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(54) Title: HAIR TREATMENT COMPOSITIONS

(57) Abstract: The invention provides a hair treatment composition such as a shampoo or conditioner suitable for topical application to hair for the repair and prevention of damage, comprising a short chain amine oxide compound of formula: in which R_1, R_2 and R_3 are independently selected from straight or branched, saturated or unsaturated alkyl, alkoxy and hydroxy alkyl chains containing from 1 to 7 carbon atoms.

HAIR TREATMENT COMPOSITIONS

FIELD OF THE INVENTION

The invention relates to hair treatment compositions. More particularly the invention relates to hair treatment compositions comprising certain specific short chain amine oxide compounds, which compositions are particularly suitable for application to hair for repair and restoration of damaged hair, and for moisturisation and protection of the hair fibre against future damage.

BACKGROUND AND PRIOR ART

Hair can suffer damage from a number of sources. The hair fibre can be damaged by environmental influences such as exposure to UV and chlorine; chemical influences such as bleaching, perming, overly frequent washing with harsh surfactant-based cleansing shampoo compositions; and mechanical influences such as prolonged use of heated styling appliances.

Damage to the hair typically manifests itself in cuticle and protein loss from the hair fibre, excessive fibre stiffness, hair fibre brittleness and breakage and frayed or split ends.

A wide array of ingredients are claimed to be effective in the treatment and prevention of hair damage, as can be seen from the literature and from marketed products.

For example, certain amino acids are known to provide beneficial results in the prevention and treatment of hair damage.

A number of shampoo and conditioner formulations are on the market which contain aloe vera extract, a substance rich in arginine, as an ingredient for fibre repair and moisturisation.

Literature references include DE 3118882-A (Noronha RV), which describes a tonic for hair which contains a mixture of amino acids. In this mixture, a 1:4:12 histidine:lysine: arginine ratio is said to stimulate keratin formation.

FR 2669224-A (Contier) describes a scalp treatment comprising amino-dicarboxylic acid complexed with a basic amino acid complex as the active ingredient. The complex is said to prevent degradation of the hair root and improve the hydration of the hair keratin by neutralisation of scalp lactic acid. US 4,201,235 (Mare Corp.) describes hair treatment with a "cocktail" of 20 different amino acids and vitamins to enhance softness, lustre and body.

There remains a need for topical hair treatment compositions which deliver improved damage repair and protection to the hair.

The present inventors have now found that certain specific short chain amine oxide compounds are effective in imparting smoothness, softness, dryness and alignment benefits to damaged hair, when delivered in a hair treatment composition

such as a shampoo. Compositions according to the present invention demonstrate improved efficacy in the repair and prevention of the principal symptoms of damaged hair.

Amine oxide compounds with a long chain hydrophobic group such as (long chain alkyl) dimethyl amine oxides have surfactant properties and have been widely used as solubilisers or emulsifying agents in compositions which contact the skin, and also to a lesser degree in hair treatment formulations. For example, US 3,990,991 (Revlon Inc.) describes aqueous shampoo/conditioner formulations comprising amphoteric, cryptoanionic and cationic surfactants. Amine oxides having surfactant properties are mentioned as useful cationic surfactants, and stearyl dimethyl amine oxide is disclosed as an example. In US 4,007,261 (Millmaster Onyx Corp.), conditioner compositions comprising aqueous emulsions or dispersions of C_{16-18} alkyl dimethyl amine oxides are described.

US 4,381,259 (Kao Soap Co.) relates to shampoos comprising a base surfactant in sufficient amount for washing hair, 0.1 to 2.5 wt% anionic phosphoric acid ester surfactant and 0.05 to 2.5 wt% of a cationic polymer effective for conditioning hair. A large range of anionic, nonionic and amphoteric surfactants are given as possible base surfactants. The amphoteric surfactant can be an alkylamine oxide in which one hydrocarbon chain is a C_{10-20} alkyl or alkenyl group and the other two hydrocarbon chains are a C_{1-3} alkyl groups.

EP 168,719 (Revlon) discloses low pH hair conditioner compositions containing C8-22 alkyl amine oxides. Preferably, the alkyl chain conatins at least 12, more preferably at least 14 carbon atoms. JP 05/320027 (Lion) discloses foamable hair cosmetic compositions containing a cationic surfactant and an amine oxide with a hydrocarbon chain of at least 8 carbon atoms. EP 334,960 (Shiseido) discloses a hair tonic for preventing hair loss containing an amine oxide comprising either at least one hydrocarbon chain of C8-24 or two hydrocarbon chains of C6-18. EP 679,385 (Shiseido) discloses a hair revitalising compositions containing a first amine oxide with a hydrocarbon chain of C22-36 and a second amine oxide with a hydrocarbon chain of C12-20.

