PERSONAL CARE

OleoCraft™ Polymers

Protecting Perfection

The **OleoCraft** range is a group of oil-structuring polymers that are able to create impressive films on the skin, lip or eyelash, delivering water- and wear-resistance benefits across a variety of colour cosmetic and sun care applications. The **OleoCraft** polymers are low colour and low odour, high performance solids, proven to form crystal clear, thermo-reversible gels. The products work with a range of high to low polarity oils, providing compatibility with an array of cosmetic ingredients. The **OleoCraft** polymers also create novel formats, from eye-catching clear sticks and balms to sprayable gels and emulsions, delivering real consumer benefits.

Product Name	INCI Name	Appearance[1]
OleoCraft™ LP-20	Polyamide-8	Clear yellow pastilles
OleoCraft™ HP-31	Polyamide-3	Clear yellow pastilles
OleoCraft™ MP-30	Polyamide-3	Clear yellow pastilles
OleoCraft™ MP-32	Polyamide-3	Clear yellow pastilles

Features & Benefits

- Forms solid sticks, gels or emulsions
- Provides emulsion stabilisation
- Allows the creation of water- and wear-resistant polymer films
- Boosts SPF
- Imparts minimal sensorial impact on formulation
- Enhances gloss
- Improves pigment dispersions

Applications

- Colour cosmetics
- Lip care
- Sun care

Figure 1: An overview of the key applications that the OleoCraft polymer range are suitable for, alongside potential, relevant claims

[1]See page 19 for more details

Chemistry

The OleoCraft polymers are macromolecules, with repeating units linked by amide bonds.

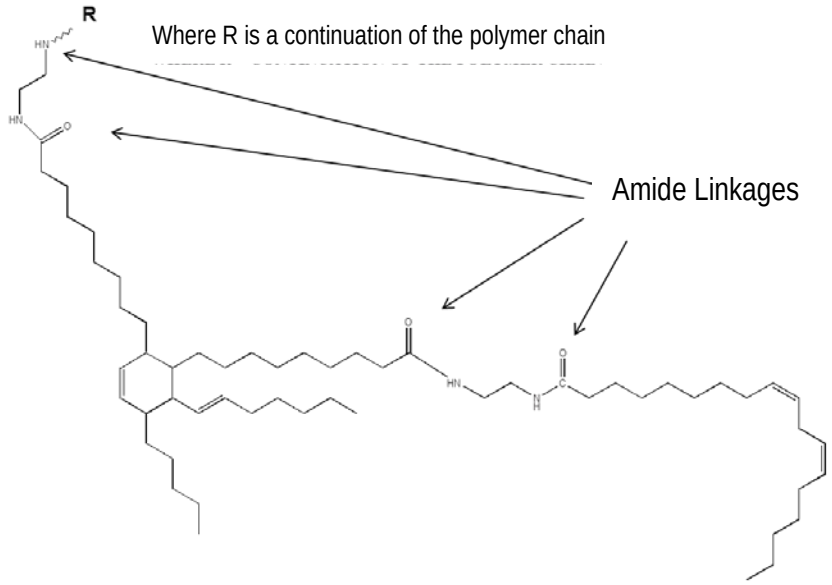

Figure 2: A theoretical polyamide structure

Each product in the OleoCraft polymer range consists of ester-terminated poly(ester-amides) and polyalkyleneoxy-terminated polyamides, with molecular weights between approximately 4,500 and 30,000 Daltons (Da) as shown in Table 1. The different in-chain or terminating groups ensure that each ingredient in the range is compatible with a wide range of other personal care ingredients.

Product Name	Approximate Molecular Weight (Mw)	Oil Polarity Compatibility
OleoCraft™ LP-20	4,500 Da	Low to medium polarity oils
OleoCraft™ HP-31	11,500 Da	High polarity oils, water and glycol systems
OleoCraft™ MP-30	20,000 Da	Medium to high polarity oils
OleoCraft™ MP-32	30,000 Da	Medium to high polarity oils

Table 1: Information about each of the products in the OleoCraft polymer range

The ingredients in the oil phase of a formulation can greatly impact the performance of the OleoCraft polymers. As a result, consideration to the intended application, product format and compatibility with other ingredients in the formulation should be given in order to select the appropriate polymer. Figure 3 provides a diagram of the varying oil compatibility of each OleoCraft polymer.

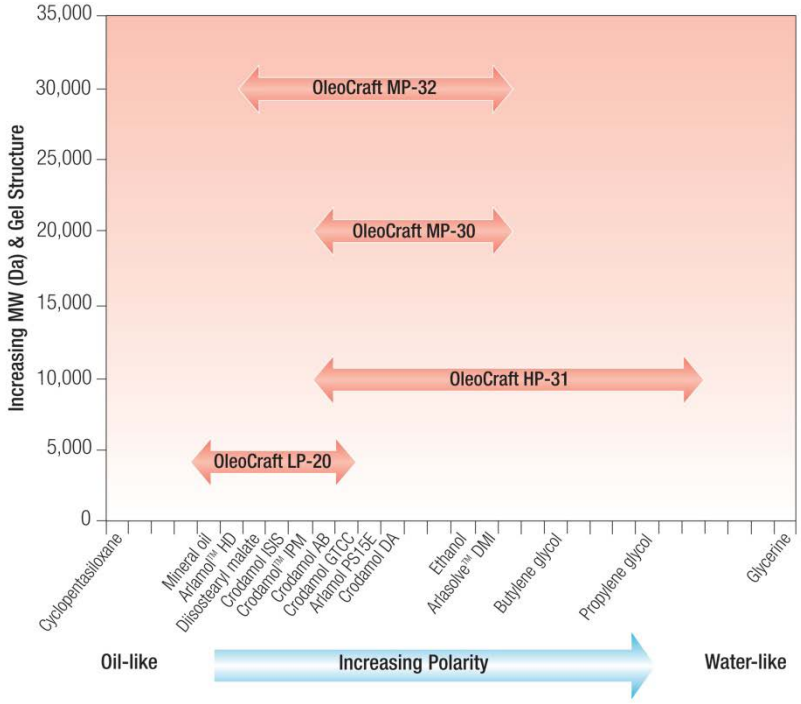

Figure 3: An overview of the varying oil compatibility of each OleoCraft polymer in the range

Structuring and Gelling

The **OleoCraft** polymers gel oils by forming a three dimensional structure, where the oil is attracted to the fatty, dimer acid chains and the chains interact via hydrogen bonding, as shown in Figure 4.

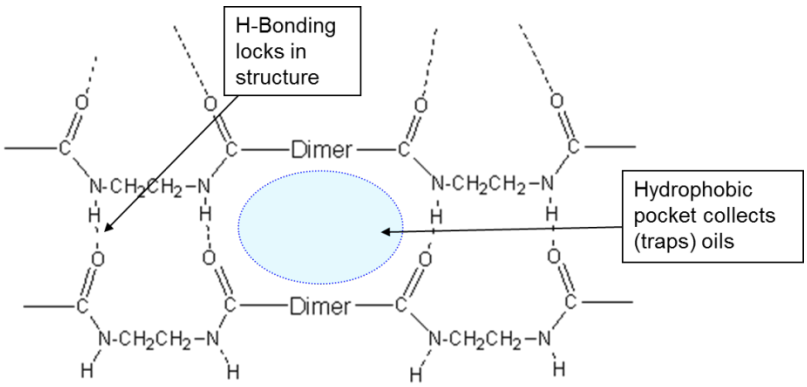

Figure 4: The OleoCraft polymers gel oils by forming a three dimensional structure

The polymers have a shear-thinning rheology which allows the gel structure to break down under strain, releasing the previously trapped oils and providing good spreadability on the skin.

Typical usage levels for the **OleoCraft** polymers range from 1%, for a jelly-like structure, to 30% for a more rigid, wax-like structure, with the gels formed being thermo-reversible. Supplied as clear pastilles, **OleoCraft** polymers dissolve in fluid when heated at, or close to, their softening point and shear can be used to reduce

this temperature. The softening points of each of the OleoCraft polymers can be seen in Table 2, alongside their gelling points in two commonly used cosmetic oils.

It is important to note that the gelling or setting point of the final formulation will always be considerably lower than the initial temperature needed to incorporate the OleoCraft polymer into the oil.

Ingredient (INCI Name)	Softening Point (°C)	Gelling Point in C12-15 Alkyl Benzoate (°C)	Gelling Point in Castor Oil (°C)
OleoCraft™ LP-20 (Polyamide-8)	83	60	55
OleoCraft™ HP-31 (Polyamide-3)	87	60	38
OleoCraft™ MP-30 (Polyamide-3)	97	62	35
OleoCraft™ MP-32 (Polyamide-3)	99	65	55

Table 2: The softening and gelling points of OleoCraft polymers

Figure 5 and Figure 6 show the viscosity-response curves of the OleoCraft polymers when used with C12-15 Alkyl Benzoate and Castor Oil respectively, where the complex viscosity stated is the viscosity obtained from the linear viscoelastic region, or LVER region, of an Oscillation Amplitude sweep.

