Eco-friendly Ingredients for Biodegradable Cosmetic Products

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Introduction

The trend toward renewable-based cosmetics that are free from ingredients with a potentially negative environmental impact has been a key driver of change in the cosmetics industry in recent years. This momentum is being generated by increasing public awareness of environmental issues as well as increasingly strict regulation of cosmetics ingredients. However, while eco-conscious consumers now demand sustainable formulations, they are not willing to accept decreased performance or reduced sensorial benefits. They expect products to contain sustainable raw materials that deliver the same properties as traditional ingredients. This creates major challenges for cosmetics manufacturers – and opens up attractive opportunities for companies that manage to meet these high expectations.

Products that claim to be free of microplastics are a high-profile example of this trend. The term “microplastics” generally refers to solid, water insoluble and synthetic polymeric particles that are five millimeters or smaller in size and that are not biodegradable. Most microplastics that enter the environment are generated by the gradual breakdown of plastic waste, while worn-off particles from vehicle tires and synthetic fibers from clothing are also making a significant contribution. Microplastics from cosmetic products contribute less than 1% to the overall microplastic debris in the environment. However, there is a growing regulatory and consumer focus on microplastics in cosmetic products.

National legislation mostly refers to “plastic microbeads,” which can be used for exfoliating and cleansing purposes in rinse-off cosmetics. These microbeads have already been almost completely phased out in Europe due to a voluntary agreement by the European cosmetics industry. There are currently no legislative restrictions at the EU level, however the European Chemicals Agency (ECHA) published a restriction proposal for microplastics in 2019 [1]. This restriction led to a so-called “final and combined opinion” of the RAC and SEAC committees. Entry into force of the restriction on intentionally added microplastic is expected to take place in 2022. In this restriction, the suggested definition of a microplastic particle uses the umbrella term “polymer,” which does not discriminate between plastic materials that maintain their rigid shape during use and disposal or – on the other hand – functional polymers that do not exist as solid, shaped particles in cosmetic products or after their disposal. As a result, many functional polymers that are commonly used in cosmetic formulations could potentially be banned under this proposal, unless the authorities can be convinced to take a more differentiated view of the specific environmental properties of individual polymers rather than simply judging them all as microplastics.

Another important aspect in the microplastic discussion is the biodegradability of personal care ingredients. Since cosmetic products usually consist of a variety of ingredients, it is necessary to assess the environmental compatibility of every single substance. Some labels such as the EU Ecolabel and the Nordic Swan Ecolabel, which is the official ecolabel in the Northern European countries, define minimum biodegradability requirements for organic cosmetic ingredients. However, the biodegradability of a substance depends solely on its structure, not on whether its starting material is natural/renewable or entirely synthetic. There are a variety of standardized methods available to evaluate the biodegradability of a substance. This makes it all the more important to be transparent about the context in which the biodegradability is assessed. For BASF Personal Care Europe, the OECD 301 standard screening tests produce the most commonly acknowledged results, but other biodegradation tests like ISO are also gaining more and more impact, particularly within the microplastic discussion.

Modern consumers want cosmetic products that are free from ingredients that have a negative impact on the environment. At the same time, consumers also expect products to deliver outstanding performance and attractive sensory properties. Cosmetics manufacturers face challenges when trying to meet these expectations while also operating in line with associated regulatory changes such as those regarding microplastics. New, readily biodegradable and renewable-based innovations such as the opacifier Euperlan® OP White and the stabilizer Lamesoft® Balance offer manufacturers sustainable ingredients for hair and skin cleansing products that are able to match or exceed the performance of traditional ingredients.
Data from Mintel [2] shows that the number of beauty and personal care products in Europe that feature a microplastic-free claim increased significantly from only 1 product in 2016 to more than 800 products in 2020. In the last 5 years, the share of cosmetic product launches in Germany that claimed to be microplastic-free rose from 0% to more than 4%. In this context, there is rising demand for ingredients that enable formulations to include a microplastic-free claim that is consistent with all relevant regulations. BASF has recently launched two innovations that are empowering cosmetics manufacturers to successfully address this trend. The first is Euperlan® OP White, a wax-based and readily biodegradable opacifier that offers an eco-friendly alternative to synthetic opacifiers in skin and hair cleansing formulations. The second is Lamesoft® Balance, a 100% natural and readily biodegradable ingredient for rinse-off skin and hair cleansing formulations that stabilizes wax-based dispersions and enhances the sensory properties of formulations.