JP 11/246363 (Shiseido) discloses a hair regrowth formulation comprising an amine oxide and coriander extract. The amine oxide contains a liner or branched C2-24 alkyl chain which may optionally be connected to the nitrogen atom by up to 5 ethoxy units.

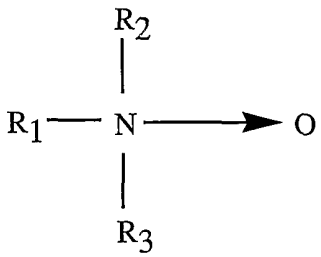
US 4,411,893 (Minnesota Mining and Manufacturing Co.) describes how certain water-soluble tertiary amine oxide compounds are extremely effective in enhancing penetration of therapeutic agents into and through the skin. The amine oxides disclosed have relatively short hydrocarbon chains, the total number of carbon atoms in the hydrocarbon chains not exceeding 28, preferably not exceeding 18.

Trimethylamine oxide and tributylamine oxide are listed as part of a range of suitable amine oxides, which also includes longer-chain species such as dimethyldodecylamine oxide and dimethylcocoamidopropylamine oxide.

There is no disclosure or suggestion in US 4,411,893 that the specific short chain amine oxide compounds as now claimed are effective in imparting smoothness, softness, dryness and alignment benefits to damaged hair, when delivered from a hair treatment composition such as a shampoo.

SUMMARY OF THE INVENTION

In a first aspect, the present invention provides a hair treatment composition suitable for topical application to hair comprising an amine oxide compound of formula:



in which R_1, R_2 and R_3 are independently selected from straight or branched, saturated or unsaturated alkyl, alkoxy and hydroxy alkyl chains containing from 1 to 7 carbon atoms.

In a second aspect, the present invention provides for use of a short chain amine oxide compound of the formula of the first aspect in a hair treatment composition to repair and/or prevent damage to the hair.

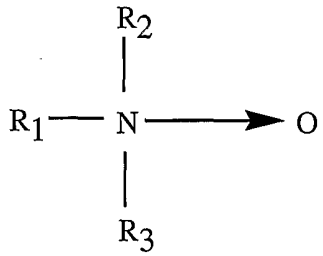
DETAILED DESCRIPTION AND PREFERRED EMBODIMENTS

Definitions

As used hereinafter, the term "wt%" is refers to the percentage by weight of the total hair treatment composition.

Short Chain Amine Oxide

Hair treatment compositions according to the invention comprise a short chain amine oxide compound of formula:



in which R_1, R_2 and R_3 are independently selected from straight or branched, saturated or unsaturated alkyl, alkoxy and hydroxy alkyl chains containing from 1 to 7 carbon atoms.

Preferably the total sum of the number of carbon atoms in R_1, R_2 and R_3 is 18 or less, more preferably 14 or less, yet more preferably 12 or less, yet more preferably 10 or less and most preferably 5 or less.

Preferably R_1, R_2 and R_3 are independently selected from straight or branched, saturated or unsaturated alkyl, alkoxy and hydroxy alkyl chains containing from 1 to 6, more preferably from 1 to 5, yet more preferably from 1 to 4 carbon atoms.

Preferably, R_1, R_2 and R_3 are independently selected from straight or branched, saturated or unsaturated alkyl and hydroxy alkyl chains.

Preferably, R_1, R_2 and R_3 are unbranched. Preferably, R_1, R_2 and R_3 are saturated.

Even more preferably, at least two of R_1, R_2 and R_3 are independently selected from alkyl and hydroxy alkyl chains of 2 carbon atoms or less.

Particularly preferred short chain amine oxides are dimethylalkyl amine oxides where the alkyl group is no more than 7, preferably no more than 6, more preferably no more than 5 carbon atoms and yet more preferably no more than 4 carbon atoms.

Suitable examples of short chain amine oxides according to the invention include:

trimethyl amine oxide
tributyl amine oxide
Dimethylethyl amine oxide
Dimethylheptylamine oxide
Dimethyloctylamine oxide
Diheptylmethylamine oxide

Most preferably, R_1, R_2 and R_3 are all methyl groups, i.e. the short chain amine oxide is trimethylamine oxide.

