Bathroom Products;

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Whatever goes on in the bathroom it frequently involves bubbles so this article will focus on the surfactants that create them, the effect that they have on skin and at ways of improving the product.

Harsh surfactants such as alkyl carboxylates (soaps) tend to cause swelling and hyper-hydration of the stratum corneum (SC), which can enhance penetration of cleanser ingredients into deeper layers leading to deleterious biochemical responses. To avoid the use of soaps the majority of shower gels and body washes are based on surfactants and in November 2014 the author of this feature looked at the INCI lists of more than sixty shower gels, selected because they had significant sales in China, Australia, North America and Europe. Despite the numerous surfactants available fifty-two contained sodium laureth sulphate (SLES) and fifty-five contained cocamidopropyl betaine (CAPB).

Surfactants are known to be irritants to the skin, which can lead to irritant contact dermatitis (ICD) that becomes chronic after frequent and prolonged exposure. Barrier damage and keratinocyte-derived cytokine release can elicit skin irritation, erythema and itching. Skin lipids are a well-balanced system of water, cholesterol, cholesterol esters, ceramides and fatty acids. Under ideal conditions, the system exists in predominantly ordered form, ensuring the proper function of skin barrier but above the critical micelle concentration surfactants are shown to remove the SC lipids.

Much research has been carried out into the effects of surfactants on the SC and into ways of measuring them [Ref 1]. Generally, anionic surfactants are potent irritant for human and animal skin. In particular, sodium lauryl sulphate is an acute and cumulative irritant, and thus, an important model of experimental ICD. Cationic surfactants have at least the same irritant effect as that of anionic surfactants, and are more cytotoxic. The irritation potential of amphoteric agents is generally lower and non-ionic surfactants are regarded as the least irritant. [Ref 2]

The effects of the SLES/CAPB combination of surfactants on the stratum corneum (SC) was the subject of a study described in the International Journal of Cosmetic Science. The authors employed SLES, CAPB and their mixtures as model anionic-zwitterionic surfactants for treating the SC. Although varying the ratio of individual surfactants in the mixture the total surfactant concentration was kept constant at 5%. The drying stress of these surfactant-treated samples was measured as a function of time and it was observed that single surfactants lead

to higher drying stress compared to mixed surfactants and the SLES–CAPB 4:1 mixture generates the lowest drying stress [Ref 3].

Even though the current market is dominated by the SLES/CAPB combination there are numerous alternatives available and some of these were appearing in the survey; either as the prime surfactant or more usually as secondary ones. Alkyl polyglucosides (APGs) were the most popular. They are formed as the condensation products of fatty alcohols with glucose and these versatile non-ionic surfactants are used as secondary surfactants in shower and bath products. They have very low irritation scores and are biodegradable.

Although APGs have been available for a long time their commercial use was promoted as Plantarens by Cognis in the 1990s and they are now distributed by **BASF** as Plantacares. An example is Plantacare 818 UP, which is an approximately 52% active aqueous solution of coco-glucoside. This is also supplied as a mixture of coco-glucoside with glyceryl oleate as Lamesoft PO 65, which is described as used as lipid layer enhancer for the production of surfactant cleansing preparations. It also contributes to the viscosity of shower gels, foam baths, shampoos and baby products.

Gilas supplies Gilsoft Cocoa [Cocoa glucoside] and Gilsoft Olea [Olive oil glucoside]; both of which are based on entirely natural raw materials. Their foam is very creamy giving a good skin feel and if added to systems based on SLES, they work as co-surfactants, moderating the aggressiveness of the primary surfactant and increasing the safety of the formula.

Lamberti Group took alkyl polyglucosides and reacted them with organic acids to create the Eucarol AGE alkyl glucoside esters; AGE/EC [INCI: Disodium coco-glucoside citrate], AGE/ET [INCI: Disodium coco-glucoside tartrate] and AGE-SS [INCI: Disodium coco-glucoside sulfosuccinate]. They have low surface tension at their critical micelle concentration, which indicates good detergency properties and published data shows very low irritancy potential and environmental toxicity. Specialising in environmentally-friendly surfactants **Colonial Chemicals** presents a wide range of anionic, non-ionic and cationic surfactants derived from sugar chemistry. These include Suga Nate 100% active APG sulfonates; Poly Suga Glycinate APG amphoterics and Poly Suga Mulse non-ethoxylated emulsifiers.

Lathanols LAL from **Stepan Peronal Care** is sodium lauryl sulfosuccinate and is marketed as a replacement for ethoxylated ether sulphates. It is said to generate a rich, creamy and

stable foam; to readily build viscosity and to be mild to the skin, providing a silky skin feel. It is also supplied as a mixture with disodium laureth sulfosuccinate as Stepan Mild LSB, which shows better foam properties with formulations containing oil. These are just two of a wide range of surfactants for personal care applications available from **Stepan**.

