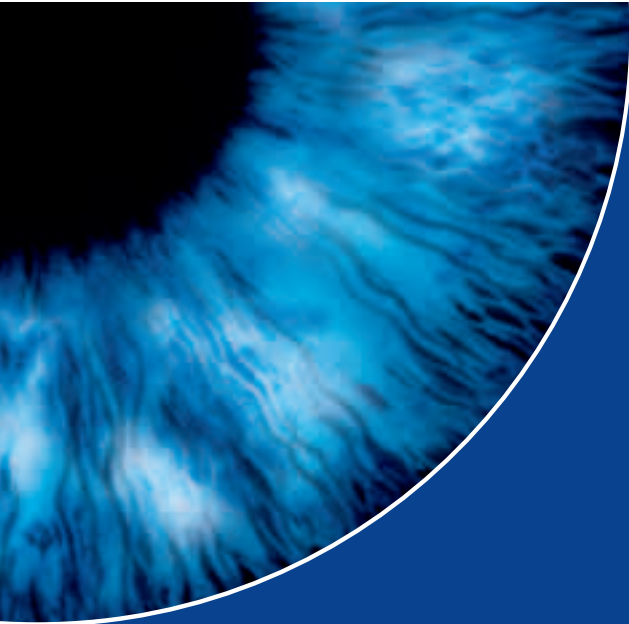




# Euperlan® Pearlescent Concentrates

Attractive effects in body cleansing and home care products



# Think Cognis

Cognis is the world's largest producer of natural-source oleochemical feedstocks. Our comprehensive know-how is founded on an experience base that goes back 160+ years. Natural oils and fats such as coconut and palm kernel oil are the sources of our products, which are offered in various processing grades of identical quality throughout the world.

With our comprehensive chemical and engineering expertise and diverse technology platform, Cognis delivers specific solutions that are consistently aligned to dermatological compatibility, application reliability, consumer safety and a superior performance profile. As an international corporation, Cognis achieves annual sales of three billion euro with more than 8,100 employees at around 30 sites worldwide and customers in over 100 countries.

We provide our customers with oleochemical raw materials, additives, formulation and marketing concepts as well as our developmental expertise and applications know-how relating to numerous industrial markets – including cosmetics, body care, detergents and cleansers, food additives, nutrition and health, polymers, coatings and inks, textiles, plant protection, oil drilling and automotive.

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# Scintillating product and process performance

Performance-aligned body and home care products can be positioned even more successfully if they are visually appealing and their inherent values are more readily apparent. With Euperlan<sup>®</sup>, Cognis offers a wide range of pearlescent concentrates impart a distinctive iridescence and give market products a singularly high-quality appearance, enhancing the value of their active constituents. In addition, these pearlizers facilitate particularly flexible, fast and cost-efficient production.

## Brilliant effects from wax and light

Pearlescent waxes generate brilliant, milky sheen effects. Although pearlescent concentrates are rather difficult to dissolve in surfactant systems, they are readily dispersible. Within a surfactant matrix, they form small, uniform, leaf-like crystals that reflect the light to generate pearlshine effects. Pearlescent waxes are usually directly embedded in surfactant-containing formulations in a hot process at temperatures of approximately 70–75 °C. This requires energy and time – both of which are costly.

Cold-processing product solutions are thus always going to be the preferred alternative in modern manufacturing processes. Euperlan<sup>®</sup> pearlescent concentrates are wax dispersions that can be readily incorporated in the cold process, thus substantially reducing the energy and time requirement in the manufacture of market products. The result is an economically optimized production capability coupled with the possibility of manufacturing larger batches within the same timeframe.

## Euperlan<sup>®</sup> pearlescent concentrates for top quality results

As one of the world's leading suppliers of raw materials and complete formulation concepts for home and personal care applications, Cognis offers decades of experience in the manufacture of a wide range of high quality pearlescent concentrates – the Euperlan<sup>®</sup> portfolio. Aside from their economic benefits over the hot dispersion process, liquid Euperlan<sup>®</sup> pearlizers can also be relied upon to produce impressive, high-quality results. The products of the Euperlan<sup>®</sup> series ensure that the pearlescent effect in the end product remains uniform. They create constant production conditions enabling consistent, batch-independent pearlescent performance. And they can be readily integrated within continuous mass production and mixing processes.