The total amount of short chain amine oxide compound in hairtreatment compositions of the invention is generally from 0.001 to 10 wt%, preferably from 0.01 to 5 wt%, more preferably from 0.05 to 2 wt% and yet more preferably from 0.1 to 1 wt%.

Product Form

The final product form of hair treatment compositions according to the invention may suitably be, for example, shampoos, conditioners, sprays, mousses or lotions. Particularly preferred product forms are shampoos, post-wash conditioners (leave-in and rinse-off) and hair treatment products such as hair essences.

Shampoo Composition

A particularly preferred hair treatment composition in accordance with the invention is a shampoo composition.

Cleansing Surfactant

Such a shampoo composition will comprise one or more cleansing surfactants which are cosmetically acceptable and suitable for topical application to the hair. Further surfactants may be present as an additional ingredient if sufficient for cleansing purposes is not provided as emulsifying agent for oily or hydrophobic components (such as silicones) which may typically be present in the shampoo. It is preferred that shampoo compositions of the invention comprise at least one further surfactant (in addition to that used as emulsifying agent) to provide a cleansing benefit.

Suitable cleansing surfactants, which may be used singularly or in combination, are selected from anionic, amphoteric and zwitterionic surfactants, and mixtures thereof. The cleansing surfactant may be the same surfactant as the emulsifier, or may be different.

Examples of anionic surfactants are the alkyl sulphates, alkyl ether sulphates, alkaryl sulphonates, alkanoyl isethionates, alkyl succinates, alkyl sulphosuccinates, N-alkyl sarcosinates, alkyl phosphates, alkyl ether phosphates, alkyl ether carboxylates, and alpha-olefin sulphonates, especially their sodium, magnesium, ammonium and mono-, di-

and triethanolamine salts. The alkyl and acyl groups generally contain from 8 to 18 carbon atoms and may be unsaturated. The alkyl ether sulphates, alkyl ether phosphates and alkyl ether carboxylates may contain from 1 to 10 ethylene oxide or propylene oxide units per molecule.

Typical anionic surfactants for use in shampoos of the invention include sodium oleyl succinate, ammonium lauryl sulphosuccinate, ammonium lauryl sulphate, sodium dodecylbenzene sulphonate, triethanolamine dodecylbenzene sulphonate, sodium cocoyl isethionate, sodium lauryl isethionate and sodium N-lauryl sarcosinate. The most preferred anionic surfactants are sodium lauryl sulphate, triethanolamine monolauryl phosphate, sodium lauryl ether sulphate 1 EO, 2EO and 3EO, ammonium lauryl sulphate and ammonium lauryl ether sulphate 1EO, 2EO and 3EO.

Examples of amphoteric and zwitterionic surfactants include alkyl amine oxides, alkyl betaines, alkyl amidopropyl betaines, alkyl sulphobetaines (sultaines), alkyl glycinates, alkyl carboxyglycinates, alkyl amphopropionates, alkylamphoglycinates, alkyl amidopropyl hydroxysultaines, acyl taurates and acyl glutamates, wherein the alkyl and acyl groups have from 8 to 19 carbon atoms. Where amine oxides are used as a cleansing surfactant, the alkyl chain is preferably at least 10 carbon atoms in length.

Typical amphoteric and zwitterionic surfactants for use in shampoos of the invention include lauryl amine oxide, cocodimethyl sulphopropyl betaine and preferably lauryl

betaine, cocamidopropyl betaine and sodium cocamphopropionate.

The shampoo composition can also include co-surfactants, to help impart aesthetic, physical or cleansing properties to the composition. A preferred example is a nonionic surfactant, which can be included in an amount ranging from 0% to about 5% by weight based on total weight.

For example, representative nonionic surfactants that can be included in shampoo compositions of the invention include condensation products of aliphatic (C_8 - C_{18}) primary or secondary linear or branched chain alcohols or phenols with alkylene oxides, usually ethylene oxide and generally having from 6 to 30 ethylene oxide groups.

Other representative nonionics include mono- or di-alkyl alkanolamides. Examples include coco mono- or di-ethanolamide and coco mono-isopropanolamide.

