

**Hair Care Feature**  
**1st Published in SPC - 2005**  
**John Woodruff**

There were several podium presentations and numerous posters devoted to various aspects of hair at the IFSCC Congress in Florence, September 2005. They included ways to promote its growth, the role of hydroxypropyltrimonium guar in deposition of actives, the measurement of deposition of silicone on hair, the effect of various conditioning agents and protection against colour loss.

Of particular interest was a poster describing a cause of alopecia as scalp glycation, which causes a hardening of the dermis around the hair follicle and it suggested that this inhibits the development of new hair. An extract of the bark of *Pterocarpus marsupium* was evaluated and found to reduce glycation, inhibit the activity of reactive oxygen species and to reduce inflammation of the scalp. [Ref 1]

A podium presentation described permanent waving of hair as a vigorous chemical process whereby the –S-S- cystine bonds are reduced so breaking the structural integrity of the hair shaft before it is reshaped and the bonds restored by oxidation. Much is done to try and minimise the damage caused and Ara Karasawa *et al* investigated the performance of various reducing agents in waving efficiency and their effects on tensile strength of hair. The structure of hair treated with each reducing agent was studied using stress-strain behaviour measurements, X-ray diffraction and differential scanning calorimetry and it was found that in permanent wave treated hair, cysteamine hydrochloride has high waving efficiency, but causes little hair damage and tends not to cause structural changes in hair, distinguishing it from other reducing agents. [Ref 2]

Looking through recently granted patents it is apparent that protecting hair colour against UV radiation [USP 6,942,851], providing protection against free radicals [PCT/EP00/07196], designing improved hair gels and styling products [USP 6,852,325] and improving condition [USP 6,927,196] are of major interest.

USP 6,939,537 summarises popular requirements as follows:-

The object of the present invention is to provide the hair treating agents which are excellent at the view point of the moist feel, slippery feel, wetting feeling, smooth feel, soft feel, slightly oily feel, rustle feeling, lustre, supple, no stickiness, non congealing of hair top, setting ability, maintaining ability of hair styling, prevention of loss of colour after hair colourings operation (prevention of loss of dye), brightness of colour developing of colour wax, smooth wave formation with waving agents, no waving unevenness, prevention of hair damage, well spread of cream, salt resistance of hair treating agents, easy removing of wax by shampoo, natural hair line (increased volume feel or decreased volume feel), smooth combing, low irritation and no liquid dropping.

Readers may be pleased to know that all these requirements can be met by incorporating the appropriate ester into the relevant hair care composition. A presentation by Dow Corning also

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provided a list of what it believes consumers and product manufacturers want from shampoos and conditioners, which is:-

- Superior wet and dry detangling
- Smooth hair feel
- Intense and longer lasting hair colour
- Mild products that are safe to use
- Materials without patent restrictions
- Less yellowing issues associated with silicones
- Easy-to-formulate materials

Ingredient suppliers at In-Cosmetics, Berlin 2005, and the IFSCC Conference, Florence 2005, were showing materials that claimed to provide many of these properties. Suggested by Dow Corning is an aqueous-based emulsion of dimethicone and cocamidopropyl betaine with laureth-3 and guar hydroxypropyltrimonium chloride. The high molecular weight of the dimethicone is said to provide superior conditioning performance thus enhancing hair smoothness and softness and improving dry combing properties. It is intended for use in 2-in-1 shampoos, rinse-off and leave-in conditioners and in shower gels at between 2% and 5%, depending on application.

Degussa introduced a silicone-based conditioning aid; trade named Abil Soft AF100, it is methoxy PEG/PPG-7/3 aminopropyl dimethicone, which is claimed to be compatible with aqueous systems, have self-emulsifying properties and be suitable for clear shampoos and body washes and for wash-out and leave-in conditioners. Damaged areas on hair exhibit polar protein structures and anionic centres because of cysteic acid groups. The amino group of this functional silicone is especially substantive to these sites on the hair surface and less so to undamaged hair. Abil Soft AF100 is also said to improve colour uptake of basic dyes from colour-in shampoos and to improve curl retention in styling products.

Another material with multi-functional claims is Sepicap MP from Seppic, which, it is claimed, counteracts oxidative stress and inhibits the generation of peroxides and free radicals. It protects the hair shaft by maintaining keratin in good condition and inhibits flaking. It is heat activated so its efficacy is enhanced when present in products used for hot styling. The material is a mixture of sodium cocoyl amino acids and potassium dimethicone PEG-7 panthenyl phosphate and is described as a water-soluble silicone, which is very substantive to hair, combined with a lipoamine moiety that penetrates deeply into the hair to deliver amino acids and panthenol. Extensive test data is available to show proof of effect when used in heat styling and other hair treatment processes.