Visual effects with pearlescent concentrates			
Product	INCI*	Appearance	Apparent density in g/cm <sup>3</sup>
<b>Anionic</b>			
Euperlan® PK 771 Pearl Effect	Sodium Laureth Sulfate (and) Glycol Distearate (and) Cocamide MEA (and) Laureth-10	 1%                      3%                      5%	Stability: 45 °C 1.025 – 1.035
Euperlan® PK 810 Pearl Effect	Glycol Distearate (and) Sodium Laureth Sulfate (and) Cocamide MEA (and) Laureth-10	 1%                      3%                      5%	Stability: 45 °C 1.025 – 1.035
Euperlan® PK 900 Pearl Effect	PEG-3 Distearate (and) Sodium Laureth Sulfate	 1%                      3%                      5%	Stability: 45 °C 1.035 – 1.045
<b>Amphoteric</b>			
Euperlan® PK 3000 Pearl Effect	Glycol Distearate (and) Laureth-4 (and) Cocamidopropyl Betaine	 1%                      3%                      5%	Stability: 45 °C 1.025 – 1.035
Euperlan® PK 4000 Pearl Effect	Glycol Distearate (and) Laureth-4 (and) Cocamidopropyl Betaine	 1%                      3%                      5%	Stability: 45 °C 1.030 – 1.040
<b>Amphoteric/Anionic</b>			
Euperlan® PK 4500 Intensive Pearl Effect	Glycol Distearate (and) Cocamidopropyl Betaine (and) PEG-7 Glyceryl Cocoate (and) Sodium Laureth Sulfate	 1%                      3%                      5%	Stability: 45 °C 1.030 – 1.040

\* International Nomenclature of Cosmetic Ingredients

(Fig. 1) Achievable visual effect with various pearlescent concentrates at 1, 3 and 5% input concentrations under the application conditions encountered in a typical surfactant system.

### Flexible formulations with Euperlan® pearlescent concentrates

The Euperlan® PK product group contains a wide range of cold-processing pearlescent concentrates supplied to a high quality standard worldwide. It includes liquid to medium-viscosity, aqueous dispersions of pearlescent waxes based on anionic, nonionic or amphoteric surfactant systems. The pearlescent effect in body and home care products can be adjusted to various degrees of brilliance, luster, silkiness, coarseness/ fineness or sheen intensity, depending on the structure of the wax.

The desired pearlshine density and brilliance in the end formulation can be controlled by selection and dosage of the pearlescent concentrate (Fig. 1). Higher concentrations increase pearlescent intensity and the whiteness/milkiness of the finished product. The versatility built into the Euperlan® PK portfolio ensures flexibility in generating the desired effects, and that these effects are kept uniform in appearance in the relevant body or home care products. It also offers ideal flexibility for ensuring rapid and effective response to new market trends.

# Euperlan® for stable formulations

The challenge for formulators of opaque, pearlshine body or home care products is that of ensuring the stability of the pearlescent concentrate incorporated in the surfactant system. Because it is imperative that market products retain their in-store integrity with zero separation and settling phenomena, if they are to be perceived as attractive high-performers.



## Stokes' law for opaque and pearlescent formulations

The stability of pearlescent surfactant formulations is substantially influenced by factors such as density and viscosity. The density and viscosity of a formulation can be modified by incorporating the appropriate combination of organic viscosity regulators (Dehydol® LS3 Deo-N, Alypon® F) and electrolyte concentrations. Polyfunctional additives such as Lamesoft® PO65 or Cetiol® LDO, and polyols also influence the viscosity of the surfactant formulations. Stokes' law may be applied to determine the susceptibility of dispersed systems to separation.

