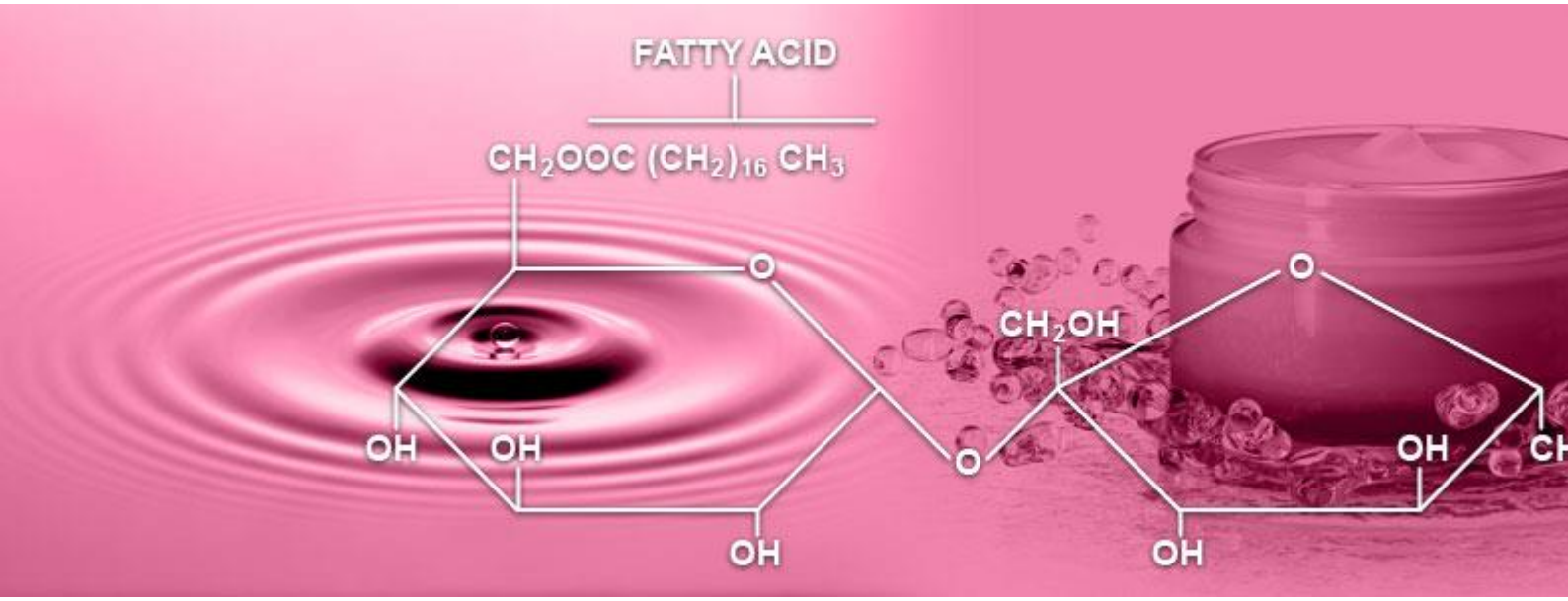
SISTERNA®

For know-how in sucrose ester techniques

Sucrose esters in gel-to-milk emulsion concepts



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Introduction

Sisterna B.V.is a young and flexible organisation that is solely active in the promotion and sales of Sisterna® sucrose esters. Furthermore Sisterna has developed countless proven and innovative applications of these natural and multifunctional emulsifiers for the cosmetic industry.

Sisterna® sucrose esters are based on sucrose and vegetable fatty acids and are a unique range of high quality, non-ionic emulsifiers with an exceptional performance and mildness to skin and eyes. Besides emulsification Sisterna® sucrose esters can offer other unique benefits to personal care formulations.

Sisterna has developed various interesting emulsion concepts, such as a gel-to-milk concept, the subject of this paper.

Sisterna's exclusive distributor network ensures the availability and technological knowhow of sucrose esters in personal care applications in the Western Hemisphere.

Summary

Sisterna® sucrose esters with a high HLB are very suitable emulsifiers for the development of natural 'oil gels' that turn into milk when diluted upon use. These 'oil gels' are in fact concentrated oil-in-glycerin (O/G) emulsions that can be produced by using standard high shear homogenising equipment. Very narrow oil droplet size emulsions with average oil droplet sizes of 300 - 500 micron are obtained.

