LESS WATER, MORE CARE

More than ever, consumers are tapping into eco-friendly claims when looking at daily goods such as detergent and cosmetic products. Additionally, waste-free lifestyles are becoming more and more popular among consumers, who place particular emphasis on replacing single-use plastics with refillable options.

Aligned with current market trends, there is also a social call for a commitment to sustainability, which further reinforces the need for innovative eco-friendly products that meet global social objectives.

To meet societal demands, the home and personal care industry is being challenged to move towards more sustainable formulations, showcasing an incredible variety of innovative formats, from super-concentrated dilutable compositions to totally water-free alternatives that cut back on single-use plastics and water transportation. However, the main challenge is to ensure the efficacy of sustainable formats and ingredients.

As a result, Kao has concentrated on designing surfactant products that facilitate the formulation of these emerging compositions. As key active ingredients in current formulations, their selected surfactants not only allow customers to be aligned with today's sustainable concerns, but also to provide the functional value consumers are looking for. This article aims to share the best of technical knowledge about innovative waterless formulations.

Society is making sustainable changes in terms of lifestyle, adopting eco-friendly practices in daily life. This situation has a direct impact on the consumer sector, where greener daily goods that have a lower environmental impact and a higher naturality content are preferred among consumers. As a result, the home and personal care industry is shifting towards sustainability, whereby products that stand out due to their eco-friendly innovation and enhanced efficacy are more and more valued in the market. Here, ingredient providers play a key role in allowing end producers to launch new products that combine green and functional attributes. Waterless formats exemplify sustainable products as they significantly reduce single-use plastics and carbon emissions through product compaction. Surfactants are essential components in the formulation of super-concentrated waterless systems.

Consequently, extensive research has been conducted to identify optimal ingredients that not only meet formulation requirements such as stability, appearance and viscosity, but also deliver the excellent performance expected by consumers.

TECHNICAL CHALLENGES

The most difficult challenge associated with these concentrated formats is to meet all the technical requirements, which vary depending on the type of format: liquid or solid phase, and either ready-to-use or dilutable.

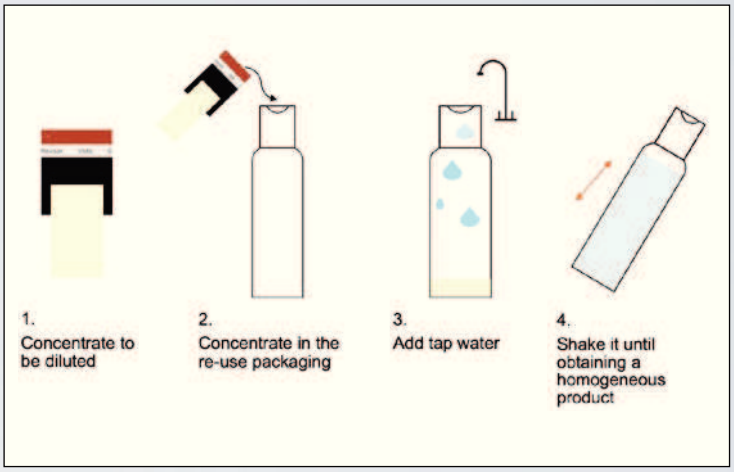
In the case of ready-to-use super-concentrates or tablets, the hydrotropic ability of surfactants is an important property, as the concentrate must provide a good level of stability and must have a clear appearance. The complexity increases with dilutable formats, as illustrated in Figure 1, which shows the representation and use of such products. A refill sample, either a liquid or solid concentrate (mini-dose or water-soluble tablet), is placed in a plastic bottle that is subsequently filled with water to produce the standard diluted product that is ready to use. The plastic bottle should be reused as many times as possible. For liquid dilutable systems, hydrophobic surfactants are crucial for ensuring the stability and clear appearance of the formulations, where the concentrate contains a low water content, requiring easy and clear dilution using tap water. Additionally, a suitable low viscosity of concentrates is essential to facilitate handling or possible encapsulation, while achieving the target viscosity once diluted. Furthermore, the final pH of the dilution, microbial preservation, and resistance to water hardness are additional challenges that must be overcome.

