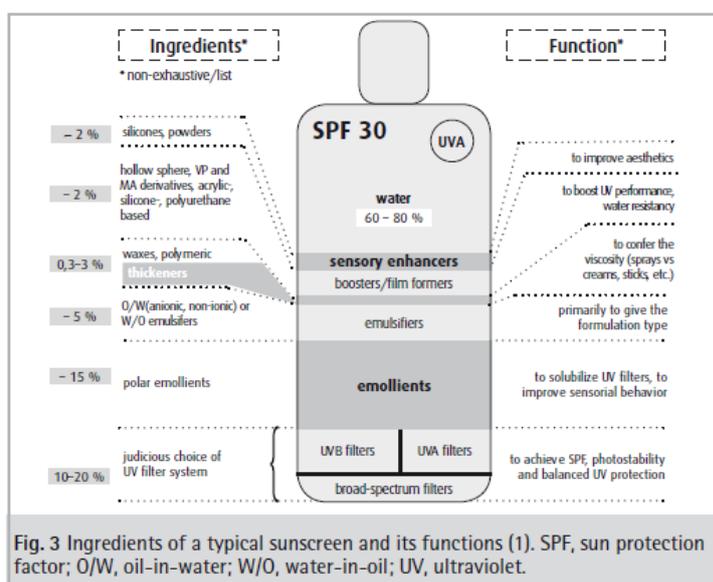


## BACKGROUND INFORMATION

### Downsides of solar radiation

The sun is a source of heat and light: It warms the seas and oceans, stirs the atmosphere, influences the weather and provides energy for plants and crops to grow. Without this star – which is now approximately 4.6 billion years old and has a diameter of around 109 times that of the earth – food, oxygen and life itself would not be possible. Yet at the same time, consumers around the world are becoming increasingly aware of downsides associated to the sun’s intense radiation – stemming from its links to skin damage and diseases such as skin cancer. At the center of these concerns are both types of the sun's ultra-violet rays – long-wave A (UVA) and short-wave B (UVB).



	Daily Care SPF15 (UVA)	Suncare SPF30 (UVA)	Lip Stick SPF50 (UVA)
A: UV absorbers	15 % Uvinul® Easy	30 % Uvinul® Easy	50 % Uvinul® Easy
B: Emollients	10 % Cetiol® Sensoft		5 % Cetiol® MM 3 % Cetiol® SB45
C: Emulsifiers			9.5 % Lameform® TGI
D: Thickeners	0.4 % Cosmedia® SP 1.5 % Tinovis® ADE	3.2 % Tinovis® ADE	10 % Candelilla Cera 2.5 % Cera Microcristallina (Paramelt) 3.5 % Polyethylene (Honeywell)
E: Sensory enhancers	2 % Polymethyl Methacrylate (Sekisui Plastic) 2 % Cyclopentasiloxane (Dow Corning)		
F: Film formers			8 % Cosmedia® DC
G: Preservatives, actives, perfume	0.5 % Dermiscan® SPB LS 9337		0.5 % Covi-ox® T90
H: Others	0.2 % Edta® BD 3 % Glycerin	0.2 % Edta® BD q.s NaOH	2 % Chione® HD Crisp Gold S230V 2 % Chione® Snowfall White S130D 2 % Chione® Super Red 434Z
I: Water	q.s	q.s	-

Frame formulations demonstrate the broad application of Uvinul® Easy.

