Emulsifier also contains cetearyl alcohol, glyceryl oleate and glyceryl stearate and forms stable O/W emulsions with liquid crystal structures.

Olivoil Avenate Emulsifier, also from **Kalichem**, has a similar composition to Olivoil Emulsifier and is said to have a silicon-like feel. Olivoil Glutamate Emulsifier is a non-ethoxylated, vegetal derived surfactant that combines the unique fatty acid profile of olive oil with the characteristic affinity of glutamic acid toward the skin surface. The result is a new emulsifier structure with high skin compatibility and maximum biodegradability. It is obtained by condensation between the amino group of glutamic acid and the carboxyl groups

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of the fatty acids to give sodium olive oil glutamate. The emulsifier also contains cetearyl alcohol and glyceryl stearate and forms stable O/W emulsions with liquid crystal structures.

Olifeel E-Nat, [INCI: Olive glycerides], from **Brasca** is a natural W/O emulsifier and emollient resulting from 100% patented green technology. It is compatible with oil-soluble UV-filters, vegetable oils and most silicones and being liquid, it may be used for cold process emulsification. Its interesting sensorial profile is linked to its excellent skin feel and unique, long-lasting and nourishing activity.

**BC Cosmetic and Food** uses olive oil as the starting point to produce its Beautyderm K10 and Beautyderm WW O/W emulsifiers and Beautyderm K9 W/O emulsifier. Beautyderm K10, [INCI: Cetearyl glucoside, sorbitan olivate, cetearyl alcohol], is effective when used at 3 – 6% to produce milks and creams exhibiting liquid crystal structures and good skin moisturising properties. Beautyderm WW is a cold-process emulsifier derived from olive oil, castor oil and vegetable glycerine, [INCI: Olive oil PEG-7 ester, ethylhexyl stearate, polyglyceryl-3 polyricinoleate, sorbitan oleate]. As well as forming O/W emulsions Beautyderm WW is also suitable for use in wet wipe emulsion technology. Beautyderm K9 is sorbitan olivate and being of low HLB, it forms W/O emulsions.

Another emulsifier based on olive oil derivatives is Phytocare-OL, [INCI: Olive oil polyglyceryl-6 ester], from **Naturalis**. Phytocare-OL is claimed to combine the beneficial properties of the fatty acids in olive oil with the moisturising and protective properties of glycerin. It can be cold processed and its gel network structure is said to strengthen the barrier properties of the epidermis. Phytocare PG from **Naturalis** is a mixture of punicic acid extracted from Punica (pomegranate) granatum seed oil and polyglyceryl esters of the fatty acids in sweet almond oil, [INCI: Polyglyceryl-10 almond oil ester. polyglyceryl-4 punicic acid ester].

Dermofeel Easymuls Plus [INCI: Glyceryl oleate citrate] from **Dr Straetmans** is an O/W emulsifier suitable for low viscosity and sprayable products. Based on sunflower oil it is effective at low dosage without any co-emulsifier and can be cold-processed. Its recommended use level is 1 - 4% as main emulsifier and 0.5 - 1% as co-emulsifier.

Symbiomuls Rich is a naturally-derived O/W emulsifier blend of polyglyceryl-3 stearate, behenyl alcohol, glyceryl stearate citrate, Helianthus annuus seed cera, glyceryl caprate, tocopherol, ascorbyl palmitate and Helianthus annuus seed oil from **Dr Straetmans**. Each component contributes to the rich texture, skin feel and the caring sensorial profiles of the

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resulting emulsions. There is no need for further stabilisers or co-emulsifiers in the oil phase and it provides stable emulsions within a wide range of viscosities and oil-concentrations.

Providing ingredients as mixtures to simplify material stock holding and reduce processing time is an effective method of selling propriety combinations of commodity items. An example from **Chemyunion** is Emulfeel SGP, which provides stable emulsions with enhanced skin feel. It is a combination of *Helianthus annuus* (sunflower) seed oil, polyacrylic acid, xylityl sesquicaprylate, glyceryl stearate, *Euphorbia cerifera* (Candelilla) wax and sodium hydroxide. It is used at 1 – 5%, is readily dispersible, stable over a wide pH range, does not need neutralising and results in liquid crystal structures stabilised by a polymer network.

