



Keralenis

“Optimized delivery system designed for hair relaxers”

Keralenis* is a self-emulsifying delivery system designed to simplify hair relaxer production and provide enhanced functionality. **Keralenis** allows for ease in manufacturing as this complete emulsifying package creates stable relaxers at lower temperatures (65°C) as compared to most nonionic systems (75-80°C). It is comprised of an optimized ratio of anionic phosphate esters, an emollient and fatty alcohols, which enables the formulator to obtain all the benefits of Crodafos CES without phase inversion.

Keralenis possesses unique emulsifying properties that allow it to form multilayer lamellar structures within the emulsion that are markedly different to those of conventional emulsifying waxes. **Keralenis** emulsions exhibit a combination of natural substantivity, greater oil deposition and shear thinning (thixotrophy) to promote fast simultaneous release of oil and water-based actives. This translates to advanced hair relaxer quality, as hair will sustain less damage from the harsh chemicals used in hair relaxers and perms.

More than an emulsifier, **Keralenis** simplifies the formulation of stable relaxers that are proven to be fast acting with less scalp irritation, less cuticle damage and greater conditioning.

Product	INCI name	Appearance
Keralenis	Dicetyl Phosphate (and) Ceteth-10 Phosphate (and) Cetearyl Alcohol (and) Cetyl Alcohol (and) PPG-5 Ceteth-20	White to off-white waxy solid (pastilles)

Hair Relaxer Benefits

- Less hair damage from a relaxer
- Quicker penetration of alkali
- Shorter relaxation time
- Protection of the cuticle
- Minimisation of scalp irritation
- Easier application/better rinseability
- Substantive to hair
- Greater conditioning/added sheen

Keralenis – Designed for Hair Relaxers

Keralenis is designed to be the premier emulsifier for hair relaxers. It was created to maximise straightening without the extreme damage often associated with non-ionic emulsion systems. Based on Crodafos CES chemistry, **Keralenis** retains the benefits of Crodafos CES without the phase inversion associated with its relaxer systems. In order to demonstrate that **Keralenis** is as effective as Crodafos CES in relaxer systems, a series of experiments were conducted comparing a formulation containing **Keralenis** (BW-38) to the Crodafos CES formulation (BW-30) utilized in its initial launch.

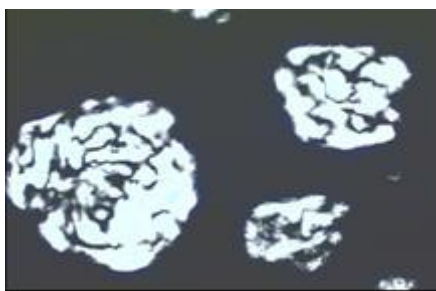
*The use of Keralenis and its applications in Personal Care are covered under U.S. Patent 6,117,915 issued to Croda Inc September 12, 2000. Additional patents pending.

Emulsion Structure – Helps to Safely Deliver Actives

Studies have shown that Crodafos CES is a superior emulsifier because of its ability to form multilayer lamellar structures (MLS). MLS are important to emulsions, as this type of liquid crystal has the capability of micro-encapsulation. Liquid crystals derived from Crodafos CES promote enhanced emulsion stability yet have the ability to break on contact with substrates, such as skin or hair, allowing for the delivery of actives. This helps to enhance penetration of actives and improve adhesion on the substrate's surface. Most importantly, an emulsion comprised of multilayer lamellar structures will help to reduce skin irritation, which is most often caused by the carrier system, or in the case of relaxer systems, the active ingredient sodium hydroxide (NaOH). Thus, a relaxer created with Crodafos CES is less damaging to the hair and scalp.

The emulsion structures of BW-38, containing **Keralenis**, and BW-30, containing Crodafos CES, were evaluated by microscopy under crossed polarisers. Crossed polarisers reveal if the emulsion exhibits liquid crystals and is then visually analyzed for multilayer lamellar structure formation.

