Esaflor® HM 22

A distinctive emulsification-aid with unique textures

Consumers' interest in natural-based products is continuously growing and formulators face the arduous challenge of finding suitable ingredients. Rheology modifiers are essential to cosmetic products, but not all of them are eco-conscious. ESAFLOR® HM 22 is a unique bio-based guar derivative, which delivers stable and pleasant O/W emulsions.

Introduction

Rheology modifiers are multifunctional ingredients widely used in cosmetic formulas, offering the chemist the opportunity to not only change the viscosity of a product, but to also significantly improve stability, flow and texture. Not all rheological agents, anyhow, fulfil the high standards set by increasingly eco-conscious consumers. The interest on ingredients from natural origin is constantly increasing, with sustainability becoming an imperative for the cosmetic industry.
Matching the performance of synthetic polymers can be quite challenging, but there is a rising demand for renewable materials, able to perform several functions, such as thickening, emulsifying, stabilizing and texture enhancing.

Guar gum

Nature offers a wide variety of polymers, with different chemical structures that lead to diverse properties. Polysaccharides, in particular, are widely used in food, cosmetic and pharmaceutical industries, because of their multifunctionality. Guar gum is a renewable and sustainable hydrophilic polysaccharide, isolated from the seeds of *Cyamopsis tetragonoloba*. It is a galactomannan comprised of linear chains of β-D-(1,4)-mannose, with branching α-D-(1,6)-galactose units. Guar derivatives are particularly appreciated as multipurpose polymers, effective as thickeners and stabilizing agents, with additional moisturization and skin feel benefits.[i]
ESAFLOR® HM 22 (INCI name: C18-C22 Hydroxyalkyl Hydroxypropyl Guar) is a unique hydrophobically modified bio-based polymer, derived from guar gum. This versatile rheology modifier can be used in all types of formulations, from thick creams to runny lotions, with a pleasant sensory profile.

Characterization

Rheology modifiers have a remarkable contribution in texture properties of formulations. These attributes need to be carefully evaluated, as the behavior of a cosmetic product upon application is one of the main drivers of the purchase process.
The performance in use of ESAFLOR® HM 22 has been extensively studied through rheology and texture analysis. The importance of rheology for the development of cosmetics has been widely proven, in particular to investigate the spreading properties of products, their internal structure and physical stability.[ii,iii]
Texture analysis, originally developed for the food sector, has been recently introduced in the cosmetic industry to instrumentally characterize the mechanical properties of topical formulations, which are related to their sensory characteristics. [iv]

Rheology

ESAFLOR® HM 22 displays a shear-thinning behavior, typical of guar derivatives **(Figure 1)**. Viscosity values of ESAFLOR® HM 22 in water gradually decrease under shear application, because the polymer chains tend to align toward the flow direction. Shear-thinning properties are highly appreciated in skin-care products, for instance, meaning that they can spread easily on the skin.

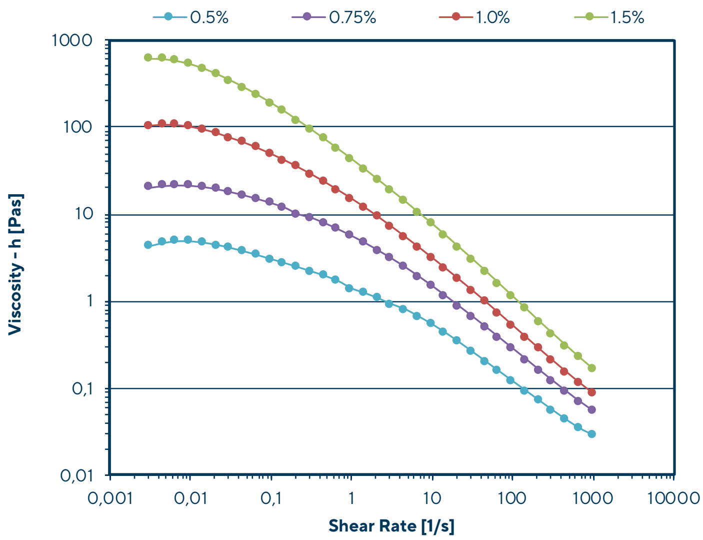

Figure 1*: Viscosity curves in function of the shear rate applied to samples with increasing concentration of Esaflor® HM 22

ESAFLOR® HM 22 shows a typical viscoelastic behavior, similar to a traditional Hydroxypropyl Guar, having both the storage G′ and the loss G″ moduli significantly dependent on the frequency with a cross-over point **(Figure 2)**.

