

We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,900

Open access books available

186,000

International authors and editors

200M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com



Introductory Chapter: Surfactants in Household and Personal Care Formulations - An Overview

Ashim Kumar Dutta

1. Introduction

Surfactants are ubiquitous and form a part of almost every essential household product we use on a daily basis and have become synonymous with detergents and cleaning agents. The global surfactant consumption is 18,000 kilotons per annum that had a market value of USD 43,655 million in 2017 and is projected to reach USD 66,408 million in 2025 with a compound annual growth rate (CAGR) of 5.4% [1]. Interestingly, the first detergent known to man was soap, the origin of which may be traced back to the Egyptian civilization in 2800 BC. Cylinders containing soap made from animal fats and ashes recovered from excavations in Babylon confirm that indeed soap was known to the Babylonians. The Ebers Papyrus (1550 BC) also mentions the use of soap for bathing and cleaning, and in the Bible, soap has been referred to as “Borith” meaning a cleaning agent made from wood and vegetable ashes. Paintings on the walls in the pyramids confirm that the Egyptians maintained a very high level of hygiene and both men and women used to be well-groomed. While the men folk especially the nobles sported a clean shaven head with a short braid, women kept their hair short [2]. The use of various oils (sesame, olive, and almonds) and herbs like lavender, myrrh, rosemary, rose, and cedar to make perfumes becomes evident from their extensive use in the embalming of Egyptian pharaohs. They also used various metallic oxides like ochre, malachite green, and antimony ground to a very fine powder and mixed with an oil to color their lips and cheeks. Antimony ground to a fine powder and mixed with burnt almonds was used as kohl [2].

Before the nineteenth century, there was extreme poverty in Europe, and people lived in squalor and under very unhygienic conditions that is supposed to be one of the main reasons for the plague epidemics that recurred time and again. The deadly bacterial strain (*Yersinia pestis*) that was transmitted from rodents to man by fleas wiped out 25 million lives in Europe between 1347 and 1665. Mass realization that plague was related to the lack of cleanliness eventually led to a renaissance in hygiene. By 1525 at least two companies in Marseilles (France) had started producing and selling soap. In 1789, Andrew Pears made the first ever transparent soap, and almost a century later in 1886, the two brothers William and James Hesketh Lever made the first commercial soap manufacturing unit in Warrington which over the years evolved to become Unilever as we know it today.

In fact soap was the only detergent commercially available till the late 1950s when linear alcohol benzene sulfonic acids (LABSA) were synthesized from crude oil. Today almost all detergents contain LABSA [3] that form the heart of a multibillion detergent industry thriving worldwide.

In this chapter, we review the basic properties of surfactants with specific focus on their use as cleansers in household and personal care applications. As these

individual subjects are large enough to cover several book volumes, we intend to cover cleaning of fabrics (laundry), skin, and hair cleansing. The intent to review the basics arises from the need to make this book equally useful to a newcomer to this area of research and at the same time be a ready reference to an expert in the subject.

2. Basic concepts

2.1 Surface tension and surface activity

Liquid surfaces are known to behave like stretched membranes that make it possible for small insects like water strider to walk across its surface as if it were a solid substrate. While molecules within the bulk of the liquid experience no net force being pulled equally from all possible directions, at an interface it experiences unbalanced forces arising from the pull from molecules in the liquid layer just below it that makes the interface behave like a stretched membrane. These forces called the surface tension act parallel to the plane of the interface and are defined as force per unit length or surface energy per unit area of the interface and are a characteristic of the interface [4]. Typical surface tension at the water-air interface is 72 mN/m, while for the mercury-air interface, it is 456 mN/m.