As can be seen below, as the percentage inclusion of polymer is increased, the viscosity of the gel also increases.

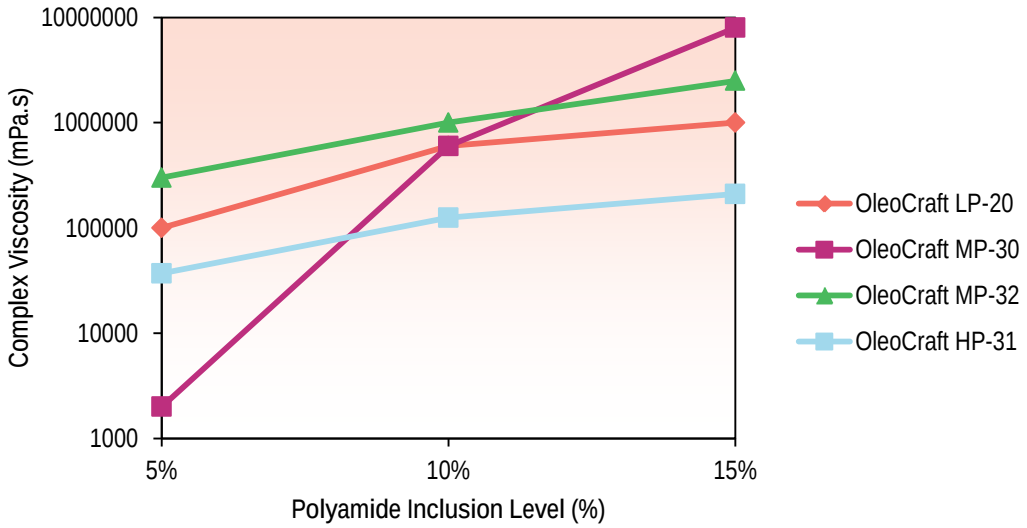

Figure 5: Viscosity response curve with C12-15 Alkyl Benzoate

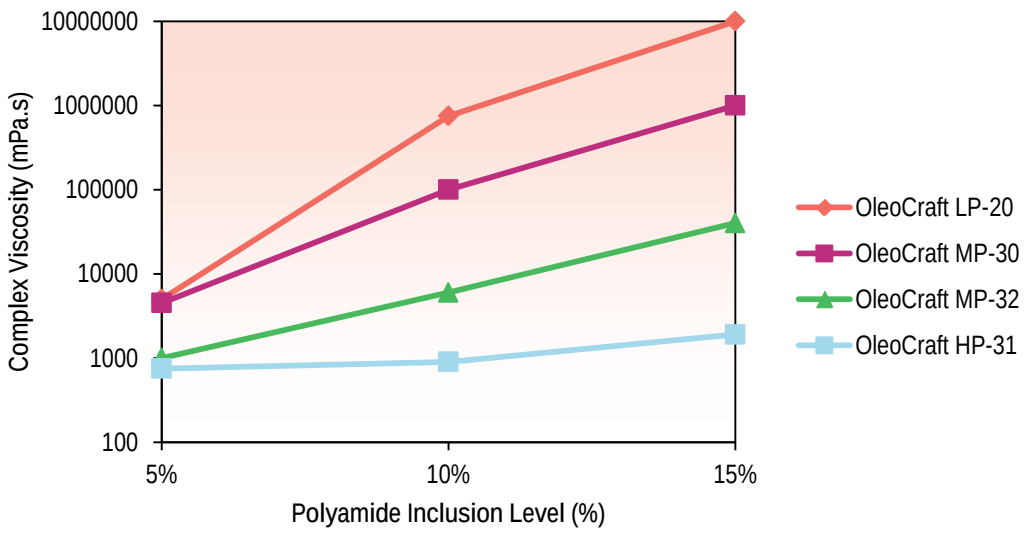

Figure 6: Viscosity response curve with Castor Oil

Gelling Silicones

Whilst unsuitable for gelling silicone-only systems, the **OleoCraft** polymers can gel silicones when used in combination with mildly polar organic liquids including polar emollients, esters, glycols and organic sunscreen actives.

Depending on the combination of silicone, polar organic liquid and **OleoCraft** polymer, it is possible to achieve clear gels of this type. The resultant gelled silicone phase can then be dispersed with an aqueous phase, if desired.

Table 4 shows the compatibility of two of the **OleoCraft** polymers with cyclopentasiloxane.

Ingredient (INCI Name)	% w/w	% w/w	% w/w	% w/w
Cyclopentasiloxane	21.7	26.1	34.8	43.5
Crodamol™ AB (C12-15 Alkyl Benzoate)[1]	65.2	60.9	52.2	43.5
OleoCraft™ MP-30 (Polyamide-3)[1]	13.0	13.0	13.0	13.0
Result:	Clear gel	Clear gel	Cloudy gel	Incompatible

Ingredient (INCI Name)	% w/w	% w/w	% w/w	% w/w
Cyclopentasiloxane	21.7	26.1	34.8	43.5
Crodamol™ AB (C12-15 Alkyl Benzoate)[1]	65.2	60.9	52.2	43.5
OleoCraft™ MP-32 (Polyamide-3)[1]	13.0	13.0	13.0	13.0
Result:	Clear gel	Clear gel	Hazy gel	Cloudy gel

Suppliers: 1: **Croda**

Table 4: Cyclopentasiloxane compatibility tables with OleoCraft MP-30 and OleoCraft MP-32 demonstrating that it is possible to achieve clear gels depending on the combination of silicone, polar organic liquid and OleoCraft polymer

Gelling Vegetable Oils

It is extremely difficult to gel vegetable oils or triglycerides of fatty acids, whilst oils containing hydroxyl functionality (-OH groups) gel readily. As a result, mixing vegetable oils with Castor Oil, which has a hydroxyl group, or other highly compatible liquids, such as C12-15 Alkyl Benzoate, will often successfully lead to a gel being formed.

Emulsion Stabilisation

Emulsions or gel dispersions can be obtained without the use of surfactants, by blending incompatible oils and water with OleoCraft polymers. The type of emulsion obtained depends on the OleoCraft polymer used and on the relative amounts of water and oil in the formulation.

There are two main types of gel dispersion possible in emulsions; water-in-gelled-oil (W/OG) and oil-gelled-in-water (OG/W), shown in Figure 7. In the W/OG, the oil phase is continuous with no restriction on the aqueous phase composition. Meanwhile in the OG/W, the aqueous phase is continuous. In both cases, the OleoCraft forms a water resistant film on the surface of the skin and can increase the delivery of actives.

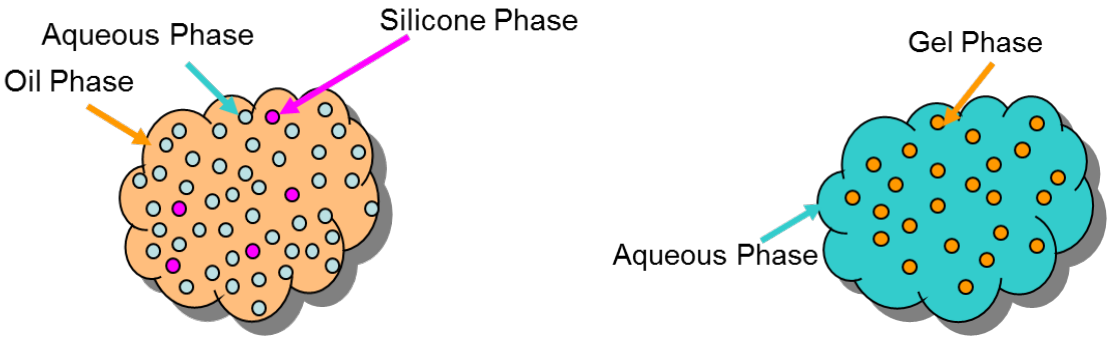

Figure 7: The two primary types of gel dispersion possible in emulsions; on the left, water-in-gelled-oil (W/OG) and, on the right, oil-gelled-in-water (OG/W)

Film-forming Benefits

The OleoCraft polymers are able to create consistent films on the surface of the skin. They deposit onto the epidermis, providing a protective layer, with their molecular weight ensuring that the polymers stay on the surface of the skin and form a cohesive, non-water-soluble film.

The OleoCraft polymers can be incorporated into the oil, aqueous or ethanol continuous phase or into the oil or aqueous phase of an emulsion.

Shear-thinning gels and emulsions are deposited onto the skin, lip or eyelash and, upon absorption of emollients and evaporation of volatiles, the polymer film and actives are retained. This can also produce a glossing and levelling effect.

Wear-resistance in a Lipstick

Studies have shown that the OleoCraft polymers are able to increase the transfer-resistance of lipsticks.

The durability and wear-resistance of an OleoCraft-based lipstick, shown in Table 5, was compared to that of a premium, commercially-available, wax-based lipstick. Performance was assessed by comparing the change in colour of lipstick on a substrate following 1 to 5 passes with an abrasion scrub tester.

