(51) International Patent Classification:
A61Q 5/02 (2006.01) A61K 8/898 (2006.01)

(21) International Application Number:
PCT/GB20 15/052419

(22) International Filing Date:
20 August 2015 (20.08.2015)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
1415 197.1 28 August 2014 (28.08.2014) GB

(71) Applicant (for all designated States except MN):
RECKITT BENCKISER LLC [USUS]; Morris Corporate Center IV, 399 Interpace Parkway, Parsippany, New Jersey 07054 (US).

(71) Applicant (for MN only): RECKITT BENCKISER (BRANDS) LIMITED [GB/GB]; 103-105 Bath Road, Slough, Berkshire SL1 3UH (GB).

(72) Inventors: BOUTROS, Iriny; Reckitt Benckiser LLC, 1 Philips Parkway, Montvale, New Jersey 07645 (US). DE
SZAFLAY, Sarah Frances; Reckitt Benckiser LLC, 1 Philips Parkway, Montvale, New Jersey 07645 (US).

(74) Agents: BOWERS, Craig et al; Reckitt Benckiser Corporate Services, Legal Department - Patents Group, Dansom Lane, Hull, East Yorkshire HU8 7DS (GB).


Declarations under Rule 4.17:
— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(H))
— if inventorship (Rule 4.17(iv))
Published:
— with international search report (Art. 21(3))

(54) Title: HAIR TREATMENT COMPOSITIONS COMPRISING TERNARY SYSTEMS OF QUATERNIZED HYDROXYETHYLCELLULOSE, AMINE FUNCTIONALIZED SILICONE COMPOUNDS AND CATIONIC GUAR

(57) Abstract: Hair treatment compositions comprising ternary systems of quaternized hydroxyethylcellulose, amine functionalized silicone compounds and cationic guar, preferably further in conjunction with an essential system of surfactants which comprise controlled amounts of each of: at least one fatty acid sulfate surfactant compound, at least one fatty acid ether sulfate surfactant compound and a betaine surfactant compound, which hair treatment compositions include reduced deposition of the silicone compounds upon the hair and at the same time improved "wet comb" and/or "dry comb" characteristics to hair which had been treated with the said hair treatment compositions.
The present invention relates to improved hair treatment compositions which comprise specific combinations of Polyquaternium-10 (a polymeric quaternary ammonium salt of hydroxyethylcellulose) in conjunction in combination with a cationic guar gum and an amine functionalized silicone compound, wherein these three constituents are present in very reduced amounts in respect to other constituents present.

Compositions to treat hair are widely used by consumers and an almost dizzying amount of such products are commercially available. Certain of these products are directed to providing specific benefits, e.g. coloring, lightening, shaping, and of course cleaning the hair, viz., hair shampoos, which in terms of volume is the predominant hair treatment product. Even within the sector of hair shampoos, various types of hair shampoos are provided each offering specific benefits, e.g. cleaning, fragrancing, anti-dandruff, as well as other technical benefits. However, it is also known that the use of excessive amounts of chemical constituents and materials, in addition to an aqueous base, can leave undesired, and excessive deposition of such chemical compounds and materials after the treatment of the hair during shampooing. Such is frequently very undesirable, as the rinse ability of the hair treatment composition, particularly the shampoo, after it provides the desire to benefit is particularly advantageous. Less deposition following rinsing, may significantly impact the combing characteristics, both of shampooed, and rinsed hair, or "wet hair", as well as of the shampooed, rinsed hair, and subsequently dried hair "dry hair". The common characteristics are particularly pertinent to consumer acceptance of any such shampoo, or other hair treatment product. Furthermore where there is excessive deposition following rinsing, the deposited chemical compounds and materials may impart an undesirable tactile "feel" to the treated hair, and/or negatively impact the visual attractiveness of the hair, and/or increase the rate of soiling of the hair,
as airborne particulates are more prone to be attracted to and retained upon such deposits. Each of these features are desirably avoided.

While the prior art has provided a plethora of shampoo compositions, the prior art does not teach nor suggest the specific combination of essential constituents discovered by the present inventors, as well as their specific weight ratios, and how such constituents, and their relative proportions or amounts and hair treatment composition, particularly in a shampoo composition, provide improved combing characteristics, and reduced deposition of certain chemical compounds or materials upon treated hair.

For example, known from the prior art are the shampoo compositions disclosed in US 5977036 and US 6040282 which compositions comprise dimethicone, Polyquaternium-10 and guar hydroxypropyltrimmonium chloride. In the example compositions demonstrating that product, the composition according to Example VIII includes these following constituents in the following amounts: 0.15%wt. Polyquaternium-10 ( interchangeably also referred to as "PQ10"), 0.15%wt. of a quaternized guar and 1%wt. of a dimethicone, a silicone compound, which are calculated to have the following ratios (w/w): a guanPQ10 ratio of 1:1, a total polymer (total amount of quaternized guar and PQ10):silicone ratio of 0.3, and guar: silicone ratio of 0.15, and a PQ10:silicone ratio of 0.15. Notably the PQ10 constituent used is indicated to be "JR30M" which is a Polyquaternium-10 polymer having a viscosity of 30,000 mPa.sec in a 2% aqueous solution, and a nitrogen content of 1.5-2.2.

From US 6451300 are known certain shampoo compositions which comprise dimethicone, as well as Polyquaternium-10 and guar hydroxypropyltrimmonium chloride. In the example compositions demonstrating that product, the composition of example XI includes the following constituents in the following amounts: 0.15%wt. PQ10, 0.25%wt. quaternized guar and 1.35%wt. of dimethicone, from which are calculated the following ratios (w/w): a guanPQ10 ratio of 1.666, a total polymer (total amount of quaternized guar and PQ10):silicone ratio of 0.29, a guarsilicone ratio of 0.18, and a PQ10:silicone ratio of 0.11. The PQ10 constituent used is identified as "UCARE Polymer LR400" which has a viscosity of 300-500 mPa.sec in a 2% aqueous solution, and a nitrogen content of 0.8 - 0.1 1.
US 2003/0158065 discloses certain compositions which comprise dimethicone, as well as Polyquaternium-10 and guar hydroxypropyltrimonium chloride. In the example compositions demonstrating those formulations, the composition of example 1 includes the constituents in the following amounts: 0.19% wt. PQ10, 0.10% wt. quaternized guar and 0.75% wt. of a cyclodimethicone, which are calculated to have the following ratios (w/w): a guanPQ10 ratio of 0.53, a total polymer (total amount of quaternized guar and PQ10):silicone ratio of 0.38, a guanilicone ratio of 0.133, and a PQ10: silicone ratio of 0.253. The composition of example 4 includes the following constituents in the following amounts: 0.14% wt. PQ10, 0.10% wt. quaternized guar and 0.75% wt. of a cyclodimethicone, which are calculated to have the following ratios (w/w): a guanPQ10 ratio of 0.71, a total polymer:silicone ratio of 0.32, a guanilicone ratio of 0.133, a PQ10: silicone ratio of 0.186. The composition of Example 44 includes the following constituents and amounts thereof from which are calculated the following ratios: a guanPQ10 ratio of 1.0, a total polymer: silicone ratio of 0.0133, a guanilicone ratio of 0.006, and a PQ10: silicone ratio of 0.006. The composition of Example 47 includes the following constituents and amounts from which are calculated the following ratios: a guanPQ10 ratio of 2, a total polymensilicone ratio of 1, a guanilicone ratio of 0.66, and a PQ10: silicone ratio of 0.33. Both compositions of examples 48 and 49 have constituents which are calculated to provide the following ratios: a guanPQ10 ratio of 1, a total polymensilicone ratio of 0.026, a guanilicone ratio of 0.0133, and a PQ10: silicone ratio of 0.0133. Again as in the foregoing reference, the PQ10 constituent used is identified as "Polymer LR400" which has a viscosity of 300-500 mPa.sec in a 2% aqueous solution, and a nitrogen content of 0.8 - 0.11.


Additionally the technical literature from a supplier of a Polyquaternium-10 which has a molecular weight which in a 2% aqueous solution exhibits a viscosity of 300 - 500 cP.s, and contains at least 1.5% nitrogen (UCARE<sup>™</sup> JR-400, ex. Dow Chem. Co.)
includes the specific recommendation that this specific polymer is useful in hair treatment products which do not include silicones. Further the demonstrated formulations provided in that supplier's technical literature which includes such Polyquaternium-10 polymers discloses a number of hair care products, in each of which however silicone constituents are notably absent.

Notwithstanding the foregoing, there remains a real and continuing need for further improved shampoo compositions, particularly compositions which exhibit good cleaning properties, reduced residual deposition of chemical compounds or materials following aqueous rinsing, and good post-treatment combing characteristics. It is to these, and further aspects that the compositions of the present invention are directed.

Surprisingly the present inventors have found hair treatment compositions may be improved by the inclusion or presence of controlled amounts of as well as specific combinations (ratios) of: Polyquaternium-10 (interchangeably referred to hereinafter as "PQ10"), a polymeric quaternary ammonium salt of hydroxyethylcellulose, and at least one amine functionalized silicone compound, which constituents are optionally but preferably also present in conjunction with a surfactant system which includes controlled amounts of each of: at least one fatty acid sulfate surfactant compound, at least one fatty acid ether sulfate surfactant compound and a betaine surfactant compound, which hair treatment compositions include improved deposition of the silicone compounds upon the hair and at the same time improved or comparable "wet comb" and/or "dry comb" characteristics to hair which had been treated with the said hair treatment compositions., notwithstanding relatively reduced amounts of polymer constituents (viz., cationic guar a/o PQ-10) a/o reduced amounts of surfactants being present. Such results are particularly technically desirable from a consumer perspective.