Surface active molecules or surfactants or amphiphiles as they are often called consist of a hydrophilic (water loving, polar) group at one end and a hydrophobic (water hating, nonpolar) group at the other. These molecules are unique in that when added to water, its surface tension reduces significantly [4, 5]. The coexistence of the hydrophilic and hydrophobic end group in the same molecule allows them to self-organize at interfaces that make them surface active. While the hydrophilic end remains in contact with water, the hydrophobic end stands out in air, and the axis of the molecule makes an angle with the plane of the air-water interface which is a characteristic of the molecule and depends on its molecular structure and packing at the interface. It is this self-organization of the amphiphile at the air-water interface that reduces the surface tension of water. It has been observed that the extent of surface tension lowering depends on several factors, namely, (a) the structure of the molecule, (b) temperature, (c) electrolyte concentration of the aqueous phase, and most importantly (d) concentration and (e) purity of the amphiphile.

Figure 1 shows that as the bulk concentration of the amphiphile is increased, surface tension decreases (**Figure 1**) and reaches a minimum beyond which it remains almost constant. This bulk concentration beyond which surface tension does not change is referred to as the critical micellar concentration (cmc) [4, 5] and corresponds to a configuration of the system where the air-water interface is fully saturated with specifically oriented surfactant monomers. Other bulk properties like conductivity and turbidity show sharp changes at cmc [4, 5] suggesting a phase transition.

As more and more molecules are added to the bulk, they rapidly migrate to the surface and get organized at the interface till the monolayer at the air-water interface is saturated; further addition causes the amphiphiles to get organized in a spherical ball-like configuration in the bulk where the hydrophilic groups are located on the surface of the sphere and the hydrophobic groups of all the molecules are clustered at the center of the sphere as shown in the inset of **Figure 1**. These spherical ball-like structures with a hydrophilic surface and a hydrophobic core are called micelles. Polarity-sensitive fluorescent dyes introduced in micelles have confirmed that the polarity within the micellar core is less polar than the aqueous environment outside the micelles [6]. Because of their nonpolar core, micelles are excellent vehicles for solubilizing highly hydrophobic and poorly water-soluble

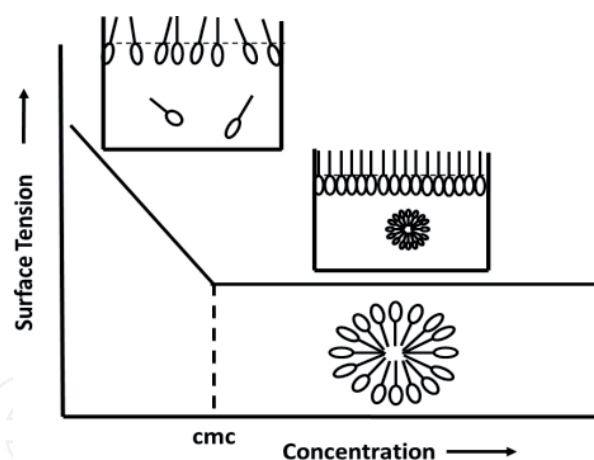


Figure 1. Schematic of surface tension versus surfactant bulk concentration. Inset shows the organization of monomers at the interface and bulk.

molecules that has been used successfully in various drug and cosmeceutical delivery systems.

Micelles are often characterized by their aggregation number (N) which is a measure of the number of monomers that form the micelle. Concentration-dependent studies have demonstrated the existence of other organized structures, namely, bilayers, lamellar, hexagonal phases, vesicles, and wormlike micelles that may be accounted for by the core packing parameter (CPP) model [4]. In fact the most important structural parameter predicting the structure of an organized ensemble formed is given by $V_H/L_c A_0$ where V_H is the volume of the hydrophobic micellar core, L_c is the length of the hydrophobic chain, and A_0 is the cross-section area of the hydrophilic head group at the micellar water interface. It is confirmed that different values of this ratio given within parenthesis yield different micellar structures in the aqueous medium, for example, spheroidal (0–0.33), cylindrical (0.33–0.5), lamellar (0.5–1.0), and inverse (reverse) micelles (>1) in nonpolar media [4, 5]. In concentrated systems where the amphiphile loading is high, multiple micelles are available that fuse together to give rise to lamellar, hexagonal, bi-continuous, and liquid crystalline phases that can be readily identified by polarized optical microscopy and X-ray diffraction or both [4, 5].