For solid formats, the main difficulty is to achieve optimal texture, stability and performance of the product. Surfactants play a key role in these aspects as well. In the following sections, the selection of key surfactant chemistries that makes the formulation of waterless formats possible will be discussed. To use the presented surfactants allows formulators to design products that offer functional value, can be cold-processed, resulting in cost and energy savings, and feature waterless formats. All proposals are considered eco-friendly innovations that align with current market demands.

Product launches in the beauty industry demonstrate the multifaceted approach to embracing sustainability. A key focus is on the introduction of innovative formats that reduce plastic consumption and carbon emissions. Nevertheless, naturality remains the predominant claim globally in terms of consumer preferences. Both cleansing and conditioning cosmetic products, combining waterless conditions and a high naturality content, have been considered in this study.

FIGURE 1

Representation of the idea behind dilutable waterless formats.



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CLEANSING AND CONDITIONING FORMULATIONS

1. Oily cleansers

In terms of cleansing shower products, shower oils are of particular interest due to their moisturizing properties resulting from the oil-based formulation. However, these products present challenges when incorporating high quantities of oil and typically exhibit poor foaming properties.

FIGURE 2

Foam volume and stability evaluation of a cleansing oil formulation ("Kao C-355") containing 40% of natural oils, 60% surfactant content and less than 5% of water, using a SITA Foam Tester. Measuring conditions: 0.5% of formula in active, 40°C temperature, addition of 200 µL of Bey Sebum, at 1000 rpm agitation speed.

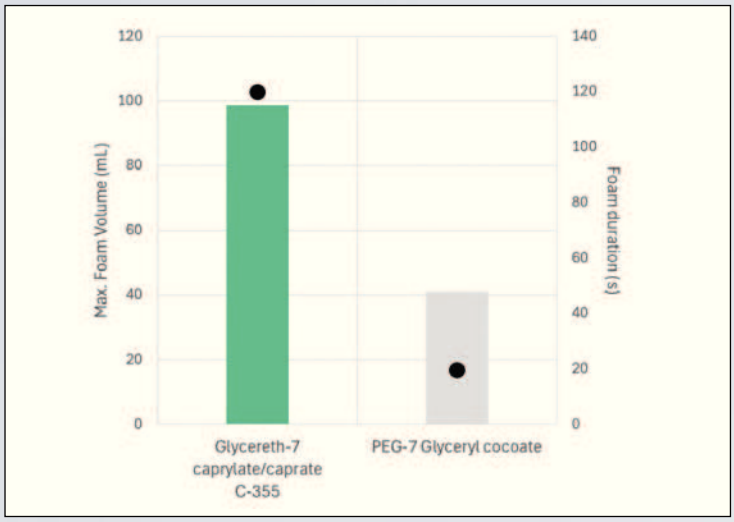
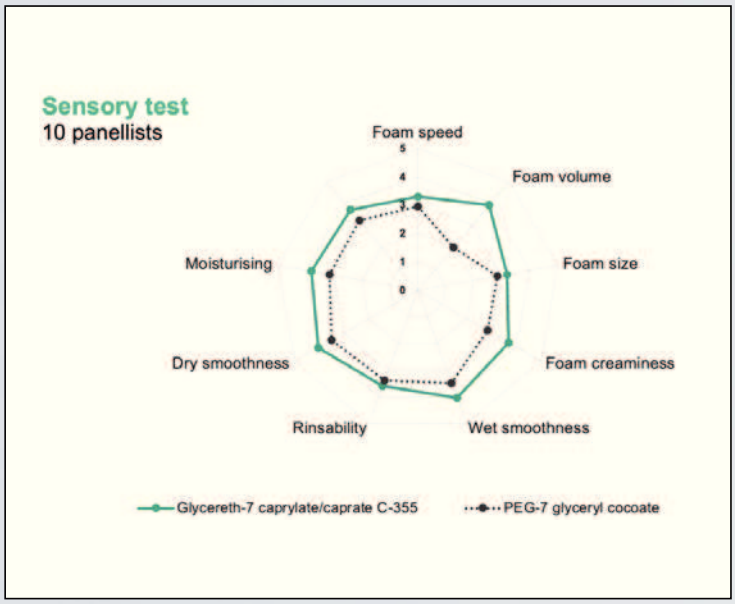


FIGURE 3

Sensory evaluation of cleansing oil formulations containing different non-ionic surfactants ("Kao C-355").