Further nonionic surfactants which can be included in shampoo compositions of the invention are the alkyl polyglycosides (APGs). Typically, the APG is one which comprises an alkyl group connected (optionally via a bridging group) to a block of one or more glycosyl groups. Preferred APGs are defined by the following formula:

$$RO - (G)_n$$

wherein R is a branched or straight chain alkyl group which may be saturated or unsaturated and G is a saccharide group. R may represent a mean alkyl chain length of from about C_5 to about C_{20}. Preferably R represents a mean alkyl chain length of from about C_8 to about C_{12}. Most preferably the value of R lies between about 9.5 and about 10.5. G may be selected from C_5 or C_6 monosaccharide residues, and is preferably a glucoside. G may be selected from the group comprising glucose, xylose, lactose, fructose, mannose and derivatives thereof. Preferably G is glucose.

The degree of polymerisation, n, may have a value of from about 1 to about 10 or more. Preferably, the value of n lies in the range of from about 1.1 to about 2. Most preferably the value of n lies in the range of from about 1.3 to about 1.5.

Suitable alkyl polyglycosides for use in the invention are commercially available and include for example those materials identified as: Oramix NS10 ex Seppic; Plantaren 1200 and Plantaren 2000 ex Henkel.

The total amount of surfactant (including any co-surfactant, and/or any emulsifying agent) in shampoo compositions of the invention is generally from 0.1 to 50% by weight, preferably from 5 to 30%, more preferably from 10% to 25% by weight of the total shampoo composition.

Cationic Polymer

A cationic polymer is a preferred ingredient in shampoo compositions of the invention, for enhancing conditioning performance of the shampoo. Typically such a polymer enhances deposition of conditioning components such as silicone from the shampoo composition onto the intended site during use, i.e. the hair and/or the scalp.

The cationic polymer may be a homopolymer or be formed from two or more types of monomers. The molecular weight of the polymer will generally be between 5 000 and 10 000 000, typically at least 10 000 and preferably in the range 100 000 to about 2 000 000. The polymers will have cationic nitrogen containing groups such as quaternary ammonium or protonated amino groups, or a mixture thereof.

The cationic nitrogen-containing group will generally be present as a substituent on a fraction of the total monomer units of the cationic polymer. Thus when the polymer is not a homopolymer it can contain spacer non-cationic monomer units. Such polymers are described in the CTFA Cosmetic Ingredient Directory, 3rd edition. The ratio of the cationic to non-cationic monomer units is selected to give a polymer having a cationic charge density in the required range.

Suitable cationic polymers include, for example, copolymers of vinyl monomers having cationic amine or quaternary ammonium functionalities with water soluble spacer monomers such as (meth)acrylamide, alkyl and dialkyl (meth)acrylamides, alkyl (meth)acrylate, vinyl caprolactone

and vinyl pyrrolidine. The alkyl and dialkyl substituted monomers preferably have C1-C7 alkyl groups, more preferably C1-3 alkyl groups. Other suitable spacers include vinyl esters, vinyl alcohol, maleic anhydride, propylene glycol and ethylene glycol.

The cationic amines can be primary, secondary or tertiary amines, depending upon the particular species and the pH of the composition. In general secondary and tertiary amines, especially tertiary, are preferred.

Amine substituted vinyl monomers and amines can be polymerized in the amine form and then converted to ammonium by quaternization.

The cationic polymers can comprise mixtures of monomer units derived from amine- and/or quaternary ammonium-substituted monomer and/or compatible spacer monomers.

Suitable cationic polymers include, for example:

- copolymers of 1-vinyl-2-pyrrolidine and 1-vinyl-3-methyl-imidazolium salt (e.g. chloride salt), referred to in the industry by the Cosmetic, Toiletry, and Fragrance Association, (CTFA) as Polyquaternium-16. This material is commercially available from BASF Wyandotte Corp. (Parsippany, NJ, USA) under the LUVIQUAT tradename (e.g. LUVIQUAT FC 370);

- copolymers of 1-vinyl-2-pyrrolidine and dimethylaminoethyl methacrylate, referred to in the industry (CTFA) as Polyquaternium-11. This material is available commercially from Gaf Corporation (Wayne, NJ, USA) under the GAFQUAT tradename (e.g., GAFQUAT 755N);

- cationic diallyl quaternary ammonium-containing polymers including, for example, dimethyldiallyammonium chloride homopolymer and copolymers of acrylamide and dimethyldiallylammonium chloride, referred to in the industry (CTFA) as Polyquaternium 6 and Polyquaternium 7, respectively;

- mineral acid salts of amino-alkyl esters of homo-and co-polymers of unsaturated carboxylic acids having from 3 to 5 carbon atoms, (as described in U.S. Patent 4,009,256 (National Starch));

- cationic polyacrylamides(as described in WO95/22311 (Unilever)).