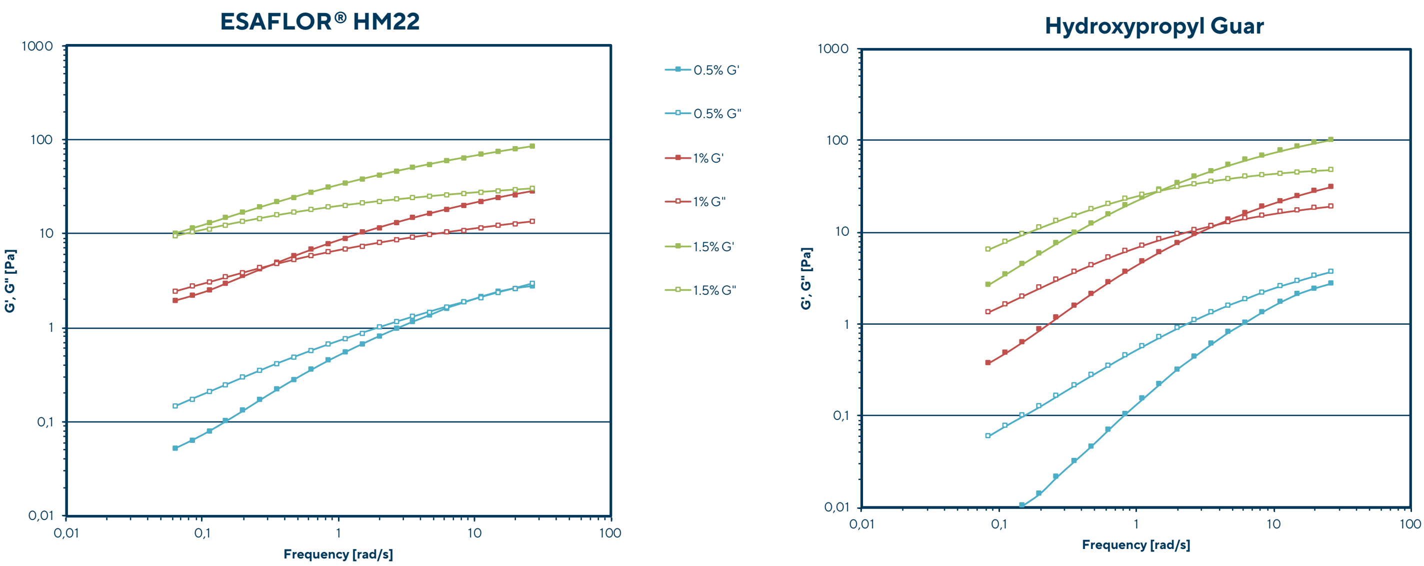

Figure 2*: Trend of elastic G′ and viscous G″ moduli in function of the frequency with increasing concentrations of polymer

ESAFLOR® HM 22, anyhow, has a more elastic character, with the hydrophobic side chains establishing stronger intermolecular interactions **(Figure 3)**, leading to more structured systems with cross-over points at lower frequencies. It can hence deliver higher yield points, together with higher viscosities at rest, providing stabilization through its suspending abilities. ESAFLOR® HM 22 offers therefore a valid support in stabilizing formulations.