Multilayer Lamellar Structure of Keralenis & Crodafos CES



Liquid crystal structure of BW-30
(Crodafos CES)

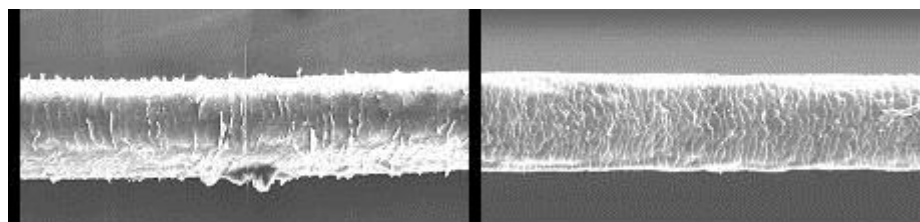


Liquid crystal structure of BW-38
(**Keralenis**)

Figure 1: Liquid crystal structure of relaxer formulas
(Magnification 400X, under crossed polarisers)

Evaluation of the Crodafos CES (BW-30) and **Keralenis** (BW-38) formulations show that both exhibit multilayer lamellar structures (Figure 1). This demonstrates that **Keralenis** emulsions have the ability to behave in a similar fashion to Crodafos CES emulsions.

Scanning Electron Microscope (SEM) Photos



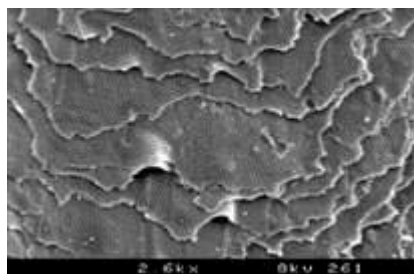
SEM image of hair relaxed with
Nonionic Emulsifier

SEM image of hair relaxed with
Crodafos CES BW-30

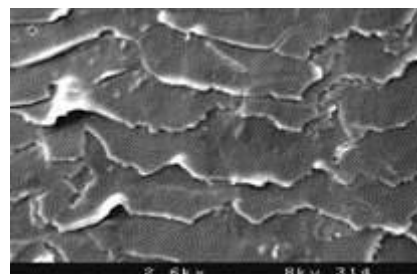
Figure 2: SEM images of relaxed hair samples from original Crodafos CES studies

Previously, hair fibres treated with a relaxer system containing Crodafos CES were compared to a relaxer system made with a nonionic emulsifier via SEM photos. These photos provided visible proof that the degree of damage hair sustains from a relaxer is **substantially lower** with Crodafos CES. These extraordinary effects are the result of the Crodafos CES emulsion providing simultaneous deposition of the oil along with immediate release of the water carrying the active (i.e., NaOH). This allows for quicker penetration of the OH ion, which shortens relaxing time and prevents hair from becoming over-processed. The combination of rapid relaxation and enhanced oil delivery by Crodafos CES helps reduce the amount of cuticle damage and scalp irritation while increasing the degree of conditioning.

To determine if **Keralenis** functioned similarly to Crodafos CES in relaxer formulations, SEM photos were taken of hair fibres treated with a relaxer containing **Keralenis** and a relaxer containing Crodafos CES.



SEM image of hair relaxed with BW-30
Crodafos CES



SEM image of hair relaxed with BW-38
Keralenis

Figure 3: SEM images of relaxed hair samples

Figure 3 illustrates that the hair relaxed with either **Keralenis** or Crodafos CES formulation shows the same level of protection against cuticle damage due to the relaxing process.

Average Dynamic Advancing Contact Angle Measurements – Demonstrates Protection from Hair Damage

“Healthy” hair can be described as the hair most similar in condition to the root end portion of the fibre. Normally this “undamaged” hair exhibits hydrophobic characteristics due to its rigid cuticle layer that is rich in surface fatty acids. Upon exposure to chemical treatments such as relaxing, hair tends to lose these natural surface protectants and exhibit a more hydrophilic (water loving) trait. Measuring the hair fibre for its resistance

to water, also known as Dynamic Advancing Contact Angle test, can assess damage associated with a specific process. Hydrophobic hair normally has a higher contact angle (greater than 90°) due to its water resistant nature. Evaluation of the hair fibre's contact angle after relaxer treatments normally results in a contact angle less than 90°, which is an indication of the hair surface's hydrophilicity. Keeping the hair fibre hydrophobic indicates a less damaging process.