Other cationic polymers that can be used include cationic polysaccharide polymers, such as cationic cellulose derivatives, cationic starch derivatives, and cationic guar gum derivatives.

Cationic polysaccharide polymers suitable for use in compositions of the invention include those of the formula:

$A\text{-}O\text{-}[R\text{-}N^{+}(R^{1})(R^{2})(R^{3})X^{-}]$,

wherein: A is an anhydroglucose residual group, such as a starch or cellulose anhydroglucose residual. R is an alkylene, oxyalkylene, polyoxyalkylene, or hydroxyalkylene group, or combination thereof. R^1, R^2 and R^3 independently represent alkyl, aryl, alkylaryl, arylalkyl, alkoxyalkyl, or alkoxyaryl groups, each group containing up to about 18 carbon atoms. The total number of carbon atoms for each cationic moiety (i.e., the sum of carbon atoms in R^1, R^2 and R^3) is preferably about 20 or less, and X is an anionic counterion.

Cationic cellulose is available from Amerchol Corp. (Edison, NJ, USA) in their Polymer JR (trade mark) and LR (trade mark) series of polymers, as salts of hydroxyethyl cellulose reacted with trimethyl ammonium substituted epoxide, referred to in the industry (CTFA) as Polyquaternium 10. Another type of cationic cellulose includes the polymeric quaternary ammonium salts of hydroxyethyl cellulose reacted with lauryl dimethyl ammonium-substituted epoxide, referred to in the industry (CTFA) as Polyquaternium 24. These materials are available from Amerchol Corp. (Edison, NJ, USA) under the tradename Polymer LM-200.

Other suitable cationic polysaccharide polymers include quaternary nitrogen-containing cellulose ethers (e.g. as described in U.S. Patent 3,962,418 (Procter & Gamble)), and copolymers of etherified cellulose and starch (e.g. as described in U.S. Patent 3,958,581).

A particularly suitable type of cationic polysaccharide polymer that can be used is a cationic guar gum derivative, such as guar hydroxypropyltrimonium chloride (Commercially available from Rhone-Poulenc in their JAGUAR trademark series).

Examples are JAGUAR C13S, which has a low degree of substitution of the cationic groups and high viscosity. JAGUAR C15, having a moderate degree of substitution and a low viscosity, JAGUAR C17 (high degree of substitution, high viscosity), JAGUAR C16, which is a hydroxypropylated cationic guar derivative containing a low level of substituent groups as well as cationic quaternary ammonium groups, and JAGUAR 162 which is a high transparency, medium viscosity guar having a low degree of substitution.

Preferably the cationic polymer is selected from cationic cellulose and cationic guar derivatives. Particularly preferred cationic polymers are JAGUAR C13S, JAGUAR C15, JAGUAR C17 and JAGUAR C16 and JAGUAR C162.

Conditioners

Conditioning Surfactant

Compositions in accordance with the invention may also be formulated as conditioners for the treatment of hair (typically after shampooing) and subsequent rinsing.

Such a conditioner will comprise one or more conditioning surfactants which are cosmetically acceptable and suitable for topical application to the hair.

Suitable conditioning surfactants are selected from cationic surfactants, used singly or in admixture.

Examples of suitable cationic conditioning surfactants include quaternary ammonium cationic surfactants.

Suitable quaternary ammonium cationic surfactants for use in hair conditioners of the invention include cetyltrimethylammonium chloride, behenyltrimethylammonium chloride, cetylpyridinium chloride, tetramethylammonium chloride, tetraethylammonium chloride, octyltrimethylammonium chloride, dodecyltrimethylammonium chloride, hexadecyltrimethylammonium chloride, octyldimethylbenzylammonium chloride, decyldimethylbenzylammonium chloride, stearyldimethylbenzylammonium chloride, didodecyldimethylammonium chloride, dioctadecyldimethylammonium chloride, tallowtrimethylammonium chloride, cocotrimethylammonium chloride, and the corresponding hydroxides thereof. Further suitable cationic surfactants include those materials having the CTFA designations Quaternium-5, Quaternium-31 and Quaternium-18. Mixtures of any of the foregoing materials may also be suitable. A particularly useful cationic surfactant for use in hair conditioners of the invention is cetyltrimethylammonium chloride, available commercially, for example as GENAMIN CTAC, ex Hoechst Celanese.