A sustainable alternative to synthetic polymer-based opacifiers

In 2019, BASF launched a wax-based and readily biodegradable opacifier dispersion for surfactant formulations called Euperlan® OP White. Its INCI name is Glycol Distearate (and) Sodium Laureth Sulfate (and) Cocamidopropyl Betaine (and) Glyceryl Oleate. It offers an opaque, pure white appearance. This creates valuable appeal for cosmetic products by giving them a lotion-like appearance, which is associated with mild and soft cleansing properties as well as moisturizing and nourishment claims. Euperlan® OP White complies with the requirements for biodegradability set out by the Organisation for Economic Co-operation and Development standard OECD 301 [3]. In addition, its unique properties also meet the requirements for the eco-label certification of skin and hair cleansing formulations in line with EU Ecolabel, Nordic Ecolabel and Bra Miljöval. Euperlan® OP White contains 90% ingredients of natural origin according to the International Organization for Standardization norm ISO 16128-2. This means that the ingredient is suitable for cosmetic products that are marketed with claims such as being microplastic-free, nature-based and sustainable.

Euperlan® OP White can be used instead of traditional opacifiers based on synthetic petrochemical polymers such as Styrene/Acrylates Copolymer. It delivers an even better pure white appearance in the final formulation of personal care rinse-off products such as shampoo, shower gel, liquid soap and facial cleansers. In April 2019, Euperlan® OP White was awarded second place in the “Functionals and Recipients” sub-category of “Cosmetics” for the BSB Innovation Prize, presented by the German consulting agency BSB [4].

An eco-friendly ingredient for stabilizing rinse-off formulations

Cosmetic manufacturers may also face challenges in stabilizing wax-based rinse-off formulations because commonly used stabilizers often involve synthetic-based polymers, which means the product may possibly not be marketed with claims about being free from microplastic. Lamesoft® Balance is a sustainable alternative that offers a solution to this challenge. It is a 100% renewable-based and readily biodegradable ingredient that offers efficient stabilization of small-sized wax dispersions in rinse-off formulations for skin and hair cleansing products while meeting high expectations for sustainability. Its INCI name is Coco-Glucoside (and) Hydrogenated Castor Oil. It meets the requirements of EU Ecolabel, Nordic Ecolabel and Bra Miljöval. Lamesoft® Balance contains 100% content of natural origin according to ISO norm 16128-2 and is also suitable for natural certified cosmetics formulations in line with the COSMOS and NATRUE standards. Furthermore, it is a suitable alternative to concepts that involve surfactants that contain ethylene oxide and sulfate.

By acting as a natural structure enhancer in surfactant-based systems, this innovative material allows cosmetics manufacturers to stabilize their formulations without using synthetic polymers. This addresses key challenges related to stabilizing fine particle wax dispersions in rinse-off formulations. Lamesoft® Balance is specially designed to stabilize and enhance wax-based opacifiers in rinse-off applications – even in low viscosity formulations. Due to its composition of hydrogenated castor oil and Coco-Glucoside, Lamesoft® Balance is cold processable, easy to formulate and provides a pleasant, homogenous rheology in final formulations.

In addition to this, tests have shown that Lamesoft® Balance offers skin care benefits in body wash formulations and significantly boosts the hair-conditioning effect in shampoos that contain cationic conditioners. The product is suitable for various skin and hair rinse-off applications including shampoo, body wash, liquid soap and facial cleansing products. It is also mild enough to be used in baby cleansing formulations.

In 2021, Lamesoft® Balance was awarded first place in the “Functionals and Recipients” sub-category of “Cosmetics” for the BSB Innovation Prize, presented by the German consulting agency BSB [5].

The performance and physical properties of Euperlan® OP White

Euperlan® OP White offers cosmetics manufacturers a new and sustainable opacifier dispersion that delivers outstanding pure white appearance without a bluish tinge. This is made possible by its special morphology of wax dispersion, which contains extra-fine wax particles with a characteristic par-
particle size distribution. Its steric particle structures create a light-scattering effect, also known as an opacifying effect, which provides a well appreciated lotion-like white appearance for personal care rinse-off products.

The opacifying performance of Euperlan® OP White was tested in a benchmark study, where the new ingredient was compared against a market-leading benchmark opacifier based on synthetic polymers (Styrene/Acrylates Copolymer) in shower gel formulations at different concentrations. To achieve a comparable level of whiteness in finished formulations, it is recommended that Euperlan® OP White is used at a ratio of 2:1 to the benchmark opacifier. The opacifying effect can be easily adjusted for individual formulation concepts by cosmetic manufacturers (Figure 1).