Progress Repair SE-4 from **Prodotti Gianni** is a PEG-free self-emulsifying base for the formulation of O/W emulsions that can be created simply by diluting with cold water. Particularly suited to hair conditioners because of the presence of quaternary compounds its INCI listing is aqua, neopentyl glycol dicaprylate/dicaprate, cetearyl alcohol, cetrimonium chloride, polyglyceryl-10 stearate, polyglyceryl-6 tristearate, guar hydroxypropyltrimonium chloride, benzyl alcohol, hydroxypropyl guar and sodium caproyl prolinatate.

From **Sabo** there is Sabowax FL 81; a non-ionic self-emulsifying base comprising palmitic acid, sorbitan oleate, hydrogenated castor oil, glyceryl stearate, paraffin, stearic acid and cetyl palmitate. It forms O/W lotions and creams and has consistency giving properties. **Bionat Consult** provides vegetable-derived Polyem emulsifying bases to manufacture O/W emulsions. Polyem emulsifying bases make thin and light emulsions that are homogeneous and micro-dispersed and tests showed them to be stable with oils of different polarity, maintaining their initial characteristics over time. An example is Polyem 80, [Polyglyceryl-8 oleate, decyl glucoside, *Vitis vinifera* (grape) seed oil, linoleic acid, oleic acid, glyceryl stearate].

Polyglyceryl-based emulsifiers are increasingly popular because of their natural claims and their exceptional skin feel. NatraGem E145 NP, [INCI: Polyglyceryl-4 laurate/succinate] from **Croda Europe** is a versatile high HLB, O/W emulsifier that is effective in the creation of sprayable to pourable lotions. NatraGem EW, [INCI: Glyceryl stearate, polyglyceryl-6 palmitate/succinate, cetearyl alcohol], is an efficient emulsifying wax with stabilising and thickening properties capable of creating formulations ranging from lotions to high viscosity creams.

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Sugar chemistry provides many useful cosmetic ingredients; Emulgade Sucro Plus from **BASF Care Creations** is a combination of sucrose polystearate and cetyl palmitate that is an effective O/W emulsifier and promotes the formation of lamellar structures. Emulsions with Emulgade Sucro Plus form a sliding film on the skin with a silky and dry skin sensation that improves application and absorption.

**GOVA** recently introduced Inutec SL1, a highly efficient O/W emulsifier based on modified inulin that has unique properties. It can emulsify very high levels of oil in water with minimal impact on viscosity, which makes it ideal for making low-viscosity stable spray emulsions. Inulin is a linear polysaccharide derived from chicory root. To obtain Inutec SL1 hydrophilic inulin is grafted with lipophilic lauryl chains from coconut oil to give inulin lauryl carbomate and glycerin. It has very high salt tolerance, wide pH stability and excellent compatibility with other cosmetic ingredients. Inutec SL1 also helps to reduce stickiness and greasy feel of emulsions and body butters, improving spread and application and very low levels are effective emulsion stabilisers.

**Seppic** suggests Simulgreen 18-2, [INCI: Hydroxystearyl alcohol, hydroxystearyl glucoside] as an O/W emulsifier manufactured using “green” chemistry principals. It is very effective, able to emulsify polar and non-polar oils, silicones and vegetable oils and, by imparting an invisible film on skin, it provides long-term moisturising properties to the stratum corneum. Use level is from 2% and emulsions are stable over a broad pH range.

From **Croda**, Crodafos BES-70 is a 70% active phosphate ester based on behenyl chemistry, [INCI: Beheneth-30 phosphate, cetearyl alcohol, dicetyl phosphate, cetyl phosphate], that creates stable O/W systems with liquid crystal structures. It is effective over a broad pH range, making it suitable for acne treatments, self-tanners and other systems with difficult to use actives.

Phosphate emulsifiers are not new but are effective and because of their propensity towards forming liquid crystal structures, they provide particularly pleasant skin feel. **Nikkol** Purephos- $\alpha$  is cetyl phosphate, which can be neutralised with arginine to form a stable  $\alpha$ -gel, a lamellar structure that has similar properties to liquid crystals.

Lecithins are well known for their emulsifying properties and this is due to their content of phospholipids. Phospholipids have one water soluble end formed by a polar phosphate head group and a lipid soluble end formed by a nonpolar tail of fatty acids. Within membranes the polar ends point outwards and non-polar ends point inwards; in this way they form lamellar

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structures. **Cosphatec** has a number of lecithin-based emulsifiers and all are derived from soy bean, are liquid and can be used for cold processing. Depending on the concentration of emulsifier and oil phase and the method of mixing O/W and W/O emulsions are possible.