Other parameters that help compare surface activity of different surface active molecules are their C_{20} and the cmc/C_{20} values. As defined by Rosen [4], C_{20} is the bulk concentration of the surface active material required to depress the surface tension of pure water by 20 mN/m. To compare the effect of environmental or external factors like temperature or an additive influencing, the adsorption and aggregation process and the cmc/C_{20} ratio provide rich insights into these two competitive processes as a function of that external parameter. While a lower C_{20} value indicates a higher tendency of the molecule to get adsorbed at the air-water interface, a lower cmc value is indicative of a higher tendency of the molecule to form micelles. While a higher cmc/C_{20} implies inhibition of micellization and an enhancement of adsorption at the air-water interface, a lower cmc/C_{20} implies inhibition of adsorption and enhancement of micellization under the given set of conditions [4].

2.2 Emulsions and emulsion stability

Oil and water when mixed are known to separate out into two distinct layers. However, when a surfactant is added to the mixture and the surfactant is water-soluble, an oil in water (O/W) emulsion is formed and vice versa. The larger the amount of surfactant used, the finer is the emulsion [7]. Because emulsions consist of two

phases, oil and water, and their refractive indexes are different, these droplets scatter light that make emulsions appear translucent or milky. The droplet size depends on the ratio of oil and water and the surfactant used. Microemulsions are special in that they appear isotropic and transparent and are known to be thermodynamically stable, and interfacial tension at the oil-water interface is zero [4, 5, 7]. Over time, emulsions tend to separate out either as a creamy layer at the top or a heavy liquid at the bottom which is caused as a result of coalescence of droplets colliding due to Brownian motion. Prevention of coalescence is key to emulsion stability which is achieved by introducing (a) electrostatic repulsion between the droplets and (b) steric hindrance. While the electrostatic repulsion may be brought about by charged surfactants anionic or cationic, steric hindrance may be brought about by using polymeric surfactants which because of its residence at the oil-water interface of the droplet prevents close approach of the droplets and their coalescence. Emulsions stabilized by adsorbing submicron silica or polymer beads at the oil-water interface of the emulsion droplets providing a physical barrier to coalescence of the droplets in the absence of charged surfactants are known as “Pickering emulsions” [4, 5, 7].

3. Mechanism of substrate cleaning and detergency

Detergents help clean a substrate on which some unwanted material or debris has deposited. Clearly, the ease with which the material may be removed depends on how firmly the material is adhering to the substrate and whether the binding is chemical or physical. In this chapter, we will not consider chemical binding of the debris to the substrate but will only consider removal of debris that is physically bonded to the substrate like food stains, sweat, sebum, oils, grease, mud, and airborne particles like silica, carbon, iron oxide, clay, etc. Often the debris is a complex composite material consisting of oily and fatty matter (sebum) and particulates. Sebum secreted from the skin differs from person to person depending on food habits and ethnicity. Typically, sebum contains triglycerides, wax esters, fatty acids and their esters, squalene, and a small amount of cholesterol and is a soft semisolid at 25°C that melts at about 35°C. A key mechanism by which sebum is removed from a substrate (e.g., fabric) is solubilization. When the concentration of surfactant is sufficiently high and exceeds cmc, a large number of micelles available readily solubilize the semisolid sebum that is retained in the micellar core.

Another important cleanup mechanism is through emulsification. Surfactant molecules get adsorbed at the sebum-water interface lowering the sebum-water interfacial tension that emulsifies the sebum which is transported away from the substrate into the bulk of the solution resulting in a cleanup of the substrate as shown in the schematic (Figure 2).