A further preferred class of cationic conditioning surfactants are acid-neutralised amidoamine compounds of the general structural formula (I):

R1 - C (O) - NH - R2 - N(R3)(R4) (I)

wherein R1 is a fatty acid chain containing from 12 to 22 carbon atoms, R2 is an alkylene group containing from one to four carbon atoms, and R3 and R4 are, independently, an alkyl group having from one to four carbon atoms.

Examples of suitable amidoamine compounds of general structural formula (I) include stearamidopropyl dimethylamine, stearamidopropyl diethylamine, stearamidoethyl dimethylamine, stearamidoethyl diethylamine, palmitamidopropyl dimethylamine, behenamidopropyl dimethylamine, myristamidopropyl dimethylamine, oleamidopropyl dimethylamine, ricinoleamidopropyl dimethylamine, and combinations thereof.

The acid used to neutralise the amidoamine compound can be essentially any organic acid or mineral acid of sufficient acid strength to neutralise a free amine nitrogen. Such acids include hydrochloric acid, sulphuric acid, nitric acid, phosphoric acid, lactic acid, citric acid, tartaric acid, acetic acid, gluconic acid, glycolic acid and propionic acid, or combinations thereof. A preferred acid is lactic acid, since neutralisation of the amidoamine compound with this acid yields an exceptionally stable composition.

In general, a sufficient amount of acid is added to neutralise the amidoamine compound and to adjust the final pH of the composition to within a range of from about 2.5 to about 6, preferably in a pH range of from about 3 to about 5.

In conditioners of the invention, the level of cationic surfactant is preferably from 0.01 to 10%, more preferably 0.05 to 5%, most preferably 0.1 to 2% by total weight of cationic surfactant based on the total weight of the composition.

Fatty Alcohol

Conditioners of the invention advantageously incorporate a fatty alcohol. The combined use of fatty alcohols and cationic surfactants in conditioning compositions is believed to be especially advantageous, because this leads to the formation of a lamellar phase, in which the cationic surfactant is dispersed.

Representative fatty alcohols comprise from 8 to 22 carbon atoms, more preferably 16 to 20. Examples of suitable fatty alcohols include cetyl alcohol, stearyl alcohol and mixtures thereof. The use of these materials is also advantageous in that they contribute to the overall conditioning properties of compositions of the invention.

The level of fatty alcohol in conditioners of the invention is conveniently from 0.01 to 10%, preferably from 0.1 to 5% by weight of the composition. The weight ratio of cationic

surfactant to fatty alcohol is suitably from 10:1 to 1:10, preferably from 4:1 to 1:8, optimally from 1:1 to 1:4.

Silicone

Silicone is a particularly preferred ingredient in hair treatment compositions of the invention. In particular, hair shampoos and conditioners of the invention will preferably also comprise emulsified particles of silicone, for enhancing conditioning performance. The silicone is insoluble in the aqueous matrix of the composition and so is present in an emulsified form, with the silicone present as dispersed particles.

Suitable silicones include polydiorganosiloxanes, in particular polydimethylsiloxanes which have the CTFA designation dimethicone. Also suitable for use compositions of the invention (particularly shampoos and conditioners) are polydimethyl siloxanes having hydroxyl end groups, which have the CTFA designation dimethiconol, and polydimethylsiloxanes having containing at least one amino functional group, which have the CTFA designation amodimethicone or trimethylsilylamodimethicone.

Examples of suitable materials include:

the DC200 series of silicone fluids, available from Dow Corning (e.g. DC200, viscosity 350 cs), or SF96 or the VISCASIL series of silicones, available from General Electric Silicones;

silicone gums such as SE30, SE54 and SE76, available from General Electric Silicones;

silicone gum/fluid blends such as Q2-1403 available from Dow Corning, or CF 1251, available from General Electric Silicones;

pre-formed emulsions of dimethiconol such as emulsions DC2-1766, DC2-1784, and microemulsions DC2-1865 and DC2-1870, all available from Dow Corning;

amino functional silicones such as Q2-8220 and Q2-8466 fluids, available from Dow Corning, and also SF-1708-D1, available from General Electric Silicones;

pre-formed emulsions of amino functional silicones such as DC929 Cationic Emulsion, DC939 Cationic Emulsion, and the non-ionic emulsions DC2-7224, DC2-8467, DC2-8177 and DC2-8154 (all ex Dow Corning);

silicone gum/silicone fluid/amino functional silicone blends.