From **Lucas Meyer** we have Lecigel, a combination of lecithin with sodium acrylates copolymer to provide a gelling agent with emulsifying properties. It is suitable for both cold and hot processes and also helps adjust the viscosity at the end of the formulation process. It is especially adapted for the formulation of gel-creams and provides the typical “phospholipid touch” with a cool, soft and non-greasy skin feel.

Also from **Lucas Meyer**, Ecogel is said to be the first Ecocert registered gelling and emulsifying agent. Ecogel, [INCI: Lysolecithin, sclerotium gum, xanthan gum, pullulan], increases the viscosity and stability of formulas. It is compatible with electrolytes and is stable over a wide pH range. It has been designed for the formulation of gel-creams and provides a silicone-like skin feel with a cool, soft and non-greasy sensation.

With so many emulsifiers available it is difficult for the formulator to make a choice. To help the decision-making process **Synerga** has produced a Sensorial Profile Kit comprising a selection of emulsifiers, application formulations and sensorial charts based on users experiences with them. The kit includes both O/W and W/O emulsifiers and all are compatible with natural claims. An example is Ewocream, which is a W/O emulsifier, [INCI: Polyglyceryl-3 sorbityl linseedate], suitable for cold processing. It can be used to prepare both milks and lotions and it imparts water-resistance to sun products. Other emulsifiers featured are Hitecream and Phytocream that form liquid crystal networks in O/W emulsions; Nanocream that gives very light O/W lotions with nano-size emulsion droplets and Prolix RB, which is polyglyceryl-3 rice branate, obtained by neutralising the fatty acids in rice bran with arginine.

**Evonik** also has an emulsifier selection tool, which can be found on its web site <http://personal-care.evonik.com>. There are 45 emulsifiers featured but a series of filters enables the user to choose an application, formulation attributes, compliance with various certification bodies including COSMOS, Ecocert and RSPO and sensory benefits, chemistry and processing requirements. There are 17 emulsifiers that meet Ecocert criteria and 4 of these are suitable for cold processing.

The majority of emulsifiers featured are Ecocert and/or COSMOS compliant but those interested are advised to seek confirmation of this plus full INCI listings from the suppliers.

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Many of these emulsifiers can form liquid crystal structures but careful attention to the processing requirements suggested by the suppliers is essential.

Trade Name	Emulsion type	HLB	Process type	Use level
Biomethics CPS INCI: Solanum tuberosum starch, aqua/water, squalane, Limnanthes alba (meadowfoam) seed oil, lecithin, xanthan gum, tocopheryl acetate	O/W	10-12	Cold or hot	5-6%
Biomethics CPS INCI: Solanum tuberosum starch, meadowfoam seed oil, squalane, hydrogenated meadowfoam seed oil, xanthan gum, hydrogenated lecithin, tocopheryl acetate	W/O	6-8	Cold or hot	5-6%
Biomethics LHS INCI: INCI: Sucrose stearate, hydrogenated lecithin, Limnanthes alba meadowfoam) seed oil, xanthan gum, tocopherol	O/W	10-12	Hot	4-8%
Biomethics O/W INCI: Solanum tuberosum starch, water, squalane, sucrose stearate, Limnanthes alba (meadowfoam) seed oil, hydrogenated lecithin, tocopheryl acetate	O/W	10-12	Hot	4-8%
Biomethics W/O INCI: Solanum tuberosum starch, squalane, hydrogenated lecithin, Limnanthes alba (meadowfoam) seed oil, hydrogenated meadowfoam seed oil, xanthan gum, tocopheryl acetate	W/O	6-8	Hot	4-5%
Imwitor 372P INCI: Glyceryl Stearate Citrate	o/w		Hot	2- 5%
Imwitor 375 INCI: Glyceryl Citrate/Lactate/Linoleate/Oleate	o/w		Hot or cold	
Imwitor 600 INCI: Polyglyceryl-3 Polyricinoleate	w/o		Hot or cold	
Lipomulse Eco H INCI: Poly(Glycerin/Propanediol) Stearates	o/w	High	Hot	
Lipomulse Eco L INCI: Propanediol Stearate	o/w	Low	Hot	
Lipomulse Eco L2 INCI: Polypropanediol Stearate	o/w	Low	Hot	

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