By using just 2% of one single high HLB sucrose ester, preferably sucrose palmitate, it is already possible to produce a gel-to-milk concept containing 60% of oil. Such a concept is very suitable for make-up cleansing. The high oil content will allow to remove all impurities. Upon rinsing with water an emulsion is formed which is easily washed off. The simple addition of exfoliating particles allows the development of all kinds of scrubs for face and body.

Transparency of the 'oil gel' can be influenced by matching refractive indices of the oil and glycerin phases.

An interesting extra benefit, due to the extremely low water content of the O/G emulsion, is the possibility to develop preservative-free formulations.

1. Investigation of the gel-to-milk concept

The objective this study is to find out which parameters are influencing the formation and stability of the 'oil gels'.

The following subjects are studied:

- Effect of sucrose ester type and concentration on
  - Droplet size & viscosity
  - Viscosity build up and stability
- Effect of oil type and concentration on
  - Droplet size & viscosity
  - Transparency
- Effect of water content on
  - Droplet size & viscosity

Performed measurements:

- Viscosity is measured by using a Brookfield viscosimeter after 1 week (1w) or 1 month (1m).
- Droplets size measurements are performed with a Malvern mastersizer after 1 week (1w) or 1 month (1m).
- 3 months stability testing at different temperatures

1.1. Basic formulation

Phase	Ingredient	% w/w
1	Glycerin (99%)	30.00-70.00
	Sisterna sucrose ester HLB 15-16	**2.00-10.00**
2	Oil blend	70.00-30.00
3	Perfume/heat sensitive actives	q.s.

Production method

1. Disperse Sisterna sucrose ester into the glycerine (1) and heat to 75°C.
2. Heat oil blend (2) separately to 75°C.
3. Add (2) to (1) very slowly while homogenising under high shear.
4. Cool down to 35°C and add (3).

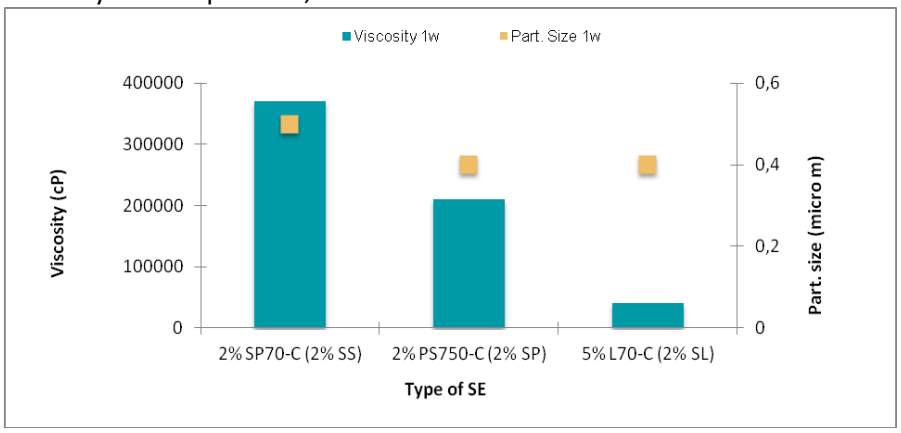
1.2. Tested sucrose ester grades

Name	Abbreviation	INCI	HLB
Sisterna SP70-C	SP70-C (SS)	Sucrose Stearate	15
Sisterna PS750-C	PS750-C (SP)	Sucrose Palmitate	16
Sisterna L70-C	L70-C (SL)	Aqua (and) Sucrose Laurate (and) Alcohol	15

1.3. Effect of sucrose ester type and concentration

- **Influence of sucrose ester type on droplet size and viscosity**
  Oil-in-glycerin emulsions are prepared with the 3 tested high HLB sucrose esters with 60% of caprylic/capric trygliceride.

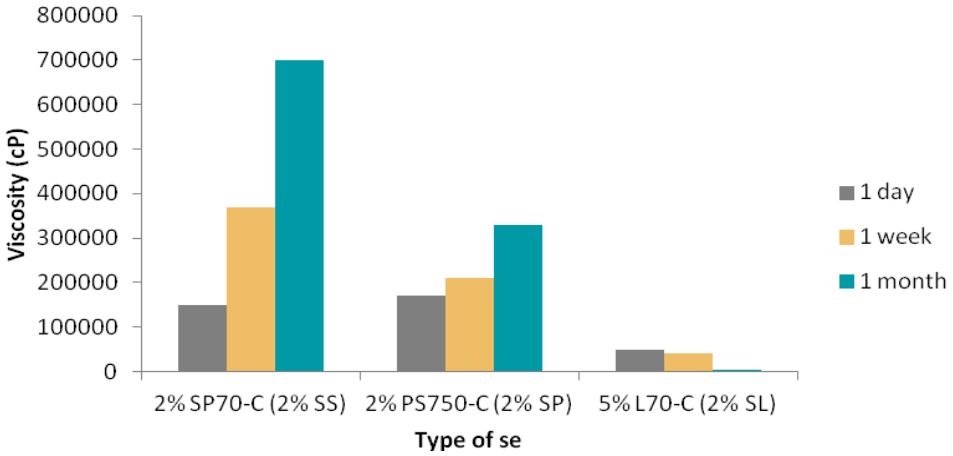
  Viscosity and droplet size, measured after 1 week:



  The graph shows that all tested sucrose esters give narrow droplet size emulsions. Viscosity however is related to the chain length of the fatty acid esterified onto the sucrose ester. The longer the fatty acid chain, the higher the viscosity.

- **Influence of sucrose ester type on viscosity build-up and stability**
  Viscosity and stability of oil-in-glycerin emulsions made with 2% of the 3 different sucrose ester grades containing 60% caprylic/capric triglyeride is followed in time.

  The viscosity of oil-in-glycerin emulsions is followed in time:

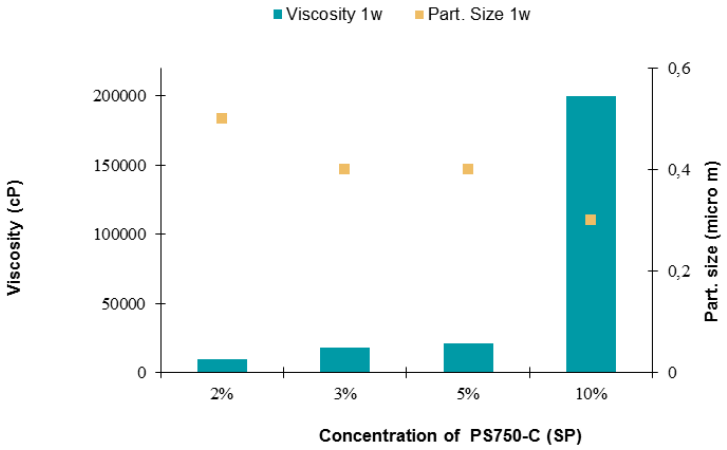


  Less viscosity build-up is observed in the emulsion prepared with sucrose palmitate compared to that prepared with sucrose stearate. Again this effect is related to the shorter fatty acid chain length in sucrose palmitate. There is no build-up in the sucrose laurate emulsion. The viscosity of the sucrose laurate emulsion is too low and shows a creaming issue over time. Therefore sucrose laurate is not suitable as a single emulsifier for this concept. However it can be used in combition with sucrose palmitate or sucrose stearate in order to reduce viscosity.

- **Influence of sucrose ester concentration**
  Oil-in-glycerin emulsions are prepared with different concentrations of only one high

HLB sucrose estertype, sucrose palmitate in this case. Emulsions are made with 40% soybean oil in glycerin.

Viscosity and droplet size, measured after 1 week:



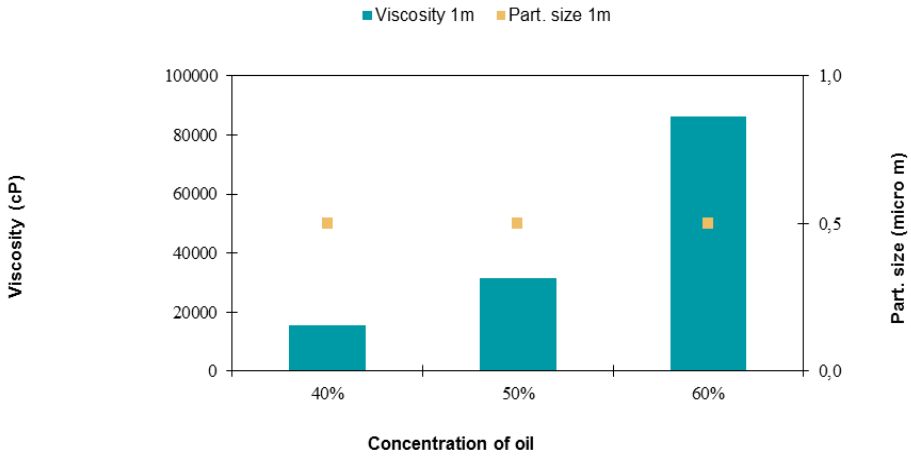
An increasing level in sucrose palmitate mainly results in a higher viscosity, while droplet sizes remain small at all concentrations, varying from 0,3 to 0,5 micron. A level of 2% of sucrose palmitate is sufficient to emulsify 40% of oil into the glycerin.