A ready-to-use formula containing 40% of natural oil and non-added water has been developed, featuring enhanced oil deposition associated with moisturizing properties, along with a gentle and creamy foam. Although the formula contains a high percentage of oil, it still provides an outstanding foam profile, leaving the skin smooth and clean, with a luxury foamy product. These properties are a result of the use of Glycereth-7 caprylate/caprate. However, other non-ionic surfactants widely used in the personal care sector, such as alkyl polyglucosides, are not suitable for formulating these highly oily systems. This composition has a 91% natural origin content if 100% bio-based Glycereth-7 caprylate/caprate is used.

Figure 2 compares the foaming profile of Glycereth-7 caprylate/caprate and PEG-7 Glyceryl cocoate, a non-ionic surfactant that is found in some cleansing oils on the market. Additionally, a sensorial comparison of the same formulation is shown in Figure 3. As can be seen, both evaluation methods demonstrate that Glycereth-7 caprylate/caprate presents better foam properties than PEG-7 Glyceryl cocoate. In the sensory evaluation, apart from the foam-related properties, significant differences are also observed in the moisturising ability and smoothness of the product.

2. Concentrated systems to be diluted

Taking advantage of the hydrotropic properties of Glycereth-7 caprylate/caprate, dilutable formats can also be designed for cosmetic applications, thanks to this key ingredient. Extensive research has been done to develop dilutable formulations that maintain an outstanding foam volume and quality, achieving dilutions of up to 1:10.

An amazing example is a hand wash formulation that has an 80% surfactant content and less than 10% of water, intended to be to be packaged in tablet form using a hydro-soluble film. This format completely eliminates plastic and reduces carbon emissions by 90% during transportation of the end product.

3. Cleansing Wipes

Cleansing wipes with optimal makeup removal efficiency can also be formulated with the multifunctional Glycereth-7 caprylate/caprate surfactant. Figure 4 shows the results of a cleansing test with the formula developed for wipes, compared with a market makeup product.

Additionally, cleansing wipes with optimal makeup removal efficiency can be formulated using the multifunctional Glycereth-7 caprylate/caprate surfactant, which provides excellent emulsifying and solubilizing properties. Figure 4 shows the results of a cleansing test conducted with the formula developed for wipes, compared to a market makeup product. This demonstrates the excellent cleansing performance that can be achieved by choosing the right surfactant that acts as the cleansing agent.

4. Solid formats

Finally, a significant number of products in the cosmetic sector are formulated in solid format, where product texture and performance are the main drivers. To facilitate the formulation of these solid formats, a cationic solid blend with optimized conditioning function has been developed.

FIGURE 4

Cleansing test using makeup. "Kao C-147" is a wipe formulation containing glycereth-7 caprylate/caprate as the cleansing agent, compared with a market product. The formulation is based on 7% surfactants (Glycereth-7 caprylate/caprate and PEG-40 hydrogenated castor oil), glycerine and other minor ingredients.