Ingredient (INCI Name)	% w/w
Cithrol™ PG32IS (Polyglyceryl-3 Diisostearate)[1]	50.00
OleoCraft™ MP-30 (Polyamide-3)[1]	15.00
OleoCraft™ LP-20 (Polyamide-3)[1]	10.00
Crodamol™ STS (PPG-3 Benzyl Ether Myristate)[1]	10.00
Iron Oxide FE	10.00
Crodamol™ W (Stearyl Heptanoate (and) Stearyl Caprylate)[1]	5.00

Suppliers: 1: Croda

Table 5: The wear-resistance of this OleoCraft-based lipstick formulation (C2681) was compared to a premium, commercially available, wax-based lipstick

An abrasion scrub tester provides a reliable and reproducible method of measuring wear-resistance of cosmetic formulations. By applying a standardised force and stress to a formulation that has been applied to a fixed substrate, the durability of the formulation can be quantified using colourimetry, with the amount of formulation removed during each pass of the abrasion scrub tester directly correlated to the durability of the formulation.

In this study, colourimeter readings were taken following the application of the lipstick to a textured film strip substrate, with focus on the colour parameter a*. The a* value relates to the balance between green and red and so was used to measure the change in redness following repeated passes with the scrubbing arm.

After the initial a* values were recorded, giving an initial measure of the redness of the lipstick formulations, the scrubbing arm was gently lowered onto the surface of the substrate and set to perform 1 pass at a set speed. Another colourimiter reading was taken following the pass. This process was repeated each time a pass occurred over the lipstick, until a total of 5 passes had been conducted.

The percentage change in redness was calculated for each lipstick tested and the average value calculated following 5 passes of the scrubbing arm. The results of this study are shown in Figure 8.

This provides quantitative analysis of durability of the lipstick formulations, with a decrease in a* relating to the removal of lipstick from the substrate; the more durable the lipstick, the lower the net change in a* value.

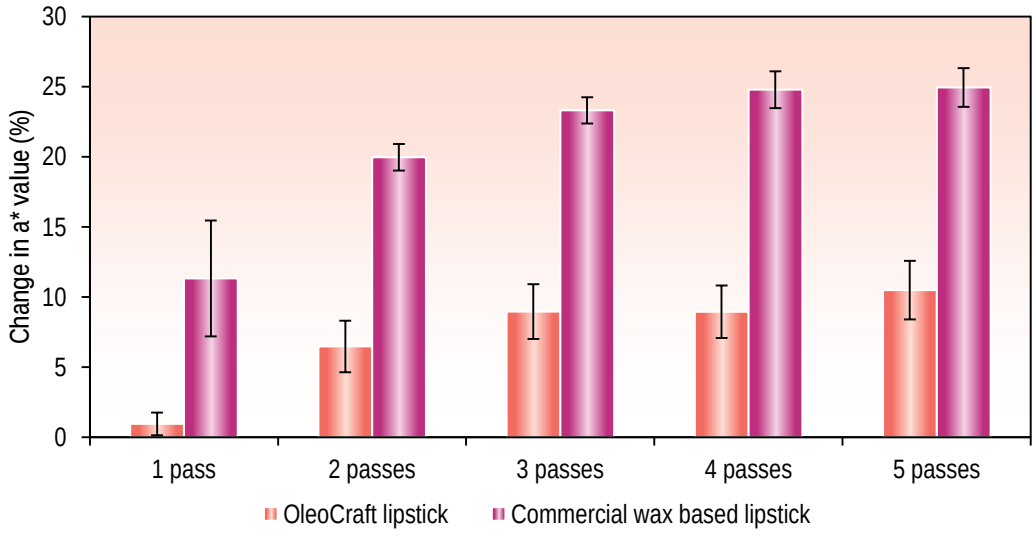

Figure 8: The percentage change of colour value a following repetitive passes of an abrasion scrub tester demonstrate that a lipstick formulation containing an OleoCraft polymer is more durable than a premium, commercially available wax-based lipstick*

As shown in Figure 8, the percentage change in a* of the formulation containing an OleoCraft polymer is lower than that of the commercial wax-based lipstick after each pass of the scrubbing arm. It can also be seen that the percentage change in a* of the OleoCraft polymer-based lipstick after 5 passes is similar to that of the commercial lipstick after just 1 pass, demonstrating the superior durability of the OleoCraft-containing formulation.

Figure 9 demonstrates these results visually. As can be seen, the amount of colour that has being wiped along the substrate is higher for the commercial lipstick. These results demonstrate that the formulation containing the OleoCraft polymer is more durable and wear-resistant than the commercial wax-based formulation

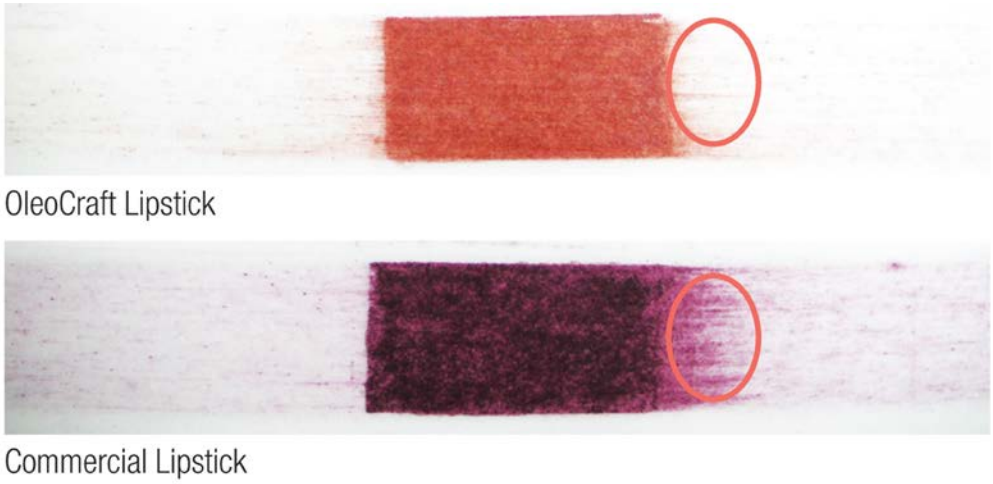

Figure 9: Visual wear-resistance results show that more of the commercial lipstick has been wiped along the substrate than the OleoCraft-containing formulation, demonstrating the superior durability and wear resistance offered by the OleoCraft polymers

Foundation Durability

The OleoCraft polymers have also been shown to increase the durability of foundation make-up. Using the abrasion scrub tester as described above, the durability of a foundation formulation containing OleoCraft polymers was compared to that of the same formulation without the OleoCraft included, shown in Table 6.

Ingredient (INCI Name)	Control Formulation, Formulation 1 % w/w	Formulation 1a % w/w
Part A		
Crodamol™ IPIS (Isopropyl Isostearate)[1]	12.00	12.00
Arlamol™ HD (Isohexadecane)[1]	3.00	3.00
Cithrol™ DPHS (PEG-30 Dipolyhydroxystearate)[1]	3.00	3.00
OleoCraft™ LP-20 (Polyamide-8)[1]	-	3.00
OleoCraft™ MP-30 (Polyamide-3)[1]	-	2.00
Xiameter PMX-0245 (Cyclopentasiloxane)[2]	3.00	3.00
Candelilla Wax	1.00	1.00
Crodamol™ GTCC (Caprylic/Capric Triglyceride)[1]	12.50	12.50
A310.01 Tudor Aspen (Titanium Dioxide)[3]	2.96	2.96
A403 Tudor Oak (Iron Oxide)[3]	0.31	0.31

A407 Tudor Willow (Iron Oxide)[3]	0.98	0.98
A311.30 Tudor Ash (Talc)[3]	8.25	8.25
Part B		
Water Deionised (Aqua)	To 100	To 100
Butylene Glycol	5.00	5.00
Sodium Chloride	0.50	0.50
Part C		
Euxyl PE 9010 (Phenoxyethanol (and) Ethylhexylglycerin)[4]	0.80	0.80

Suppliers: 1: Croda 2: Dow Corning 3: Kingfisher Colours 4: Schülke

Table 6: The durability of a formulation containing OleoCraft polymers (Formulation 1a, C2696a) was compared to a control formulation without the OleoCraft included (Formulation 1)

Each foundation formulation was applied to silicone strips before being left to dry at room temperature for 24 hours. After being immersed in water for 1 minute and following a short drying phase, colourimeter readings were taken to provide an initial measure of colour. Following a procedure similar to that described previously, the scrubbing arm was then gently lowered onto the surface of the substrate and set to run for 1 pass at a set speed. Another colourimiter reading was taken following the pass. This process was repeated each time a pass occurred over the foundation, until a total of 5 passes had been conducted.

Focus during this study was placed on the percentage change in colour (Delta E (CMC) or $\Delta E_{(CMC)}$). Representing the colour difference before and after a pass of the scrubbing arm, $\Delta E_{(CMC)}$ is used to show the amount of foundation removed, the results of which can be seen in Figure 10.

