SURFACTANTS AND SHAMPOOS

IN GENERAL THE USE OF SHAMPOOS IS FOR CLEANING THE HAIR. THE RANGE OF SHAMPOOS AVAILABLE IN THE SHOPS IS NOW QUITE ENORMOUS AND EVER INCREASING.

It seems that every year the major manufacturers feel compelled to produce another new range of products. Each range has newer features and benefits with more complex formulations and ingredients. Though some of these changes are no doubt for the better there are those that may be of doubtful benefit to the user. In this article I seek to explain the meaning of some of the major ingredients included in shampoos. This may then give some insight into the nature and purpose of the product and help to de-mystify the ingredients label somewhat.

Surfactants

For all of these formulations the main work of cleaning is done by surfactants. These are molecules that have the ability to be both hydrophobic and hydrophilic. This is achieved by having two very different functional groups attached to each other. The hydrophobic part of the molecule usually consists of a hydrocarbon of variable length. Common chain lengths are between C8 and C18, the most used being C12 in cosmetics formulations. This strikes the balance between mildness and detergency or the ability to remove grease from the hair. Shorter chain lengths have stronger grease removing properties, longer chain lengths have greater mildness but less lathering properties and a balance has to be achieved in the formulation.

The hydrophilic part of the molecule can be of many and varied functional groups and will determine the nature of the surfactant and a lot of its properties. These include sulphate, ethoxy sulphate, succinates, polyhydroxylates, quarternerised groups and many more.

Surfactants can be divided into four groups, according to their ionic nature. These are:

Anionic - carries a negative charge when ionized
Cationic - carries a positive charge when ionized
Nonionic - has no charge to the molecule, unionizable
Amphoteric - carries both positive and negative charges when ionized.

General properties can be attributed to the different classes of surfactants.

Anionics provide a lot of the lather and detergency in the shampoo. The most commonly used anionics are sodium laureth sulphate and sodium lauryl sulphate. Occasionally ammonium lauryl ether sulphate and ammonium lauryl sulphate are used too. The increase steric hinderance and lower ionization level of the ammonium group help prevent precipitation in the presence of

conditioning agents in a 2-in-1 type formulation. It can also prevent precipitation of surfactants due to the common ion effect if a lot of sodium ions are otherwise present in the formulation.

Nonionics are often not included in shampoos now due to the harshness of their detergency. They can strip the hair and lead to scalp irritation due to excessive defatting. The few that do appear in formulations are very mild and act as foam stabilisers, thickeners and may be more necessary in formulations for greasy hair types. These include laureth-3 or 4, cocamide DEA or coco glucosides.

Amphoteric surfactants are used a lot in shampoo formulations now. They are very useful for decreasing the irritancy of a formulation while increasing the active contents level of the product and quality of the lather produced. Amphoterics are so mild that baby shampoos often consist entirely of them. By far the most used is cocamido propyl betaine, or occasionally cocamido betaine.

Cationics are used most in conditioners. Cationic molecules have the ability to cling to wet surfaces by static attraction. Consequently they are not easily removed during the rinsing process and form the basis of conditioning. Polyquarternium-10 is one of the most common cationic conditioners. It is based on a cellulose polymer that is then quarternerised to give the desired properties.

The major problem of the 2-in-1 products is the inclusion of anionic and cationic surfactants in the same formulation. Due to the opposite charges of the ions precipitation is very likely and large bulky sterically hindered counterions have to be used to reduce the ionisation of each species .

Other ingredients in shampoos
The other ingredients encountered in shampoos I shall deal with in list format.

Colours - These are denoted by their colour index numbers e.g. CI17200 or CI42090. The lists of permissible dyes and their allowed areas of use are in the Cosmetics Regulations and must be checked before use. If in doubt ask the manufacturers.

Parfum - Under legislation any aroma substance added to the formulation need only be listed as parfum. This is because the actual chemical composition of a perfume is so incredibly complex as to be useless for labeling purposes. If you wish to add perfume to your formulation you must get a declaration from the manufacturers which, either, gives the limit %w/w to which you may add the perfume. Alternatively, you state at the level at which you wish to add the perfume and they will formally verify that this is safe for cosmetic use.