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## Sun care made easy

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Websites: [www.personal-care.basf.com](http://www.personal-care.basf.com); [www.carecreations.basf.com](http://www.carecreations.basf.com)



The sun is by far the largest object in our solar system. While the heat and light it provides are essential to every form of life on earth, unprotected exposure to intense ultra-violet radiation can result in skin damage and diseases. As a result, state-of-the-art sun care products are in high demand. These should offer the same level of protection as clothing or the shade, and provide equal protection against both UVB and UVA rays. For consumers to enjoy

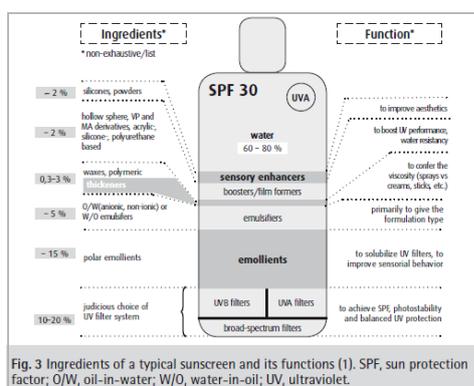
using a sunscreen, it must also be gentle on the skin, have a light texture, absorb quickly and have an attractive sensory profile for a pleasant feeling on the skin. All this means that designing and manufacturing sunscreen has become increasingly complex. The easiest way to make a sunscreen is by simply adding water to a sunscreen concentrate – such as Uvinul Easy – a transparent, oil-based concentrate developed by BASF. With this concentrate, any sunscreen ranging from SPF 6 to SPF 50 can be readily manufactured.

The sun is a source of heat and light: It warms the seas and oceans, stirs the atmosphere, influences the weather and provides energy for plants and crops to grow. Without this star – which is now approximately 4.6 billion years old and has a diameter of around 109 times that of the earth – food, oxygen and life itself would not be possible. Yet at the same time, consumers around the world are becoming increasingly aware of downsides associated to the sun's intense radiation – stemming from its links to skin damage and diseases such as skin cancer. At the center of these concerns are both types of the sun's ultra-violet rays – long-wave A (UVA) and short-wave B (UVB). Consumers are now wary of unprotected exposure to both types, and are paying greater attention to effective sun protection. This has sparked demand for sun protection products that offer higher SPFs and broad-spectrum protection.

According to Datamonitor (source: Datamonitor Report “Consumer and Innovation Trends in Sun care 2014”, September 23, 2014) the global sun care market was valued at \$8.7 billion in 2013, with sun protection accounting for almost two-thirds (64%) of spending in this category. Strong growth in the sun care market is also expected over the next few years. There is also an ongoing trend towards daily skincare products that incorporate UV protection. However, formulating and manufacturing sunscreen has become increasingly complex. A decade ago, sunscreen was viewed as a product to support “tanning without sunburn” – but its purpose has now shifted to preventing skin damage, premature aging and skin cancer. In addition, performance standards have become more stringent over the years and specific UVA protection criteria must now be fulfilled – including the European recommendation that the UVA protection factor to be at least one-third or greater of the sun protection factors (SPF) value ( $UVA-PF \geq 1/3 \text{ SPF}$ ). Technology has therefore improved to cover UVA protection and provide higher SPF.

### Aiming for a pleasant consumer experience

Furthermore, a sunscreen has to please its user. When it comes to the texture of a sun care product, the trend towards lighter formulations continues. This means the product must have a pleasant feeling on the skin during and after application, as well as being visually appealing, e.g. no excessive whitening, and having a nice scent. There is also increasing demand for quick and easy-to-use solutions, which clearly reflects the convenience megatrend. Sun protection products that can be applied to wet skin are just one example of this trend. In addition to being suitable for use on wet skin and allowing quick and easy application, these products remove water from the skin’s surface and do not leave the skin feeling greasy. Besides actively contributing to consumers’ wellbeing, products offering pleasant textures and ease of use also encourage frequent application of sunscreen in sufficient amounts.



### **Expertise meets creativity**

For a sun care product to be successful on the market, it needs to meet strict performance requirements, including a high SPF value and UVA protection, as well as water resistance, photostability and certain sensory properties. For designers and manufacturers of sun care products, four key requirements must be met:

- **Efficacy:** Choosing the right combination of UV filters and other key ingredients to achieve the desired performance.
- **Safety:** Be it objective or just perception by the media and the consumer.
- **Registration:** This is most important if the sunscreen is to be distributed in different regions or even globally.
- **Patent freedom:** “Freedom to operate” while respecting 3rd party intellectual property rights.