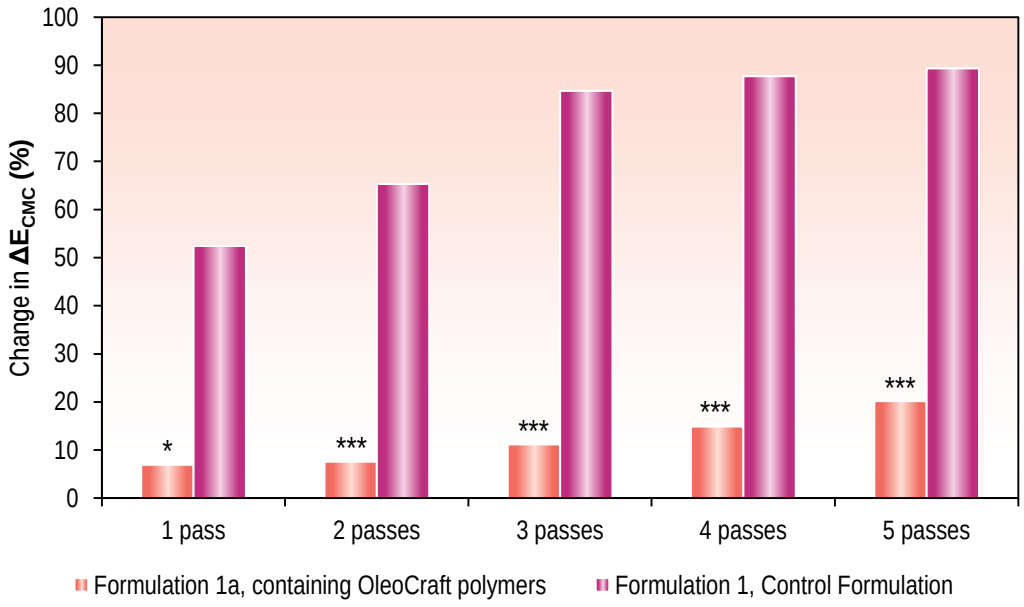

*Figure 10: The change in colour value $\Delta E_{(CMC)}$ shows that including OleoCraft polymers in a foundation formulation can greatly improve the durability of the formulation (*p<0.05, ***p<0.001)*

The results shown in Figure 10 illustrate that the average percentage change in $\Delta E_{(CMC)}$ for the formulation containing OleoCraft polymers is lower than that of the formulation not containing an OleoCraft ingredient after each pass of the scrubbing arm. This demonstrates that less foundation is being removed by the scrub tester, thus proving that the formulation containing OleoCraft polymers is more durable than the equivalent formulation not containing OleoCraft polymers. The visual results of this test are shown in Figure 11.

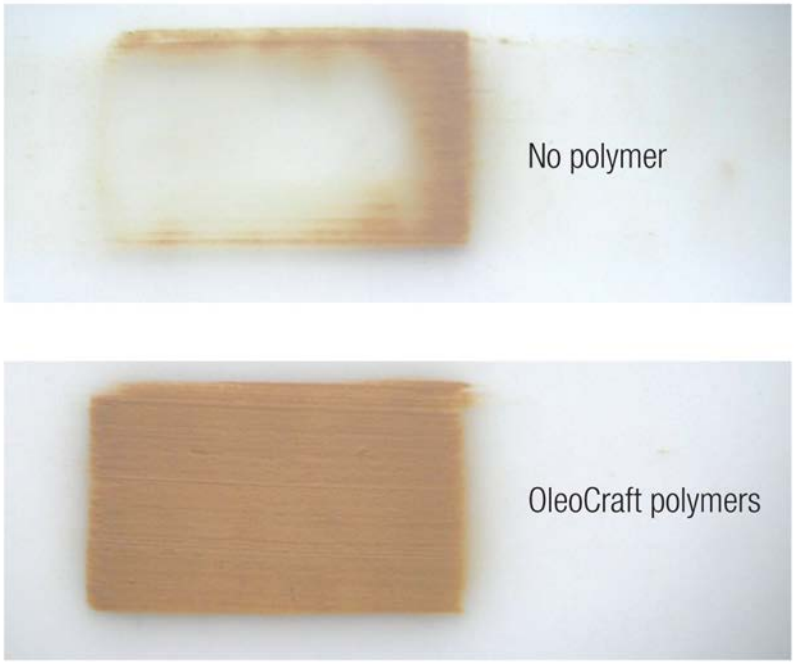

Figure 11: Visual wear-resistance results show that the formulation containing OleoCraft polymers is more durable than the equivalent formulation not containing OleoCraft polymers

Transfer-resistance in Mascara

The film-forming properties of the OleoCraft polymers can also be seen through the transfer-resistance of mascara when compared to a premium commercial mascara. Figure 12 shows the transfer of wetted mascara onto tissue paper. It is clear that when OleoCraft LP-20 is used as a gelling agent in a very simple mascara formulation, the transfer is visually reduced compared to the commercial mascara.

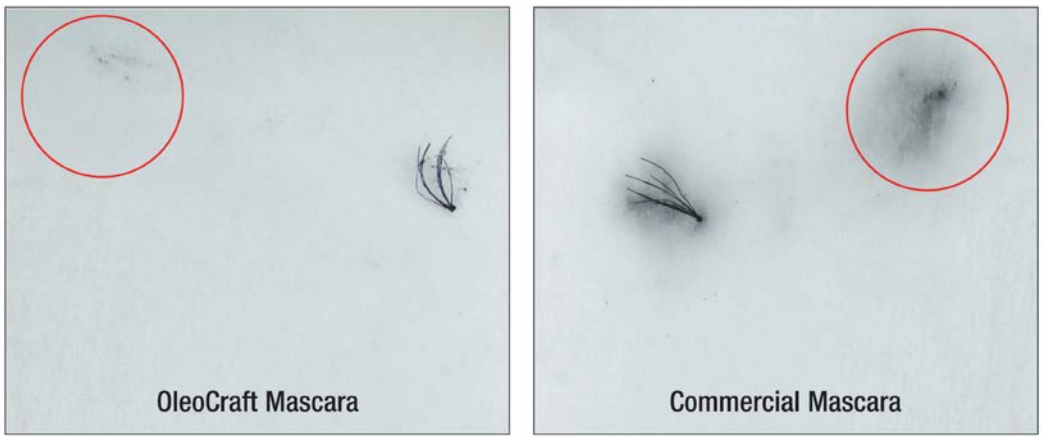

Figure 12: Visual results of the transfer resistance of mascara containing OleoCraft LP-20 and a premium commercial benchmark

Ingredient (INCI Name)	% w/w
Part A	
Arlamol™ HD (Isohexadecane)[1]	To 100
Black Iron Oxide	20.00
Beeswax White (Cera Alba)	13.00
OleoCraft™ LP-20 (Polyamide-8)[1]	8.50
Carnauba Wax	3.50
Span™ 83 (Sorbitan Sesquioleate)[1]	1.00
Part B	
Xiameter PMX-0245 (Cyclopentasiloxane)[2]	8.00
Part C	
Preservative	0.40

Suppliers: 1: Croda 2: Dow Corning

Table 7: This simple mascara formulation containing OleoCraft LP-20 (C2684) showed superior transfer-resistance to the commercial mascara

Water Resistance in Sunscreens

The OleoCraft range can be incorporated into a wide range of sun care formulations, from emulsions to clear oil sprays. In addition to modifying the rheology of the oil phase of a formulation, the exceptional film-forming capabilities of the OleoCraft range can also enhance the water resistance of formulations or provide a boost in SPF performance.

As active consumers seek assurance that their sunscreen will not be washed off after swimming or undertaking sporty beach-based leisure activities, water resistance is a key requirement for many sun care products.

Whilst test methods and associated claims on-pack vary around the world, in Europe tests for the water resistance of sunscreens are conducted according to COLIPA methodology. There are two permitted claims; 'water resistant' and 'very water resistant'. For a sunscreen to be labelled water resistant in Europe, it must retain at least 50% of its original SPF after 40 minutes immersion in water, whereas for a very water resistant claim, the sunscreen must retain at least 50% of its original SPF after 80 minutes immersion in water.

In order to investigate the water resistance efficacy of the OleoCraft polymers in comparison to market-leading polymers offering water resistance benefits, four sunscreen formulations were tested for in vivo water resistance using the COLIPA very water resistant test methodology, incorporating an immersion time of 80 minutes.

The formulations tested are shown in Table 8. As can be seen in the table, each formulation contained 1% of a film-forming polymer, either OleoCraft LP-20, PVP/Eicosene Copolymer or Acrylates Copolymer, whilst a control formulation, containing no polymer, was also prepared.