Roll-up mechanism is yet another important mechanism at work. This is applicable for liquid oil sticking to the substrate. The work of adhesion (W_{SO}) is given by



Figure 2.

(1) Oily material, (2) adsorption of surfactant on oily material, (3) solubilization of oily material and emulsification, and (4) oily mass removal.

$W_{SO} = \gamma_{SO} (1 + \cos \theta)$ where θ is the contact angle of the oil with the substrate and γ_{SO} is the surface tension at the substrate-oil interface. For W_{SO} to be zero, $\cos \theta$ has to be -1 which means that this condition $\gamma_{so} = \gamma_{ws} + \gamma_{ow}$ has to be fulfilled for the removal of oil from the substrate. Now γ_{so} and γ_{ow} (oil-water interfacial tension) are constants and therefore $\gamma_{ws} = \gamma_{so} - \gamma_{ow}$ which is readily achieved as surfactant adsorbing at the substrate-water interface (γ_{ws}) lowers the surface-water interfacial tension. Once the above condition is achieved, the oil detaches itself from the substrate that is subsequently removed by hydraulic current generated through agitation which removes the oil from the substrate. Because sebum has a melting point of about 35°C , the roll-up mechanism does not come into picture when wash temperature is below 35° as sebum at that temperature is in a semisolid state.

4. Classification of surfactants

Surfactants typically have a hydrophobic chain (R) with an end group. Anionics have a negatively charged polar group, while the charge on a cationic is positive, and zwitterionics have a positive charge at one end and a negative charge at the other end. Nonionics have neutral end groups.

1. Anionics—Carboxylates (R-COO^-), alkyl sulfonates (R-SO_3^-),
2. Cationics—Alkyl ammonium chloride ($\text{RNH}_3^+\text{Cl}^-$)
3. Zwitterionics—Sulfobetaines ($\text{RN}^+(\text{CH}_3)_2\text{CH}_2\text{CH}_2\text{SO}_3\text{O}^-$)
4. Nonionics—Polyoxyethylenated alcohols $\text{R(OC}_2\text{H}_4)_n\text{OH}$

4.1 Surfactants in household cleaning

Household cleaning may be divided into two main groups: (a) hard surface cleaning (floors, table and kitchen tops, toilets, etc.) and (b) soft surface cleaning (fabrics, linens, etc.). In this section we will focus on some aspects of fabric cleaning only. The most common surfactants used in laundry are anionics and nonionics. The anionics used are the sodium salts of (1) linear alkyl benzene sulfonate, (2) paraffin sulfonate, (3) alkyl ether sulfate, (4) fatty acid soaps, and (5) methyl ester sulfonate, while in nonionics (6) fatty alcohol ethoxylates, (7) amine oxides, and (8) N-methylglucamide are extensively used.

The most extensively used surfactant in fabric wash is LABSA which consists of a mixture of C_{10} and $\text{C}_{13}\text{--C}_{14}$ chains with a phenyl group substituted either at 2 or 5 position of the carbon chain. The chain distribution and substitution depend upon the raw materials and the substitution process used. It has excellent wetting and foaming properties in addition to being highly stable over a wide range of temperatures and pH. Moreover, LABSA have no proven adverse effects on human health or the ecosystem, but its lower biodegradability is a concern as it tends to accumulate in the environment.

Calcium (Ca^{2+}) and magnesium (Mg^{2+}) ions naturally present in water replaces the sodium in LABSA to form surface inactive calcium and magnesium salts of LABSA. Hence, detergency or cleaning efficiency decreases in hard water. The insoluble calcium salt of LABSA gets entrapped in the interfiber spaces in fabrics making it appear dull, gray, and rough over time. To prevent deactivation of LABSA, sequestering agents called builders are added to soften the water. Some of the common sequestering agents are sodium tripolyphosphate (STTP), sodium

silicate, and sodium carbonate which added to hard water removes the Ca^{2+} and Mg^{2+} by converting them into insoluble phosphates, silicates, and carbonates. Zeolites and soaps are also used as builders. Although used extensively in the 1980s and 1990s, the use of phosphates is strongly discouraged as they tend to cause eutrophication of water masses that adversely affects the environment.

