

Chemical Reaction



Hair Today

Contemporary approaches to hair care feature a vast array of innovative raw materials. **BY STEVE HERMAN**

Antonio S.: **Why is Time such a niggard of hair...?**

Dromio S.: **Because it is a blessing that he bestows on beasts: and what he hath scanted men in hair, he hath given them in wit.**

—Shakespeare,
A Comedy of Errors, II,ii

SHAKESPEARE knew we had more brains than hair. Man differs from beasts by the use of his wits to develop technologies that can make hair healthier and more attractive.

Last month, "Chemical Reaction" considered the basic anatomy of hair. Until recently, "hair treatment" essentially was limited to washing and simple conditioning with a quaternary ammonium compound.

Conditioning restored some of the oily material removed by detergents and provided some lubrication for combing. Quaternary compounds overcame some static effects resulting from combing. Recent approaches deal with UV and thermal damage, advanced technology for restoring the lipid layer, and repair of damaged areas of the hair shaft.

The photodegradation of hair results in a variety of physical and chemical changes.

Among the physical changes are elimination of cuticle cells, roughening of the hair surface, loss of mechanical and elastic strength, and increased porosity. Chemically, we find photo-oxidation of cysteine, cholesterol, and fatty acids; the decomposition of tryptophan; breakage of disulfide bonds; and bleaching of melanin and artificial hair colors.

The effect of light on hair is similar to that on skin: The more melanin, the less damage is evident. Sunscreens used for skin are not suitable for hair because they are either not substantive or leave the hair dull and tacky. Several sunscreens have been created especially for hair, two examples being Escalol® HP-610 from ISP and Croda's Incroquat UV-283.

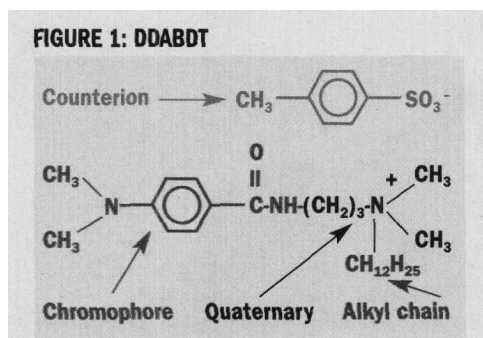
Escalol HP-610's INCI name is dimethylpabamido-propyl laurimidium tosylate (and) propylene glycol stearate. The real chemical name is equally poetic: dodecyl dimethylaminobenzamido-propyldimethylammonium tosylate (known as DDABDT). The chemical structure is shown in Figure 1, which illustrates the molecule's working parts: UV absorption, a quaternary ammonium region for substantivity, a fatty group for

lubricity, and a mild counterion.

Figure 2 is a quick review of ammonia's structure. Ammonia is a pyramid, with three NH bonds creating the sides and an unpaired pair of electrons left as the crown of the pyramid. The bonds are sp^3 hybrid orbitals. The four possible bonds provide the term "quaternary," commonly referred to as a "quat." When another bunch of atoms hungry for electrons wanders by, it devours the exposed free electrons, leaving a positive charge on the nitrogen. The electrostatic attraction to the negative charge on hair gives quats their substantivity.

Croda makes a similar product, Incroquat UV-283 (INCI: Cinnamidopropyltrimonium Chloride), that has the chromophore part and quat structure, but no fatty group, which allows it to be water and alcohol soluble. It is covered by U.S. Patent 5,601,811, "Substantive water-soluble cationic UV-absorbing compounds." The government patent office has a Website to find and view patents, <http://www.uspto.gov/patft/index.html>. It provides information on cosmetic ingredients and formulations.

Thermal damage typically originates from the use of blow dryers or curling irons.



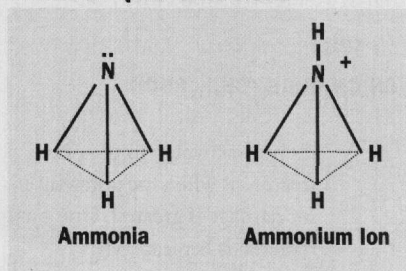
Heat styling devices are used daily by 63 percent of females. Chemical changes to hair caused by heat include discoloration, production of gaseous products, and the formation of amide crosslinks. The surface lipids, protein structure, and chromophores also are affected. ISP is able to evaluate thermal damage using spatially resolved combing analysis, fluorescent spectrophotometry, and observations with a scanning electron microscope.

The products identified by ISP as effective against thermal damage include PVP/DMAPA Acylates Copolymer and Quaternium-70. Several mechanisms have been

proposed for the protection offered by selected polymers and surfactants: the formation of an insulating layer to modify the temperature distribution, elimination of local overheating, and anti-oxidation effect.