Ingredient (INCI Name)	Control Formulation, Formulation 2 (%w/w)	Formulation 2a (%w/w)	Formulation 2b (%w/w)	Formulation 2c (%w/w)
Part A				
Crodamol™ SFX (PPG-3 Benzyl Ether Ethylhexanoate)[1]	9.00	9.00	9.00	9.00
Eusolex OCR (Octocrylene)[2]	7.00	7.00	7.00	7.00
Eusolex 9020 (Butyl Methoxydibenzoylmethane)[2]	4.00	4.00	4.00	4.00
Eusolex OS (Ethylhexyl Salicylate)[2]	3.50	3.50	3.50	3.50
Arlacel™ 165 (Glyceryl Stearate (and) PEG-100 Stearate)[1]	1.50	1.50	1.50	1.50
Span™ 60 (Sorbitan Stearate)[1]	1.00	1.00	1.00	1.00
Xiameter PMX-0245 (Cyclopentasiloxane)[3]	1.00	1.00	1.00	1.00
OleoCraft™ LP-20 (Polyamide-8)[1]	-	1.00	-	-
PVP/Eicosene Copolymer	-	-	1.00	-
Titriplex III (Disodium EDTA)[4]	0.02	0.02	0.02	0.02
Part B				
Water (Aqua)	To 100	To 100	To 100	To 100
Pricerine™ 9091 (Glycerin)[1]	3.00	3.00	3.00	3.00
Crodafos™ MCK (Potassium Cetyl Phosphate)[1]	3.00	3.00	3.00	3.00
Acrylates Copolymer	-	-	-	1.00
Veegum Ultra (Magnesium Aluminum Silicate)[5]	0.40	0.40	0.40	0.40
Keltrol CG-SFT (Xanthan Gum)[6]	0.10	0.10	0.10	0.10
Part C				
Solaveil™ CT-12W (Aqua (and) Titanium Dioxide (and) Oleth-10 (and) Isodeceth-6 (and) Aluminum Stearate (and) Alumina (and) Simethicone (and) Phenoxyethanol)[1]	13.50	13.50	13.50	13.50
Part D				
SolPerForm™ 100 (Aqua (and) Hydrolyzed Wheat Protein/PVP Crosspolymer)[1]	2.00	2.00	2.00	2.00
Euxyl PE 9010 (Phenoxyethanol (and) Ethylhexylglycerin)[7]	1.00	1.00	1.00	1.00

Suppliers: 1: Croda 2: Merck 3: Dow Corning 4: Azelis 5: RT Vanderbilt 6: CP Kelco 7: Schülke

Table 8: Four sunscreen formulations were tested for in vivo water resistance using the COLIPA very water resistance test methodology. Each formulation contained 1% of a film-forming polymer, either OleoCraft LP-20, PVP/Eicosene Copolymer or Acrylates Copolymer, whilst a control formulation, containing no polymer, was also prepared

Figure 13 shows the results of the in vivo water resistance testing of these formulations. As can be seen below, the control formulation, which did not contain any film-forming polymers, retained only 41.4% of its SPF after 80

minutes immersion in water. As a result, the control formulation could not be labelled very water resistant according to European regulations.

Following the inclusion of 1% of a film-forming polymer in the formulation, it was shown that the retention of SPF was increased, resulting in Formulation 2a, 2b and 2c all passing the criteria needed for a very water resistant claim to be made on-pack. The addition of OleoCraft LP-20 to the formulation enhanced SPF retention following immersion in water to 53.4%, resulting in a very water resistant formulation and demonstrating that OleoCraft LP-20 exhibits comparable water resistance efficacy to two market-leading film-forming polymers.

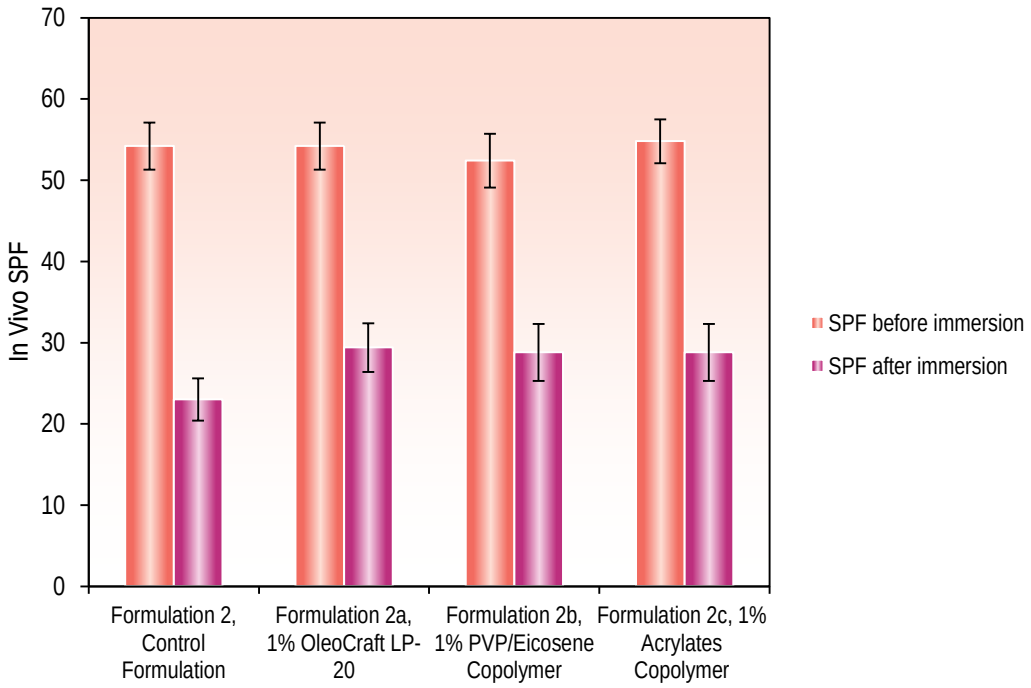

Figure 13: In vivo SPF results of formulations before and after 80 minutes immersion in water show that the addition of a film-forming polymer improves the retention of SPF of a sunscreen, allowing a very water resistant claim to be made in accordance with European regulations. The addition of 1% OleoCraft LP-20 to a formulation allowed 53.4% retention of SPF, demonstrating comparable performance to two market leading polymers

Generally, consumers desire a light skin feel without the tackiness, stickiness or tight skin feel commonly associated with polymers and traditional water resistant formulas.

To investigate the sensorial impact of the inclusion of 1% OleoCraft LP-20 on a formulation, the Control Formulation and Formulation 2a detailed in Table 5 were assessed by an expert sensory panel. The panel follows a strict testing routine, which includes calibration sessions and statistical reproducibility, with objective studies reviewing a variety of attributes in the pick-up, rub-out and after-feel stages of applying a skin care formulation.

This study found that there were no significant differences in the attributes listed in Table 9 when comparing the control formulation to the same formulation containing 1% OleoCraft LP-20. As a result, it was shown that at a low inclusion level in this type of formulation, OleoCraft LP-20 is able to improve the water resistance of a formulation in accordance with European regulations, allowing a very water resistant claim to be made on-pack, without detrimentally impacting the sensory properties of the formulation.

Pick-up	Rub-out	After-feel
Cohesiveness	Grease	Amount of residue
Firmness	Oil	Gloss
Peaking	Wax	Slipperiness
Stickiness	Spreadability	Stickiness
	Wetness	Thickness of Residue
	Thickness	

Table 9: The sensory attributes analysed by a trained panel of experts to assess the sensorial impact of OleoCraft LP-20 on a sunscreen formulation

SPF Boosting and Water Resistance

In order to investigate the benefits that higher inclusion levels of OleoCraft polymers bring to sunscreen formulations, three sun care emulsions were tested using the COLIPA very water resistant test method. Once again, one formulation was kept as a control, not including any film-forming polymers, whilst two other formulations contained 3% of either OleoCraft MP-30 or PVP/Eicosene Copolymer. The formulations are shown in Table 10.

Ingredient (INCI Name)	Control Formulation, Formulation 3a (% w/w)	Formulation 2a (% w/w)	Formulation 2b (% w/w)
Part A			
Solaveil™ XT-300 (Titanium Dioxide (and) Caprylic/Capric Triglyceride (and) Polyhydroxystearic Acid (and) Stearic Acid (and) Alumina)[1]	22.00	22.00	22.00
Crodamol™ GTCC (Caprylic/Capric Triglyceride)[1]	6.00	6.00	6.00
Crodamol™ CAP (Cetearyl Ethylhexanoate (and) Isopropyl Myristate)[1]	5.00	5.00	5.00
Crodafos™ CES (Cetearyl Alcohol (and) Dicetyl Phosphate (and) Ceteth-10 Phosphate)[1]	4.00	4.00	4.00
Crodamol™ IPM (Isopropyl Myristate)[1]	4.00	4.00	4.00
Crodamol™ ISIS (Isostearyl Isostearate)[1]	3.00	3.00	3.00
OleoCraft™ MP-30 (Polyamide-3)[1]	-	3.00	-
PVP/Eicosene Copolymer	-	-	3.00
Part B			
Water (Aqua)	To 100	To 100	To 100
Pricerine™ 9091 (Glycerin)[1]	5.00	5.00	5.00
Veegum Pure (Magnesium Aluminum Silicate)[2]	0.80	0.80	0.80
Keltrol CG SFT (Xanthan Gum)[3]	0.20	0.20	0.20
Titriplex III (Disodium EDTA)[4]	0.05	0.05	0.05
Part C			
Preservative	0.5	0.5	0.5

Suppliers: 1: Croda 2: RT Vanderbilt 3: CP Kelco 4: Azelis

Table 10: Three sunscreen formulations were tested for in vivo water resistance using the COLIPA very water resistance test method. Each formulation contained 3% of either OleoCraft MP-30 or PVP-Eicosene Copolymer, whilst a control formulation, containing no polymer, was also prepared

The graph in Figure 14 shows that the inclusion of **OleoCraft** MP-30 leads to a 44% increase in the static SPF of the formulation compared to the control (ie the SPF of the formulation prior to its immersion in water). It can also be seen that, similar to the results shown for **OleoCraft** LP-20 above, **OleoCraft** MP-30 also ensures that more than half of the SPF is retained following 80 minutes immersion in water, again allowing a very water resistant claim to be made on-pack in accordance with European regulations.

