

Technical Bulletin  
AarhusKarlshamn  
Lipids for Care



Lipex<sup>®</sup> Shea Butter  
Waxes and Surfactants

Natural Vegetable Functional



## Lipex® Shea Butter Waxes and Surfactants

### Introduction

This technical bulletin describes a range of new derivatives of shea butter developed for use in cosmetic and personal care applications. The aim of this range is to extend the use of shea butter into applications where the ordinary shea butter is unsuitable or difficult to work with, introducing new functionalities to the Lipex® Shea Butter Family.

The two ranges of derivatives, the Shea Waxes and the Shea Surfactants have give different options to the formulator. The shea waxes are emollients with a dry skin-feel, making it possible to formulate even lighter and non-oily skin care products with a shea butter content. The mild and gentle shea surfactants extend the use of shea butter into hair and body care, an area where the traditional shea butters have had limited applicability.

### Shea butter – a multifunctional raw material for cosmetics

Shea butter is obtained from the kernels of the shea tree, *Vitellaria paradoxa* (botanical synonym *Butyrospermum parkii*, which is also the currently adopted INCI name for shea butter). The trees grow in the semi-arid savannah woodland of western Africa, ranging from Senegal to Uganda. The main shea producing countries include Benin, Ghana, Nigeria, Burkina Faso and Ivory Coast, which are also the main sources of shea butter for AarhusKarlshamn.

All Lipex® Shea Butters and derivatives are made from crude shea butter that has been alkali refined to remove phospholipids and free fatty acids, followed by bleaching with a clay mineral to remove pigments. The final step before packaging is always deodorisation, a process utilising steam at low pressure to remove volatile components that give rise to undesired flavours. The processing steps used in making Lipex® Shea Butters efficiently remove all contaminants from the oil while still preserving the content of unsaponifiables (triterpene alcohols, phytosterols and tocopherols). Contaminants that are removed are for example metals from the soil and processing equipment, polyaromatic hydrocarbons from environmental pollution and solvent residues from the extraction and processing.

Shea butter is unique in its composition compared to other vegetable oils. The main component in shea butter – the triglycerides - is derived primarily from oleic and stearic acid, both comprising about 40-45 % of the fatty acids.

The other peculiarity of shea butter is its high content of unsaponifiable matter. Most vegetable oils contain less than 1 % of unsaponifiable matter, mainly Vitamin E (tocopherols) and phytosterols such as beta-sitosterol. Shea butter, in contrast, can contain between 4-10% of unsaponifiables, such as cinnamic acid esters of lupeol, alpha- and beta-amyrin and butyrospermol, collectively known as triterpene alcohols. These triterpene alcohol esters are known for their anti-inflammatory and skin repairing properties, making shea butter a popular ingredient in many type of cosmetic applications. Shea butter naturally also contains low amounts of Vitamin E and other phytosterols.

## **Wax esters from shea butter**

The shea waxes are prepared by converting the triglycerides found in natural shea butter into esters, giving a number of formulating advantages. First of all, the skin feel of the esters is different due to different viscosity and spreading properties. For semi-solid and solid esters we also see advantages in crystallisation with a more simple and robust crystallisation behaviour in the esters compared to the triglycerides.

## **Wax ester chemistry**

Wax esters are normally defined as esters between long-chain (C16-C24) fatty alcohols and long-chain (C16-C24) fatty acids. The fatty alcohols and the fatty acids may have varying degrees of unsaturation, leading to a large variety of available melting points in this group of ingredients. High-melting waxes are obtained by combining saturated fatty acids with saturated fatty alcohols. Consequently, liquid waxes consist of unsaturated compounds. Naturally occurring solid wax esters are found in beeswax and several plant waxes while the most known liquid wax ester is jojoba oil.

The Lipex® shea waxes derive their fatty acids from shea butter fractions that are selected to give the desired melting behaviour to the wax. The shea butter fractions are esterified with either solid fatty alcohols (cetyl alcohol) or liquid ones (oleyl alcohol). Apart from the wax esters, the Lipex® shea waxes contain small residual amounts of di- and triglycerides from the shea butter.