According to Stokes, the tendency of the pearlescent particles to separate is influenced by the density differential between the disperse phase (inner crystal phase) and the continuous matrix (surfactant phase). Consequently, the lower the density differential and the smaller the particle size, the smaller is the risk of separation of the pearlescent wax.

### Stokes' law

$$v = \frac{g \cdot Q \cdot d^2}{18 \cdot \eta}$$

- v Sedimentation rate  
g Gravity constant  
Q Difference between apparent density of pearlescent concentrate and density of formulation  
d Diameter of pearlescent particles  
η Viscosity of formulation

### Formulation advantages:

- High stability
- Density and viscosity can be adjusted as required
- Possibility of adding polyfunctional adjuvants
- Effects achieved can range from silky sheen and brilliant shine to metallic pearlescence

Product profile of Cognis' pearlescent concentrates at a glance						
	Euperlan® PK 771 Benz	Euperlan® PK 810 AM	Euperlan® PK 900 Benz-W	Euperlan® PK 3000 AM	Euperlan® PK 4000	Euperlan® PK 4500 Benz
Dry residue (%)	approx. 46	approx. 38	approx. 37	approx. 43	approx. 63	approx. 54
Wax content (%)	approx. 23	approx. 20	approx. 20	approx. 25	approx. 40	approx. 40
Anionic surfactant (%)	approx. 20	approx. 13	approx. 17	–	–	< 5
Nonionic surfactant (%)	–	–	–	–	–	< 5
Amphoteric surfactant (%)	–	–	–	approx. 6	approx. 7	< 5
Nonionic dispersant (%)	< 5	< 5	–	approx. 12	approx. 15	< 5
Apparent density (g/cm <sup>3</sup> )	1.025 – 1.035	1.030 – 1.040	1.039 – 1.049	1.023 – 1.033	1.030 – 1.040	1.030 – 1.040
Preservation	0.5% Benzoic Acid	0.5% Formic Acid	0.85% Benzoic Acid	0.3% Formic Acid	Unpreserved	0.3% Benzoic Acid
Pumpable	no	yes	yes	yes	yes	yes

(Fig. 2) Cognis offers a wide range of pearlescent concentrates within its Euperlan® portfolio. The decision as to which product is best suited to an application depends on the specific requirements and desired effects.



### Influence of viscosity

Viscosity is one of the major factors affecting pearler stability in surfactant-containing formulations. It is advisable to ensure that the viscosity of the final product is kept above a minimum of 4,000 mPas. In view of the fact that viscosity decreases with increasing temperature, a certain viscosity allowance should be provided. In the case of lower-viscosity formulations, the aim should be to achieve the best possible coincidence between the apparent density of the wax particles in the pearlescent concentrate and the relative density of the surfactant matrix. The viscosities of surfactant-containing preparations are normally adjusted using electrolytes such as sodium chloride (NaCl), such additions serving to increase density. High electrolyte concentrations have a negative effect on pearler stability, promoting pearlescent particle agglomeration, which in turn can lead to product instabilities. It is thus advisable to select a balanced formulation concept comprising additives such as organic viscosity regulators, polyfunctional performance adjuvants and suitable electrolyte concentrates (Fig. 3).

### Influence of density

Depending on the composition and the manufacturing process, the wax particles in the various Euperlan® PK types can exhibit different apparent densities (Fig. 4). These are determined by embedding the wax dispersions concerned in common salt solutions of a known density and maintaining the complex at a temperature of 45 °C for four hours. After storage for a further 48 hours, the degree of separation of the pearlescent particles in the various salt solutions is measured. In stable systems, the density of the wax particles is the same as that of the salt solution, which is then taken as the apparent density figure (Fig. 5). The density of the external surfactant matrix of end products is controlled by selecting an appropriate surfactant system and modifying its concentration (Fig. 6). The density of the basic formulation can be adapted to the apparent density of all the Euperlan® PK types used by ensuring a balanced combination of the surfactants employed and appropriate addition of electrolytic salts (sodium chloride) (Fig. 7).

