Film-forming polymer increases sun protection

ONE of this year's ingredient launches from Bayer MaterialScience was the polyurethane raw material Baycusan C 1000 for sunscreen formulations. Although it contains no UV-absorbing components, the film-forming polymer raises the sun protection factor (SPF) of sample formulations. In other words, it acts as an SPF booster. It also makes sunscreen products more water-resistant.

'We developed and tested a whole series of possible formulations, varying the UVA and UVB filters, both inorganic and organic, while doing so,' explains Dr Sophie Viala, head of cosmetics application engineering at Bayer MaterialScience. 'In our suggested formulations, we also took into account that people in various countries around the world have very different ideas about skin feeling.'

To provide protection across the entire relevant wavelength of the sun's spectrum, sunscreen products almost always include several UV filters. Viala and her team worked with cosmetic testing institutes to measure how the addition of up to ten percent Baycusan C 1000 influences the sun protection factor of various sample formulations. Both *in-vitro* and *in-vivo* procedures that meet the guidelines of the European Cosmetics Association (Colipa) were used. The results showed that this solvent-free polyurethane dispersion increases the SPF significantly – from 30 to 50, for example.

'Baycusan C 1000 offers the perfect solution to a well-known dilemma: how to respond to the trend towards ever-higher protection factors without compromising on the pleasant skin feeling provided by products with lower SPF values,' says Viala. Without boosters, the SPF can only be increased by using higher concentrations of UV filters, and this change in formulation usually feels wax-like, greasy or sticky on the skin. Baycusan C 1000 forms elastic films that feel very pleasant on the skin. As new tests confirm, they support a high level of water-vapour transmission and allow the skin to breathe.

A proportion of just five percent Baycusan C 1000 can be enough to make sunscreen more water-resistant, in line with Colipa specifications, which SA mostly follows. 'We have developed numerous sample formulations for sunscreens based on our polyurethane that pass the water-resistance test,' confirms Viala. These also include formulations that exhibit a lower than usual proportion of emulsifiers, so that on contact with water they are much less likely to re-emulsify and thus reduce the level of protection provided. 'Such formulations outside the standard are possible because Baycusan C 1000 has a stabilising effect and acts as a co-emulsifier.'

Two other properties of the polymer have a positive impact on water resistance. First, it forms a very even and uninterrupted film on the skin, which provides the mechanical influences of the water with few points of attack. And second, it boasts excellent compatibility with all the usual UV filters, including inorganic filters such as coated zinc oxide or titanium dioxide particles. Poor compatibility would result in the emulsion rejecting the particles so that they could be easily washed away by water. In addition, the polymer from Bayer MaterialScience also helps fix the UV filter on the skin by preventing its migration, an effect that is seen in some formulations even when not exposed to water.

'In sunscreen formulations, Baycusan C 1000 not only provides consumers with safe, pleasant and largely invisible protection, but also makes the life of the formulator much easier,' explains Viala. The polyurethane dispersion has a low viscosity, which means it is easy to integrate into the formulation. Other established film formers, such as vinylpyrrolidone co-polymers, have to be melted before they are ready for processing. Baycusan C 1000 is available locally through Savannah Fine Chemicals.

The Baycusan C product line is also renowned for satisfying the key requirements that the cosmetics industry places on 'green' raw materials. These synthetic polyurethane dispersions are based on water and contain neither preservatives nor co-solvents. During their manufacture, process-related by-products, such as waste materials, are kept to a minimum, while the chemical reactions take place using energy-saving and efficient procedures under mild conditions.

'We are able to offer Baycusan C products without preservatives, because they are manufactured and filled at our plant in ChemPark Dormagen using a high-quality process developed in-house,' explains Dr Steffen Hofacker, head of cosmetics at Bayer MaterialScience. As a result, the raw materials give cosmetic companies freedom to design their products as they see fit and to preserve them in line with the appropriate statutory requirements. The Baycusan C range includes a polyurea powder as a sensory additive and four solvent-free polyurethane dispersions with film-forming and conditioning properties. These raw materials can be used

to good effect in skin care products, decorative cosmetics, sunscreen and hair styling products.

'Green' chemistry requirements also include detailed criteria for waste reduction and energy efficiency. For example, the production of waste materials during manufacture can best be avoided by using catalysts to influence the reaction processes. This eliminates the need for large excess quantities of source materials to control the process of chemical synthesis, for example.

A further requirement is the avoidance or reduction of hazardous starting materials in the production of cosmetic raw materials. All these criteria are designed to conserve resources and reduce the potential for accidents.

Another ingredient for sunscreens available through Savannah Fine Chemicals is Hydrolyzed Jojoba Esters (HJE). One proposed action of topical products is that it increases the activity of molecules that are beneficial to the skin. For example, in a controlled study, it has been proven that HJE works synergistically with glycerin to improve skin moisturisation. HJE is a substantive material which demonstrates deposition on skin and hair, even in wash-off formulations such as body wash or shampoo. Its properties have been more recently explored in the sun care category at load levels of less than 1% in a test solution containing benzophenone-3 (0.5%), octyl methoxycinnamate (1.9%), and octyl salicylate (0.75%) dissolved in ethanol in solutions with and without HJE.

A calibration curve was created by treating subjects' forearms with test solutions of known concentrations of sunscreen actives followed by immediate evaluation with Attenuated Total Reflectance Fourier Transform Infrared Spectroscopy (ATR-FTIR). Other subjects' forearms were treated with a test solution, some with and some without HJE. These subjects then immersed their forearms in turbulent, room-temperature fresh water or salt water four times for 20 minutes, for a total immersion time of 80 minutes. After the final immersion, the subjects' forearms air-dried and the sunscreen active ingredients remaining were quantified with ATR-FTIR using the calibration curve. Sunscreen actives in the HJE-containing test article remained on the skin in higher concentrations than did the sunscreen actives in the product without HJE. ■

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