Hydrophobicity of Hair Relaxed with Keralenis & Crodafos CES

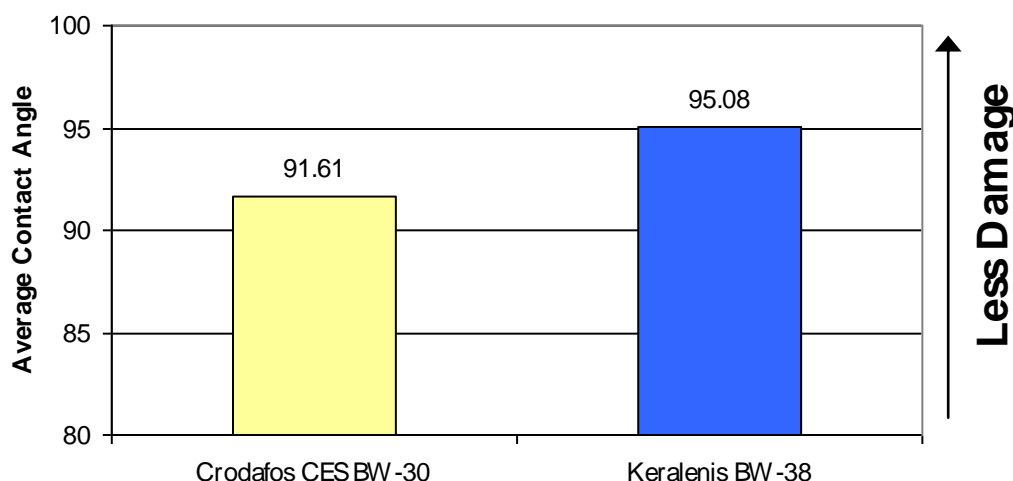


Figure 4: Average Contact Angle of Relaxed Hair Samples

Figure 4 represents the average dynamic advancing contact angles of hair fibres relaxed with either the **Keralenis** or Crodafos CES formulation. Both formulations maintain a hydrophobic quality on the hair fibre surface. **Keralenis** is able to display a slightly higher contact angle (more hydrophobic), illustrating that the liquid crystal structures are able to release oil onto hair fibres. Using **Keralenis** in a relaxer formulation will generate a superior formulation that will help protect the hair.

Salon Evaluation – Determines Consumer Perception

A salon evaluation was conducted to illustrate how, from a consumer's perspective, **Keralenis** can help to create a relaxer that will enhance the relaxation process. The salon assessment was carried out on 6 panelists and the relaxer was judged for both wet and dry hair properties.

For wet hair, several properties were evaluated during the various stages of the relaxation process. Immediately after the relaxer was applied to the hair, the ease of application, penetration and ease of rinsing were assessed. Following this, the product was assessed for combability and feel (smooth/slip). The hair was then shampooed to stop the relaxation process and was evaluated for sheen, effectiveness of curl removal (relaxation) and conditioning.

Dry hair was also assessed for its properties including combability, smooth/slip, sheen, effectiveness of curl removal (relaxation), body/fullness, lustre and manageability.

The Keralenis (BW-38) formulation scored excellent marks in all of the areas described above. In addition, all six panelists reported that the Keralenis (BW-38) formulation provided no irritation or tingling of the scalp.

These all prove that using Keralenis in a relaxer formulation will help to create consumer perceived benefits on both the hair and scalp.