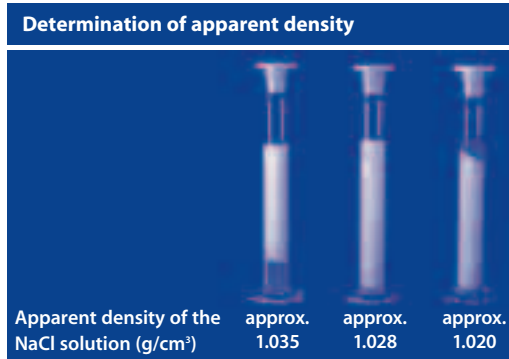
Density and viscosity of formulations			Density	Viscosity
<b>Plantapon® ACG 35</b>	Secondary surfactant	Disodium Cocoyl Glutamate	+	-
<b>Plantacare® 1200 UP</b>	Secondary surfactant	Lauryl Glucoside	o	++
<b>Plantacare® K 55</b>	Primary/secondary surfactant	Lauryl Glucoside (and) Cocamidopropyl Betaine	+	++
<b>Dehyton® PK 45</b>	Secondary surfactant	Cocamidopropyl Betaine	+	++
<b>Texapon® SB 3 KC</b>	Secondary surfactant	Disodium Laureth Sulfosuccinate	+	-
<b>Dehyton® DC</b>	Secondary surfactant	Cocoamphodiacetate	++	++
<b>Arlypon® F</b>	Associative thickener	Laureth-2	-	++
<b>Dehydol® LS 3 DEO-N</b>	Associative thickener	Laureth-3	-	++
<b>Lamesoft® PO 65</b>	Skin and hair care additive	Coco-Glucoside (and) Glyceryl Oleate	-	+
<b>Cetiol® LDO</b>	Skin and hair care additive	Dicaprylyl Ether (and) Lauryl Alcohol	-	+
<b>Glycerin</b>	Polyol	Glycerin	++	o
<b>Sorbitol</b>	Polyol	Sorbitol	++	+
<b>1,2-Propylene Glykol</b>	Polyol	Propylene Glycol	++	-
<b>PEG 400</b>	Polyol	PEG 8	+	-
<b>Xanthan Gum</b>	Structuring polymer	Xanthan Gum	o	++
<b>Carbopol Aqua SF 1</b>	Structuring polymer	Acrylates Copolymer	o	++

++ Strong influence | + Moderate influence | o No influence | - Reducing  
 (Fig. 3) Possibilities for modifying the viscosity and density of the base formulation in order to adapt it to the apparent density of the pearlescent concentrate.



Apparent density of selected Euperlan® pearlescent concentrates	
Product	Apparent density in g/cm <sup>3</sup>
Euperlan® PK 3000	1.023 – 1.033
Euperlan® PK 4000	1.030 – 1.040
Euperlan® PK 4500	1.030 – 1.040
Euperlan® PK 771	1.025 – 1.035
Euperlan® PK 810	1.025 – 1.035
Euperlan® PK 1200	1.030 – 1.040
Euperlan® PK 900	1.039 – 1.049

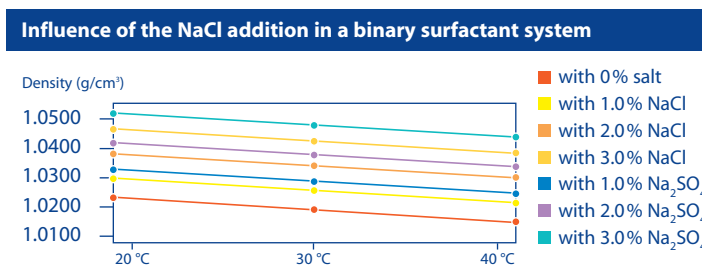
(Fig. 4) Apparent density of various Euperlan® PK types.