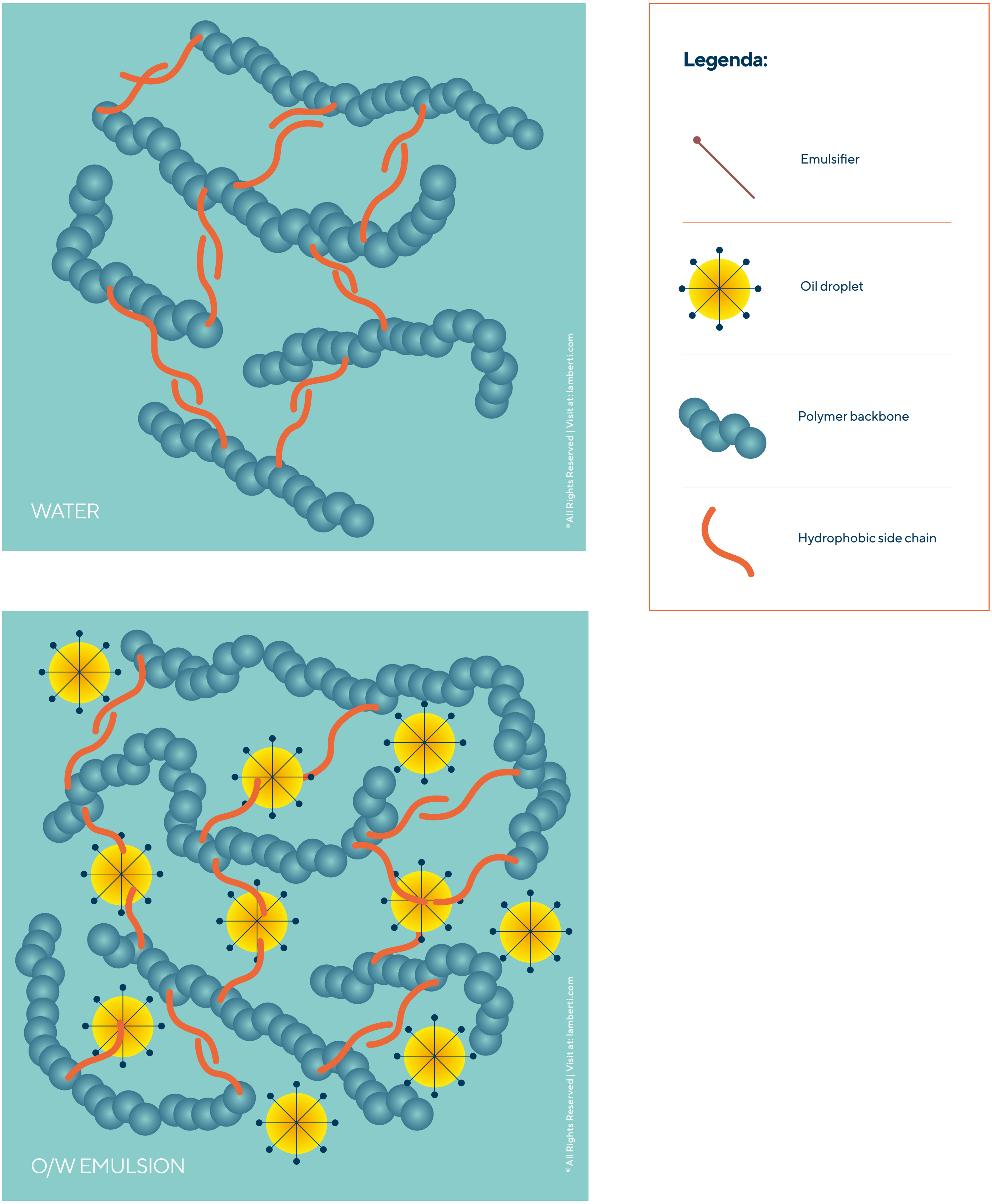

Figure 3: Associative behavior of ESAFLOR® HM 22

Applications

The distinctive chemistry of ESAFLOR® HM 22, together with its rheological behavior, make it an excellent emulsification-aid. Not only it can improve stability of O/W emulsions thanks to its structuring properties, but also its hydrophobic chains can enhance the performance of emulsifiers because of their affinity with lipophilic ingredients. It makes therefore possible, for example, to lower the amount of emulsifiers, reducing the unpleasant white-effect upon spreading. This polymer is versatile and easy to use: it is very stable in presence of electrolytes and it adapts well to a broad pH range.

ESAFLOR® HM 22 works in combination with the most common emulsifiers, to create characteristic textures. By varying the emulsifying agents and their amounts, several attractive and pleasant consistencies can be obtained with this guar derivative **(Table 1)**.

Phase	Ingredient name	Formulation A % w/w	Formulation B % w/w	Formulation C % w/w	Formulation D % w/w
A	Aqua (Water)	To 100	To 100	To 100	To 100
A	Glycerin	3.0	3.0	3.0	2.0
A	Trisodium Ethylenediamine Disuccinate	0.1	0.1	0.1	0.1
A	**ESAFLOR® HM 22**	**0.3**	**0.3**	**0.3**	**0.3**
A	Citric acid	To pH 5.5	To pH 5.5	To pH 5.5	To pH 5.5
B	Cetearyl Alcohol, Cetearyl Glucoside	4.0	-	-	-
B	Sodium Stearoyl Lactylate	-	1.0	-	-
B	Polyglyceryl-3 Stearate/Citrate	-	2.5	-	-
B	Cetearyl Alcohol	-	3.0	2.0	-
B	Glyceryl stearate, PEG-100 stearate	-	-	3.0	-
B	Sodium Polyacryloyldimethyl Taurate, Hydrogenated Polydecene, Trideceth-10	-	-	-	4.0
B	Dicaprylyl Carbonate	5.0	5.0	5.0	5.0
B	Coco-caprylate	5.0	5.0	5.0	5.0
B	Caprylic/Capric Triglyceride	5.0	5.0	5.0	5.0
C	Phenoxyethanol, Ethylhexylglycerin	1.0	1.0	1.0	1.0
D	Citric acid	To pH 5-6	To pH 5-6	To pH 5-6	To pH 5-6
	Appearance	Cream Light texture Less oily feel	Very thick cream Good pick-up Rich skin feel	Creamy lotion Easy spreading Reduced white effect	Thick cream Easy absorption Rich emollient texture
	Centrifuge (4800 rpm – 30')	Stable	Stable	Stable	Stable

Table 1: Synergy with different types of emulsifiers, delivering different textures

Texture analysis provided a useful support to highlight the benefits of ESAFLOR® HM 22 in the different O/W emulsions **(Figure 4)**. It is a powerful tool to predict sensorial attributes by means of an instrumental characterization, which measures mechanical properties such as consistency, firmness, adhesiveness, cohesiveness and stringiness **(Table 2)**.