A similar effect is observed with sucrose stearate.

1.4. Effect of oil type and concentration

- **Influence of oil concentration**
  Oil-in-glycerin emulsions with 2% sucrose stearate are prepared with different oil concentrations.

  Viscosity and droplet size, measured after 1 month:



The more oil is incorporated, the higher the final viscosity.
The droplet size does not decrease with increasing oil levels up to 60% at a concentration of 2% of sucrose ester.

- **Influence of oil type**
  Transparent emulsions can be obtained by matching the refractive index of the oil phase with the refractive index of glycerin, **1.472**.
  Some examples are given in table below.

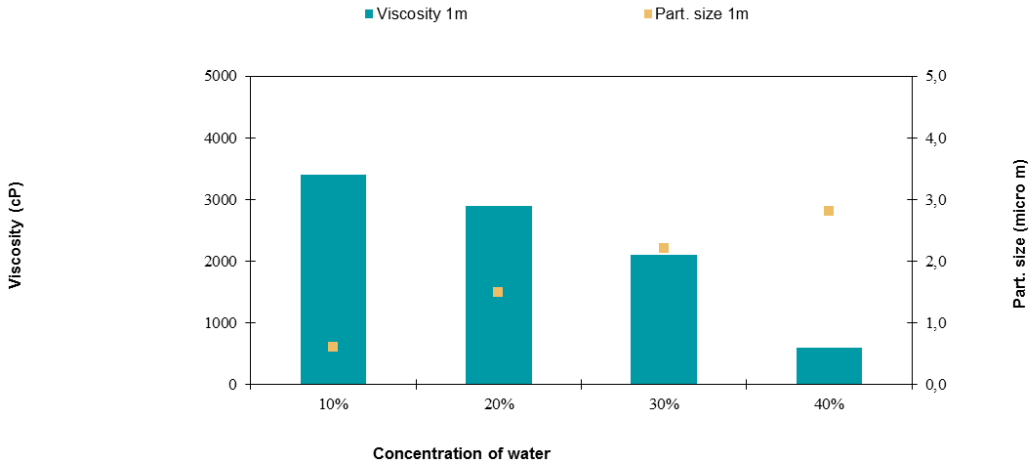
Oil	Refractive index	Transparency O/G emulsion
Sunflower oil	1.474	good
Avocado oil	1.475	good
Caprylic/Capric Triglyceride	1.451	Opaque
Ethylhexyl Palmitate	1.447	Opaque
Isopropyl Myristate	1.435	White

Furthermore oil type may influence emulsion viscosity and stability.
In general good results are obtained with vegetable oils, Caprylic/Capric Triglyceride.
Isopropyl Myristate, Ethyl Hexyl Palmitate gave bad stability

1.5. Effect of water

Oil-in-glycerin emulsions are prepared with sucrose stearate and different concentrations of water are added to the glycerin phase.

Viscosity and droplet size, measured after 1 month:



The addition of water to the glycerin phase has a negative effect as it leads to increasing droplet sizes and decreasing viscosities. It is recommended to avoid water as much as possible in the oil- in-glycerin emulsion. Therefore it is preferred to work with 99% pure glycerin.

2. Conclusion

The tested sucrose esters all give narrow droplet size emulsions.

Viscosity and viscosity build-up is related to the chain length of the fatty acid esterified onto the sucrose ester. The longer the fatty acid chain, the higher the viscosity and build-up:

- Less viscosity build-up is observed in the emulsion prepared with sucrose palmitate compared to that prepared with sucrose stearate.
- The sucrose laurate emulsion shows no viscosity build up. The viscosity of the sucrose laurate emulsion is too low and is showing a creaming issue over time. Therefore sucrose laurate is not suitable as a single emulsifier for this concept. However it can be used in combition with sucrose palmitate or sucrose stearate in order to reduce viscosity.

Transparent systems can be obtained by matching the refractive indices of the oil and glycerin phase. Best emulsion stability is obtained with vegetable oils, caprylic/capric triglyceride. The higher the amount of oil used in the oil-in-glycerin emulsion, the higher the final viscosity.

In general the best sucrose ester for gel-to-milk concepts is Sisterna PS750-C (sucrose palmitate). A concentration of 2% is sufficient to emulsify 60% of oil into glycerin.

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