(Fig. 5) The pearlescent concentrates used here by way of example are Glycol Distearate (and) Laureth-4 (and) Cocamidopropyl Betaine.

Overview of the density of selected surfactants at 15 % AS		Product	20 °C	30 °C	40 °C
Density (g/cm <sup>3</sup> )			(g/cm <sup>3</sup> )	(g/cm <sup>3</sup> )	(g/cm <sup>3</sup> )
	Disodium Cocoyl Glutamate	(Plantapon® ACG 35)	1.0703	1.0659	1.0616
	Disodium Cocoamphodiacetate	(Dehyton® DC)	1.0640	1.0599	1.0551
	Disodium Laureth Sulfosuccinate	(Texapon® SB 3)	1.0539	1.0502	1.0457
	Cocamidopropyl Betaine	(Dehyton® PK 45)	1.0364	1.0328	1.0285
	Coco-Glucoside	(Plantacare® 818)	1.0275	1.0246	1.0206
	Sodium Laureth Sulfate	(Texapon® NSO)	1.0220	1.0183	1.0140
	Ammonium Laureth Sulfate	(Texapon® ALES 3EO)	1.0123	1.0088	1.0045
	Ammonium Lauryl Sulfate	(Texapon® ALS)	1.0069	1.0033	0.9990
	Laureth-10	(Dehydol® 100)	1.0040	1.0005	0.9964

(Fig. 6) Influence on the density of the external surfactant phases by appropriate selection of the surfactant system employed and modification of its concentration.



(Fig. 7) Example of how the basic formulation can be adapted to the required apparent density: Variation in the market-relevant, binary surfactant system (Sodium Lauryl Ether Sulfate – SLES/Cocamidopropyl Betaine – CAPB) with 15% active substance (AS) in response to different electrolyte concentrations.



# Increased efficiency – Reduced costs

In contrast to traditional pearlescent concentrates, Euperlan® PK products from Cognis are specifically formulated for cold-processing. This significantly reduces energy costs and production time. The latter advantage can also be utilized in order to increase production capacity per unit time – with assured constant first-class quality.



## Cost-saving cold-processing

Traditionally, pearlescent waxes are introduced into surfactant formulations in a hot process at temperatures approximately 70–75 °C. As a result of the high energy input alone, this process represents a significant cost factor. Heating, cooling and additional stirring operations not only require large amounts of power but are also costly in terms of time (Fig. 8). The solution: Applying the alternative cold process with Cognis Euperlan® pearlescent concentrates. Employment of the cold-processing Euperlan® PK types leads to significant savings in energy consumption and the substantial batch time savings simultaneously achieved facilitate a considerable increase in production capacity. Cold-processing Euperlan® pumpable liquid pearlescent concentrates from Cognis are impressive not only through their cost-efficiency but

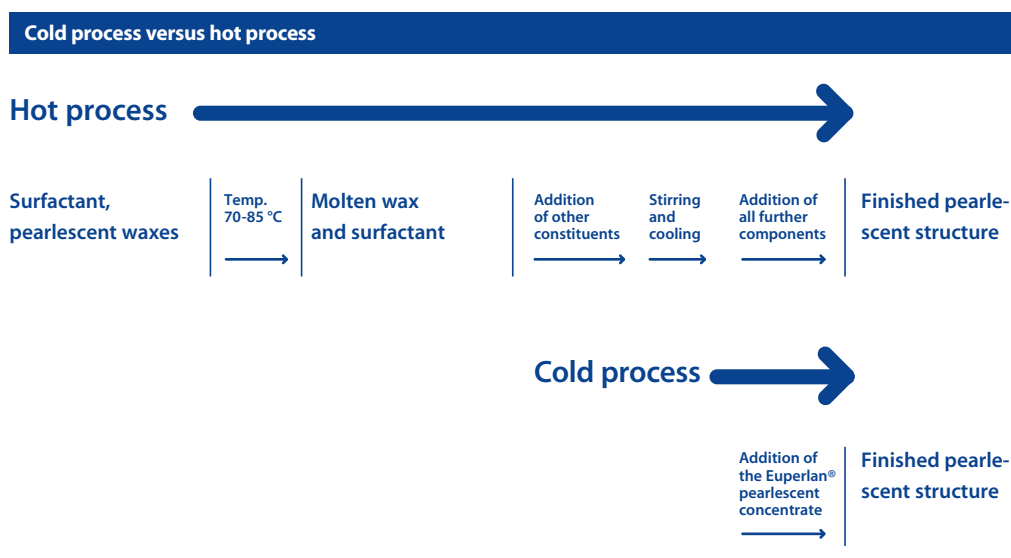
also through the uniformly high quality encountered in the associated end products.