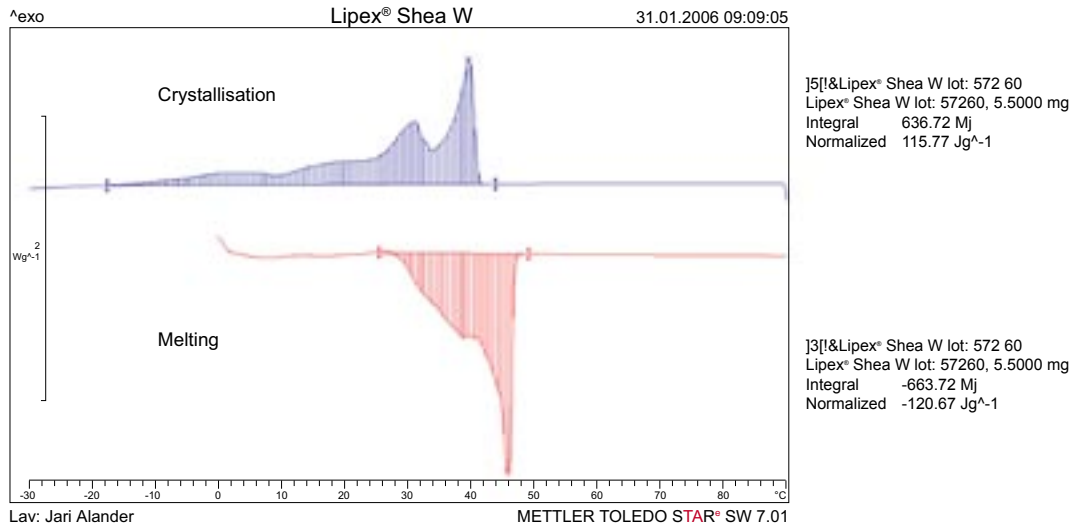
The level of unsaponifiable matter in the Lipex® shea waxes is high, 15-25 %. The main part of this is the fatty alcohol used in the synthesis. 3-5 % of the unsaponifiable matter originates from the triterpene esters found in the shea butter used for making the waxes.

### ***Lipex® Shea W (INCI: Shea Butter Cetyl Esters)***

#### **Semi-solid wax with dry skin feel**

Lipex® Shea W is a soft, off-white solid wax with a melting point around 43-47 °C. The melting and solidification behaviour as analysed by Differential Scanning Calorimetry is seen in Figure 1. It is seen that Lipex® Shea W melts in two fractions, one at 28-38 and the second at 40-47 °C, reflecting the combination of oleic and stearic acids in the shea butter. When cooling, the crystallisation starts at 41 °C, being essentially completed at 25 °C.

Figure 1



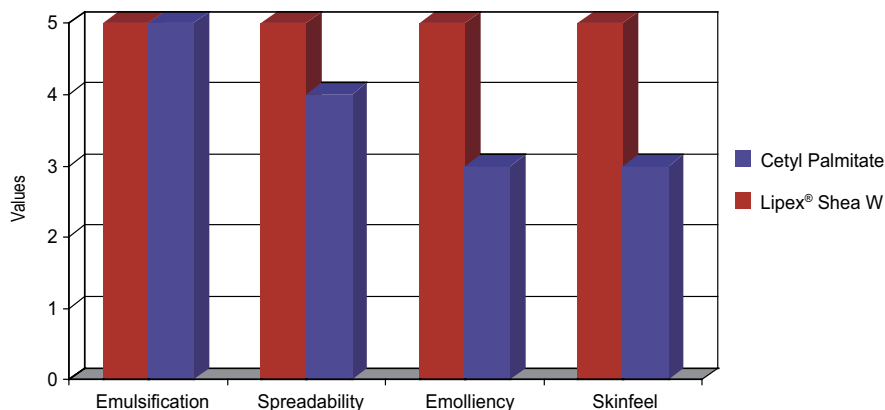
Lipex® Shea W crystallises neatly into the orthorhombic beta-prime crystal structure, making it well compatible with other waxes normally used in colour cosmetics and skin care.

## Structuring agent for creams and anhydrous products

Lipex® Shea W is a good emollient with a pleasant skin feel. Although the melting point is above body temperature, Lipex® Shea W melts partially when applied to the skin. This characteristic gives Lipex® Shea W its combination of low spreadability, dry skin feel and rich emolliency.

The semi-solid consistency of Lipex® Shea W makes it an ideal ingredient in skin care creams, ointments and body butters. It can be used to control the viscosity and consistency of emulsions and anhydrous products. Figure 2 shows the comparison of using 2% Lipex® Shea W versus 2% cetyl palmitate in a hydrating body lotion, evaluated by a trained panel. The differences in emolliency and skinfeel were obvious with a slight difference in spreading properties.