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Studies of aged follicles by Arch Personal Care found that inadequate capillary circulation to the follicle and the resultant lack of nutrient flow may be a contributory factor in the thinning of hair with age. ProCircul 8 was developed to provide a mechanism to not only enhance microcirculation in the scalp, but to also deliver protective nutrients to the follicle. The material is a mixture of *Visnaga vera* which is known to contain a powerful microcirculation stimulant called visnadine; betaine, which is known to strengthen hair, and a protein stabilised superoxide dismutase, an ingredient that has been shown to protect hair colour from solar damage. Another approach to retarding hair loss by Arch is Vital Hair & Scalp Complex, which is a mixture of *Saccharum officinarum* (Sugar cane) extract, *Citrus medica limonum* (Lemon) fruit extract, betaine, *Pyrus malus* (Apple) fruit extract, *Camellia sinensis* leaf extract and hexapeptide-11 in an aqueous-glycolic solution.

Natural materials also form the basis for Cremogen Alpha-Pulp, INCI: *Prunus amygdalus dulcis* (Sweet almond) seed extract, *Actinidia chinensis* (Kiwi) fruit juice, *Citrus aurantium dulcis* (Orange) juice, *Citrus grandis* (Grapefruit) juice, *Pyrus malus* (Apple) juice and PEG-40 hydrogenated castor oil in an aqueous-glycolic base. The ingredients were selected to combat environmental pollution and to restore hair to its natural condition with improved shine and hair volume and to leave it more supple and smooth and easier to comb.

Unitamuron H-22 is a tamarind seed extract suggested for hair care and scalp treatment products from Chesham Chemicals. It has anti-oxidative and anti-inflammatory properties. Phycosaccharide AP from the same supplier is an oligosaccharide from brown seaweed that has a proven affinity for hair. It is recommended as a protective barrier between the hair and the environment and is said to protect it from cigarette smoke and pesticides and it chelates heavy metals.

Said to improve colour uptake is Crodafos HCE, INCI: oleth-5 phosphate and diolethyl phosphate. It is a complex mixture of mono- and di-phosphate esters that slows down the initial oxidation rate and then promotes faster release of the oil-based dye actives within the hair. It is suggested that the oxidation step occurs in the hair rather than in the mixture before application and that a longer time is available for the dye intermediates to penetrate the hair cortex before reacting.

Improving colour uptake is a claim made for various materials but it is also important to enhance colour durability. Dow Corning (DC) undertook an investigation into colour loss from hair that had undergone oxidative hair dyeing. Contrary to expectations it was found that most loss of colour was not due to UV exposure, which required about 90 hours of radiation to make a noticeable difference, but to washing and the use of rinse-off conditioners. Significant colour loss could already be observed after just one shampooing. It was suggested that colour is lost because a portion remains on the upper layers of cuticle and can easily be removed when hair is washed.

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Having determined the major cause of colour loss the investigators then proceeded to investigate the colour protection potential of various DC materials when incorporated in hair dyes. Results confirmed that silicones and particularly amodimethicone, are effective for protecting hair against colour fading from washing. When deposited on hair, amodimethicone forms an external homogeneous film that helps colour stay on the hair. It was also suggested that a synergistic deposition mechanism between the colour and the amodimethicone can occur resulting in a re-deposition of the colorant when hair is washed. Also silicones and amodimethicone have very low surface tension and help the colorant spread on hair and form a homogeneous film, which may assist penetration into the hair cuticle.

Also claimed to protect colour loss through washing is Protesil LH, Seiwa Kasei. Described as a multi-functional hybrid polymer composed of hydrolyzed silk protein, silicone and an alkyl group its INCI designation is hydrolyzed silk PG-propyl methylsilanediol crosspolymer. It has both hydrophilic and hydrophobic characteristics and it forms a smooth film on the hair, thus protecting it from moisture loss and loss of hair dyes through washing. Seiwa Kasei also supply UV filters encapsulated in a silicone-resin-polypeptide under their Silasoma trade mark. The average particle size is 2 microns, they are 54% active and recommended for UV protection of skin and hair.