A typical fabric wash formulation today contains about 10–20% LABSA, 15–30% sodium carbonate, and 4–6% sodium silicate as the main ingredients. Because LABSA perform the best at high pH >10, detergent formulations usually have pH between 10 and 12 [8–10]. A mixed active consisting of LABSA and nonionic (a fatty alcohol ethoxylate) is often used to boost cleaning that is achieved through lowering of cmc of the mixture and improved wetting as nonionics are unaffected by Ca^{2+} and Mg^{2+} . Not more than 2–3% of nonionics may be added in spray-dried powders as blue fumes that catch fire are produced during spray drying. However, in liquid formulations no such restrictions exist. Because soil removed from fabrics remains dispersed in the wash liquor, it tends to get reabsorbed back into the fabric to prevent which anti-redeposition agents like carboxymethylcellulose or sodium polyacrylate (0.1–0.2%) are added. Other ingredients used to complete the formulated products are fillers (zeolites, sodium sulfate bentonite, etc.), enzyme mixtures (proteases, lipase, and cellulases), and perfume. It must be pointed out that cleaning efficiency depends on several factors (a) the recipe, (b) the soil composition (food, oil, stains, etc.), (c) water hardness, (d) the wash protocol, (e) temperature of wash, (f) the agitation provided, and (g) the fabric under consideration.

In developing countries like India, Pakistan, Sri Lanka, Bangladesh, and the Philippines, a substantial fraction of the population still washes clothes by hand and often using a brush to scrub the fabrics clean. In India about 60% of the population still washes clothes by hand using a detergent powder for soaking and a detergent bar and brush to scrub their clothes clean. The divide between hand and machine-wash users is about 60:40, although the number of machine users is rising rapidly due to the availability of affordable machines and a higher disposable income. Powder detergents dominate the Indian market, while liquid detergents are the only product in the European and American markets.

The challenges for the detergent industry in India, Pakistan, and Bangladesh include harsh conditions like water hardness which varies from 80 to 200 ppm and acute water shortage in many areas. Again average temperatures exceed 40°C that cause profuse sweating, and because of high atmospheric pollution, clothes rapidly become dirty. The high levels of sebum and fine suspended matter from the atmosphere make the soil tough and difficult to remove. In contrast, water hardness and atmospheric pollution in the USA and Europe is very low, and hence, the soil generated is very low and easy to remove as washing with hot water is the usual practice. Despite the large differences between the Indian and European and American washing practices, there however exists a similarity—need for a lower cost per wash. While in Europe and the USA a large fraction of the cost per wash may be attributed to electrical heating costs, in India a large component of the cost per wash arises from the need to use larger quantities of surfactants and builders. One solution to the above problem is to find an alternative to LABSA.

Fatty alcohol methyl ester sulfonates (FAMES) that are obtained from sulfation of fatty alcohols derived from renewable sources like palm, rapeseed, soya, or corn oils have been used as alternatives to LABSA. Although 100% biodegradable, it is yet to find a substantial place in the detergent industry as it is often not very cost-competitive, and availability of the same in very large quantities is often a matter of concern. Moreover, increasing demands of palm and soya oils have given rise to massive deforestation in Malaysia, Indonesia, and Brazil that is a huge concern for the

environment. Other challenges include a slightly lower performance of FAMES than LABSA at lower temperatures and its tendency to decompose in humid and high temperatures. Decomposition of FAMES is associated with a foul odor that interferes with the fragrance of detergents which is unacceptable to most consumers that continues to make FAMES unfavorable for commercial use in household products [11].