The latter is achieved through uniform distribution of the wax particle sizes in the Euperlan® PK types. In the hot process traditionally employed in the manufacture of market products, the likelihood of a wide scatter of wax particle sizes is higher – because inconsistent stirring/agitation operations and cooling times can lead to irregular crystallization and size distribution patterns.

The Euperlan® PK types can also be incorporated in continuous production processes, and they can be used in existing mixing facilities without any major additional investment outlay. This is because the cold process with Euperlan® is a simple mixing operation. Complex stirring vessels with integrated heating and cooling circuits are not necessary.

### Economic advantages available with the cold process:

- Liquid input
- Pumpable
- Time savings achieved through higher production rates
- Fewer process stages
- Reduced energy costs – no heating or cooling



(Fig. 8) While the hot process required to achieve the desired pearlescent wax structure involves four production stages (heating, addition of further components, stirring and cooling), the cold-processing Euperlan® pearlescent concentrates are merely added in the final stage of the process. This saves time and energy, and increases production capacity.

### Highly concentrated Euperlan® products for further efficiency enhancements

#### Logistical advantages available with high-concentrates:

- Reduced transport and handling costs
- Reduced storage requirement
- Less quality control input

Aside from its standard series of pearlescent concentrates with a wax content of 20 – 25%, Cognis also offers highly concentrated variants, again specifically developed for cold-processing. High concentrates such as Euperlan® PK 4000 and Euperlan® PK 4500 Benz feature a wax content of around 40% (Fig. 9) to yield even greater cost efficiencies. The increased wax content means that correspondingly lower input concentrations are required in order to achieve the same pearlescent effects (Fig. 10).

The substitution rate of Euperlan® PK 4000 as compared with a pearlescent concentrate having a wax content of 25% lies in the region of 60%, while Euperlan® PK 4500 Benz offers the even more favorable ratio of 55%. Moreover, comparative studies confirm that the substitution rates for these highly concentrated EGDS-based pearlescent concentrates as compared

with conventional cold-processing and EGDS-based pearlescent dispersions generally lie in the region of 45 to 60%.

Cognis' high-concentrate pearlizers provide manufacturers of body care preparations with a simple and particularly cost-efficient means of producing pearlescent surfactant products (Fig. 11).

And there are additional cost advantages that derive from a reduced logistical requirement, because the increased wax content of these high-concentrate pearlizers yields a proportional decrease in annual purchase volumes (Fig. 10). The reduced input of these high-concentrate products also results in reduced transportation and handling costs, increased storage capacities and savings in quality control.

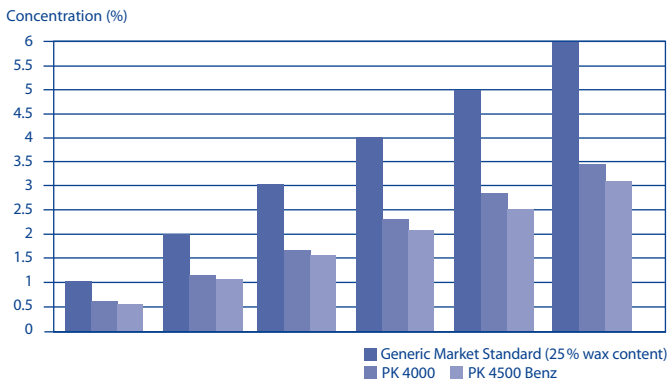
Overview of Cognis' Euperlan® high-concentrate pearlizers			
Composition per INCI*	Euperlan® PK 3000 AM	Euperlan® PK 4000	Euperlan® PK 4500 Benz
Glycol Distearate	approx. 25%	approx. 40%	approx. 40%
Cocamidopropyl Betaine	+	+	+
Sodium Laureth Sulfate	no	no	+
Laureth-4	+	+	no
PEG-7 Glyceryl Cocoate	no	no	+
Preservative	Formic Acid	nein	Benzoic Acid
Cold-processable	yes	yes	yes