Most preferably, the silicone for inclusion in the hair treatment composition of the invention, is sourced as a pre-formed aqueous emulsion, for example a mechanically-formed aqueous emulsion. In such emulsions, it is highly preferable that the emulsion additionally includes at least one emulsifier in order to stabilise the silicone emulsion. Suitable emulsifiers are well known in the art and include anionic and nonionic surfactants.

Preferably, the average particle size of the silicone droplets in the emulsion and also in the final hair treatment composition is less than 20 microns, more preferably less than 10 microns. A smaller silicone particle size enables a more uniform distribution of silicone on the hair for the same amount of silicone in the composition.

A particularly suitable silicone emulsion for use in compositions of the invention is an emulsion containing silicone gum with a viscosity greater than 1 Mcs, silicone fluid with a viscosity of less than 100 kcs and an amino functional silicone, in a nonionic surfactant base, of silicone particle size 5 microns.

Silicone particle size in the emulsion may be measured by means of a laser light scattering technique, for example using a 2600D Particle Sizer from Malvern Instruments.

Viscosity (of the silicone itself and not the emulsion or the final hair treatment composition) can be measured by means of a glass capillary viscometer as set out further in Dow Corning Corporate Test Method CTM004, July 20 1970.

The total amount of silicone incorporated into hair treatment compositions of the invention depends on the level of conditioning desired and the material used. A preferred amount is from 0.01 to about 10% by weight of the total composition although these limits are not absolute. The lower limit is determined by the minimum level to achieve conditioning and the upper limit by the maximum level to avoid making the hair and/or skin unacceptably greasy.

We have found that a total amount of silicone of from 0.3 to 5%, preferably 0.5 to 3%, by weight of the total composition is a suitable level.

Solvents and Carriers

Composition of the invention are preferably aqueous based, but non-aqueous solvents also can be used in order to help solubilise ingredients that are not sufficiently soluble in water. Suitable non-aqueous solvents include the lower alcohols like ethyl alcohol and propyl alcohol; polyols like glycerol; glycols or glycol ethers, like 2-butoxyethanol, ethylene glycol, ethylene glycol monoethyl ether, propylene glycol and diethylene glycol monoethyl ether or monomethyl ether and mixtures thereof. These non-aqueous solvents can be present in the composition of the invention in an amount of from 1 to 100%, preferably 5 to 50%, by weight based on the total weight of the vehicle of the composition of the invention.

Optional Ingredient

Compositions of this invention may contain any other ingredient normally used in hair treatment formulations. These other ingredients may include viscosity modifiers, preservatives, colouring agents, polyols such as glycerine and polypropylene glycol, chelating agents such as EDTA, antioxidants such as vitamin E acetate, fragrances, antimicrobials and sunscreens. Each of these ingredients will be present in an amount effective to accomplish its purpose. Generally these optional ingredients are included

individually at a level of up to about 5% by weight of the total composition.

The invention is further illustrated by way of the following non-limitative examples. All percentages quoted are by weight based on total weight unless otherwise stated.

EXAMPLES

Example 1

The following base shampoo compositions were prepared:

	Composition A (wt%)	Composition I Control : (wt%)
Sodium lauryl ether sulphate(2EO)	12	12
Cocoamidopropyl betaine	2	2
TMAO dihydrate	0.2	
Water	to 100	to 100

TMAO dihydrate: Trimethylamine oxide dihydrate

The compositions were tested in a cuticle abrasion test. Root end hair (as received form the supplier) was pre-cleaned by washing for 1 minute in Composition I followed by copious rinsing in double deionised water. The hair was left to dry naturally over 24 hrs.

For each test, 4 g of hair was washed in 0.4 g of the test composition for 30 seconds, rinsed for 30 seconds, and the

washing/rinsing cycle repeated. The hair was left to dry naturally overnight.

The hair was cut into 1 cm lengths, placed in a blender bucket and 200 ml of double de-ionised water was added. The blender was placed on full power for 1 minute. The liquor was decanted off and transferred to a 50 ml centrifuge tube and centrifuged for 10 minutes at 4,300 RPM. The resulting clear liquor was decanted off leaving the cuticle sediment at the bottom of the tube.