Preservatives - The choice is vast and confusing. In many shampoo formulations it appears that there are 4 or 5 preservatives. This is because they are often sold together as a preparatory mix. The advantage of this is that the manufacturer has put together a blend that they know is capable of killing a wide range of microbes likely to spoil a particular product type. Common varieties of preservative are DMDM - Hydantoin, phenoxyethanol, methyl paraben, propyl paraben etc. and the isothiazolinone types.

Conditioners - Conditioning can be done in several ways depending on how basic or complex a formulation you have. Basic methods involve the addition of glycerol, mineral oil or dimethicone - a silicone polymer also used for making car bumpers look shiny! The use of dimethicone is difficult since it can accumulate on the hair if used constantly in a 2-in-1 formula. It needs a plain

washing shampoo to be used periodically to prevent such a build up from happening. Quantities in the formulation are therefore crucial.

Two commonly used ingredients in hair conditioners are cetyl alcohol and cetrimonium bromide. The cetyl alcohol coats the hair and makes it easier to comb when wet, while the cetrimonium bromide/chloride is anti-static and improves the look and shine of the hair.

The more complex and expensive way of conditioning is to use the polyquats and PEG fatty glycerides e.g. PEG-55 oleate. These have a far more subtle effect upon the hair and are less likely to lead to lankness due to conditioner build up. Being surfactants themselves they are more easily removed from the hair too. It is this class of conditioners that is more commonly used in "use alone" conditioners.

Another ingredient that is becoming more common in conditioning agents is hydrolysed silk and other hydrolysed proteins. This is used to give shine and flow to the hair. Also the use of keratin amino acid is supposed to help with improving the strength of the hair by adding keratin from which the hair is made. One does have to question the validity of these inclusions since the levels used in the formulae are so low that a discernible effect must be hard to prove, though proven it must be if a claim is to be made about a cosmetic product.

Sodium chloride - this is a cheap and easy way of thickening the product. Alternatives to this are magnesium salts or cellulose thickeners such as hydroxy ethyl cellulose.

Citric acid - this is used to rebalance the product pH as the product is usually slightly alkaline by nature. Some products have a buffering system added to them to ensure the pH is maintained over a long period of time but this is not the rule.

Tetrasodium EDTA - or just EDTA is a water-softening agent. If the product is made in a hard water area there are some big problems that can occur if the water is not pre-treated to remove calcium and magnesium salts. Anionic surfactants are most at risk since the counter ion can be replaces by the Ca or Mg to produce a less soluble salt of the anionic. This can then lead to haziness or precipitation in the product. With the addition of even small levels of EDTA e.g. 0.1% the product remains clear and looks much more aesthetically pleasing.

Many other more specific ingredients are going into formulations now. One of the biggest growth areas seems to be plant extracts. Quite what the functions of many of these are is hard to tell. It is again a matter of the quantities and method of application not being enough to give a long lasting effect to the user.

As a herbalist this is an area that I have some insight into. The number of extracts in a shampoo varies from one or two, up to eleven in one product that I have seen. From a herbalists point of view I can see no therapeutic necessity to many of the additions.

There are a few exceptions such as Symphytum officinale (comfrey) and Equisetum arvense(horsetails) for healing properties in damaged scalps or dandruff. Buxus chinensis (jojoba oil) for its conditioning properties and refatting. Rosmarinus officinale(rosemary) has been used for centuries as a hair tonic. But the use of Panax ginseng, Origanum vulgare(marjoram), Morus alba(white mulberry), Taraxacum officinale(dandelion), Sambucus nigra (elderflower), Allium sativum(garlic!) and so on, seems not to be answering any specific therapeutic need in the product and more wishing to make the formula appear more "natural". Such plant extracts are also not likely to be added for their perfume since they are not strong enough for such purposes.

Other fashionable additions are vitamins and proteins. Proteins have been covered somewhat under the 'conditioners' section. But the addition of vitamins is rather similar to the addition of plant extracts. Are they there in high enough concentrations and substantive enough, given the contact time with the hair to be of great benefit to the user? If not then they must surely be a very expensive addition to the formulation. The commonest addition seems to be Vitamin E, or tocopherol and its relatives.

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