\* International Nomenclature of Cosmetic Ingredients

(Fig. 9) The highly concentrated Euperlan® types with concentrations up to 40% are particularly economic to use.

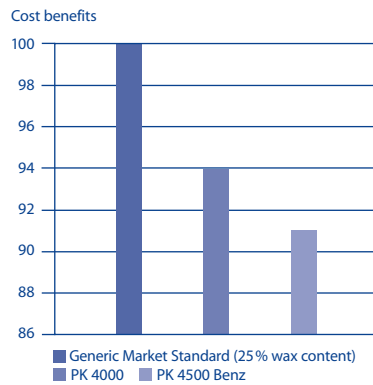


### Euperlan® PK 4000/PK 4500 Benz – Substitution rate



(Fig. 10) Overview of the dosages required in order to achieve the same pearlescent effect. The substitution rates of Euperlan® PK 4000 and of PK 4500 Benz were determined on the basis of input concentrations of 1 to 6% of the generic market standard in a 14% Sodium Lauryl Ether Sulfate solution (NaLES).

### Comparative cost-efficiency



(Fig. 11) Based on a 100% wax content (Ethylene Glycol Distearate – EGDS), the high-concentrate pearlizers Euperlan® PK 4000 and Euperlan® PK 4500 Benz offer convincing cost advantages.

# Storage and processing

## Storage recommendations

The Euperlan® PK types are available both in ready-preserved and in unpreserved formats (Fig. 12). In order to ensure unimpaired quality, the storage temperature should not exceed 30 °C. During handling and transport, these concentrates will tolerate brief temperature increases up to max. 35 °C. Lengthy storage can result in small degrees of separation and slightly increased viscosity. Such phenomena can, however, generally be rectified by re-stirring – with no discernible adverse influence on the quality of pearlescence in the final product. Ideally, the full contents of

a container should be processed and consumed at one time. Storage at temperatures below 15 °C can impede pumpability of pearlescent concentrates, but this effect is reversible by heating to 20–25 °C (with stirring where appropriate). Storage of certain Euperlan® PK types in metal tanks can lead to corrosive reactions. Tanks employed for this purpose should be manufactured either from DIN steel grade 1.4539 or plastics (GRP) (Fig. 13). The V4A steels 1.4401, 1.4404 and 1.4571 are not suitable for Euperlan® PK types containing sodium chloride.

Euperlan® PK products		
Product	INCI*	Preservation
Euperlan® PK 771 Benz	Sodium Laureth Sulfate (and) Glycol Distearate (and) Cocamide MEA (and) Laureth-10	0.5% Benzoic Acid
Euperlan® PK 810 AM	Glycol Distearate (and) Sodium Laureth Sulfate (and) Cocamide MEA (and) Laureth-10	0.5% Formic Acid
Euperlan® PK 900 Benz-W	PEG-3 Distearate (and) Sodium Laureth Sulfate	0.85% Benzoic Acid
Euperlan® PK 3000 AM	Glycol Distearate (and) Laureth-4 (and) Cocamidopropyl Betaine	0.3% Formic Acid
Euperlan® PK 4000	Glycol Distearate (and) Laureth-4 (and) Cocamidopropyl Betaine	none
Euperlan® PK 4500 Benz	Glycol Distearate (and) Cocamidopropyl Betaine (and) PEG-7 Glyceryl Cocoate (and) Sodium Laureth Sulfate	0.3% Benzoic Acid