Accordingly, in a first aspect the present invention provides a hair treatment composition, preferably a shampoo composition, which necessarily comprises: a PQ10 polymer, a cationic guar gum, and at least one amine functionalized silicone compound which may be provided in an emulsion or microemulsion composition, wherein the foregoing constituents are present in one (preferably two, and especially preferably three or more) of the following ratios (wt%:wt%):

cationic guar:PQ10 ratio of 0.1-10:1 (preferably 0.25-9:1);
a total polymer amount (the total amount of cationic guar and PQ10): total amine functionalized silicone compound(s) ratio of 0.25 - 1.5:1 (preferably 0.4-1.3:1);

a cationic guar: total amine functionalized silicone compound(s) ratio of 0.001-1:1 (preferably 0.025-0.85:1),

a PQ10: total amine functionalized silicone compound(s) ratio of 0.01-1:1 (preferably 0.05-0.75:1). Particularly preferred ratios are also demonstrated with reference to one or more of the example compositions disclosed hereinafter.

In a second aspect, there are provided hair treatment compositions according to the first aspect, in which the PQ10 polymer is characterized by exhibiting a molecular weight which in a 2% aqueous solution exhibits a viscosity of 300 - 500 mPa.s, and further which polymer contains at least 1.5% nitrogen.

In a third aspect, the invention provides hair treatment compositions according to the first and/or second aspects, in which the amine functionalized silicone compound comprises at least one amodimethicone compound.

In a fourth aspect the present invention provides improved hair treatment compositions, according to any of the first, second or third aspects of the invention, wherein the foregoing recited essential constituents further necessarily additionally require a surfactant system which includes at least one, but preferably at least two or more anionic sulfate surfactant compounds.

In a fifth aspect the present invention provides an improved hair treatment composition according to any of the first through fourth aspects of the invention, which additionally require the inclusion as a ternary surfactant system: at least one fatty acid sulfate surfactant compound, (e.g., preferably, a sodium cocosulfate compound) at least one fatty acid ether sulfate surfactant compound (e.g., preferably, sodium lauryl ether sulfate compound; sodium laureth sulfate) and at least one betaine surfactant compound (e.g. preferably, cocoamidopropyl betaine). Preferably the total amount of the ternary surfactant system relative to the total polymer amount (the total amount of cationic guar and PQ10) is with the following ratios (wt%:wt%): 20-80:1, preferably 25-70:1.

Particularly preferred ratios are also demonstrated with reference to one or more of the example compositions disclosed hereinafter.
In a sixth aspect of the present invention, there are provided improved hair treatment compositions according to the fifth aspect of the invention in which the at least one fatty acid sulfate surfactant compound, the at least one fatty acid ether sulfate surfactant compound and the at least one betaine surfactant compound wherein the are present in one (preferably both) of the following ratios (wt%:wt%):

- cocoamidopropyl betaine: sodium coco sulfate of 0.5-2:1 (preferably 0.9-1.3:1);
- sodium laureth sulfate: sodium coco sulfate of 2.5-7.5:1 (preferably 3.8 - 5.25:1).

Particularly preferred ratios are also demonstrated with reference to one or more of the example compositions disclosed hereinafter.

In a seventh aspect the present invention provides a process for producing hair treatment compositions which may provide improved wet combing and/or dry combing characteristics, the method comprising the step of adding or including within the further constituents which may be present, the following essential constituents: controlled amounts of as well as specific combinations of: Polyquaternium-10, a cationic guar, and at least one amine functionalized silicone compounds provided in an emulsion or microemulsion, which essential constituents optionally but particularly preferably also include a surfactant system which necessarily includes one or more anionic surfactants, and particularly preferably include each of at least one fatty acid sulfate surfactant compound, the at least one fatty acid ether sulfate surfactant compound and the at least one betaine surfactant compound, and where further wherein optionally but particularly preferably, the hair treatment compositions exclude surfactants based on succinate compounds, (e.g., sulfosuccinates).

These and further aspects of the invention will become more apparent from a consideration of the following.

In certain aspects the hair treatment compositions necessarily include a system of essential constituents, which comprise each of: a Polyquaternium-10 polymer, a cationic guar, and at least one amine functionalized silicone compound, which is preferably provided in a mixture, a suspension, a dispersion, and emulsion or a microemulsion of the silicone compound(s) in a liquid carrier and/or with other liquid or solid constituents.

The Polyquaternium-10 polymer, (interchangeably referred to as "PQ10" herein) is itself, per se, known to the art, and is a polymeric quaternary ammonium salt of
hydroxyethyl cellulose reacted with a trimethyl ammonium substituted epoxide. Such are based on modified hydroxyethyl cellulose polymers which are quaternized in order to impart a cationic charge which is a characteristic of the resultant polymer. Particularly preferably the Polyquaternium-10 is one which has a molecular weight which in a 2%
aqueous solution exhibits a viscosity of 300 - 500 mPa.s, and contains at least about 1.5% nitrogen, and preferably contains between about 1.5 - 2.2 % nitrogen. The inventors have unexpectedly observed that the utilization of such a particular Polyquaternium-10 polymer in conjunction with the further essential constituents provides improved technical characteristics disclosed herein. Is to be noted that while a wide variety of Polyquaternium-10 polymers are available, from a variety of sources, the variation in the molecular weights, nitrogen content of Polyquaternium-10 polymers also varies greatly, and in particular a wide range of molecular weights are available, similarly, the nitrogen content of such polymers can also vary widely. However nothing in the prior art appears to indicate the particular suitability of the Polyquaternium-10 polymers which may be characterized as exhibiting a viscosity of 300 - 500 cP.s, as a 2%wt. aqueous solution at 25°C, and which contains at least about 1.5% nitrogen, and preferably contains between about 1.5 - 2.2 % nitrogen as only taught by the present applicants, and only disclosed in the following Examples. Such specific Polyquaternium-10 polymers are commercially available, for example as UCARE™ JR-400, (ex. Dow Chem. Co.), and exemplify a particularly preferred species of the required Polyquaternium-10 polymers of the inventive compositions.

In certain preferred embodiments, the Polyquaternium-10 polymer is present as the sole named "Polyquaternium" polymer in the hair treatment compositions, such that the all further Polyquaternium-"X" polymers, wherein "X" is a whole number, other than 10, are expressly excluded.

The Polyquaternium-10 polymer constituent is present in the hair treatment composition in an amount of from 0.0001 - 1%wt, preferably from 0.05 - 0.5%wt, and particularly preferably in an amount of from 0.1 - 0.45%wt, yet more preferably is present in an amount of 0.05%, or 0.1%wt, or 0.25%wt, based on the total weight of the hair treatment composition of which it forms a part.
A next essential constituent of the inventive compositions is a cationic guar gum. The cationic guar gum may be guar gum and hydroxy alkylated guar gum. Preferably the cationic guar gum has a molecular weight in the range of about 100,000-2,000,000, and preferably of about 100,000 - about 1,200,000. Preferred are cationic guar gums which are modified to comprise a cationic group, such as the group --CH₂-CH=CH-CH₂N(C≡)C-. Advantageously the degree of substitution of the cationic group is from about 0.1 - 1, preferably of about 0.2-0.8. Such cationic guar gums are presently commercially available under the tradenames Jaguar 6-17 and Jaguar C-13, both of which are described as being guar hydroxypropyltrimonium chlorides.

The cationic guar gum constituent is present in the hair treatment composition in an amount of from 0.0001 - 1%wt, preferably from 0.05 - 0.5%wt, and particularly preferably in an amount of from 0.1 - 0.45%wt, more preferably from 0.1-0.4%wt, or 0.1 - 0.3%wt. based on the total weight of the hair treatment composition of which it forms a part.

The next essential constituent of the invention is at least one amine functionalized silicone compound. Such is usually provided in a mixture, a suspension, a dispersion, and emulsion or a microemulsion of the silicone compound(s) in a liquid carrier and/or with other liquid or solid constituents.

One type of one amine functionalized silicone compound which may be present are those which are generally referred to as "amodimethicones", which may also be used to refer to alkylamino substituted silicone compounds which are silicone oils, which include at least one, preferably a plurality of amino functional groups. Such amino groups may be primary-, secondary- and/or tertiary-amine groups. Such amodimethicones may be linear silicone compounds including those of which may be represented by the following structure:

![Structure I](image)

and/or may be cyclic silicone compounds including those of which may be represented by the following structure (II)
in which in each of (I) and (II), each R is an aliphatic group, preferably alkyl or alkenyl,
or R is an aryl group, each of which R groups may be substituted or unsubstituted, with
the proviso that at least one R group includes an amino functionality, e.g., an alkylamine
group such as a primary amine, a secondary amine, a tertiary amine or a quaternary
ammonium. Such include (but are not limited to) mono-, di- tri- alkylamino as well as
mono-, di- and tri-alkoxyamino groups. With respect to the R group, examples of
suitable R groups include alkoxy, aryloxy, alkaryl, arylalkyl, arylalkenyl, alkylamine, and
ether-substituted, hydroxyl-substituted, and halogen-substituted aliphatic and aryl groups.

Each of the R groups attached to each monomeric silicone unit may be the same, or they
may be different, e.g., where one of the R groups is an unsubstituted aliphatic group such
as a C1-C3 alkyl group, and the other R group is a group which includes an amino
functionality. Preferred alkyl and alkenyl substituents are C1-C5 alkyls and alkenyls,
more preferably from C1-C3, most preferably from C1-C2. The aliphatic portions of
other alkyl-, alkenyl-, or alkynyl-containing groups (such as alkoxy, alkaryl, and
alkamino) can be straight or branched chains and preferably have from one to five carbon
atoms, more preferably from one to four carbon atoms, still more preferably from one to
three carbon atoms, most preferably from one to two carbon atoms. The R groups may be
unsubstituted R groups which include alkoxy, aryloxy, alkaryl, arylalkyl, arylalkenyl,
groups as well as ether-substituted, hydroxyl-substituted, and halogen-substituted
aliphatic and aryl groups. The R groups can also be substituted with further atoms or
groups, such as halogens (e.g. chloride, fluoride, and bromide), halogenated aliphatic or
aryl groups, and hydroxy (e.g. hydroxy substituted aliphatic groups). Suitable
halogenated R groups include, for example, tri-halogenated (preferably fluoro) alkyl
groups such as -R" -C(F)3, wherein R" is C1-C3 alkyl. Further suitable R groups
include methyl, ethyl, propyl, phenyl, methylphenyl and phenylmethyl, each of which
may be optionally substituted.
The amodimethcone compounds, such as may be represented by structural formulae (I) and (II), may have any structure, and molecular weight such that the resultant compounds of (I) and (II) remain fluid at room temperature (20°C) and are hydrophobic. As such in formula (I), x, and in formula (II), y, may be any integer which is at least 2 and which provides such a fluid amodimethione compound (or composition containing the amodimethicone compound), and preferably x and y are integers in the range of 2 - 1,000,000, more preferably are integers in the range of 100 - 1,000,000 and especially preferably are integers having a value of at least 1,000 (and in order of increasing preference) 2,000; 3,000; 4,000; 5,000; 7,500; 10,000; 12,500; 15,000; 17,500; 20,000; 25,000; 30,000; 40,000; 50,000, and concurrently have a value of not more than 1,000,000 (and in order of increasing preference) 900,000; 850,000; 800,000; 750,000; 700,000; 650,000; 600,000; 550,000; 500,000; 450,000; 400,000; 350,000; 300,000; 250,000; 200,000; 175,000, 150,000; 125,000 and 100,000.