The cuticle was transferred from the tube into a beaker with 3 x 5 ml washes and passed through a series of sieves (425 and 53 microns). The sieves were washed with a further 2 x 10 ml of water to ensure complete recovery of the cuticle. The sample was made up to 50 ml in a centrifuge tube, centrifuged for 15 minutes and the liquor decanted off. The cuticle was transferred with double deionised water (2 x 10 ml washes) to a beaker and freeze-dried.

The freeze-dried cuticle was weighed back to determine percentage recovery.

This test was performed in duplicate for Composition A and Composition I.

The results were as follows:

	Composition A	Composition I
% cuticle lost/g of hair	0.05	0.11

In conclusion, Composition A, containing the short chain amine oxide trimethylamine oxide leads to a significant reduction in the amount of cuticle lost by mechanical wear, and thus prevents damage to hair, as compared with the control Composition I.

Example 2

The following shampoo compositions were prepared:

	Composition B (wt%)	Composition II (wt%) : Control
Sodium lauryl ether sulphate(2EO)	12.0	12.0
Cocoamidopropyl betaine	2.1	2.1
Dimethiconol emulsion	1.5	1.5
Jaguar C13S	0.3	0.3
TMAO dihydrate	0.2	
Other ingredients	3.2	3.2
Aqua	to 100	to 100

The compositions were tested in a sensory panel test.

10 g, 10 inch switches of hair were bleached twice using a commercial hair bleach formulation following the manufacturer's instructions. The bleached switches were then washed with 1 g of Composition B or Composition II for 30 seconds and rinsed for 30 seconds. The washing process was repeated and the switches dried at 50ºC. The switches were then assessed in ambient conditions using a forced-

choice paired comparison test for a variety of attributes and the results analysed for statistical significance.

The results were as follows:

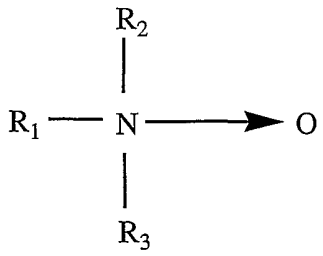
% votes in favour	Composition II	Composition B
Smoothest	94%	6%
Easiest to comb	74%	26%
Driest	7%	93%
Softest	89%	11%
Most alignment	81%	9%

(All results significant to <5%)

In conclusion, Composition B, containing the short chain amine oxide trimethylamine oxide leads to a significant reduction in the perception of damage in bleach-damaged hair as compared with the control Composition II.

CLAIMS

1. In a first aspect, the present invention provides a hair treatment composition suitable for topical application to hair comprising an amine oxide compound of formula:



in which R_1, R_2 and R_3 are independently selected from straight or branched, saturated or unsaturated alkyl, alkoxy and hydroxy alkyl chains containing from 1 to 7 carbon atoms.

2. A composition according to claim 1, in which R_1, R_2 and R_3 are independently selected from straight or branched, saturated or unsaturated alkyl, alkoxy and hydroxy alkyl chains containing from 1 to 6, more preferably from 1 to 5, yet more preferably from 1 to 4 carbon atoms.

3. A composition according to claim 1 or claim 2, in which the total sum of the number of carbon atoms in R_1, R_2 and R_3 is 18 or less, more preferably 14 or less, yet more preferably 12 or less, yet more preferably 10 or less and most preferably 5 or less.

4. A composition according to any preceding claim, in which R_2 and R_3 are independently selected from alkyl and hydroxy alkyl chains of 2 carbon atoms or less.

5. A composition according to claim 4, in which R_1 is a straight, saturated alkyl or hydroxy alkyl chain.

6. A composition according to claim 4 or claim 5, in which R_2 and R_3 are methyl groups.

7. A composition according to claim 6, in which R_1 is a methyl.

8. A hair treatment composition according to any preceding claim, in which the total amount of short chain amine oxide compound is from 0.001 to 10 wt%, preferably from 0.01 to 5 wt%, more preferably from 0.05 to 2 wt% and yet more preferably from 0.1 to 1 wt%.

9. A hair treatment composition according to any preceding claim in the form of a shampoo composition and which further comprises one or more cleansing surfactants, a cationic polymer and emulsified particles of silicone.

10. A hair treatment composition according to any one of claims 1 to 8 which is in the form of a conditioner and which further comprises one or more conditioning surfactants, a fatty alcohol and emulsified particles of silicone.

11. Use of a short chain amine oxide compound according to the formula of claim 1 in a hair treatment composition for the repair of and/or prevention of damage to the hair.