In addition to its excellent properties as an opacifier, tests have also shown that Euperlan® OP White provides benefits for hair care. Performance tests in simple shampoo formulations have clearly demonstrated that this new and sustainable opacifier significantly improves wet and dry combability as well as suppleness (smoothness and softness). This was particularly evident when Euperlan® OP White was used in formulations that included cationic guar (Dehyquat® Guar types, INCI: Guar Hydroxypropyltrimonium Chloride). When used in combination with the Dehyquat® Guar types N and HP, hair breakage was dramatically reduced to just 1 or 2%. This opens up possibilities for cosmetics manufacturers to use Euperlan® OP White in shampoo products with claims related to hair protection and strengthening (Figure 2).

Overall, these tests prove that Euperlan® OP White is able to offer the same high level of white appearance that is provided by typical opacifiers based on synthetic polymers. This readily biodegradable new opacifier dispersion for surfactant formulations also provides important benefits for hair care, including wet and dry combability, smoothness and softness. On top of this, it also offers attractive physical properties such as low viscosity, which makes it fluid and pumpable over a broad temperature range. Euperlan® OP White provides robust product stability, with no sedimentation or agglomeration over time and no need for intermediate filtering. It is self-dispersible and can be introduced in any step of the production process without pre-dispersion or a premix step. This reduces complexity in production, opening up opportunities for producers to meet shifting consumer demand and stay ahead of regulatory changes by switching to an eco-friendly opacifier.

![Image](image_url)
The performance and physical properties of Lamesoft® Balance

Lamesoft® Balance features a stabilizing mechanism that prevents the aggregation of small particles in formulations. This reduces the sedimentation speed of wax dispersions such as Euperlan® OP White in surfactant systems, which is an important benefit for cosmetics manufacturers. Van-der-Waals forces lead to the fact that tiny particles agglomerate to bigger ones. With this in mind, dispersions will eventually separate to reduce the surface to volume ratio. These aggregations then build large particles that will sediment more rapidly and cause formulation instabilities.

Tests have shown that Lamesoft® Balance acts as a natural structurant in surfactant-based systems, especially those that can be micellar thickened. Different formulations containing the small-sized opacifying wax dispersion Euperlan® OP White at a concentration of 2.2% with a concentration of 1.5% Lamesoft® Balance and without the stabilization of this new ingredient were evaluated. Thin films of the formulation samples were heated on a heating plate and viewed under a microscope. The results of this test show that Lamesoft® Balance significantly reduces particle aggregation volume and speed. In this way, it extends the long-term stability of the formulation (Figure 3).

Further tests have also demonstrated that Lamesoft® Balance enhances sensory properties in body wash formulations. When compared to a placebo in various parameters, the new stabilizer boosted the foam properties and provided a pleasant skin feeling.

In additional tests of shampoo formulations containing cationic conditioning agents, Lamesoft® Balance significantly boosted the hair-conditioning effect in terms of residual wet combing and dry combing. The new ingredient is suitable for use as a care additive in rinse-off formulations at higher usage levels between 3% and 5% (Figure 4 and 5).

Overall, tests have shown that Lamesoft® Balance offers a stabilizing mechanism that reduces the sedimentation speed of wax dispersions in surfactant systems. It also enhances sensory properties in body wash formulations and improves the hair-conditioning effect in shampoo formulations containing cationic conditioning agents. In addition to this, it is cold processable and easy to formulate because it can be stirred into the surfactant solution before the addition of wax dispersion with no pre-dispersion. It even stabilizes low-viscosity formul-
Especially when combined, these two innovations are powerful examples of how the latest sustainable technologies can allow manufacturers to meet consumer demand for eco-friendly cosmetics that deliver high performance – while also meeting regulatory and legislative definitions for being free of microplastic. As the trend for sustainability and conscious consumerism gather momentum, producers will need to adapt their formulations and stay ahead of the trend. Euperlan® OP White and Lamesoft® Balance can make that possible.

References:

Conclusion

BASF has developed eco-friendly new ingredients that enable cosmetics manufacturers to respond to rising consumer demand for sustainable products that match or exceed the performance of traditional products. Euperlan® OP White is a readily biodegradable, wax-based opacifier that offers a sustainable alternative to synthetic opacifiers for surfactant formulations within hair and skin cleansing formulations. It is proven to offer the same high level of white appearance that is provided by opacifiers based on synthetic polymers. It also offers important benefits for hair care such as wet and dry combability, softness and smoothness. Lamesoft® Balance is a readily biodegradable and 100% natural ingredient that stabilizes wax-based dispersions such as Euperlan® OP White and enhances the sensory properties of rinse-off skin and hair cleansing formulations. Tests have demonstrated that it reduces the sedimentation speed of wax dispersions in surfactant systems, enhances sensory properties in body wash formulations and improves the hair conditioning effect when used in shampoo formulations containing cationic conditioning agents.

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