Non-limiting examples of specific suitable amodimethicone compounds include those which may be represented by the following structure:

in which, a and b are independently integers which have a value of at least 1, z and w are independently integers having a value of from 1 - 5, and the terminal groups R' and R' are independently selected from: -H, -OH, R". and -Si(R")3 and -OSi(R")3 wherein R" denotes a monovalent C1-C16 hydrocarbon radical, preferably a monovalent C1-C6 hydrocarbon radical which may be optionally substituted such as an alkyleneoxy radical, which R" is preferably a C1-C6 radical such as methyl, such that the molecular weight of
the amodimethicone compound is such that it is a fluid at room temperature, and preferably has a molecular weight of at least 10,000.

Particularly preferred amodimethicone compounds include those which include a hydrophobic portion which includes one or more siloxane moieties and a hydrophilic block which includes one or more polyalkylene moieties, e.g. ethoxy, propoxy and/or butoxy moieties. Such block may be regularly alternating and repeating (e.g. "AB" blocks) or may be randomly distributed in a polymeric chain, viz., are not regularly alternating groups. An exemplary hydrophobic portion may be represented by the following structure:

![Hydrophobic Structure]

and an exemplary hydrophilic portion may be represented by the following structure:

![Hydrophilic Structure]

and a preferred example of such a "AB" regularly repeating block formed from the foregoing may be represented by:

![Preferred AB Structure]

In which in the foregoing, x may be any integer value such that that a hydrophobic nature is imparted, each of a and b are independently any integer value such that that a hydrophilic nature is provided, and n may be any integer value of 5 or more, and preferably has an integer value of between about 2 - 15, preferably about 5 - 10. and/or alternately n has an integer value such that the resultant polymeric amodimethicone may be formed into an emulsion, preferably an aqueous emulsion. A commercial example of the foregoing and a particularly preferred example of the foregoing is a
methylaminopropyl/hydroxypropyl dimethicone which is presently commercially available as SILSOFT A+ (ex. Momentive, Inc.) which is a suspension or emulsion which includes the amodimethicone having a regularly repeating hydrophobic portions and hydrophilic portions described above. The SILSOFT A+ is described to be a surfactant free emulsion of the amodimethicone having a regularly repeating hydrophobic portions and hydrophilic portions described above, having a maximum viscosity of 10,000 cPs, (at 25°C) and having a silicone content of 30%.

A further preferred amodimethicone is a silicone amodimethicone microemulsion which is presently commercially available as SME253 (ex. Momentive, Inc.) which is described to be a suspension containing 20% silicone solids with an average particle size of less than 20 nanometers. This SME253 product additionally comprises a C₁₁₋₁₅ ethoxylated secondary alcohol nonionic surfactant, a polyoxyethylene (12) tridecyl ether nonionic surfactant, and glycerine. The SME253 product is further described to have a viscosity of up to 2000 cPs (at 25°C), a silicone content of 20%, and a solids content in the range of 26.5%-32.5%.

The at least one amine functionalized silicone compound, viz, the amodimethicone compound is present in the hair treatment composition in an amount of from 0.0001 - 1%wt, preferably from 0.05 - 0.5%wt, and particularly preferably in an amount of from 0.1 - 0.45%wt, based on the total weight of the hair treatment composition of which it forms a part. Such a weight percentage is based on the actual content of the at least one amine functionalized silicone compound which may be present and forming part of a commercial preparation which may include further constituents such as a liquid carrier, one or more surfactants as well as one or more other silicone compounds.

In preferred embodiments at least two different amine functionalized silicone compounds are present. In further preferred embodiments the at least two different amine functionalized silicone compounds are present such that a first amine functionalized silicone compound is present in an amount of at least 3, 4, 5, 6, 7, 8, 9 or 10 times that of a second amine functionalized silicone compound.

In certain preferred embodiments the amine functionalized silicone compounds are the predominant silicone compounds present in the hair treatment compositions, and
in particular linear and/or cyclic siloxanes, according to the foregoing formulae (I) and (II) which exclude an amino functionality, e.g., an alkylamine group such as a primary amine, a secondary amine, a tertiary amine or a quaternary ammonium, are excluded from the hair treatment compositions taught herein. In further preferred embodiments the amine functionalized silicone compounds comprise at least 90%wt. of the total amount of the linear and/or cyclic siloxanes present, more preferably comprise at least 95%, 96, 97%, 98%, 99%, or 100%wt. of the linear and/or cyclic siloxanes present.

According to particularly preferred embodiments the essential constituents of: cationic guar compound, Polyquaternium-10 compound and amine functionalized silicone compound are concurrently present within at least one of the following ratios:

(a) cationic guanPQIO ratio of 0.1-10:1; preferably 0.4-8.25:1;

(b) total polymer amount (namely, the total amount of cationic guar and PQ10): total amine functionalized silicone compound(s) ratio of 0.25 - 1.5:1; preferably 0.45-1.1:1;

(c) a cationic guar: total amine functionalized silicone compound(s) ratio of 0.001-1:1; preferably 0.15-0.8:1;

(d) aPQIO: total of amine functionalized silicone compound(s) ratio of 0.01-1:1; preferably 0.075 - 0.55:1. Further preferably at least two, more preferably at least three and most preferably all four of the ratios (a), (b), (c) and (d) are met.

The inventors have surprisingly found that the foregoing respective weight ratios of the foregoing identified compounds/materials provide unexpected benefits in hair treatment compositions which are believed to be unknown prior to the present invention. Such benefits are demonstrated with one or more of the example compositions described below. While not wishing to be bound by the following hypothesis, the inventors nonetheless believe that the specific ternary combination of Polyquaternium-10, with the cationic guar hydroxypropyl trimonium chloride (viz., an example of a cationic guar gum) especially when present in the preferred relative weight ratios provide improved "wet combining" and/or "dry combing" characteristics to treated hair when used to deposit one or more amine functionalized silicone compound to the hair. It is suspected that the said the specific ternary combination of essentially constituents, and particularly preferably when such are also present with the preferred surfactant system, provides
coascervates which are deposited upon the surface of hair and acts to reduce the irregular surface thereof, viz., the cuticles present on the exterior of each strand of hair which results in the improved combing characteristics disclosed herein. The deposited coascervates may also facilitate the deposition of various aqueous insoluble or partially aqueous soluble active constituents, e.g. silicone containing compounds including one or more amodimethicone compounds. Such results in improved hair treatment characteristics which are attained without undue deposition of chemical constituents upon each strand of hair which might otherwise cause the buildup of undesired surface residues which would increase the friction and thereby reduce advantageous wet combing and/or dry combing characteristics. In particular good "wet combing" and "dry combing" results are obtained, with a reduced amount of the Polyquaternium-10 and cationic guar gum being required, which polymeric materials often undesirably contribute to the buildup of undesired surface residues. Further, such an undesired buildup, would also lead to a reduction in the luster, and attractive appearance of treated hair, which detrimental effects may be avoided by the use of the present inventive compositions. It is suspected that the applicant's claimed ternary system of essential constituents, and optionally but preferably with applicant's preferred surfactants, provide for improved deposition of the one or more amodimethicone compounds which contribute to overall hair combability and reduced friction, hence reduced work required during "wet combing" and "dry combing", and at the same time desired luster and appearance of the treated hair are not compromised notwithstanding the reduced amount of Polyquaternium-10 and cationic guar gum being present. Such a benefit also provides for long term benefits, as reduced amounts of polymers required per application also imparts long term reduction in total polymer being present particularly following multiple applications of the hair treatment compositions. Further, such benefits as described above are also provided in compositions which have relatively reduced amounts of one or more surfactants as well.

The hair treatment compositions optionally, (but in preferred embodiments also necessarily,) comprise one or more anionic surfactants. Such provide good cleaning of hair, and generate a lather which is an important consumer attribute. Non-limiting examples of useful anionic surfactants include may water soluble or water dispersible
anionic surfactants including, but not limited to: linear C8-C24 alkyl benzene sulfonates; alkaryl sulfonates, C8-C24 paraffin sulfonates, alpha C8-C24 olefin sulfonates, alkyl sulfates, alkyl ether sulfates, alkyl succinates, alkyl sulfosuccinates, N-alkoyl sarcosinates, alkyl phosphates, alkyl ether phosphates, alkyl ether carboxylates, alkylamino acids, alkyl peptides, alkoyl taurates, acyl and alkyl glutamates, alkyl isethionates, and mixtures thereof, and or salts thereof. In the foregoing, the alkyl groups may be unsaturated, or partially saturated, and generally contain from about 8 to about 24 carbon atoms. Examples of salts of such anionic surfactant compounds include alkali metal or alkaline earth metal salts, e.g., sodium, potassium, lithium, and magnesium salts as well as ammonium and alkanolammonium salts such as mono-, di- and triethanolamine salts.

