Performance Products

EMPICOL® C Alkyl Ether Carboxylates

Beauty & Personal Care
Introduction

The Performance Products division of Huntsman manufactures a wide range of chemistries which are utilised in diverse applications. Our expertise and awareness of the individual demands of diverse markets helps to make us one of the foremost suppliers of ingredients for cosmetics, including anionic, non-ionic, amphoteric and cationic surfactants and formulation aids.

The unique properties of surfactants and related products, such as hydrotores and dispersants, can be used to give numerous benefits within cosmetics, apart from the most obvious functions of cleaning and wetting.

Functions might include:
- Modification of viscosity or rheology to enhance the flow characteristics of liquids.
- Optimisation of the volume, characteristics and stability of foam.
- Enhancing mildness to the skin and eyes.
- Suspension or emulsification of insoluble oils and vitamins.
- Emolliency and humectancy.

Many surfactants are multi-functional and the selection of a surfactant can therefore have a valuable impact on a formulation. The following list represents the most common products available from Huntsman typically employed within the cosmetics market, according to what we perceive as the primary function of a given product.

For further information about a particular product please request the individual Safety and Technical data sheets.
EMPICOL® C Surfactants: Formulating For Mildness

The EMPICOL® C surfactants are a high quality versatile range of Alkyl ether carboxylates and their salts. These products display a variety of desirable properties for the personal care formulator:

- Excellent mildness
- Tolerant to hard water
- No nitrosamines
- No colour
- Good cleaning
- Lime soap dispersion
- Good skin compatibility

The EMPICOL® C range is offered in the form of low active sodium salts and high active carboxylic acids.

The Chemistry

EMPICOL® C can be tailored to achieve the desired surfactant characteristics (foam level, mildness, solubility etc.) by altering either the degree of ethoxylation (m) or the carbon chain distribution as illustrated above.

This publication will particularly focus on the Laureth Carboxylates in the Huntsman range, providing an overview of their key properties and benefits.
Benefits of Laureth Carboxylates

Mildness in formulations

- Laureth Carboxylates are characterised by outstanding mildness and good skin compatibility
- Graph A below depicts results from Human Patch Test and demonstrates the low irritancy of Sodium Laureth-4 Carboxylate (SLE4C) and Sodium Laureth-5 Carboxylate (SLE5C)
  - Low irritancy is further supported by Eyetex Draize equivalent test; the measured Zein Number is << 200
- Substituting SLES with Laureth Carboxylates has been shown to progressively reduce the potential to cause eye irritation (Graph B)
  - Mildness can be optimised by changing the degree of ethoxylation as shown in the comparison between Sodium Laureth-4 Carboxylate (SLE4C) and Sodium Laureth-7 Carboxylate (SLE7C).

<table>
<thead>
<tr>
<th>Product</th>
<th>SLE (4) C</th>
<th>SLE (7) C</th>
<th>SLE (13) C</th>
<th>SLE (3) S</th>
<th>ALE (3) S</th>
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</thead>
<tbody>
<tr>
<td>Erythema</td>
<td>1.0</td>
<td>0.4</td>
<td>0.4</td>
<td>5</td>
<td>1.8</td>
</tr>
<tr>
<td>Surface Damage</td>
<td>0.7</td>
<td>0.4</td>
<td>0.0</td>
<td>6.9</td>
<td>5</td>
</tr>
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</table>

- Tested as unpreserved 20mM solutions
Benefits of Laureth Carboxylates

Foam Properties

- Graph C demonstrates that Laureth carboxylates have excellent high foam characteristics and show:
  - Good tolerance to hard water
  - High foam stability, even in the presence of soap
- Increasing the level of ethylene oxide (EO) in the product leads to an increase in foam stability
- Laureth carboxylates can significantly improve the foaming characteristics of formulated products (Graph D)
Lime soap dispersing power (LSDP)

Lime soap dispersion power is a measure of how much surfactant is required to disperse the insoluble soap, calcium oleate. The EMPICOL® C range displays good lime soap dispersion properties required by formulators working with shampoos, shower and bath foams and hard water.

- **EMPICOL® CED 5 surfactant (SLE5C) gives outstanding performance**

- **Significant improvement over sodium cocoyl isethionate (SCI), which is traditionally used in synthetic soap for this reason**

Sensory Perception

**When is Soap Not Soap?**

Soap vs Laureth Carboxylic Acid Containing Formulation

Compared to soap, formulations containing Laureth Carboxylates demonstrate superior;

- **Soap-like lather and skin feel**
- **Excellent rinsing from skin**
Neutralization properties of EMPICOL® CED 5

EMPICOL® CED 5 surfactant is an alkyl ether carboxylate in the acid form. Alkyl ether carboxylates are weak acids.

When EMPICOL® CED 5 surfactant is included in formulations it can be neutralised with a variety of bases to any chosen pH target. Each base will have a different neutralization equivalent.

The Neutralization Curve

Complete neutralisation of EMPICOL® CED5 occurs at pH 9.16

The Neutralization Equivalent

<table>
<thead>
<tr>
<th>pH value</th>
<th>mg KOH/g</th>
<th>mg NaOH/g</th>
<th>mg TEA/g</th>
</tr>
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<tbody>
<tr>
<td>4.0</td>
<td>29.45</td>
<td>18.80</td>
<td>67.00</td>
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<tr>
<td>5.5</td>
<td>95.50</td>
<td>64.5</td>
<td>232.25</td>
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<tr>
<td>7.0</td>
<td>109.65</td>
<td>73.05</td>
<td>291.25</td>
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<tr>
<td>9.0</td>
<td>112.30</td>
<td>73.85</td>
<td>2,560.50</td>
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</table>
Foam vs pH

- EMPICOL® C surfactants are weak acids, hence their foam profile is pH dependant.
- The neutralised form of these products offer the formulator a system with enhanced foam stability.
- The ionised anionic form of the neutralised product contributes to charge stabilisation of foam structures thereby enhancing foam stability. This is demonstrated below with EMPICOL® C CED5.
## Product Range

<table>
<thead>
<tr>
<th>EMPICOL®</th>
<th>INCI Name</th>
<th>Huntsman Name</th>
<th>Viscosity</th>
<th>Active Matter %</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBC S</td>
<td>Sodium Laureth-4 Carboxylate</td>
<td>Sodium Laureth-4 Carboxylate</td>
<td>200</td>
<td>22</td>
<td>6</td>
</tr>
<tr>
<td>CED 5</td>
<td>Laureth-5 Carboxylic Acid</td>
<td>Laureth-6 Carboxylic Acid</td>
<td>200</td>
<td>92</td>
<td>3</td>
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<tr>
<td>CED 5 S</td>
<td>Sodium Laureth-5 Carboxylate</td>
<td>Sodium Laureth-6 Carboxylate</td>
<td>&lt; 200</td>
<td>22</td>
<td>6</td>
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<tr>
<td>CBJ</td>
<td>Laureth-11 Carboxylic Acid</td>
<td>Laureth-11 Carboxylic Acid</td>
<td>500</td>
<td>86</td>
<td>3</td>
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</table>

* Huntsman preferred naming system n+1  \( R-O-(CH₂CH₂O)^n-CH₂CO₂X \)