Sulfosuccinates are a large group of anionic surfactants many of which are suitable as foaming and cleansing agents and they are generally less irritating than the alkyl sulphates and ethoxylated alkyl sulphates. An example is Tego Sulfosuccinate DO 75 from **Evonik**, which is compatible with anionic, amphoteric and non-ionic surfactants and is suitable for body washes and cleansing formulations with up to 50% oil content. Despite the high oil content it enables formulations with good foaming properties and a very creamy texture however the pH of final formulations should be 5 – 7 to avoid hydrolysis.

Incorporating oils into shower gels can greatly improve skin feel but consumers still expect their products to foam and prefer them to be clear. NatraGem S150 from **Croda Europe** is a solubiliser specifically developed to incorporate lipophilic cosmetic actives and their carrier oils into clear formulations. Based on a mixture of polyglyceryl-4 laurate/sebacate and polyglyceryl-6 caprylate/caprate experiment shows it to be a more effective solubiliser than either polysorbate-20 or PEG-40 hydrogenated castor oil for commonly used emollients and for many essential oils. It is also shown to significantly reduce the irritation effects of aggressive surfactants like sodium lauryl sulphate. An alternative material is **Sasol**'s Cosmacol NII-9 Emulsifier [INCI: C12-13 Pareth-9], which is a biodegradable, non-ionic surfactant that is an effective solubiliser for fragrances and polar essential oils.

Polyglyceryl esters are finding increasing applications in cosmetic products and polyglyceryl-4 cocoate marketed as Cremercoor PG4 Cocoate by **Cremer Oleo GmbH** has Ecocert organic certification. It is said that in combination with other surfactants it can be beneficially incorporated in all kinds of liquid personal care products to improve skin feel, mildness and foam characteristics. Other polyglyceryl esters available from **Cremer Oleo** include polyglyceryl-2 caprate, which acts as a skin friendly refatting agent and the polar head consisting of two glycerol units helps to moisturise skin and hair. Polyglyceryl-4 cocoate is blended with glyceryl stearate citrate, sucrose stearate, cetyl alcohol and sodium ricinoleate to form DUB Base Expert + from **Stearinere Dubois.** This 100% vegetable-derived self-emulsifying base is recommended at 3% to 10% in foaming products where it creates a rich creamy lather and an opaque pearlescent product.

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Coconut oil polyglyceryl-6-esters is available as Resassol PG6 from **Res Pharma** and tests show that when used as a secondary surfactant at 6% it improves the foam height and consistency of formulations based on SLES and other surfactant systems. **Res Pharma** has developed numerous vegetable-based amphoglycinate surfactants that are exceptionally mild to the skin. Published data shows that they can replace CAPB to improve foam consistency and lessen irritancy in both SLES and non-SLES systems. Lipex Shea Betaine [INCI: Shea butteramidopropyl betaine] is a shea butter based amphoteric surfactant from **AAK** that improves viscosity and foaming properties of rinse off formulations; it is mild and non-irritant and is also free from PEG and ethoxylates.

EK Cosmetics produces a family of lipoaminoacids of vegetable origin, with high surfactant, detergent and foaming activities. Ekkasoft LG/S is lauroyl glycine lysine salt and the presence of lysine can help alleviate some skin problems like dryness, hyper-oil production and wrinkles and it is particularly indicated for impure skin and very delicate intimate cleansers. It exhibits excellent compatibility with many surfactants and if added to SLES/CAPB systems it reduces irritation and improves foaming properties.

Amino acids form the backbone of surfactants available from **Ajinomoto** and its Amisoft range is derived from l-glutamic acid and natural fatty acids. Described as extremely hypoallergenic and well suited as mild cleansing agents their pH is similar to that of the skin, they do not dry the skin, but leave it feeling moisturised after washing. Amisoft is available in a variety of forms including potassium salts, sodium salts, non-neutralized forms (acid type), and compounds with varying acyl chain length so the compound most suited to the end product may be selected. Ajinomoto's Amilite series are based on glycine or alanine and are noted for their high foaming ability.

Another example of an amino acid derived surfactant is Eversoft ULS-30S [INCI: Sodium lauroyl glutamate] from **Sino Lion**. It is a liquid amino-acid based additive which reduces the irritancy level of SLES in cleansing products and can be added to existing formulation at 3-5% to make the formulation easier to rinse off and reduce residual SLES on the skin or hair.