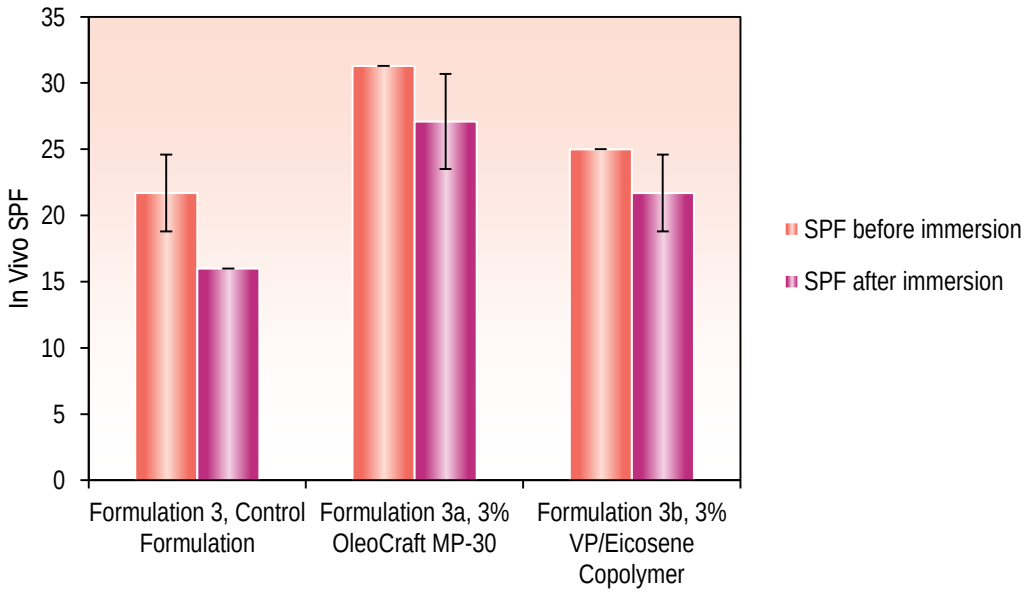

Figure 14: In vivo SPF results of formulations before and after 80 minutes immersion in water show that the addition of 3% OleoCraft MP-30 to a formulation allows a very water resistant claim whilst also boosting the static SPF by 44%, allowing an SPF30 claim to be made on-pack. The other film-forming polymer did not offer the same SPF boosting benefit

The SPF of the formulation containing **OleoCraft** MP-30 shows an SPF boost of 44%, from label SPF 20 to an SPF 30. When the formulation is subjected to 80 minutes immersion in water, the SPF boost does not collapse and the very water resistant claim is obtained. This attribute is not seen with the PVP/Eicosene Copolymer which, although allowing a very water resistant claim, only achieves an SPF 20 and does not exhibit the same SPF-boosting properties.

Pigment Dispersion

OleoCraft polymers contain low levels of residual acid and amine functionality. These functional groups allow for steric stabilisation of pigment dispersions, offering great benefits in colour cosmetic applications by providing higher and truer colour and gloss levels. It can also be utilised in sun care applications, where higher solid loadings at lower viscosities can be produced with inorganic sunscreens. Figure 15 shows the reduction in dispersion viscosity using the **OleoCraft** polymers at 1.5% w/w.

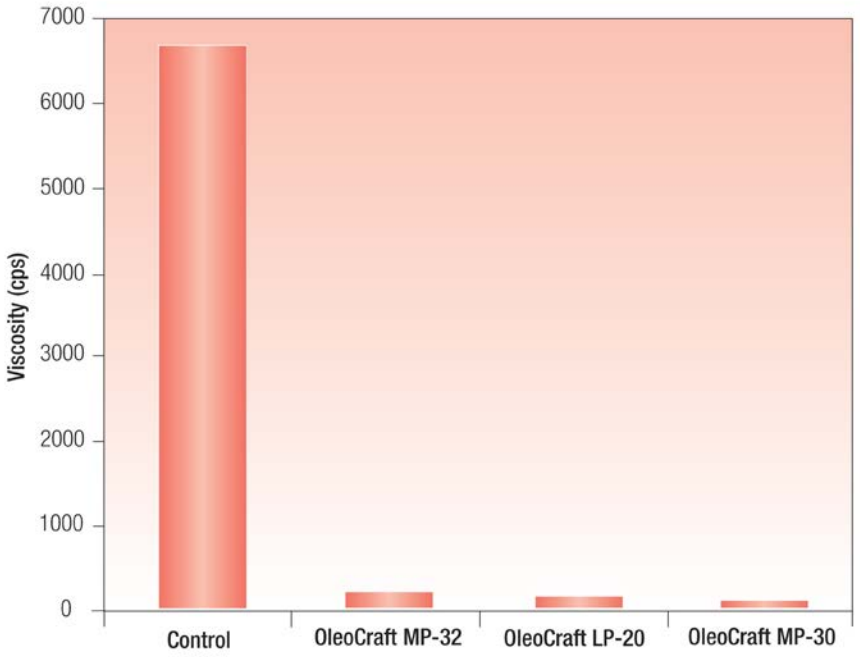

Figure 15: Viscosity measurements of zinc oxide (25%) in C12-15 Alkyl Benzoate dispersions after 24 hours

System Compatibility

Since **OleoCraft** polymers are suitable for inclusion in a wide range of applications, the below list has been designed to provide some initial hints and tips when formulating with the range.

- To increase the system compatibility:
  - Choose a polymer with a lower molecular weight, or
  - Adjust the polarity of the system
- To increase the resistance to syneresis:
  - Increase the concentration of the polymer, or
  - Choose a polymer with a lower molecular weight
- To increase gel clarity:
  - Increase the concentration of the polymer, or
  - Choose a polymer with a lower molecular weight
- To increase gel strength:
  - Increase the polymer concentration, or
  - Choose a polymer with a higher molecular weight

Sun Care Compatibility

As shown previously, the **OleoCraft** polymers have demonstrated SPF-boosting effects in addition to their ability to modify the rheology of the oil phase of a formulation, and are compatible with many organic and inorganic UV actives. Table 11 shows the compatibility of the **OleoCraft** range with a number of different organic sunscreen filters.

Active	SPF 30 (% w/w)	SPF 30+ (% w/w)
Butyl Methoxydibenzoylmethane	3.00	0.00
Benzophenone-3	4.50	0.00

Octocrylene	4.00	10.00
Ethylhexyl Salicylate	5.00	5.00
Ethylhexyl Methoxycinnamate	0.00	0.00
Homosalate	0.00	10.00
4-Methylbenzylidene	0.00	3.00
C12-15 Alkyl Benzoate	79.50	72.00
OleoCraft™ Polymer (OleoCraft LP-20, OleoCraft MP-32 or OleoCraft HP-31)	4.00	4.00
Observation:	Clear Gel	Clear Gel

Table 11: Compatibility of OleoCraft polymers with sunscreen actives

Formulation Guidelines

The OleoCraft polymers are low colour and low odour, high performance solids, proven to form crystal clear thermos-reversible gels. The products work with a range of high to low polarity oils, providing compatibility with an array of cosmetic ingredients. The OleoCraft polymers also create novel formats, from eye-catching clear sticks and balms to sprayable gels and emulsions, delivering real consumer benefits.

For Clear Lipsticks

To formulate an appealing clear lipstick, a mixture of low and high molecular weight OleoCraft polymers is recommended; 20% OleoCraft LP-20 and 10% OleoCraft MP-30 has been found to be an effective combination.

The use of one or two esters at around 40% inclusion has been found to be most successful. Very low or very high polarity esters can result in a hazy formulation, whilst large molecules will struggle to gel. As a result, the emollient oils Crodamol GTEH (Triethylhexanoin), Crodamol SFX (PPG-3 Benzyl Ether Ethylhexanoate), Crodamol STS (PPG-3 Benzyl Ether Myristate), Crodamol TN (Isotridecyl Isononanoate), Crodamol IPIS (Isopropyl Isostearate) and Crodamol GTIS (Triisostearin) are all highly recommended for use.