\* International Nomenclature of Cosmetic Ingredients (Fig. 12)

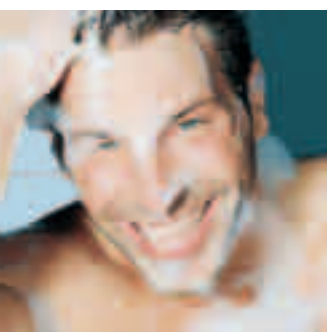
Recommended tank materials for Euperlan® PK products						
Euperlan® PK type	Tank materials					
	1.4539	1.4401	1.4404	1.4541	1.4571	GRP
Euperlan® PK 771 Benz	Not suitable for storage in tanks					
Euperlan® PK 810 AM	+	+	+	+	+	+
Euperlan® PK 900 Benz-W	+	-	-	-	-	+
Euperlan® PK 3000 AM	+	-	-	-	-	+
Euperlan® PK 4000	+	-	-	-	-	+
Euperlan® PK 4500 Benz	+	-	-	-	-	+

(Fig. 13) + suitable | - not suitable



## Processing recommendations

Euperlan® PK types should preferably be processed at temperatures between 15 and 35°C. Owing to the high wax concentrations of Euperlan® PK 4000 and Euperlan® PK 4500 Benz, application of the same processing methods as used for low-viscosity 28% fatty alcohol ether sulfate solutions and highly concentrated 70% fatty alcohol ether sulfate pastes is recommended. This will also ensure that the stirring times are reduced to a minimum. The processing recommendations are based on standard formulations. When using associative or polymeric thickening agents such as Arlypon® F or Carbomer types, the manufacturing process may need need to be appropriately modified.



### 28% low-viscosity fatty alcohol ether sulfate solutions

1. Add Euperlan® PK 4000 to water and stir to homogenize.
2. Stir in secondary surfactants (e.g. Cocamidopropyl Betaine – Dehyton® PK 45, Alkyl Glycocide – Plantacare® types).
3. Thoroughly stir in the primary surfactant (e.g. low-viscosity Texapon® NSO) and then add and dissolve two thirds of the sodium chloride content specified in the formulation.
4. Adjust the pH value with dilute caustic soda or citric acid solution.
5. Add fragrant oil and preservative and adjust to specified final viscosity with the remaining sodium chloride (approx. one third of specified quantity – preferably as an aqueous solution).



### Highly concentrated 70% fatty alcohol ether sulfate pastes

1. Add primary surfactant (high-viscosity SLES pastes, e.g. Texapon® N70) in combination with two thirds of the sodium chloride content specified in the formulation, and stir thoroughly.
2. Thoroughly stir in Euperlan® PK 4000.
3. Slowly add water in order to dilute the primary surfactant. Stir until complete dilution is achieved.
4. Stir in secondary surfactants (e.g. Cocamidopropyl Betaine – Dehyton® PK 45, Alkyl Glucoside – Plantacare® types).
5. Adjust the pH value with dilute caustic soda or citric acid solution.
6. Add fragrant oil and preservative and adjust to specified final viscosity with the remaining sodium chloride (approx. one third of specified quantity – preferably as an aqueous solution).





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**Note:** Suggestions for the processing and use of our products and suggested formulations are non-binding in each case. They are offered in good faith on the basis of current knowledge and information available to us and do not discharge our customers from the duty to test the suitability of the products for the processes and purposes for which they are intended. Cognis accepts no liability for risks associated with the use of its products other than in cases of wanton misconduct or gross negligence. Under no circumstances shall we be held liable for consequential damage. Each processor using our products is individually responsible for compliance with all legal regulations, including the industrial property rights of third parties and patent law. Cognis Deutschland GmbH & Co. KG offers no guarantees either implicit or inferred in respect of the suitability of a product for a purpose designated by the user.

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#### **Credits**

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