Designing a sun care product therefore requires clear insight into consumers’ needs and expectations, a strong commitment to innovation, and the ability to be creative when developing new products, as well as in-depth formulation expertise and high-quality ingredients. As one of the world’s leading suppliers of high-performance ingredients to the personal care industry, BASF is constantly striving to develop more efficient UV filters that enable a high degree of formulation flexibility and offer more balanced UV protection. A recent example is Tinosorb<sup>®</sup> A2B. BASF’s highly efficient broad-spectrum filter protects the skin against UV wavelengths ranging from 290 to 340 nanometers, thereby being the first of a new generation of finely-ground (micronized) UV filters: It complements conventional oil-soluble UV filters by closing the current gap between UVA and UVB absorbers, thus enabling a balanced protection across the entire spectrum of solar UV radiation.

### **Easy yet effective**

As already mentioned, designing and manufacturing sun care products is usually a complex process. To overcome this complexity, BASF has now developed a sunscreen concentrate that considerably simplifies the process of designing and manufacturing products: Uvinul<sup>®</sup> Easy is a transparent, oil-based concentrate that combines UV filters, emollients and emulsifiers and that can be transformed into an effective sunscreen by simply adding water and a thickener. The technology behind Uvinul<sup>®</sup> Easy is based on phase inversion processes, which can be used for the low-energy formation of fine emulsions. The most common emulsion structures for personal care applications are either oil-in-water emulsions (O/W), which consist of oil droplets in a continuous water phase, or water-in-oil emulsions (W/O), where water droplets are present in a continuous oil phase. The emulsion type depends on many factors, including the emulsifier type, temperature, salt concentration and more. An initial estimate of the preferred emulsion structure is defined by the Bancroft rule, which states that the solubility of the emulsifier sets preference for the continuous phase of an emulsion. This rule explains the principle influence of the emulsifier structure, salt concentration and temperature. Phase inversions

of emulsions, from O/W to W/O or vice versa, can be enforced by a variation of these parameters. The addition of water at a constant temperature with moderate stirring leads to the spontaneous formation of a white O/W emulsion. This emulsion will show creaming on standing due to its low viscosity. Therefore, it is necessary to adjust the rheological profile through the addition of a thickener. With Uvinul® Easy, any sunscreen between SPF 6 and SPF 50, i.e. the range of SPF recommended in Europe, can be readily manufactured. For desired SPF X, the Uvinul® Easy concentrate must be diluted to X%. For example, to produce an SPF 30 sunscreen, the concentrate must be diluted down to 30%. This automatically ensures the correct amount of UVA protection. Thickener can be added to achieve the desired rheological properties, e.g. to make various product formats such as lotions, creams, sprays, etc.

### From daily use creams to lipsticks

Consumers' desires to stand out as individuals also calls for sun care products that can be tailored to their specific needs and target either men or women of different ages at different stages in their lives. It's possible to customize the formulation by adding other emollients and sensory-enhancing products. Furthermore, preservatives and fragrances can be added to make the product even more unique. It is even possible to make other cosmetic formats such as skincare formulations, e.g. a daily use cream with SPF 15 and a make-up formulation such as a BB cream or lipstick with SPF 50 (see Fig. 1).

	Daily Care SPF15 (UVA)	Suncare SPF30 (UVA)	Lip Stick SPF50 (UVA)
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I: Water	q.s	q.s	-

(Caption)

Frame formulations demonstrate the broad application of Uvinul® Easy.

Although manufacturing sunscreen can be very complex, there are now easier ways to go about it. For instance, by using the BASF sunscreen simulator in the design or to just to gain better understanding of how the performance of sunscreens can be influenced by varying the composition and concentrations of UV filters. Uvinul® Easy is another option for manufacturing sun care products in an easy way and has been created to rapidly incorporate an SPF claim into different application formats, without requiring specific knowledge of sun care.

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