Although washing may be the prime cause of colour loss in dyed hair UV radiation is the main cause for lightening of natural coloured hair and it also causes loss of condition. Many materials have been introduced in recent years that are useful in combating colour fade and hair degradation through UV exposure. Examples are Silsoft A-454, Degussa, INCI: dimethicone bisaminohydroxyethylhydroxypropyl copolyol stearate, which is promoted as a colour-retaining conditioning agent when added to shampoos at about 1%. Crodasorb UV-HPP, INCI: Polyquaternium-59, is a cationic UV absorber for hair. It is effective in preventing UVB damage, and in doing so, protects UV-exposed hair from protein degradation and a loss in integrity, preserving its tensile strength, combing properties and natural colour. Parsol SLX, DSM, INCI: Polysilicone-15, is backed by extensive test data that show that in a leave-on product it significantly protects semi-permanent dyed colour from fading and reduces chromatic changes after UV irradiation. Tests also show a 50% reduction in tryptophan and cysteine degradation and improved combing when a conditioner containing Parsol SLX is used.

For those preferring materials from natural sources Heliogenol, Sederma, is an extract of *Helianthus annuus* (Sunflower) in butylene glycol that is claimed to reduce the fading of dyes when added to shampoos at 0.2% - 1% and Vegeles Phyto Filtre, Laboratoires Serobiologiques, is a concentrated botanical complex extracted from the fruit of *Citrus aurantium* or bitter orange and the leaves of the Baobab tree, *Adansonia digitata*. The mixture is said to provide photoprotection from UVB and UVA radiation

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A consequence of UV exposure is photodegradation of keratin and destruction of disulfide cross-links, leading to loss of tensile strength, which decreases with the duration of UV exposure. Tensile strength measurements and post-yield slope studies are therefore a means of determining hair-strengthening properties of various compositions. Tensile strength measurements by Fanning Corporation demonstrated the hair strengthening properties of Fancosil LIM-2, INCI: dimethicone PEG-8 meadowfoamate, on virgin and treated hair. Post-yield slope studies were used to demonstrate an improvement in hair strength when Phyto Filtre was added to hair treatment compositions and was also used to show the benefits of creatine. Creatine is an amino acid complex trade named Cosmo 100 by Degussa, which increases hair strength by increasing the number of electrostatic bonds between the polypeptide chains in the hair shaft. Degussa also publish data to show how human hair-identical ceramides can improve the tensile strength of damaged hair.

Thermal processing of hair is a major cause of hair damage. Initially it was from hot air dryers, and then it was blow-drying, which combines heat with mechanical stress. More recently the use of heated ceramic tongs, which actually turn the moisture content of hair into steam and disrupt the cuticle, has caused even more problems. Work by DC showed that it was important to protect the internal moisture content of hair during thermal processing and that various silicone compounds provided this protection. Of these DC 2-9027 Styling Aid, which is a blend of an ultra high viscosity dimethiconol and silicone elastomer in cyclomethicone, achieved the best overall results.

A material from Croda trade named Crodasone W is a copolymer of hydrolysed wheat protein and silicone that is soluble in water and water-alcohol mixtures. It forms a substantive protective film on the hair shaft that protects hair during thermal processing and it helps address damage already caused by cementing loose and raised cuticle back onto the hair shaft. Wheat proteins are the basis of Dragoderm, Symrise, which is also shown to increase hair strength and to bind to specific sites of hair damage.

Styling products must combine holding power, even under conditions of high humidity, with ease of removal by washing. Bimodal Syntran Polymers from Interpolymer claim to provide these contradictory properties through an innovative technology that uses a bimodal, interpenetrating network delivering both cationic and anionic functions. The result is a reversible, cross-linked polymer complex achieved by the ionic associations of the two types of polymer chains which provides both holding power and ease of removal. The anionic chain contributes to the polymer's removal properties and the cationic chain imparts strong hold and ease of styling. The bimodal polymers have film formation temperatures that are balanced to give a pleasant crisp feel without flaking and because of their ionic cross-linking, impart improved flexibility and humidity resistance. Bimodal polymers can be formulated in pump sprays, gels, mousses or lotions. The test data indicate that bimodal polymers provide high humidity curl retention and exhibit good aesthetic performance when evaluated on dried hair.

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Finally, if you wish for happy hair then ArEAUmats from Chesham Chemicals may be the answer. The ArEAUmat range of natural aromatic plant waters stimulates the release of  $\beta$ -endorphin by keratinocytes and sensory neurones.  $\beta$ -endorphin is the so-called 'happy molecule', which is also released by eating chocolate.

Ref 1. A new way to prevent hair loss: scalp anti-aging by glycation reduction, Christine Jeanmaire PhD,

Ref 2. Effects of cysteamine on reduction of human hair, Aya Karasawa

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