Physical Characteristics

As an optimized, phosphate-based, self-emulsifying delivery system, it is necessary to neutralize the free fatty acids present in **Keralenis**. Because it is based on phosphate ester chemistry, it consists of complex esters of phosphoric acid, which unlike conventional soap-based emulsifiers give **Keralenis** its stability over an extremely wide pH range.

Keralenis is neutralized *in-situ* with any standard base during the addition of the 'active' to the formulation. Because the active in relaxer systems is normally sodium hydroxide or another strong base, the amount of base will need to be adjusted to accommodate the neutralization process. Calculation of the percent active to neutralize **Keralenis** can be achieved by using the equation below. The total percent active to be used in a **Keralenis** formulation will be the neutralization amount plus the active.

Grams of neutralizing base per gram of Keralenis:

$$A.V. * (0.70)/56110 * Y$$

A.V. = Acid value of Keralenis

Y = Molar equivalent weight of base
(given in Certificate of Analysis)

Typical Acid Value: 17-26

Neutralizing Base	Molar Equivalent Wt. (Y)
KOH	56.1
NaOH	40.0
Ca(OH) ₂	37.05
LiOH	23.94

Regulatory

INCI Name: Dicetyl Phosphate (and) Ceteth-10 Phosphate (and) Cetearyl Alcohol (and) Cetyl Alcohol (and) PPG-5 Ceteth-20

EINECS: 218-594-7 + Polymer + 267-008-6 + 253-149-0 + Polymer

Appearance: White to off-white waxy solid (pastilles)

Certified Sustainable Palm – Mass Balance

SP-Keralenis-MBAL is Croda's sustainable palm oil variant allowing customers to use sustainably sourced material if they wish. The product is manufactured by the RSPO's Mass Balance system. The Mass Balance supply chain allows certified sustainable palm oil material and non-certified material to be mixed throughout the supply chain but administratively monitors the mass of certified material produced and sold. The Mass Balance system is fully audited allowing buyers of the material to view the products life span. Another advantage of this system is that it actively encourages palm growers to produce sustainable palm and move towards a segregated supply chain system. By choosing these ingredients, you contribute to the production of sustainable palm oil. Products manufactured with sustainable palm oil do not in any way compromise on performance.

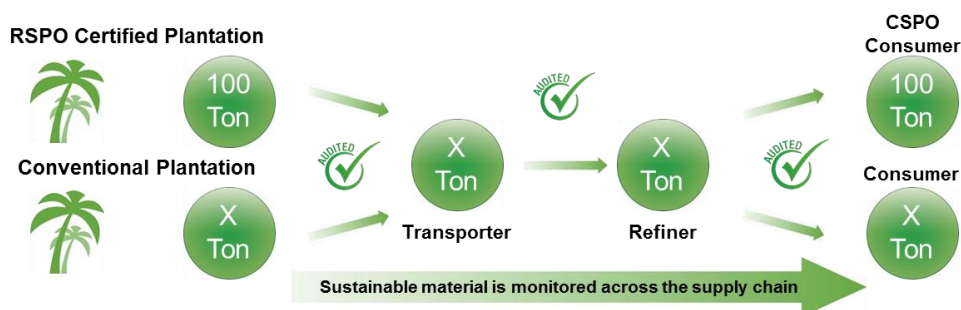


Figure 4: RSPO Mass Balance Supply Chain

Health and Safety

Keralenis can be considered an acceptable cosmetic raw material. A separate health and safety datasheet is available on request

PERSONAL CARE

Non-warranty

The information in this publication is believed to be accurate and is given in good faith, but no representation or warranty as to its completeness or accuracy is made. Suggestions for uses or applications are only opinions. Users are responsible for determining the suitability of these products for their own particular purpose. No representation or warranty, expressed or implied, is made with respect to information or products including, without limitation, warranties of merchantability, fitness for a particular purpose, non-infringement of any third party patent or other intellectual property rights including, without limit, copyright, trademark and designs. Any trademarks identified herein are trademarks of the Croda group of companies.
©2009 Croda Europe Ltd