In certain preferred embodiments, the anionic surfactant(s) predominantly consist of one or more alkyl alkoxylated ether sulfates, e.g., alkyl ethoxylated ether sulfates or salt form thereof. Such compounds include those which may be represented by either of the following formula I and II as follows:

\[
R-(\text{OC-CH}_2)_x-\text{OSO}_3^\text{M} \quad (\text{I})
\]

\[
H \quad R-(\text{OC-CH}_2)_x-\text{OSO}_3^\text{M} \quad (\text{II})
\]

in which formulae, \(x\) has a value of from 1 - 22 inclusive, but preferably has a value of 1-10 inclusive, \(R\) is an alkyl group having 8 - 18 carbon atoms, and \(M\) is a radical or cation which renders the compound water soluble or water miscible, e.g., These anionic surfactants may be provided as salts of one of these aforementioned compounds, which salts may render them, or improve their solubility or miscibility in water. Non-limiting examples of water soluble or water dispersible salts include alkali metal or alkaline earth metal salts, such as sodium, potassium, ammonium, lithium, and magnesium as well as
alkanolammonium salts. An exemplary and preferred alkyl alkoxylated ether sulfate is sodium laureth ether sulfate. Such a material is presently commercially available as Texapon N-70 NA (ex. BASF).

A further exemplary and preferred anionic surfactant is a sodium cocosulfate, which is a solid material at room temperature and which may be comminuted into a pulvurent form. Such a material is presently commercially available as Mackol® CAS-100N (ex. Rhodia).

In preferred embodiments, the inventive compositions comprise both at least one fatty acid sulfate surfactant compound, (e.g. preferably, a sodium cocosulfate compound) at least one fatty acid ether sulfate surfactant compound (e.g., preferably, sodium lauryl ether sulfate compound; sodium laureth sulfate) as necessary constituents of the ternary surfactant system when such a ternary surfactant system is present in an inventive composition. Further preferably the total amount of the at least one fatty acid sulfate surfactant compound is not in excess of 2.5%wt. based on the total weight of the hair treatment composition.

In place or, or in addition to the recited anionic surfactants, the hair treatment compositions may include an anionic soap. Such are typically anionic materials (i.e. alkali metal salts, e.g., sodium or potassium salts) of fatty acids, typically having from about 8 to about 24 carbon atoms, preferably from about 10 to about 20 carbon atoms.

Further suitable soaps include alkali metal, ammonium and alkanolammonium salts of aliphatic alkane or alkene monocarboxylic acids having about 8 to about 18 carbon atoms. Sodium, potassium, ammonium, mono-, di-, and triethanolammonium cations or combinations thereof, are preferred. The fatty acids used in making the soaps can be obtained from natural sources such as, for instance, plant or animal-derived glycerides (e.g., palm oil, coconut oil, soybean oil, castor oil, tallow, lard, etc.). The fatty acids can also be synthetically prepared. Soaps may be prepared by either direct saponification of fats and oils or by neutralization of free fatty acids. Particularly useful are the sodium, potassium, ammonium and alkanolammonium salts of lauric acid, myristic acid, palmitic acid, stearic acid, oleic acid, linoleic acid, ricinoleic acid, coconut fatty acid, palm kemel fatty acid and tallow fatty acid, as well as technical grade mixtures thereof.
Advantageously, the one or more anionic surfactants and/or anionic soaps are present in the hair treatment compositions in amounts of about 1% - 50%wt, more preferably in amounts of about 5% - 35%wt.

Particularly preferred anionic surfactants and preferred amounts thereof in the compositions of the invention are disclosed in one or more of the Examples.

In accordance with certain preferred embodiments the hair treatment compositions necessarily comprise a ternary surfactant system: at least one fatty acid sulfate surfactant compound, (e.g., preferably, a sodium cocosulfate compound) at least one fatty acid ether sulfate surfactant compound (e.g., preferably, sodium lauryl ether sulfate compound; sodium laureth sulfate) and at least one betaine surfactant compound (e.g. preferably, cocoamidopropyl betaine). Preferably the total amount of the ternary surfactant system relative to the total polymer amount (the total amount of cationic guar and PQ10) is with the following ratios (wt%:wt%): 20-80:1, preferably 25-70:1. In certain preferred embodiments the hair treatment compositions expressly exclude surfactants based on succinate compounds, (e.g., sulfosuccinates), such as disodium oleamido MIPA sulfosuccinate. In certain alternative preferred embodiments the hair treatment compositions expressly include surfactants based on succinate compounds, (e.g., sulfosuccinates), such as disodium oleamido MIPA sulfosuccinate.

The treatment compositions of the invention may further include one or more further optional constituents, and amounts which provide a desired benefit but which do not undesirably detract from the technical performance of the essential constituents. Such a desired benefit may be an aesthetic benefit and/or a technical benefit.

One or more further surfactants may also be included in the hair treatment compositions. Such include nonionic surfactants, cationic surfactants, amphoteric surfactants and/or zwitterionic surfactants.

The inventive compositions may include at least one nonionic surfactant. Useful nonionic surfactants in the hair treatment compositions are virtually all known art nonionic surfactants may be used in the present inventive compositions. Illustrative examples of suitable nonionic surfactants include, inter alia, condensation products of alkylene oxide groups with an organic hydrophobic compound, such as an aliphatic compound or with an alkyl aromatic compound. The nonionic synthetic organic
detegents generally are the condensation products of an organic aliphatic or alkyl aromatic hydrophobic compound and hydrophilic ethylene oxide groups. Practically any hydrophobic compound having a carboxy, hydroxy, amido, or amino group with a free hydrogen attached to the nitrogen can be condensed with ethylene oxide or with the polyhydration product thereof, polyethylene glycol, to form a water soluble nonionic detergent. Further, the length of the polyethenoxy hydrophobic and hydrophilic elements may be varied to adjust these properties. Illustrative examples of such a nonionic surfactant include the condensation product of one mole of an alkyl phenol having an alkyl group containing from 6 to 12 carbon atoms with from about 5 to 25 moles of an alkylene oxide. Another example of such a nonionic surfactant is the condensation product of one mole of an aliphatic alcohol which may be a primary, secondary or tertiary alcohol having from 6 to 18 carbon atoms with from 1 to about 10 moles of alkylene oxide. Preferred alkylene oxides are ethylene oxides or propylene oxides which may be present singly, or may be both present.

Still further illustrative examples of nonionic surfactants include primary and secondary linear and branched alcohol ethoxylates, such as those based on C₆-C₁₈ alcohols which further include an average of from 2 to 80 moles of ethoxylation per mol of alcohol. Examples include the Genapol® series of linear alcohol ethoxylates from Clariant Corp., Charlotte, NC. The 26-L series is based on the formula RO(CH₂CH₂₀)ₙH wherein R is a mixture of linear, even carbon-number hydrocarbon chains ranging from C₁₂H₂₅ to C₁₆H₃₃ and n represents the number of repeating units and is a number of from 1 to about 12. Further illustrative examples of useful nonionic surfactants include secondary C₁₂-C₁₅ alcohol ethoxylates, including those which have from about 3 to about 10 moles of ethoxylation. Such are available in the Tergitol® series of nonionic surfactants (Dow Chemical, Midland, MI), particularly those in the Tergitol® "15-S-" series. Yet further exemplary nonionic surfactants include linear primary C₁₁-C₁₅ alcohol ethoxylates, including those which have from about 3 to about 10 moles of ethoxylation. Such are for example available in the Neodol® and the Tomadol® series of nonionic surfactants. Yet further examples of useful nonionic surfactants include C₅-C₁₅ straight chain alcohols ethoxylated with about 1 to 13 moles of ethylene oxide, particularly those which include about 3 to about 6 moles of ethylene oxide. Examples of such nonionic...
surfactants include Alfonic® 810-4.5, which is described as having an average molecular weight of 356, an ethylene oxide content of about 4.85 moles and an HLB of about 12; Alfonic® 810-2, which is described as having an average molecular weight of 242, an ethylene oxide content of about 2.1 moles and an HLB of about 12; and Alfonic® 610-3.5, which is described as having an average molecular weight of 276, an ethylene oxide content of about 3.1 moles, and an HLB of 10.

Still further examples of suitable nonionic surfactants for use as the (b) at least one nonionic surfactant include include alkyl glucosides, alkyl polyglucosides and mixtures thereof. Alkyl glucosides and alkyl polyglucosides can be broadly defined as condensation articles of long chain alcohols, e.g., C8-C30 alcohols, with sugars or starches or sugar or starch polymers i.e., glycosides or polyglycosides. These compounds can be represented by the formula \((S)_{n}—O—R\) wherein \(S\) is a sugar moiety such as glucose, fructose, mannose, and galactose; \(n\) is an integer of from about 1 to about 1000, and \(R\) is a C8-30 alkyl group. Examples of long chain alcohols from which the alkyl group can be derived include decyl alcohol, cetyl alcohol, stearyl alcohol, lauryl alcohol, myristyl alcohol, oleyl alcohol and the like. Commercially available examples of these surfactants include decyl polyglucoside (available as APG 325 CS from Henkel) and lauryl polyglucoside (available as APG 600 CS and 625 CS from Henkel).

A further class of nonionic surfactants which may find use in the present inventive compositions include ethoxylated octyl and nonyl phenols include those having one of the following general structural formulas:

\[
\begin{align*}
\text{CH}_3 & \quad \text{CH}_3 \\
\text{CH}_3 & \quad \text{CH}_3 \\
\end{align*}
\]

\[(\text{OCH}_2\text{CH}_2)_x\text{—OH}\]

or,

\[
\begin{align*}
\text{C}_{9}\text{H}_{19} & \quad \text{—O—R} \\
\end{align*}
\]

\[(\text{OCH}_2\text{CH}_2)_x\text{—OH}\]

in which the \(\text{C}_{9}\text{H}_{19}\) group in the latter formula is a mixture of branched chained isomers, and \(x\) indicates an average number of ethoxy units in the side chain. Particularly suitable non-ionic ethoxylated octyl and nonyl phenols include those having from about 7 to
about 13 ethoxy groups. Such compounds are commercially available under the trade name Triton® X (Dow Chemical, Midland, MI), as well as under the tradename Igepal® (Rhodia, Princeton, NJ). One exemplary and particularly preferred nonylphenol ethoxylate is Igepal® CO-630.