Figure 2: Hydrating body emulsion – Comparative test. Lipex® Shea W vs Cetyl Palmitate



Lipex® Shea W can also be used together with other waxes in colour cosmetics, including lipsticks, pencils and other anhydrous sticks such as antiperspirants, deodorants and fragranced body moisturising sticks.

Another use for Lipex® Shea W is in hair conditioners and treatments. It can be included at low concentrations in order to improve the hair softness, gloss and combing properties.

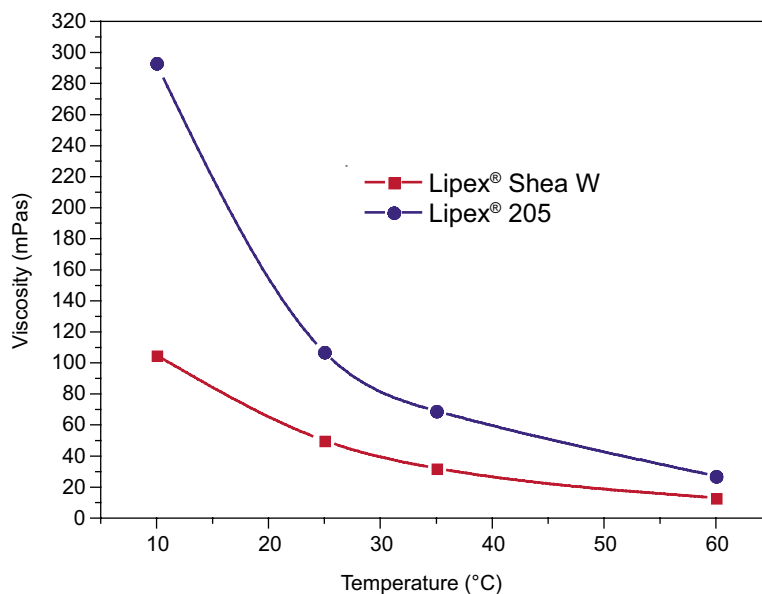
## Lipex® Shea WL (INCI: Shea Butter Oleyl Esters)

### Liquid shea wax for elegant skin feel

Lipex® Shea WL is a liquid wax that solidifies if cooled to approximately 0-3 °C.

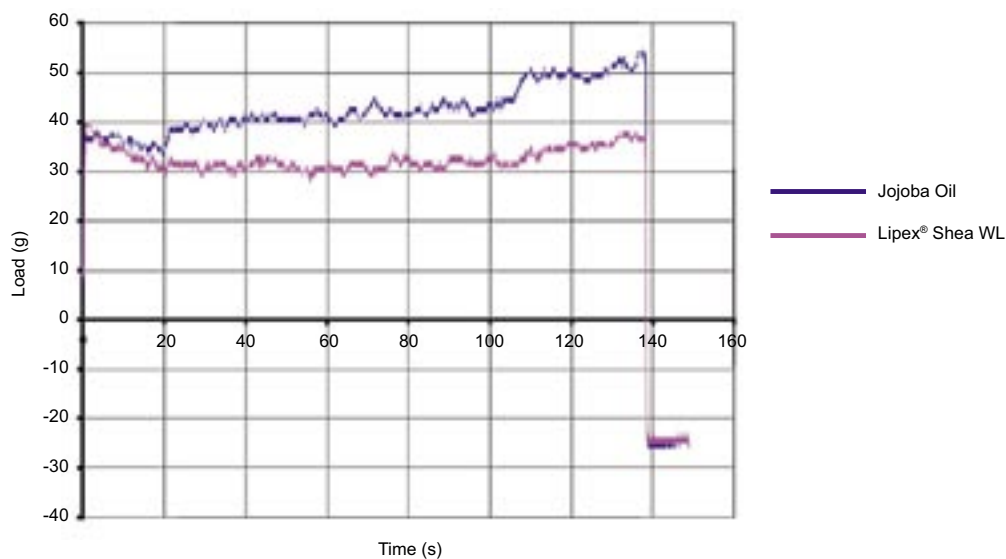
The viscosity of Lipex® Shea WL is lower than for liquid shea butter, Lipex® 205, over a wide temperature range (Figure 3).