In order to make a stick clear, compatible oils must be incorporated into the formulation, as these oils are needed to solubilise the OleoCraft polymers. Prisorine™ 3515 (Isostearyl Alcohol), Crodamol AB (C12-15 Alkyl Benzoate) or Castor Oil are fantastic at providing this solubilisation and are recommended at a minimum of 15% inclusion. A mix of 10% Prisorine 3515 and 5% Castor Oil has been found to be particularly effective.

With this chassis formulation, you can add additional functional ingredients at up to 15% in order to broaden consumer appeal. These ingredients can include:

- Emollients and butters (Crodamol ISIS, Super Sterol Liquid, Liquiwax™ PolyEFA, Coca butter, Shea butter, Coconut oil)
- Actives (Volulip™, NG Shea Unsaponifiable)
- Pay-off enhancers (Crodamol W)
- Fragrances/Flavours
- Dyes
- Glitters

To improve the stability of the stick and significantly reduce the chance of syneresis, a temperature-controlled structuring step at the end of formulating is recommended. The formulation should be poured into a heated mould (~ 40°C) and the mould placed in an oven at 50°C for approximately one hour. After removing the mould from the oven, the formulation can then be left to cool down to room temperature. This additional step allows the polymer to create a more robust structure therefore, improving the lipstick stability.

Figure 16: It is possible to create eye-catching clear lipsticks using the OleoCraft polymers

For Pigmented Lipsticks

The recommended usage level to achieve a suitable structure for a pigmented lipstick is 20-25% of OleoCraft polymer. If used in combination with waxes, this can be reduced.

To optimise pay-off and firmness, it is recommended to use a combination of OleoCraft polymers with different molecular weights.

Heat all ingredients to 100°C, with stirring, to ensure homogeneity. If using metal moulds, spray the moulds with silicone, but leave them at room temperature as no other heating or cooling is required.

For Sun Care Applications

The OleoCraft polymers have very broad compatibility with organic and inorganic UV actives, as well as emollients that are commonly used in sun care. The polymers can be incorporated into a wide variety of formulations from sprays to lotions and gels to sticks. A usage level of 1-10% w/w in formulation is recommended, depending upon the desired product format.

OleoCraft LP-20 and OleoCraft MP-30 are highly recommended for use in sun care emulsions. A usage level of 1-3% w/w can improve the water-resistance of a sun care emulsion whilst providing a non-tacky skin feel.

OleoCraft polymers can be used in both water-in-oil (W/O) and oil-in-water (O/W) emulsions and sun care oil sprays. In W/O emulsions, 2-3% of the polymer provides film-forming benefits and increases the viscosity of the external oil phase, improving the formulation stability. Additional OleoCraft polymer can be used to increase the viscosity of the formulation.

In O/W emulsions, 2-3% of the polymer provides film-forming from the gelled internal oil phase.

OleoCraft polymers can easily be incorporated into sun care emulsions by combining them with the oil phase ingredients and heating the oil phase until the polymer dissolves. Ensure the selected polymer is soluble in at least one of the oils in the oil phase. Typically the polymer will dissolve when the oil phase reaches between 80–100°C but this is dependent on the polymer that is selected, the compatibility of the polymer with the oil phase ingredients and how thoroughly the mixture is agitated.

OleoCraft HP-31 is recommended for use in sun care oils due to its high polarity, but any of the OleoCraft polymers can be used in this application if they are compatible with the oil phase ingredients.

Sun oils have a low efficacy due to their Newtonian rheology. Efficacy can be improved by the inclusion of OleoCraft polymers to enhance the film formed by the oil on the skin.

The OleoCraft polymers can be used to formulate clear sun care oils where the viscosity of the formulation can be adjusted by changing the level of polymer in the formulation, allowing for the production of sprays to gels. To formulate a clear system ensure the OleoCraft polymer is compatible with the oils in the formulation. The

addition of Prisorine 3515 (isostearyl alcohol, approximately 5 %) will also improve the clarity of the formulation.

To provide optimum efficacy whilst maintaining a low viscosity and fine spray pattern in sun oil sprays, it is recommended that a high level of OleoCraft is used in combination with ethanol. The inclusion of ethanol disrupts the structuring effect of the OleoCraft but maintains its film-forming effects. A combination of 6% OleoCraft LP-20, 3% OleoCraft MP-30 and 10% ethanol is recommended.

[1]Storage and Appearance

Blooming is a normal phenomenon during long term storage of these polymers. It occurs when small amounts of residual terminator migrate onto the flaked resin surface, resulting in the appearance of a white powdery film over the pastille. It has no influence on the final performance of the product.

Resin compaction can occur with low softening point or high surface tack polymers such as the OleoCrafts. Pastilles can stick together due to increases in pressure (from stacked bags or pallets) or temperature (increases the surface tack). This physical property of each product is not a defect and can be managed by good storage and handling practices.

Showcase Formulations

Melting Cleansing Gel CH0001

This gel cleanser instantly transforms in to an oil when applied to the skin. Apply liberally before wiping off with a cotton pad to effectively cleanse your skin. The structuring polymer OleoCraft™ LP-20 creates this novel gel texture, ensuring easy application and avoiding any unwanted drips; whilst the inclusion of Crodamol™ STS keeps the formulation feeling light and leaves the skin feeling silky.

Ingredient (INCI Name)	Functionality	% w/w
Crodamol™ AB (C12-15 Alkyl Benzoate)[1]	Light bodying emollient	44.00
OleoCraft™ LP-20 (Polyamide-8)[1]	Low molecular weight gelling agent	12.00
Crodamol™ IPIS (Isopropyl Isostearate)[1]	Cleansing emollient	11.00
Crodamol™ ML (Myristyl Lactate)[1]	Emollient to improve stability	11.00
Crodamol™ STS (PPG-3 Benzyl Ether Myristate)[1]	Silicone-like emollient	11.00
Prisorine™ 3515 (Isostearyl Alcohol)[1]	Clarity enhancer	11.00

Suppliers: 1: Croda

Procedure:

Combine all ingredients. Heat to 80-85°C with stirring. Pour-off hot and leave to cool.

Appearance: Clear flowable gel; pH: n/a; Viscosity: 4550 cP ± 10% (Brookfield DV-I+, small sample adapter, spindle 27, 5rpm, wait 5 min, measure after 1 min, 25°C)
Stability: 3 months at 4°C, 25°C, 40°C, 45°C and 50°C and 7 x -10°C/+40°C 24 hour freeze-thaw cycle

Wash Your Troubles Away Gelled Cleansing Oil CH0003

Wash your troubles away with this light skin cleansing oil suitable for daily use. Crodamol™ IPIS easily removes impurities including waterproof make-up, whilst Crodamol™ SFX imparts a silky smooth skin feel. The inclusion of the mild and gentle emulsifier Cithrol™ 10GTIS ensures this formulation emulsifies immediately upon contact with water, allowing all of the emulsified oils and impurities to be effortlessly washed away. The addition of OleoCraft™ HP-31 gives the formulation its gel-like structure.

Ingredient (INCI Name)	Functionality	% w/w
Crodamol™ SFX (PPG-3 Benzyl Ether Ethylhexanoate)[1]	Light emollient	40.00
Crodamol™ IPIS (Isopropyl Isostearate)[1]	Cleansing emollient	20.00
Cithrol™ 10GTIS (PEG-20 Glyceryl Triisostearate)[1]	Surfactant that helps cleansing	10.00
Crodamol™ ML (Myristyl Lactate)[1]	Emollient to improve stability	10.00
Prisorine™ 3515 (Isostearyl Alcohol)[1]	Clarity enhancer	10.00
OleoCraft™ HP-31 (Polyamide-3)[1]	High polarity oil gelling agent	10.00

Suppliers: 1: Croda

Procedure:

Combine all ingredients. Heat to 80-85°C with stirring. Pour-off hot and leave to cool.

Appearance: Clear flowable gel; pH: n/a; Viscosity: 3300 cP ± 10% (Brookfield DV-I+, small sample adapter, spindle 27, 5rpm, wait 5 min, measure after 1 min, 25°C)
Stability: 3 months at 4°C, 25°C, 40°C, 45°C and 50°C and 7 x -10°C/+40°C 24 hour freeze-thaw cycle

Moisturising Lip Oil C2747

Inspired by the latest facial and hair care oils comes this new moisturising lip oil. Crodamol™ ISIS provides a novel mechanism of skin hydration, able to work in synergy with the natural skin barrier to significantly improve its performance for optimum hydration. The combination of emollients creates a shiny and glossy look but with no sticky feel. OleoCraft™ LP-20, an oil structuring polymer, provides a little body to the formulation ensuring the oil does not run off the skin. OleoCraft LP-20 also has film-forming benefits, helping to increase shine on the lips.

Ingredient (INCI Name)	Functionality	% w/w
Seatons Virgin Castor Oil (Ricinus Communic (Castor) Seed Oil)[2]	Clarity enhancer	To 100
Crodamol™ ISIS (Isostearyl Isostearate)[1]	Emollient providing skin hydration benefits	10.00
Crodamol™ ML (Myristyl Lactate)[1]	Solid emollient with light and dry skin feel and pay-off enhancer	10.00
OleoCraft™ LP-20 (Polyamide-8)[1]	Low molecular weight gelling agent	7.00

Suppliers: 1: Croda 2: Seatons

Procedure:

Combine all ingredients and heat to 75-80°C and stir until homogenous. Pour into suitable containers.