Still further examples of suitable nonionic surfactants for use as inventive compositions are alkoxy block copolymers, and in particular, compounds based on ethoxy/proproxy block copolymers. Polymeric alkylene oxide block copolymers include nonionic surfactants in which the major portion of the molecule is made up of block polymeric \( \text{C}_2-\text{C}_4 \) alkylene oxides. Such nonionic surfactants, while preferably built up from an alkylene oxide chain starting group, and can have as a starting nucleus almost any active hydrogen containing group including, without limitation, amides, phenols, thiols and secondary alcohols.

One group of such useful nonionic surfactants containing the characteristic alkylene oxide blocks are those which may be generally represented by the formula (A):

\[
\text{HO—}(\text{EO})_x(\text{PO})_y(\text{EO})_z \cdot \text{H} \quad (A)
\]

where EO represents ethylene oxide,

PO represents propylene oxide,

\( y \) equals at least 15,

\( (\text{EO})_{x+z} \) equals 20 to 50% of the total weight of said compounds, and,

the total molecular weight is preferably in the range of about 2000 to 15,000.

Another group of nonionic surfactants for use in the new compositions can be represented by the formula (B):

\[
\text{R—}(\text{EO,PO})_a(\text{EO,PO})_b \cdot \text{H} \quad (B)
\]

wherein R is an alkyl, aryl or aralkyl group, where the R group contains 1 to 20 carbon atoms, the weight percent of EO is within the range of 0 to 45% in one of the blocks a, b, and within the range of 60 to 100% in the other of the blocks a, b, and the total number
of moles of combined EO and PO is in the range of 6 to 125 moles, with 1 to 50 moles in
the PO rich block and 5 to 100 moles in the EO rich block.

Further nonionic surfactants which in general are encompassed by Formula B
include butoxy derivatives of propylene oxide/ethylene oxide block polymers having
molecular weights within the range of about 2000-5000.

Still further useful nonionic surfactants containing polymeric butoxy (BO) groups
can be represented by formula (C) as follows:

\[
\text{RO—(BO)}_n\text{(EO)}_x\text{—H} \quad (C)
\]

wherein \( R \) is an alkyl group containing 1 to 20 carbon atoms,
\( n \) is about 5-15 and \( x \) is about 5-15.

Also useful as the nonionic block copolymer surfactants, which also include
polymeric butoxy groups, are those which may be represented by the following formula

\[
\text{HO—(EO)}_x\text{(BO)}_n\text{(EO)}_y\text{—H} \quad (D)
\]

wherein \( n \) is about 5-15, preferably about 15,
\( x \) is about 5-15, preferably about 15, and
\( y \) is about 5-15, preferably about 15.

Still further useful nonionic block copolymer surfactants include ethoxylated
derivatives of propoxylated ethylene diamine, which may be represented by the following
formula:

\[
\text{H(EO)}_y\text{(PO)}_x\text{—N—CH}_2\text{—CH}_2\text{—N—PO)}_x\text{(EO)}_y\text{—H} \quad (E)
\]

where \( \text{(EO)} \) represents ethoxy,
\( \text{(PO)} \) represents propoxy,
the amount of \( \text{(PO)}_x \) is such as to provide a molecular weight prior to ethoxylation
of about 300 to 7500, and the amount of \( \text{(EO)}_y \) is such as to provide about 20% to 90% of
the total weight of said compound.
Further exemplary nonionic surfactants which may be used include alkanolamides such as monoethanolamides and diethanolamides, particularly fatty monoalkanolamides and fatty dialkanolamides. Commercially available monoethanolamides and diethanolamides include those marketed under the trade names Alkamide® and Cyclomide® by Rhone-Poulenc Co., (Cranbury, NJ).

Yet further useful nonionic surfactants include condensates of alkylene oxides, particularly ethylene oxide with sorbitan fatty acid esters. Such materials are presently commercially available under the tradename TWEENS from Imperial Chemical Industries and include polyoxyethylene sorbitan monolaurate, polyoxyethylene sorbitan monopalmitate, polyoxyethylene sorbitan monostearate, polyoxyethylene sorbitan tristearate, polyoxyethylene sorbitan monooleate, polyoxyethylene sorbitan trioleates which are available in a variety of grades, and with differing amounts of polyoxylethylene groups per molecule.

Still further compounds which are here classified as nonionic surfactants are polyoxyalkylene ethers, such as PPG-3-Buteth-5, PPG-5-Buteth-7, PPG-7-Buteth-10, PPG-9-Buteth-12, PPG-12-Buteth-16, PPG-15-Buteth-20, PPG-20-Buteth-30, PPG-28-Buteth-35, PPG-33-Buteth-45 and the like.

Exemplary amphoteric surfactants include water-soluble betaine surfactants which may be represented by the general formula:

\[
R_1\begin{array}{c}R_2\mathrm{N}^-\mathrm{C}^{+}\mathrm{O}^\cdot \\
\mathrm{CH}_3
\end{array}
\]

wherein \(R_1\) is an alkyl group containing from 8 to 18 carbon atoms, or the amido radical which may be represented by the following general formula:

\[
\begin{array}{c}0\mathrm{H} \\
\mathrm{R}^-\mathrm{C}^{+}\mathrm{N}^\cdot \left(\mathrm{CH}_2\right)_a^- \\
\end{array}
\]

wherein \(R\) is an alkyl group having from 8 to 18 carbon atoms, \(a\) is an integer having a value of from 1 to 4 inclusive, and \(R_2\) is a \(C_1\) to \(C_4\) alkylene group. Examples of such
water-soluble betaine surfactants include dodecyl dimethyl betaine, as well as cocoamidopropylbetaine.

As noted previously in certain preferred embodiments betaines are necessary constituents of the ternary surfactant system when such a ternary surfactant system is present in an inventive composition.

Examples of preferred cationic surfactant compositions include quaternary ammonium compounds and salts thereof, which may be characterized by the general structural formula:

\[
\begin{array}{c}
\text{R}_1 \\
\text{N} \\
\text{R}_2 \\
\text{R}_3 \\
\text{R}_4 \\
\text{X}^-
\end{array}
\]

where at least one of \( R_1, R_2, R_3 \) and \( R_4 \) is a alkyl, aryl or alkylaryl substituent of from 6 to 26 carbon atoms, and the entire cation portion of the molecule has a molecular weight of at least 165. The alkyl substituents may be long-chain alkyl, long-chain alkoxyaryl, long-chain alkylaryl, halogen-substituted long-chain alkylaryl, long-chain alkylphenoxyalkyl, arylalkyl, etc. The remaining substituents on the nitrogen atoms other than the abovementioned alkyl substituents are hydrocarbons usually containing no more than 12 carbon atoms. The substituents \( R_1, R_2, R_3 \) and \( R_4 \) may be straight-chained or may be branched, but are preferably straight-chained, and may include one or more amide, ether or ester linkages. The counterion \( X \) may be any salt-forming anion which permits water solubility of the quaternary ammonium complex.

Exemplary quaternary ammonium salts within the above description include the alkyl ammonium halides such as cetyl trimethyl ammonium bromide, alkyl aryl ammonium halides such as octadecyl dimethyl benzyl ammonium bromide, N-alkyl pyridinium halides such as N-cetyl pyridinium bromide, and the like. Other suitable types of quaternary ammonium salts include those in which the molecule contains either amide, ether or ester linkages such as octyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride, N-[(laurylcocoaminoformylmethyl)-pyridinium chloride, and the like. Other very effective types of quaternary ammonium compounds which are useful as germicides include those in which the hydrophobic radical is characterized by a
substituted aromatic nucleus as in the case of lauryloxyphenyltrimethyl ammonium chloride, cetylaminophenyltrimethyl ammonium methosulfate, dodecylphenyltrimethyl ammonium methosulfate, dodecylbenzytrimethyl ammonium chloride, chlorinated dodecylbenzytrimethyl ammonium chloride, and the like.

When present such one or more further nonionic surfactants, cationic surfactants, amphoteric surfactants and/or zwitterionic surfactants may be present in amounts of as little as 0.001%wt, to about 50%wt, more preferably in amounts of 0.1 - 15%wt, and particularly preferably in amounts of 1-10%wt.

As noted previously in certain preferred embodiments the hair treatment compositions necessary include as essential constituents a ternary surfactant system which include: at least one fatty acid sulfate surfactant compound, (e.g., preferably, a sodium coco sulfate compound) at least one fatty acid ether sulfate surfactant compound (e.g., preferably, sodium lauryl ether sulfate compound; sodium laureth sulfate) and at least one betaine surfactant compound (e.g. preferably, cocoamidopropyl betaine).

Preferably the total amount of the ternary surfactant system relative to the total polymer amount (the total amount of cationic guar and PQ10) is with the following ratios (wt%:wt%): 20-80:1, preferably 25-70:1 Preferred surfactants of the ternary surfactant system as well as preferred ratios of one or more of the surfactants comprising the ternary surfactant system are disclosed with reference to one or more of the Examples. In such preferred embodiments wherein the ternary surfactant system is present, these surfactants comprise between about 8-20%wt, preferably between about 12 - 20%wt, of the total amount of hair treatment composition of which the ternary surfactant system forms a part. In such an embodiment it is also to be expressly understood that one or more further or additional surfactants may be present in the hair treatment compositions.