4.2 Surfactants in personal care

4.2.1 Surfactants in skin care

A glowing skin and shiny well-groomed hair not only adds to self-confidence but also is a reflection of health and personality of that person. It is something that every person looks forward to that forms the base on which the multibillion global cosmetic industry thrives. The global skin care market in 2016 was estimated to be USD 136,304 million and estimated to reach USD 194,961 million in 2024 with a CAGR of 4.5%, while the global hair care market is about USD 18072 million in 2017 and is expected to reach USD 23601 million in 2024 with a CAGR of 4.1%.

The skin happens to be the largest organ of the human body that provides a tough barrier to almost all types of bacteria and allergens in addition maintaining a constant body temperature through expulsion of moisture in the form of sweat and exchange of heat with the surroundings. Sweat contains mineral salts and sebum (a waxy organic material organic matter secreted by the sebaceous glands) that keep the skin surface lubricated and forms a moisture barrier preventing excess moisture loss. Because of its waxy nature, dirt mainly particles from the atmosphere (carbon, silica iron oxide, etc.) and dead skin cells readily accumulate and forms the breeding ground for bacteria which readily finds nutrients for its survival and growth giving rise to foul odor and irritation [12]. Hence, skin cleansing is essential.

The structure of the skin is complex and may be broadly divided into three main layers, (1) epidermis, the outermost layer; (2) dermis, the middle layer; and (3) hypodermis, the bottom layer. The epidermis may be further subdivided into five sublayers: (a) stratum corneum (SC), (b) stratum lucidum (SL), (c) stratum granulosum (SG), (d) stratum spinosum (SS), and (e) stratum basale (SB). The outermost layer SC consists of dead cells called corneocytes, the main constituent of which is keratin. The SG layer contains active cells that produce lipids, which are released into the SC. Keratin-producing cells called keratinocytes are located in the SS and the SB and consists of a single layer of cells that undergoes cell division continuously. The dermis consists of collagen and provides structural strength and flexibility, while the lowermost layer called the hypodermis or subcutis consists of fat cells that act as a shock absorber and insulator that helps preserve heat.

Because secretion of sebum and sweat facilitates deposition of airborne dust and allows bacteria to thrive, the essential cleaning step must be such that the soil residing on the skin surface is removed without interfering with the subepidermal structures of the skin. The SC is often modeled as a brick and mortar ensemble where the dead cells correspond to the bricks and the lipid layers represent the mortar [13, 14]. These tightly packed lipid layers help retain moisture and also prevent its loss. Measurements of transepidermal water loss (TEWL) have been identified as a parameter that is directly related to irritation of the skin [15]. Surfactants and strong chemicals disrupt the organization in the protein and lipid layers that enhance TEWL causing dryness, irritation, itch, and feeling of tightness of the skin [14–16].

The pH of the human skin surface varies between 4 and 6, but within the skin structure, the pH varies between 7 and 9, i.e., there exists a clear pH difference of two to three units between the SC and layers deep inside the skin [15, 16]. pH influences homeostasis, SC integrity, cohesion, and antimicrobial immunity, and

although low pH is a potent defense against microorganisms, it helps the synthesis of key enzymes that act as a skin barrier [13–16]. High pH in the absence of surfactants was seen to cause SC swelling and lipid rigidity resulting in skin irritation and feeling of discomfort that explains the feeling of tightness and dryness of the skin on using soap. Synthetic detergents (syndets), namely, sodium cocylisethionate (SCI) and sodium isethionate, on the other hand did not induce such feelings. Detailed studies [13, 15] revealed that syndets had pH in the range 5–7 soaps had pH >10.