**Figure 3: Viscosity as function of temperature for Lipex® WL and Lipex® 205**



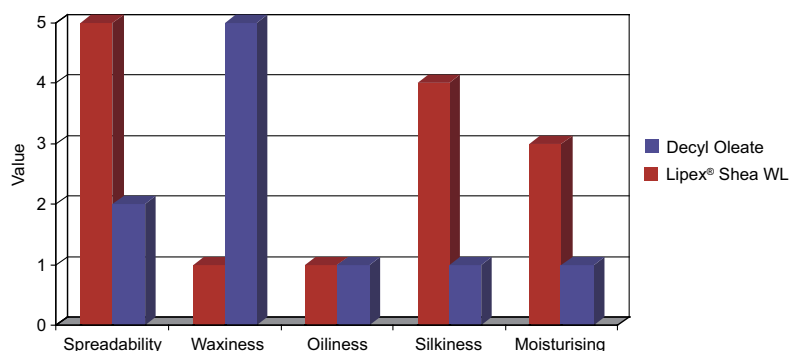
In a formulation Lipex® Shea WL can reduce the drag and friction on the skin which is desirable especially when used on sensitive skin areas. An eye care cream with Lipex® Shea WL was compared to the same formulation with Jojoba oil. Figure 4 shows the difference in friction between the two formulations, with a significant improvement shown by the shea ester.

**Figure 4: Friction characteristics of Lipex® Shea WL vs Jojoba oil**



Several improvements in formulation performance were seen in a comparison of a hydrating body lotion where Lipex® Shea WL was compared to decyl oleate (Figure 5).

**Figure 5: Hydrating body lotion – comparative test. Lipex® Shea WL vs Decyl Oleate**



Lipex® Shea WL or decyl oleate was added at 5% in a standard formulation and a trained panel evaluated the sensory properties. The decyl oleate formulation was perceived as more waxy and less spreadable while the Lipex® Shea WL emulsions gave a silky skin feel and better moisturisation. Both emulsions had an equally low oiliness.

## Emollient for facial care and for sensitive skin

The liquid character and the good spreadability of Lipex® Shea WL make it a suitable emollient for any type of skin care cream or lotion. It is well adapted for “non-oily” formulations for facial care and eye care products where the dry skin feel and lubricity of Lipex® Shea WL is especially appreciated.

It is also a mild emollient suitable for sensitive skin products and products for babies and children.

Lipex® Shea WL is compatible with all types of emollients and it is easy to emulsify with standard emulsifying systems.

## Surfactants from shea butter

Amphoteric and cationic surfactants are popular ingredients in many types of hair and body care products. Amphoteric surfactants are generally regarded as milder compared to anionics and due to their partially cationic character, they have some conditioning effects as well as cleansing ability.

### *Alkylamide surfactant chemistry*

The Lipex® Shea surfactants are both based on derivatives of N,N-dimethylaminopropylamine which is reacted with the shea butter to form an N,N-dimethylaminopropylamide. The amide is further reacted to create the betaine or trimonium chloride. For further information on the chemistry of amidopropyl betaines and cationic surfactants, see for example reference 1.

### *Toxicity tests*

The following eye and skin irritation tests have been carried out by Institut Dr Schrader in Holzminden, Germany.

Acute irritation potential to mucous membranes has been evaluated by the Hen's Egg Chlorio-allantonic Membrane (HET-CAM) Test, as alternative to the Draize-Test on rabbit eyes (OECD Guideline No. 405). The test is based on the Standard Operating Procedure (SOP) of the COLIPA project "Methodology Alternatives, Standard Operating Procedure (2nd edition). The calculated irritation potentials and estimated in vivo irritation statements are reported in Table 1.

**Table 1: In vitro (HET-CAM) estimations of eye and mucous membrane irritation**

Lipex® Shea Betaine at 1% in PBS	Irritation potential 0.20	"Slightly irritant"
Lipex® Shea Betaine at 6% in PBS	Irritation potential 0.30	"Slightly irritant"
100% of Lipex® Shea Betaine	Irritation potential 1.01	"Moderately irritant"
Lipex® Shea Q at 1% in PBS	Irritation potential 0.74	"Slightly irritant"
Lipex® Shea Q at 6% in PBS	Irritation potential 0.80	"Slightly irritant"
100% of Lipex® Shea Q	Irritation potential 1.59	"Irritant"
Reference substance: Texapon ASV at 5% in PBS	Irritation potential 1.00	"Moderately irritant"

Potential irritant effect or contact allergy caused by Lipex® Shea Betaine or Lipex® Shea Q was evaluated by means of a single application closed epicutaneous patch test according to Korting et al. (2001).