The upper layer of the cuticle sheets is the epicuticle or upper β -layer. A significant component of this layer is saturated lipids, especially 18-methyl eicosanoic acid (18-MEA), shown in Figure 3 (p. 14). The 18-MEA provides lubrication and lessens friction, and thus is vital for healthy hair. 18-MEA is an example of an ante-iso fatty acid, since the methyl group is attached to carbon preceding the iso carbon. Hair and wool

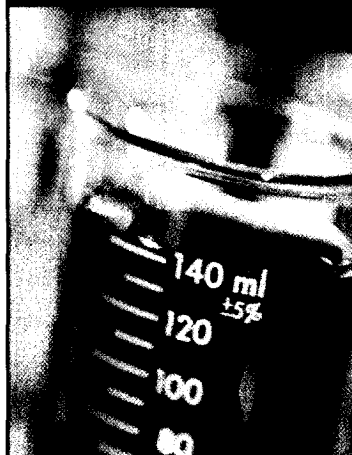
FIGURE 2: "QUAT" STRUCTURE



are similar in many ways, and lanolin is indeed a source for 18-MEA. Using the quat to provide substantivity, Croda has created a version dubbed Incroquat Behenyl 18-MEA (INCI: Behentrimonium Methosulfate (and) Quaternium-33 (and) cetyl alcohol).

Some products are >>>>

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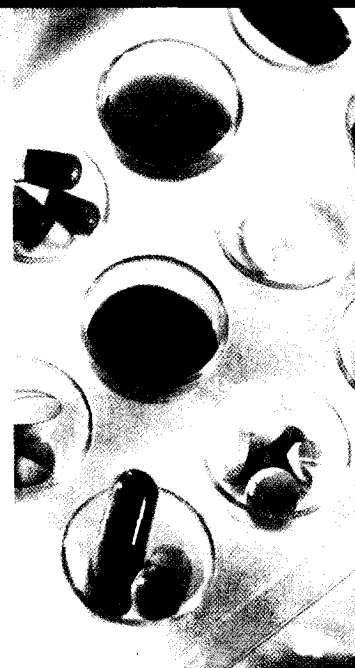
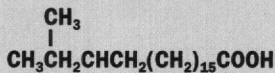


FIGURE 3: 18-METHYL EICOSANIC ACID



Some products are thermo-activated to provide treatment when the potential for damage is greatest.

thermo-activated to provide treatment when the potential for damage is greatest. One such material is Sepicap[®] MP (Sodium cocyl amino acids (and) potassium dimethicone copolyol panthenyl phosphate). It is constructed by conjugating a fatty chain (cocyl) with an amino acid cocktail (glutamic acid, aspartic acid, alanine, and glycine), and then adding panthenol combined with a water-soluble silicone. The multifunctionality allows it to inhibit the generation of

peroxides, stimulate metabolism at the hair root, prevent keratin breakdown, and reduce flaking. It is claimed to be 80 percent more active at high temperatures based on tests performed on heat-stressed keratinocytes. Sepicap MP is representative of the high-tech possibilities of hair treatment through the creation of new molecules.

Croda, ISP, and Seppic products provide examples to illustrate some contemporary approaches to hair care, but many other companies also have worthy products to explore. The modern formulator has an array of innovative raw materials to choose from, and a sea of eager consumers

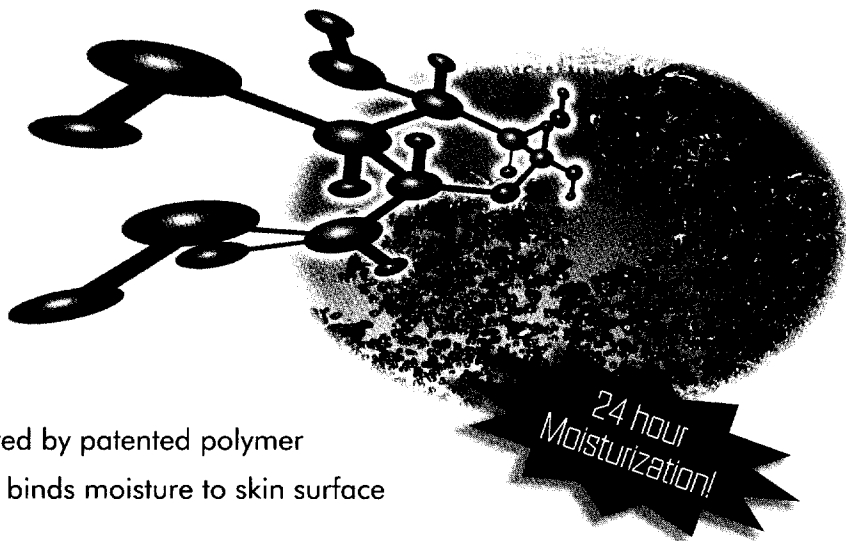
waiting for the latest advances in hair care. **GCI**

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