Sensorial attribute	Textural parameter	Description
Pick-up *Manipulation of product between fingertips*	Firmness Adhesiveness Stringiness	Ease of compression of products between thumb and index fingers Ease of separation of fingertips Amount of product that strings rather than breaks when fingertips are separated
Application *Rub-out on the skin*	Firmness Consistency Stringiness	Ease of spreading on the skin Amount of product felt between fingertip and skin Degree to which products string
After-feel *Skin-feel after use*	Adhesiveness/ Cohesiveness	Degree to which fingers adhere to product residue

Table 2: Correlation between personal care sensorial attributes and textural parameters

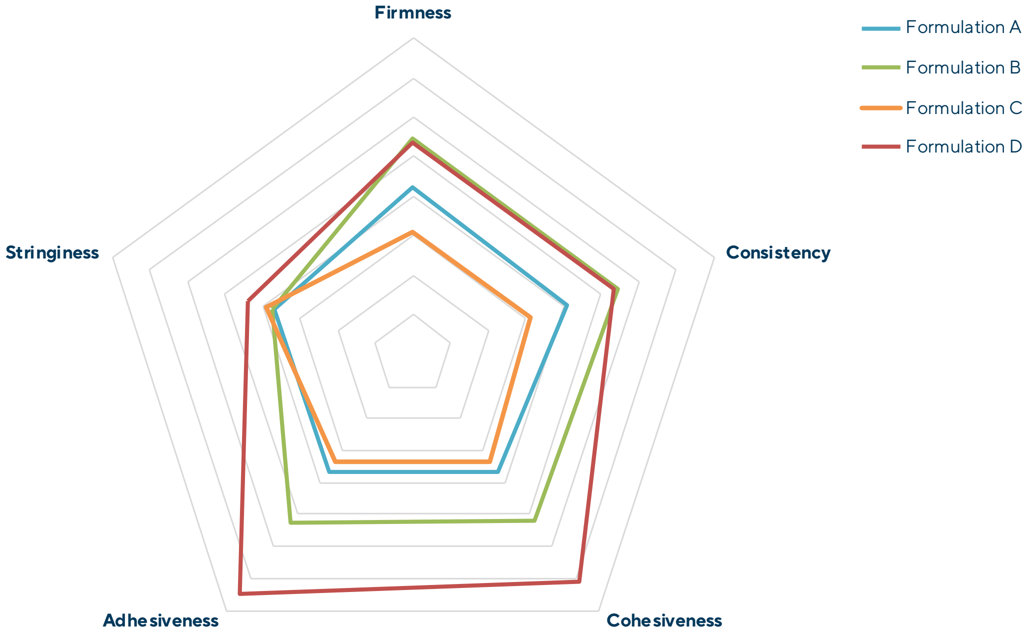

Figure 4*: Radar of textural parameters for formulations of Table 1

Spreadability is another very important feature in personal care, usually highly correlated to firmness. The lower the firmness, the easier the application because less force is needed to make the product flow on the skin.[v]
Formulation C, for example, would be a great body lotion, easy to be applied in a thin, even layer. Even thicker emulsions with ESAFLOR® HM 22, in any case, guarantee a very good spreading: Formulation D would make an excellent body cream, with a soft touch and a long playtime, since it shows high stringiness and adhesiveness.

Together with firmness, stringiness and adhesiveness help predicting pick-up and after-feel. Formulation B, with medium values for both parameters, shows a medium-high pick-up and good rub-out. Combined with its high consistency, these properties make Formulation B a good base for a face mask. Formulation A, with a balanced textural profile, results in a cream with a very light texture, not-oily feel and easy absorption.

A too high stringiness, on the other hand, should be avoided in emulsified skin-care preparations: it can make application unpleasant, causing sliminess, stickiness and poor spreadability. This phenomenon often occurs using some natural polymers at high concentrations together with an increasing viscosity, but even very thick creams with ESAFLOR® HM 22 show textures with highly acceptable stringiness values.

*Data provided by Unired Srl, Padova Italy

Conclusions

ESAFLOR® HM 22 is a unique bio-based polymer, which offers a valid support for developing O/W emulsions with distinctive and tunable textures, matching current demand for natural-based ingredients. This rheology modifier works in combination with the most common emulsifiers, enhancing stability and conveying characteristic sensorial properties, even at low dosage. Natural-based formulations can therefore be easily stabilized, thickened and texturized, without the drawbacks of stringiness and tackiness.

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