As further optional constituents, the hair treatment compositions may include silicone emulsifiers, which are distinguished from and separate from the essential amodimethicone constituent discussed above in the optional silicone emulsifiers do not include or require an amine functionality or amine moiety. Such optional silicone emulsifiers may include polydiorganosiloxane-polyoxyalkylene copolymers containing at least one polydiorganosiloxane segment and at least one polyoxyalkylene segment. The polyoxyalkylene segments may be bonded to the polydiorganosiloxane segments with
silicon-oxygen-carbon bonds and/or with silicon-carbon bonds. The polydiorganosiloxane segments consist essentially of siloxane units which are interlinked by Si-O-Si linkages and which have the formula:

\[ R_bSiO_{d(b)/2} \]

The value of \( b \) may range from 0 to 3 for said siloxane units with the provision that there is an average of approximately 2, i.e. from 1.9 to 2.1 R radicals for every silicone in the copolymer. Suitable siloxane units thus include R3SiO1/2, R2SiO2/2, RSiO3/2, and SiO4/2 siloxane units taken in such molar amounts so that \( b \) has an average value of approximately 2 in the copolymer. Said siloxane units may be arranged in linear, cyclic and/or branched fashion. The R radicals may be any radical selected from the group consisting of methyl, ethyl, vinyl, phenyl, and a divalent radical bonding a polyoxyalkylene segment to the polydiorganosiloxane segment. At least 95 percent of all R radicals are methyl radicals; preferably there is at least one methyl radical bonded to each silicon atom in (d). Divalent R radicals preferably contain no more than 6 carbon atoms. Examples of divalent R radicals include \(-O-, -C_mH_{2m}O-, \sim C_mH_{2m}H_{2m} - \) and \( \sim C_mH_{2m}CO\sim \) where \( m \) is an integer greater than zero. Illustrative of the siloxane units that make up the polydiorganosiloxane segments are the following, where Me denotes methyl and Q denotes said divalent R radical and bonded polyoxyalkylene segment:

- \( R3SiO1/2 \) units such as Me3SiO1/2, Me2(CH=CH)SiO1/2, Me2(C6H5)SiO1/2,
- \( Me(C6H5)(CH=CH)SiO1/2, Me2(CH3CH2)SiO1/2, Me2QSIO1/2, MeQ2 SiO1/2, Q3SiO1/2, Q2(CH=CH2)SiO1/2, and Me(C6H5)(Q)SiO1/2 ; R2SiO2/2 units such as Me3SiO2/2,
- Me(C6H5)SiO2/2, Me(CH=CH)SiO2/2, (C6H5)2SiO2/2, MeQSiO2/2, and Q(C6H5)SiO2/2 ;
- RSiO3/2 units such as MeSiO3/2, C6H5SiO3/2, CH2=CHSiO3/2, CH3CH2SiO3/2 and QSiO3/2 ; and
- SiO4/2 units.

Representative and preferred silicone emulsifiers are compounds which may be represented by the structure:

\[
\text{CH}_3\begin{array}{c}
\text{Si} \\
\text{CH}_3
\end{array}
\begin{array}{c}
\text{O} \\
\text{Si} \\
\text{O} \\
\text{Si} \\
\text{CH}_3
\end{array}\begin{array}{c}
\text{CH}_3 \\
\text{R} \\
\text{R} \\
\text{R} \\
\text{CH}_3
\end{array}\begin{array}{c}
\text{CH}_3
\end{array}
\]

wherein
R\(^1\) represents a C\(_{1-30}\) straight chained, branched or cyclic alkyl group.
R\(^2\) represents a moiety selected from:

\[
- (\text{CH}_2)\_n^0 - (\text{CH}_2\text{CHR}^3_0)\_m^0 - \text{H}
\]

and

\[
- (\text{CH}_2)\_n^0 - (\text{CH}_2\text{CHR}^3_0)\_m^0(\text{CH}_2\text{CHR}^4_0)\_p^0 - \text{H}
\]

in which n represents an integer from about 3 to about 10, R\(^3\) and R\(^4\) are selected from hydrogen and C\(_{1-6}\) straight chain, or branched chain alkyl groups with the proviso that R\(^3\) and R\(^4\) are not simultaneously the same, each of m, p, x and y are independently selected from integers of zero or greater, such that the molecule has a molecular weight of between about 200 to about 20,000,000 and wherein both m and p are not both simultaneously zero, and z is selected from integers of 1 or greater.

Such organosiloxane containing constituents may be sold and supplied in the forms of emulsions, microemulsions, dispersions, suspensions or mixtures of one or more linear or cyclic organosiloxanes in a fluid carrier or fluid medium, which may be aqueous based and/or organic solvent based, and which further include one or more surfactants, hydrotropes or emulsifiers. In such emulsions, microemulsions, dispersions, suspensions or mixtures the organosiloxanes are typically present in an amount of from about 1%wt. - 99.9%wt, more prevalently in an amount of about 1 %wt. - 50%wt.

When present, one or more of the foregoing organosiloxane containing constituents may comprise up to about 5%wt. of the hair treatment composition of which it forms a part, but advantageously, when present in included in an amount of from about 0.001%wt. to about 3%wt. In certain embodiments a organosiloxane containing constituent is necessarily present. In certain embodiments the essential amodimethicone compounds are necessarily present, while the aforesaid optional organosiloxane compounds are absent from the hair treatment compositions.

Further optional constituents include glycol esters, such as glycol mono-, and diesters of C\(_{10-28}\) fatty acids, such as glycol monostearate and glycol distearate. When present such may be included in amounts of as little as 0.001%wt. to about 5%wt, more preferably in amounts of 0.1 - 3%wt, and particularly preferably in amounts of 0.25-1.5%wt.
One or more organic solvents may also be included in the inventive compositions. Such include alcohols, glycols, and glycol ether materials. Such materials tend to have aliphatic moieties containing 2 to 6 carbon atoms. Examples of such materials include ethanol, propanol, isopropanol, butanol, 2-butanol, 2-methyl-2-propanol, butoxy diglycol, ethoxy diglycol, polypropylene glycol, ethylene glycol methyl ether, ethylene glycol dimethyl ether, propylene glycol methyl ether, dipropylene glycol n-butyl ether, butoxy ethanol, phenoxy ethanol, methoxy propanol, propylene glycol, n-butyl ether, tripropylene glycol, n-butyl ether, propylene glycol, hexylene glycol and other similar oxygenated solvents. When present such may be included in amounts of as little as 0.001%wt. to about 10%wt, more preferably in amounts of 0.1 - 7.5%wt, and particularly preferably in amounts of 0.25-5%wt.

The inventive compositions may include one or more polyols. Such include compounds having two or more hydroxyl groups and which are highly water soluble, preferably freely soluble, in water. Non-limiting examples of suitable polyols include: relatively low molecular weight short chain polyhydroxy compounds such as glycerol and propylene glycol; sugars such as sorbitol, manitol, sucrose and glucose; modified carbohydrates such as hydrolyzed starch, dextrin and maltodextrin, and polymeric synthetic polyols such as polyalkylene glycols, for example polyoxyethylene glycol (PEG) and polyoxypropylene glycol (PPG).

Of these said polyols, preferred are relatively low molecular weight compound which are either liquid or readily soluble in aqueous solutions, e.g., low molecular weight polyols and sugars. Particularly preferred polyols are glycerine, glycerol, sorbitol and their mixtures. Glycerine and glycerol are particularly preferred, as such may also provide benefits as humectants in the bar soaps.

When present, such one or more polyols may be included in minor but effective amounts, e.g. from about 0.001%wt. to about 0.5%wt, more preferably from about 0.1 - 2.5%wt. and especially preferably from about 0.5 - 1.5%wt. based on the total weight of the hair treatment composition of which it forms a part.

A further optional constituents is a chelating agent, which advantageously may form complexes with undesired inorganic salts present in water, e.g. in hard water, which may otherwise undesirably react to form unwanted complexes with one or more of the
further constituents which are present in the treatment compositions. Exemplary useful chelating agents include those known to the art, including by way of non-limiting example; aminopolycarboxylic acids and salts thereof wherein the amino nitrogen has attached thereto two or more substituent groups. Such include one or more of: ethylene diamine tetra acetic acid (EDTA), diethylene triamine penta acetic acid (DTPA), ethane-1,1-hydroxy-1,1-diphosphonate (EHDP), ethylene diamine- N,N'-disuccinate (EDDS), nitrilo triacetic Acid (NTA), sodium imino disuccinate (IDS), ethylene glycol-bis-(2-aminoethyl)-N,N', N'-tetra acetic acid (EGTA), methyl glycine diacetic acid (MGDA), N-(2-hydroxyethyl) ethylene diamine N,N',N'-thacetic acid (HEDTA), ethylene diamine tetra methylene phosphonic acid (EDTMP), diethylene thamine-penta-methylene phosphonic acid (DTPMP), glutamic acid-N,N-diacetic acid (GLDA), cyclohexane-1,2-diamine-N,N,N',N'-tetra-acetic acid (CDTA), 1,3-propylenediamine tetra acetic acid (PDTA), ethylene diamine triacetic acid (EDTA), L-hydroxy imino disuccinic acid (L-IDS), trisodium N-carboxyethyl imino succinate (CEIS), sodium tripolyphosphate (STP), thethylene tetramine hexaacetic acid (TTHA). Other preferred chelating agents are succinates, e.g., trisodium ethylene diamine disuccinate, tetra-sodium imino disuccinate, glutamic acid-N,N diacetic acid tetra sodium salt, 2-hydroxyethyl iminodiacetic acid, sodium salt (disodium ethanol diglycinate), tetrasodium 3-hydroxy-2,2 imino disuccinate, trisodium methylglycine diacetic acid, L-aspartate-N,N-diacetic acid tetrasodium salt. Particularly preferred chelating agents include acids and salts, especially the sodium and potassium salts of ethylenediaminetetraacetic acid, diethylenetriaminepentaacetic acid, N-hydroxyethylthelyenediaminetriacetic acid, and of which the sodium salts of ethylenediaminetetraacetic acid may be particularly advantageously used, as well as those chelating agents based on amino acid based compounds, e.g., methyl glycine diacetic acid (MGDA) and especially glutamic acid-N,N-diaceitic acid (GLDA).