The results are presented in Table 2.

**Table 2: Human closed patch tests for skin irritation**

Lipex® Shea Betaine at 1%	17 reaction points	"Very well tolerated"
Lipex® Shea Betaine at 6%	33 reaction points	"Well tolerated"
Lipex® Shea Q at 1%	17 reaction points	"Very well tolerated"
Lipex® Shea Q at 6%	27 reaction points	"Well tolerated"
Reference substance: Sodium Lauryl Sulphate at 0.3%	127 reaction points	"Not tolerated"

In summary it can be concluded that performed evaluations indicate, for both Lipex® Shea Betaine and Lipex® Shea Q, very well tolerated and mild products.

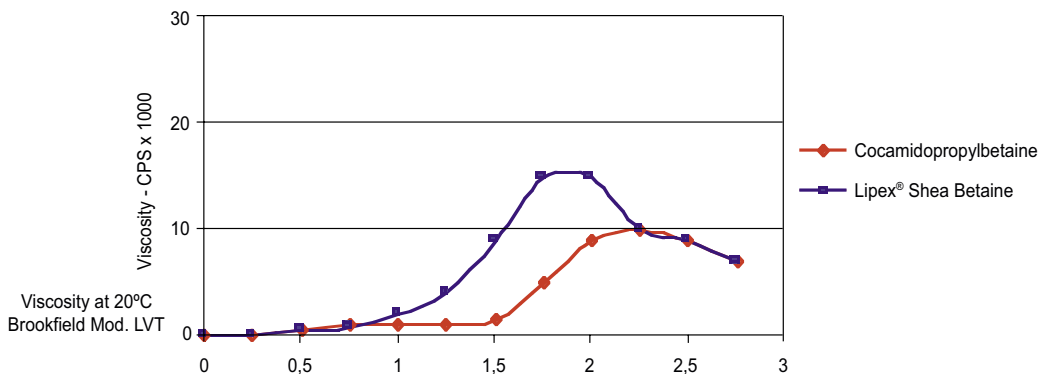
### ***Lipex® Shea Betaine (INCI: Shea Butteramidopropyl Betaine)***

#### **Amphoteric surfactant for improved hair properties**

Lipex® Shea Betaine is a viscous liquid comprising the surfactant diluted in water to an active content of 30 %. It is free from polyethylene glycol and other ethoxylated materials.

Due to the high ability to form liquid crystals in combinations with anionic surfactants, Lipex® Shea Betaine has both good viscosity building and foam stabilising properties. Figure 6 shows the viscosity response on increased sodium chloride concentration in a simple shampoo formulation in comparison with a traditional cocamidopropylbetaines at a concentration of 0.9%.

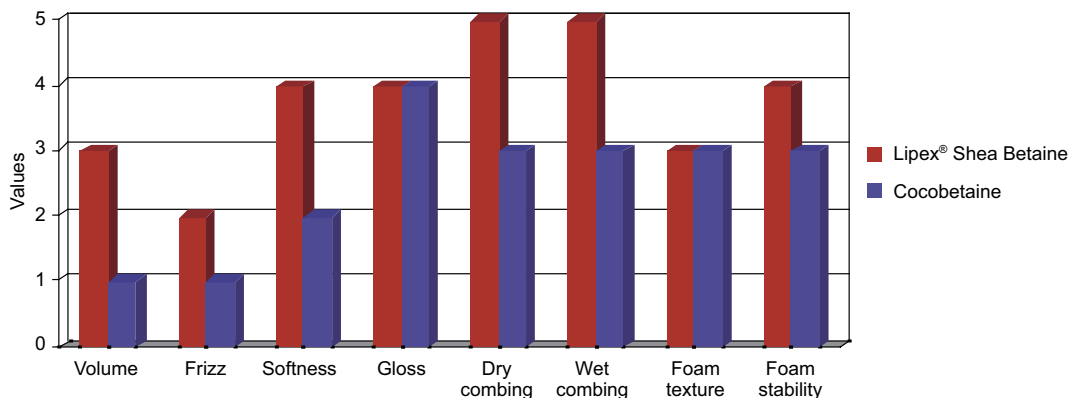
**Figure 6: Shampoo - Comparative test of thickening behaviour.**



**Lipex® Shea Betaine vs Cocamidopropylbetaine**

A further test was conducted on hair tresses by a trained panel. Lipex® Shea Betaine or cocamidopropylbetaines at 3% were compared in a shampoo formulation. The results are presented in Figure 7.