Other mild nonirritating cleansers frequently used are sodium salts of lauryl ether sulfates (SLES) containing 1–3 moles of ethylene oxide (EO). It is an excellent degreasing and foaming agent without the harshness of its parent sodium lauryl sulfate (SLS). Detailed studies have demonstrated that addition of EO groups in the main chain reduced detergency and skin irritation. Although SLES (1EO) is extensively used in body washes and shampoos, SLES (3EO) being milder is used in baby products as baby skin is thinner and prone to irritation. Cocoamidopropylbetaine (CAPB), sulfosuccinates, and alkylpolyglucosides (APG) are even milder than SLES. In fact in a scale of 1 to 100 where 1 is the mildest and 100 is the harshest, the sequence is as follows:

Water < APG < SLES+CAPB (2:1) < syndet < SCI < soap < SLS [13].

CAPB has therefore been used successfully in tearless shampoos, and often mixtures of SLES:CAPB (2:1) are used in baby shampoos. Very high-end mild products are formulated with CAPB and APG's mixtures containing glycerin as humectant.

4.2.2 Surfactants in hair care

The human hair consists of the outermost layer called the cuticle which consists of dead and overlapping hard scalelike structures. The inner layer is the cortex that imparts strength and color to hair, and the innermost layer is the medulla which is present in thick hair but often absent in thin and fine hair. Detailed studies [12] have revealed distinct differences between Caucasian, African, and Asian hair. Not only the cross sections are distinctly different, but the very structures and strengths are different. While the African hair is fine and tends to be kinky, Asian hair is straight, thick, and strong. Sebum secreted from the scalp acts as an emollient that coats the hair shaft making it soft, shiny, and manageable. Atmospheric dust and aerosols present in the environment is readily captured by hair owing to its large surface area making it appear greasy, and because colonies of bacteria flourish due to sebum, it gives rise to an unpleasant odor which may be highly embarrassing. Although the mechanisms of cleaning remain the same as discussed in an earlier section, for skin, extra caution is necessary while designing a cleanser for hair as harsh chemicals and unfavorable pH may make hair dry and brittle [9]. Very clean hair is unattractive and may appear to be dry, lifeless, without shine or gloss, difficult to comb, and unmanageable as it tends to tangle. It is the presence of moisture and oil, natural or otherwise, that imparts a smooth, silky appearance that makes hair manageable and looks beautiful. Therefore, ingredients in shampoos need to be carefully selected such that balance of oil and moisture is maintained for hair to appear attractive and lively. Because hair washing practices vary from country to country and the quality of hair is very different, shampoo formulations used in different countries are different although the same ingredients may be used. For oily hair, sodium lauryl sulfate (SLS) or triethanolamine dodecylbenzene sulfonate (TEA-DBS) is used solo being an excellent degreaser and foaming agent or often as a mixture with its milder counterpart SLES (1EO). A conditioner is usually not added in the formulations for oily hair. However, for normal and dry hair, a milder surfactant like ammonium lauryl sulfate (ALS) with a conditioner like fatty alcohols or fatty esters, vegetable and mineral oils, and humectants (glycerin) is

preferred. As in the skin, pH control is of utmost importance as it tends to cause the hair shaft to swell that causes the protective layer, i.e., the cuticle, to loosen allowing the hair shaft to be damaged. Neutral pH is the best. Conditioner imparts volume and adds sheen and gloss in addition to making hair soft and manageable. Cationics like distearyltrimethylammonium chloride or ceto-stearyl trimethyl ammonium chloride, polyquaternium-6 (poly-diallyldimethylammonium chloride), or polyquaternium-10 (cationic hydroxycellulose) are used as voluminizer [9, 16]. Silicone oils are often used as anti-tangling agent for lubrication and minimal resistance while combing. In skin and hair formulations, the addition of fruit oils, herbal and floral extracts that are rich in antioxidants, and vitamins that contain antimicrobial and antifungal ingredients besides their characteristic perfume is a common trend.