When present, such one or more chelating agents may be included in minor but effective amounts, e.g, from about 0.001%wt. to about 2.5%wt, more preferably from about 0.05 -1%wt. and especially preferably from about 0.05 - 0.5%wt. based on the total weight of the hair treatment composition of which it forms a part.
A further optional constituent is a pH adjusting constituent which may be used to establish and/or maintain, viz., buffer, a pressurized, sprayable treatment composition at a desired pH or within a bounded pH range. Essentially any material which may increase or decrease the pH of the pressurized, sprayable treatment composition is suitable as a pH adjusting constituent. Suitable pH adjusting constituents are one or more acids and/or bases whether such be based on organic and/or inorganic compounds or materials. By way of non-limiting example, pH adjusting agents include phosphorus containing compounds, monovalent and polyvalent salts such as of silicates, carbonates, and borates, certain acids and bases, tartrates and certain acetates. Further exemplary pH adjusting agents include mineral acids, basic compositions, and organic acids, which are typically required in only minor amounts. By way of further non-limiting example, pH buffering compositions include the alkali metal phosphates, polyphosphates, pyrophosphates, triphosphates, tetraphosphates, silicates, metasilicates, polysilicates, carbonates, hydroxides, and mixtures of the same. Certain salts, such as the alkaline earth phosphates, carbonates, and hydroxides, can also function as buffers. It may also be suitable to use as buffers such materials as aluminosilicates (zeolites), borates, aluminates and certain organic materials such as gluconates, succinates, maleates, citrates, and their alkali metal salts. Particularly useful and preferred is citric acid and metal salts thereof such as sodium citrate which are widely available and which are effective in providing these pH adjustment and buffering effects. Further exemplary and useful pH adjusting constituents include monoalkanolamines, dialkanolamines, trialkanolamines, and alkylalkanolamines such as alkyl-dialkanolamines, and dialkyl-monoalkanolamines. Such may also function as detergents surfactants. The alkanol and alkyl groups are generally short to medium chain length, that is, from 1 to 7 carbons in length. For di- and trialkanolamines and dialkyl-monoalkanolamines, these groups can be combined on the same amine to produce for example, methylethlyhydroxypropylhydroxylamine. One of ordinary skill in the art can readily ascertain other members of this group.

When present such one or more pH adjusting constituent may be included in any effective amount in order to establish a desired pH or pH range and/or to maintain the pH of the composition within a targeted pH range. Advantageously such one or more pH adjusting constituents are effective even in relatively minor amounts, and may be present
in any effective amount up to about 2%wt, more preferably in an amount of 0.0001 - 1.5%wt.

The hair treatment compositions may include one or more particulate antimicrobial constituents, non-limiting examples of which include the heavy metal salts of pyridinethione, especially zinc pyridinethione, as well as other particulate antimicrobials such as climbazole, piroctone olamine, selenium sulfide and ketoconazole. Preferably such particulate antimicrobial constituents have an average particle diameter of from about 0.2 to about 50 microns, preferably from about 0.4 to about 10 microns. Preferably such particulate antimicrobial constituents comprise from 0.001% to about 1% by weight of the total hair treatment composition. In certain embodiments, one or more particulate antimicrobial constituents, and especially preferably climbazole, is an essential constituent of the invention. When present said more particulate antimicrobial constituents may be included in any effective amount in order to provide an effective antimicrobial benefit to a desired degree. Advantageously such one or more more particulate antimicrobial constituents are effective even in relatively minor amounts, and may be present in any effective amount up to about 2%wt, more preferably in an amount of 0.0001 - 1.5%wt.

The compositions of the invention may include an antimicrobially effective amount of an organic acid, which provide an antimicrobial effect to hair and scalp treated with the composition. Exemplary organic acids are those which generally include at least one carbon atom, and include at least one carboxyl group (-COOH) in its structure and which provide an antimicrobial benefit onto surfaces to which they are applied. Derivatives of said organic acids, as well as mixtures of one or more acids are contemplated as being useful. Exemplary organic acid include linear aliphatic acids such as: acetic acid; dicarboxylic acids, acidic amino acids, and hydroxy acids such as glycolic acid, lactic acid, hydroxyacrylic acid, alpha-hydroxybutyric acid, glyceric acid, malic acid, tartaric acid and citric acid, as well as acid salts of these organic acids. Of these, citric acid, sorbic acid, acetic acid, boric acid, formic acid, maleic acid, adipic acid, lactic acid, malic acid, malonic acid, glycolic acid, salicylic acid and/or derivatives thereof, e.g., salicylic acid derivatives such as esters of salicylic acid, such as ethylhexyl salicylate, dipropylene glycol salicylate, TEA salicylate, salicylic acid 2-ethylhexylester,
salicylic acid 4-isopropyl benzylester, salicylic acid homomenthylester are preferred. Preferred antimicrobially effective organic acids include lactic acid, salicylic acid and citric acid and/or derivatives thereof; particularly preferred of these are salicylic acid as well as salicylic acid and salicylate esters, including octyl, amyl, phenyl, benzyl, menthyl, glyceryl, and dipropylene glycol esters. When present, these may be included in effective amounts in order to provide the desired antimicrobial effect. Advantageously one or more of such antimicrobially effective organic acids may be present in amounts of from about 0.01-5%wt. The specific identity of preferred antimicrobially effective organic acids and preferred weights and/or weight ranges thereof are described with reference to one or more of the following examples. It is also to be noted there that the antimicrobially effective organic acids may also be used to adjust the pH of the hair treatment compositions of which they form a part when such are present in sufficient amounts to provide that function as well.

The inventive compositions may also include one or more preservative compounds, compositions or preparations, and as a significant portion of the formulation comprises water, it is preferably that the preservative be water soluble. Desirably, the selected water soluble preservatives are those which exhibit stability and efficacy in the compositions according to the invention. Such water soluble preservatives include compositions which include parabens, including methyl parabens and ethyl parabens, glutaraldehyde, formaldehyde, 2-bromo-2-nitropropoane-1,3-diol, 5-chloro-2-methyl-4-isothiazolin-3-one, 2-methyl-4-isothiazoline-3-one, and mixtures thereof. One exemplary composition is a combination 5-chloro-2-methyl-4-isothiazolin-3-one and 2-methyl-4-isothiazolin-3-one where the amount of either component may be present in the mixture anywhere from 0.001 to 99.99 weight percent, based on the total amount of the preservative. For reasons of availability, the most preferred preservative are those commercially available preservative comprising a mixture of 5-chloro-2-methyl-4-isothiazolin-3-one and 2-methyl-4-isothiazolin-3-one marketed under the trademark KATHON® CG/ICP as a preservative composition presently commercially available from Rohm and Haas (Philadelphia, PA). Further useful preservative compositions include KATHON® CG/ICP II, a further preservative composition presently commercially available from Rohm and Haas (Philadelphia, PA), PROXEL® which is
presently commercially available from Zeneca Biocides (Wilmington, DE), SUTTOCIDE® A which is presently commercially available from Sutton Laboratories (Chatam, NJ) as well as TEXTAMER® 38AD which is presently commercially available from Calgon Corp. (Pittsburgh, PA). When present such preservatives may be included in any effective amount in order to provide an effective benefit to a desired degree. Advantageously such preservatives are effective even in relatively minor amounts, and may be present in any effective amount up to about 1% wt. more preferably in an amount of 0.0001 - 0.25% wt.

An important aesthetic benefit is imparted to the hair treatment composition when it includes a fragrance constituent. Such a fragrance constituent may be based on natural and synthetic fragrances and most commonly are mixtures or blends of a plurality of such fragrances, optionally in conjunction with a carrier such as an organic solvent or a mixture of organic solvents in which the fragrances are dissolved, suspended or dispersed. By way of non-limiting example, natural fragrances include the extracts of blossoms (lily, lavender, rose, jasmine, neroli, ylang-ylang), stems and leaves (geranium, patchouli, petitgrain), fruits (anise, coriander, caraway, juniper), fruit peel (bergamot, lemon, orange), roots (nutmeg, angelica, celery, cardamon, costus, iris, calamus), woods (pinewood, sandalwood, guaiac wood, cedarwood, rosewood), herbs and grasses (tarragon, lemon grass, sage, thyme), needles and branches (spruce, fir, pine, dwarf pine), resins and balsams (galbanum, elemi, benzoin, myrrh, olibanum, opoponax). Animal raw materials, for example civet and beaver, may also be used. Typical synthetic perfume compounds are products of the ester, ether, aldehyde, ketone, alcohol and hydrocarbon type. Examples of perfume compounds of the ester type are benzyl acetate, phenoxyethyl isobutyrate, p-tert.butyl cyclohexylacetate, linalyl acetate, dimethyl benzyl carbinyl acetate, phenyl ethyl acetate, linalyl benzoate, benzyl formate, ethylmethyl phenyl glycinate, allyl cyclohexyl propionate, styrallyl propionate and benzyl salicylate. Ethers include, for example, benzyl ethyl ether while aldehydes include, for example, the linear alkanals containing 8 to 18 carbon atoms, citral, citronellal, citronellyloxyacetaldehyde, cyclamen aldehyde, hydroxycitronellal, lilial and bourgeonal. Examples of suitable ketones are the ionones, alpha.-isomethylionone and methyl cedryl ketone. Suitable alcohols are anethol, citronellol, eugenol, isoeugenol, geraniol, linalool, phenylethyl
alcohol and terpineol. The hydrocarbons mainly include the terpenes and balsams. However, it is preferred to use mixtures of different perfume compounds which, together, produce an agreeable fragrance. Other suitable perfume oils are essential oils of relatively low volatility which are mostly used as aroma components. Examples are sage oil, camomile oil, clove oil, melissa oil, mint oil, cinnamon leaf oil, lime-blossom oil, juniper berry oil, vetiver oil, olibanum oil, galbanum oil, labolanum oil and lavandin oil. When present in a composition, in accordance with certain of the preferred embodiments, the fragrance constituent may be present in any effective amount such that it can be discerned by a consumer of the composition, however is advantageously present in amounts of up to about 2%wt, preferably are present in amounts of from about 0.00001%wt. to about 1.25%wt, and most preferably is present in an amount of from about 0.0001%wt. to 1.0%wt. based on the total weight of the composition of which it forms a part.

The hair treatment compositions of the invention are largely aqueous in nature, and as such comprise at least about 50%wt. of water. The water may be distilled, deionized, demineralized, filtered and/or unfiltered water. Preferably the water is distilled or deionized so to minimize the likelihood of an undesired reaction with the water and the one or more further constituents forming the hair treatment composition.