Appearance: Clear liquid; pH: n/a; Viscosity: 1300 cP ± 10% (Brookfield DV-III, spindle 27, 5rpm, 25°C)
Stability: 3 months at 4°C, 25°C, 40°C, 45°C and 50°C

PERSONAL CARE

Skin Nourishing Travel Wand C2743b

This crystal clear Skin Nourishing Travel Wand is ideal for targeting dry and tired skin with easy application and no mess. **OleoCraft™ LP-20** and **OleoCraft MP-32** are oil structuring polymers used to provide the structure for this convenient clear stick. **Crodamol™ ISIS** works in synergy with the natural skin barrier, providing optimised skin hydration, whilst **Liquid Medilan™ Ultra** aids in skin nourishment and repair. This crystal clear wand is perfect for immediate, on-the-go skin moisturisation, right where it's needed most.

Ingredient (INCI Name)	Functionality	% w/w
Crodamol™ IPIS (Isopropyl Isostearate)[1]	Light and easy spreading emollient with moisturisation properties	35.00
Seatons Castor Oil BP (Ricinus Communis (Castor) Seed Oil)[2]	Clarity enhancer	20.00
OleoCraft™ MP-32 (Polyamide-3)	High molecular weight gelling agent	17.50
Crodamol™ ISIS (Isopropyl Isostearate)[1]	Emollient providing superior skin hydration benefits	15.00
OleoCraft™ LP-20 (Polyamide-8)[1]	Low molecular weight gelling agent	7.50
Liquid Medilan™ Ultra (Liquid Lanolin)[1]	Skin repairing and wound healing agent	5.00

Suppliers: 1: Croda 2: Seatons

Procedure:

Combine emollients and **OleoCrafts**. Heat up to 90°C and stir until homogeneous. At ~85°C pour off into the stick packaging and transfer to the 50°C oven for approximately one hour to allow time to structure. Remove the stick from the oven and leave to cool to room temperature.

NB: When pouring stick formulations in packaging, ensure slight overfill to create a convex meniscus as the formulation will shrink during cooling.

Appearance: Clear pale yellow stick; pH: n/a; Viscosity: n/a
Stability: 3 months at 4°C, 25°C, 40°C, 45°C and 50°C

PERSONAL CARE

Ultra-Wear Foundation C2696a

This light and smoothing foundation is sure to stay with the combination of OleoCraft™ LP-20 and OleoCraft MP-30 delivering fantastic wear-resistant benefits. Cithrol™ DPHS provides a light skin feel while emulsifying this w/o foundation with Crodamol™ IPIS leaving a silky touch.

Ingredient/INCI Name	Functionality	% w/w
Part A		
Crodamol IPIS (Isopropyl Isostearate)[1]	Light and silky emollient with moisturising properties	12.00
Arlamol™ HD (Isohexadecane)[1]	Light and velvety emollient with excellent spreading properties	3.00
Cithrol DPHS (PEG-30 Dipolyhydroxystearate)[1]	W/O emulsifier	3.00
OleoCraft LP-20 (Polyamide-8)[1]	Low molecular weight gelling agent	3.00
OleoCraft MP-30 (Polyamide-3)[1]	High molecular weight gelling agent	2.00
Xiameter PMX-245 (Cyclopentasiloxane)[2]	Silicone	3.00
Candelilla wax	Bodying agent	1.00
Crodamol GTCC (Caprylic/Capric Triglyceride)[1]	Pigment wetting emollient	12.50
A310.01 Tudor Aspen (Titanium Dioxide)[3]	Pigment TiO_2	2.96
A403 Tudor Oak (Iron Oxide)[3]	Pigment red, yellow, black oxide of iron	0.31
A407 Tudor Willow (Iron Oxide)[3]	Pigment yellow oxide of iron	0.98
A311.30 Tudor Ash (Talc)[3]	Talc	8.25
Part B		
Water Deionised (Aqua)	-	To 100
Butylene Glycol	Humectant	5.00
Sodium Chloride	Emulsion stabiliser	0.50
Part C		
Euxyl PE 9010 (Phenoxyethanol (and) Ethylhexylglycerin)[4]	Preservative	0.80
Suppliers: 1: Croda 2: Dow Corning 3: Kingfisher Colours 4: Schülke		

Procedure:

Prepare the pigment dispersion with Tudor Aspen, Oak, Willow and Ash in Crodamol GTCC. Prepare Part A (OleoCrafts, Oils, Wax, Cithrol DPHS, Pigment dispersion) and heat it up to 85-90ºC. Prepare Part B and heat it up to 80-85ºC. Add Part B to Part A with fast stirring. Homogenise for 1min/100g at 10,000rpm. Stir to cool down and add Part C when below 40ºC

Appearance: Liquid brown-tinted emulsion; pH: n/a; Viscosity: 7,700cP (Brookfield Model DV-III, 25°C, spindle 27, 5 rpm, after 1 min)
Stability: 3 months at 4ºC, 25ºC, 40ºC and 2 months at 45ºC

PERSONAL CARE

Sun-Shielding Spray SPF15 C2685a

This easy to spray, crystal clear sun care oil forms a shield against the sun, ideal for convenient use on the beach. OleoCraft™HP-31 provides exceptional film-forming benefits whilst the inclusion of Crodamol™ SFX ensures effective solubilisation of organic filters whilst enhancing aesthetic appeal.

Ingredient (INCI Name)	Functionality	% w/w
Crodamol™ AB (C12-15 Alkyl Benzoate)[1]	Solubilising emollient	39.50
Crodamol™ IPIS (Isopropyl Isostearate)[1]	Light emollient	17.50
Crodamol™ W (Stearyl Heptanoate (and) Stearyl Caprylate)[1]	Emollient	17.50
Eusolex OCR (Octocrylene)[2]	Organic UVB filter	8.00
Tinosorb S (Bis-Ethylhexyloxyphenol Methoxyphenyl Triazine)[3]	Organic broad spectrum filter	6.00
Crodamol™ SFX (PPG-3 Benzyl Ether Ethylhexanoate)	Solubilising emollient with light sensory	5.00
Prisorine™ 3515 (Isostearyl Alcohol)	Clarity enhancer	5.00
OleoCraft™ HP-31 (Polyamide resin)[1]	Film former	1.50

Suppliers: 1: Croda 2: Merck 3: BASF

Procedure:

Part A was combined and heated to 90-100 °C with stirring until the OleoCraft HP-31 and the organic UV filters had dissolved in the oil phase. The formulation was allowed to cool to room temperature.

Appearance: Clear oil; pH: n/a; Viscosity: 27 cP ± 10% Brookfield, DV-I+, small sample adapter, spindle 21, 100rpm, 25°C
Stability: 3 months at 4°C, 25°C, 40°C, 45°C and 50°C
In vitro SPF (Croda): 18, Label SPF 15
In vitro UVAPF (Colipa 2011, Croda): 8, predicted to be PA+++

PERSONAL CARE

Smoothing and Conditioning Hair Oil C2744

No more hair oil running through your hand and onto the floor, **OleoCraft™ LP-20** makes applying this smoothing hair oil effortless! The oil structuring polymer creates an easy-to-handle gelled texture. On rubbing between your hands, the structure breaks down leaving the oils to be applied to your hair. The emollient oils ensure the hair is left feeling nourished and silky with no greasy feel at all.

Ingredient (INCI Name)	Functionality	% w/w
Crodamol™ IPM (Isopropyl Myristate)[1]	Light emollient with good spreading properties	23.00
Crodamol™ ML (Myristyl Lactate)[1]	Light, powdery feel emollient and structure modifier in combination with OleoCrafts	10.00
OleoCraft™ LP-20 (Polyamide-8)[1]	Low molecular weight gelling agent	7.00
Prisorine™ 3515 (Isostearyl Alcohol)	Clarity enhancer	10.00
Mineral Oil (Paraffinum Liquidum)	Light emollient	30.00
Xiameter PMX-0245 (Cyclopentasiloxane)[2]	Volatile silicone	20.00

Suppliers: 1: Croda 2: Dow Corning

Procedure:

Combine all ingredients and heat to approximately 80-85°C with stirring until homogenous, ensuring that the **OleoCraft LP-20** is completely melted. Leave to cool.

Appearance: Clear gel; pH: n/a; Viscosity: 2000cP (Brookfield Model DV-III, 25°C, spindle 27, 5 rpm, after 1 min)
Stability: 3 months at 4°C, 25°C, 40°C, 45°C and 50°C and 5 cycles Freeze & Thaw

Xiameter is a registered trademark of Dow Corning
Euxyl is a registered trademark of Schülke
Veegum is a registered trademark of RT Vanderbilt
Keltrol is a registered trademark of CP Kelco
Eusolex is a registered trademark of Merck
Titriplex is a registered trademark of Merck

These formulations were developed in Europe. Contact your local sales representative with enquiries as ingredient availability can vary by region.