5. Conclusions

In this chapter, we have briefly reviewed various surfactants commonly used in household and personal care industry. The mechanisms at the heart of the cleaning processes whether it be for skin, fabrics, or hair has been discussed. Because local conditions like water hardness, temperature, food habits, nature of food stains, extent of atmospheric pollution, nature of soil, and most importantly cleaning habits differ from country to country, surfactants need to be chosen judiciously so as to optimize performance under those local conditions. Mild surfactants suitable for skin and hair care for people with sensitive skin and babies have been discussed in some detail.

Author details

Ashim Kumar Dutta
India Glycols Limited, Kashipur, Uttarakhand, India

*Address all correspondence to: askdu1@gmail.com

IntechOpen

© 2019 The Author(s). Licensee IntechOpen. This chapter is distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. 

References

- [1] Allied Market Research Report. 2018. Available from: <http://www.alliedmarketresearch.com/surfactant-market>
- [2] Lucas A. Cosmetics, perfumes and incense in ancient Egypt. *The Journal of Egyptian Archaeology*. 1930;**16**(1/2):41-53
- [3] Sweeney WA, Olson AC. Performance of straight chain alkylbenzene sulfonates (LAS) in heavy duty detergents. *Journal of the American Oil Chemists' Society*. 1964;**41**(12):815-822. DOI: 10.1007/BF02663964
- [4] Rosen MJ. *Surfactants and Interfacial Phenomena*. 3rd ed. New York: Wiley-Interscience; 2004. ISBN 0-471-47818-0
- [5] Holmberg K, Jonsson B, Kronberg B, Lindman B. *Surfactants and Polymers in Aqueous Solution*. 2nd ed. New York: Wiley; 2002. ISBN 978-0-4714-9883-4
- [6] Matzinger S, Hussey DM, Fayer MD. Fluorescent probe solubilization in the head group and core region of micelle: Fluorescent lifetime and orientational relaxation measurements. *The Journal of Physical Chemistry. B*. 1998;**102**:7216-7224
- [7] Tadros TF. *Emulsion Formation and Stability*. 1st ed. New York: Wiley; 2013. ISBN 978-3-527-31991-6
- [8] Miller CA, Raney KH. Solubilization-emulsification mechanisms of detergency. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*. 1993;**74**:169-215. DOI: 10.1016/0927-7757(93)80263-E
- [9] Ho LTT. *Formulating Detergents and Personal Care Products: A Complete Guide to Product Development*. 1st ed. New York: AOCS Press; 2000. ISBN 1-8939-9710-3
- [10] Watson RA. Laundry detergent formulations. In: Showell M, editor. *Handbook of Detergents Part D*. New York: CRC Press Taylor & Francis Group; 2006. ISBN 978-0-8247-0350-9
- [11] Cox MF, Weerasooriya U. Methyl Ester Ethoxylates. In: Friedli F, editor. *Detergency of Specialty Surfactants*. New York: Marcell Dekker Inc; 2001. ISBN 0-8247-0491-6
- [12] Freinkel RK, Woodley DT. *The Biology of the Skin*. 1st ed. New York: The Parthenon Publishing Group; 2001. ISBN 1-85070-006-0
- [13] Ananthapadmanabhan KP, Subramanyan K, Rattinger GB. Moisturizing cleansers. In: Leyden JJ, Rawlings AV, editors. *Skin Moisturization*. 1st ed. New York: Marcel Dekker Inc.; 2002. ISBN 978-0-8247-4413-7
- [14] Loden M, Maibach HI. *Dry Skin & Moisturizers: Chemistry and Function*. 1st ed. New York: CRC Press; 2000. ISBN 0-8493-7520-7
- [15] Chew AL, Maibach HI. *Irritant Dermatitis*. 1st ed. New York: Springer; 2006. ISBN 978-3-540-00903-0
- [16] Wolfram LJ. Hair cosmetics. In: Barel AO, Paye M, Maibach HI, editors. *Handbook of Cosmetic Science and Technology*. 1st ed. New York: Marcel Dekker Inc; 2001. ISBN 0-8247-0292-1