Beautycare surfactants from **B.C. Cosmetic & Food Srl** are amphoacetates directly derived from the triglycerides of oils and butters including argan oil, shea butter, cocoa butter, olive and mango oils. They are said to retain the nutrient and emollient characteristics of the original oils and butters and may be employed in a wide range of skin-friendly detergent systems and are particularly indicated for very delicate skin. Also from **B.C.** is Beautyolea S3

[INCI: Olive oil PEG-7 esters] and Beautyolea S4 [INCI: Sodium PEG-7 olive oil carboxylate]. Both are derived from olive oil and together combine exceptional mildness with good foaming properties with Beautyolea S4 being suitable as a primary surfactant and the S3 used to improve creaminess of the foam and to leave the skin feeling soothed and hydrated.

Olive oil PEG-7-esters is also available from **B&T** as Olivem 300 and B&T also supplies sodium PEG-7 olive oil carboxylate as Olivem 400. Olivem 300 is a 100% active mild emollient and non-foaming cleanser that can reduce irritation caused by commonly used surfactants. Olivem 400 is a very mild cleansing agent containing 36% active anionic PEG-7 olive oil carboxylate and Olivem 460 is a preservative-free, 60% active version with foaming, cleansing and solubilising properties.

Returning to the SLES/CAPB basic mixture; this can be much improved by the addition of skin-friendly additives and many of the secondary surfactants mentioned can be added to reduce irritation and improve foam. Cromollient SCE [INCI: Di-PPG-2 myreth-10 adipate] from **Croda Europe** was developed to mitigate irritation from surfactants and enhance sensory benefits in a wide range of applications. It is particularly recommended for baby products and sensitive skin. It provides a silky skin after feel and enhances slip, while being suitable for clear systems.

Alkanolamidees were once popular additives as they are good solubilisers and add thickening and foam stabilising properties to surfactant systems. Suggested as an alternative to alkanolamides is Cosmacol ELI [INCI: C12-13 alkyl lactate] from **Sasol.** Described as a multi-functional emollient it improves skin barrier, restores the lipid film and reduces irritation of surfactants and also has good surfactant thickening properties

Thickening alternative surfactant systems can be difficult; a thickening agent available from **Alfacos** is Sucraclear HC-31 [INCI: cellulose gum, carrageenan, ceratonia siliqua gum, sucrose], which gives clear thickened solutions with sodium lauroyl glutamate and sodium lauroyl sarcosinate. The gels have good suspending powers making them ideal for products containing exfoliating particles. It will also successfully thicken decyl and coco-glucoside systems but solutions are cloudy.

Another thickening aid for aqueous liquid cleansing products is Stepan-Mild GCC [INCI: Glyceryl Caprylate/Caprate], which is made by esterification of glycerin from vegetable oil sources and medium chain fatty acids from coconut or palm kernel oil. It is particularly effective with sodium C14-16 olefin sulfonate and TEA lauryl sulfate and with SLES/CAPB

systems where it is recommended as a replacement for alkanolamides to improve skin feel and foam and to build viscosity.

Versathix from **Croda Europe** is described as a versatile rheology modifier that provides viscosity building across a wide variety of surfactant systems with a neutral effect on foaming. Versathix is a 70% active aqueous solution of PEG-150 pentaerythrityl tetrastearate with PPG-2 hydroxyethyl cocamide and literature available from Croda shows that it provides excellent thickening in traditional, as well as sulphate-free systems, coupled with shear thinning rheology.

The author's survey of ingredients revealed that the most frequent additive to shower gels and body washes was polyquaternium-7. This material is widely available and the information supplied by **White Sea & Baltic** about its Marasoft-CP7 is generally applicable to all supplies. It is described as a highly substantive cationic copolymer that provides excellent conditioning properties for hair and skin and imparts slip and lubricity to formulations. It is compatible with a wide range of anionic, non-ionic and cationic surfactants and shows complete water solubility giving clear products.

The next issue of SPC incorporates a feature on Spa products wherein the surfactant systems described here are further improved by the addition of active ingredients.

Ref 1 Corazza, M., Lauriola, M., Zappaterra, M., Bianchi, A. and Virgili, A. (2010), Surfactants, skin cleansing protagonists. Journal of the European Academy of Dermatology and Venereology, 24: 1–6

Ref 2: Bárány, E., Lindberg, M. and Lodén, M. (1999), Biophysical characterization of skin damage and recovery after exposure to different surfactants. Contact Dermatitis, 40: 98–103

Ref 3 Purohit, P. *et al*, (2014) Effect of mixed surfactants on stratum corneum: a drying stress and Raman spectroscopy study. International Journal of Cosmetic Science, 36: 379–385

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