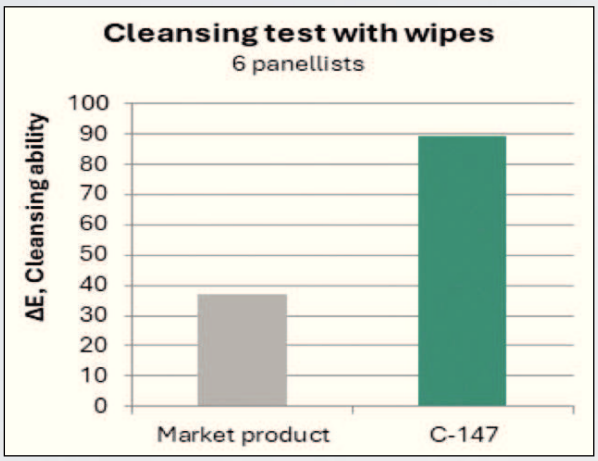
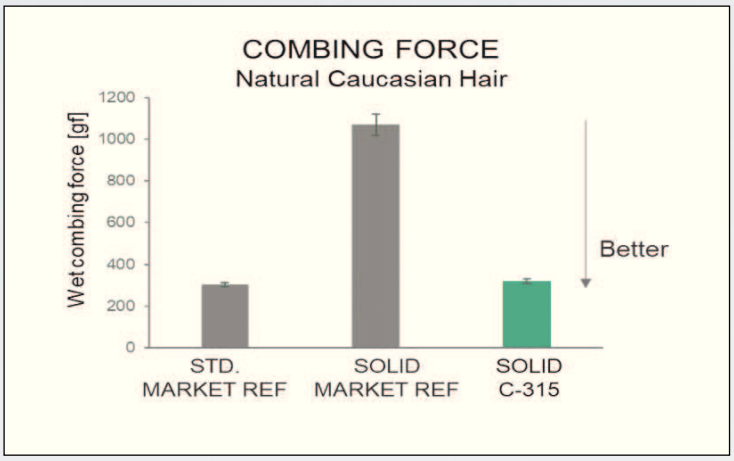


FIGURE 5

Combing results comparing two market products with the developed formulation "Kao C-315". The composition of "Kao C-315" is based on 60% cationic blend, 15% Cetearyl alcohol and other minor ingredients. Market products are formulated with Cetearyl Alcohol, SLS and Polyquaterniums.



This product improves the handling for a single-step formulation process as a ready-to-use conditioning agent.

The cationic blend comprises a combination of 67% fatty alcohols (Cetyl Alcohol and Stearyl Alcohol) with 33% cationic surfactants (Behenamidopropyl Dimethylamine and Dipalmitoylethyl Hydroxyethylmonium Methosulfate). This is a 100% concentrated product in the form of pellets, derived from vegetable sources. It boasts an excellent environmental profile and is classified as a non-labelled chemical.

An example of a solid format is a smooth conditioner formulation, incorporating the previously introduced cationic surfactant blend as a key ingredient. This blend imparts excellent conditioning properties, which are associated with a reduction in combing forces, thereby facilitating easier combing of any hair type. This is illustrated in Figure 5, where the developed composition is compared to two well-known market products: a standard conditioner and a solid sample.

This formulation provides an appropriate solid texture, ensuring the product is highly convenient for use. By adopting a solid format, the use of plastic can be eliminated, and carbon emissions are also reduced during transportation. This cationic blend is also suitable for the formulation of solid body moisturizers and cleansing conditioners, thereby imparting a dual functionality to solid shampoo formulations.

CONCLUSIONS

Our environmental awareness, together with the observed market demand, has prompted us to explore sustainable waterless solutions with a convenient method of use. In this article, we have explained how the following can be achieved by choosing key surfactant products for each application and format: Stable and clear concentrated surfactant systems, with proper physicochemical properties as a function of the concentration, without compromising the product's performance and sensory profile compared to ready-to-use formulations.

This helps with the introduction of innovative and sustainable consumer products that are aligned with today's market demands. Additionally, other eco-benefits that are also gaining importance among consumers can be integrated in the presented solutions: an increased natural content of final formulas, free of sulphates and non-natural solvents, end products with increased mildness and good eco-tox profiles. Overall, the outcomes presented here show how environmental progress is feasible, and we make it easy by choosing eco-responsible innovation, production and consumption.

photos and graphics: Kao

Mireia Collado
Research & Development Technician, Kao, Barcelona, Spain,
www.kaochemicals-eu.com

Carmen Pey
Research & Development Group Leader, Kao, Barcelona, Spain,
www.kaochemicals-eu.com