**Figure 7: Shampoo – comparative application test.**



**Lipex® Shea Betaine vs cocamidopropylbetaine**

Significant improvement was seen in hair volume, reduction of “frizz” and wet and dry combing properties in the formulation with Lipex® Shea Betaine. The foam stability was also slightly improved while the foam creaminess was equal.

**Ingredient for shampoos and body washes**

Lipex® Shea Betaine is well suited for inclusion in shampoos, shower gels, body washes and liquid soaps. It is mainly suitable for opaque and translucent formulations, clear formulations being more difficult to obtain due to the strong liquid crystal forming ability of the long chain betaines. Lipex® Shea Betaine is used either alone or in combination with cocamidopropylbetaines to supplement anionic surfactants such as sodium lauryl ether sulphates or carboxylates.

Lipex® Shea Betaine is used in these formulations as a primary mild detergent. It also acts as an auxiliary thickener and foam stabiliser. It also reduces the irritation potential of more aggressive surfactants in the formulation.

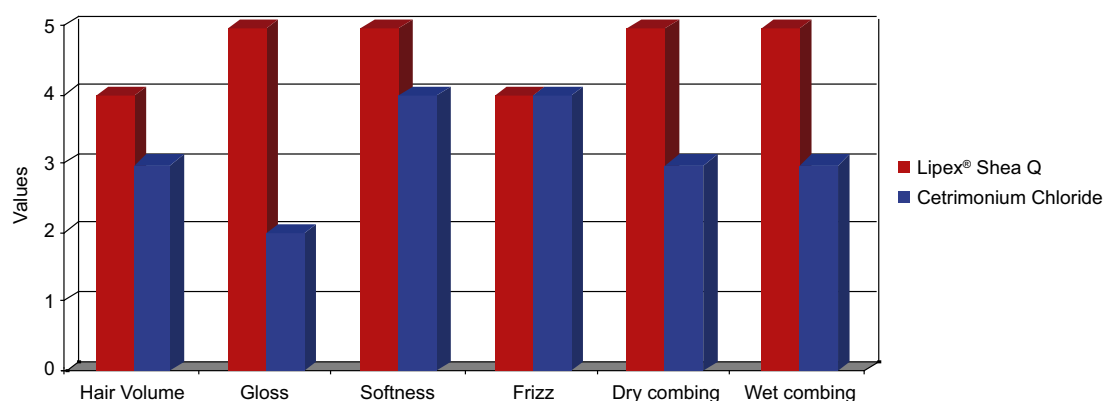
## **Lipex® Shea Q (INCI: Shea Butteramidopropyltrimonium Chloride)**

### **Cationic conditioning agent**

Lipex® Shea Q is a low-viscous liquid comprising the surfactant diluted in water to an active content of 25%.

Lipex® Shea Q was tested for functionality at 1% active concentration in a simple conditioner formulation versus cetrimonium chloride. Hair tresses treated with the formulations were evaluated by 10 experienced panellists and graded on a scale from 1-5. The results are shown in Figure 8.

**Figure 8: Hair conditioner – Comparative application test. Lipex® Shea Q vs Cetrimonium Chloride.**



Lipex® Shea Q shows significant improvement in hair gloss, softness and volume compared to a standard conditioning agent (cetrimonium chloride). The wet and dry combing properties are also improved, showing the advantages of formulating with this cationic shea butter surfactant.

### **Conditioner ingredient and cationic emulsifier**

Lipex® Shea Q is a cationic surfactant with good substantivity to hair and skin. This makes Lipex® Shea Q a good ingredient for hair conditioners and masks. It can be added in amounts ranging between 1-5 % of the conditioner formulation. It can also be combined with traditional conditioning agents such as alkyltrimonium chlorides.

Lipex® Shea Q can also be used as a cationic emulsifier in combination with non-ionic surfactants when creating novel product types such as in-shower body moisturisers. The concentrations used range between 2-3 % of the formulation.

## **Formulations and formulation guidelines**

Please consult the AarhusKarlshamn's formulary for formulations with the Lipex® Shea derivatives.

## **References**

1. O'Lenick, A.J., "Surfactants: Strategic Personal Care Ingredients", Allured Publishing Corp, 2005 (ISBN 1-932633-08-1)

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