The pH of the compositions is generally within the range of about 3.5 - 7, and more preferably within the range of about 4.25 - 6.

The hair treatment compositions of the invention may be "water-thin", e.g., have a viscosity equivalent to that of distilled water under like temperature conditions, but preferably the hair treatment compositions have a viscosity of at least about 5000 - 15000 cPs, and preferably in the range of 8500-14000 cPs as measured at room temperature (25°C) using conventional quantitative methods (e.g., Brookfield viscometer with an appropriate spindle).

The inventive compositions may be packaged in any suitable container or vessel within which they may be sold as a vendible product. Advantageously such is a flexible or deformable plastics bottle having a resealable spout, nozzle or other opening through which a quantity of the hair treatment composition may be dispensed.

In a further aspect of the invention there is provided a method for treating hair which includes the steps of: optionally but very preferably first wetting the hair,
thereafter applying a quantity of the hair treatment composition onto the hair and
distributing it amongst the individual hairs, thereafter optionally but very preferably
rinsing the hair treated by the hair treatment composition in order to remove the majority
thereof from the treated hair, and subsequently wet combing and/or dry combing the hair.

Several embodiments of the invention, including certain particularly preferred
embodiments of the invention are disclosed in the following examples.

Examples

Several hair treatment compositions of the invention were produced having the
constituents set forth on Table 1. In the following tables, comparative example
compositions are identified by a prepended letter "C", (e.g., "CI") while example
compositions according to the present invention are identified by a prepended letter "E"
(e.g., "El").

<table>
<thead>
<tr>
<th>Table 1</th>
<th>C1</th>
<th>E1</th>
<th>E2</th>
<th>E3</th>
<th>E4</th>
<th>E5</th>
<th>E6</th>
</tr>
</thead>
<tbody>
<tr>
<td>cationic guar</td>
<td>0.4</td>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
<td>0.4</td>
<td>0.4</td>
<td>0.2</td>
</tr>
<tr>
<td>hydroxypropyltrimonium chloride</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polyquaternium-10</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.05</td>
<td>0.10</td>
<td>0.05</td>
</tr>
<tr>
<td>amodimethicone</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>amine functionalized dimethicone</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>sodium cocosulfate (95%)</td>
<td>4.0</td>
<td>2.4</td>
<td>2.4</td>
<td>2.4</td>
<td>2.4</td>
<td>2.4</td>
<td>2.4</td>
</tr>
<tr>
<td>tetrasodium EDTA</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>sodium laureth sulfate (70%)</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
</tr>
<tr>
<td>glycol distearate</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>glycol monostearate</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>salicylic acid</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>1.0</td>
<td>1.0</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>citric acid (anhy.) (to q.s., for pH adjustment)</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>propylene glycol</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>climbazole</td>
<td>0.475</td>
<td>0.475</td>
<td>0.475</td>
<td>0.475</td>
<td>0.475</td>
<td>0.475</td>
<td>0.475</td>
</tr>
<tr>
<td>cocamidopropyl betaine (30%)</td>
<td>8.5</td>
<td>8.5</td>
<td>8.5</td>
<td>8.5</td>
<td>8.5</td>
<td>8.5</td>
<td>8.5</td>
</tr>
<tr>
<td>polyoxyethylene ether</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>preservative</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>fragrance</td>
<td>0.88</td>
<td>0.88</td>
<td>0.88</td>
<td>0.88</td>
<td>0.88</td>
<td>0.88</td>
<td>0.88</td>
</tr>
<tr>
<td>d.i. water (to q.s.)</td>
<td>58.64</td>
<td>64.05</td>
<td>63.95</td>
<td>63.34</td>
<td>63.44</td>
<td>63.89</td>
<td>64.15</td>
</tr>
</tbody>
</table>
The compositions of the foregoing Table 1 demonstrate the following ratios of the specific constituents discussed with reference to the following (ancillary) Tables 1A and 1B which identify the relative wt%/wt% ratios. The calculated ratios of Table 1A were based on the "%wt. actives" of the identified constituent(s), or in the case of the amodimethicone was used the "(avg.) 7.5%wt. actives" and for amine functional dimethicone was used the "(avg.) 32.5%wt. actives" as disclosed on Table 2.

<table>
<thead>
<tr>
<th>Table 1A</th>
<th>C1</th>
<th>E1</th>
<th>E2</th>
<th>E3</th>
<th>E4</th>
<th>E5</th>
<th>E6</th>
</tr>
</thead>
<tbody>
<tr>
<td>%wt. of constituent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>amodimethicone</td>
<td>0.0375</td>
<td>0.0375</td>
<td>0.0375</td>
<td>0.0375</td>
<td>0.0375</td>
<td>0.0375</td>
<td>0.0375</td>
</tr>
<tr>
<td>amine functionalized dimethicone</td>
<td>0.487</td>
<td>0.487</td>
<td>0.487</td>
<td>0.487</td>
<td>0.487</td>
<td>0.487</td>
<td>0.487</td>
</tr>
<tr>
<td>cationic guar</td>
<td>0.4</td>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
<td>0.4</td>
<td>0.4</td>
<td>0.2</td>
</tr>
<tr>
<td>Polyquaternium-10</td>
<td>0.2425</td>
<td>0.2425</td>
<td>0.2425</td>
<td>0.2425</td>
<td>0.0485</td>
<td>0.097</td>
<td>0.0485</td>
</tr>
<tr>
<td>total polymer**</td>
<td>0.6425</td>
<td>0.3425</td>
<td>0.4425</td>
<td>0.5425</td>
<td>0.4485</td>
<td>0.497</td>
<td>0.2485</td>
</tr>
</tbody>
</table>

| relative ratios in %wt.%wt.    |     |     |     |     |     |     |     |
| total polymer**: amodimethicone + amine functionalized dimethicone | 1.225:1 | 0.65:1 | 0.84:1 | 1.03:1 | 0.85:1 | 0.95:1 | 0.47:1 |
| cationic guar: amodimethicone + amine functionalized dimethicone | 0.76:1 | 0.19:1 | 0.38:1 | 0.57:1 | 0.76:1 | 0.76:1 | 0.038:1 |
| Polyquaternium-10: amodimethicone + amine functionalized dimethicone | 0.46:1 | 0.46:1 | 0.46:1 | 0.46:1 | 0.09:1 | 0.18:1 | 0.09:1 |
| cationic guar: Polyquaternium-10 | 1.65:1 | 0.41:1 | 0.82:1 | 1.24:1 | 8.25:1 | 4.12:1 | 4.12:1 |

amodimethicone = amine functionalized silicone compound
amine functionalized dimethicone** = amine functionalized silicone compound
total polymer** = total amount of cationic guar and PQ10

The calculated ratios of Table 1B were based on the "%wt. actives" of the identified constituent(s); the "total surfactants" was the total amount of the sodium laureth sulfate, cocoamidopropyl betaine, and the sodium coco sulfate surfactants present in each composition on an "actives weight" basis.
The foregoing constituents of Table 1 are indicated in "%wt" of the identified material which was used "as supplied" from its respective supplier; the identity of each of the foregoing constituents is described more fully on the following Table 2 which identifies the constituent used, its supplier and the "% active".

<table>
<thead>
<tr>
<th>Table 1B</th>
<th>C1</th>
<th>E1</th>
<th>E2</th>
<th>E3</th>
<th>E4</th>
<th>E5</th>
<th>E6</th>
</tr>
</thead>
<tbody>
<tr>
<td>% wt of constituent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sodium laureth sulfate</td>
<td>11.2</td>
<td>11.2</td>
<td>11.2</td>
<td>11.2</td>
<td>11.2</td>
<td>11.2</td>
<td>11.2</td>
</tr>
<tr>
<td>cocamidopropyl betaine</td>
<td>2.55</td>
<td>2.55</td>
<td>2.55</td>
<td>2.55</td>
<td>2.55</td>
<td>2.55</td>
<td>2.55</td>
</tr>
<tr>
<td>sodium cocosulfate</td>
<td>3.8</td>
<td>2.28</td>
<td>2.28</td>
<td>2.28</td>
<td>2.28</td>
<td>2.28</td>
<td>2.28</td>
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<tr>
<td>total surfactants</td>
<td>17.55</td>
<td>16.03</td>
<td>16.03</td>
<td>16.03</td>
<td>16.03</td>
<td>16.03</td>
<td>16.03</td>
</tr>
<tr>
<td>total polymer**</td>
<td>0.6425</td>
<td>0.3425</td>
<td>0.4425</td>
<td>0.5425</td>
<td>0.4485</td>
<td>0.497</td>
<td>0.2485</td>
</tr>
<tr>
<td>relative ratios %wt : %wt.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total surfactants; total polymer</td>
<td>27.31</td>
<td>46.80:1</td>
<td>36.23:1</td>
<td>29.55:1</td>
<td>35.74:1</td>
<td>32.25:1</td>
<td>64.51:1</td>
</tr>
<tr>
<td>cocamidopropyl betaine: sodium cocosulfate</td>
<td>0.67:1</td>
<td>1.1:1</td>
<td>1.1:1</td>
<td>1.1:1</td>
<td>1.1:1</td>
<td>1.1:1</td>
<td>1.1:1</td>
</tr>
<tr>
<td>sodium laureth sulfate: sodium cocosulfate</td>
<td>2.97</td>
<td>4.9:1</td>
<td>4.9:1</td>
<td>4.9:1</td>
<td>4.9:1</td>
<td>4.9:1</td>
<td>4.9:1</td>
</tr>
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</table>

<table>
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<tr>
<th>Table 2</th>
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</thead>
<tbody>
<tr>
<td>sodium cocosulfate (95%)</td>
<td>sodium cocosulfate (95%wt. active), supplied as Mackol CAS 100N</td>
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<tr>
<td>tetrasodium EDTA</td>
<td>tetrasodium ethylenediamine tetraacetic acid, supplied as Trilon B Powder (100%wt. active)</td>
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<tr>
<td>cationic guar</td>
<td>guar hydroxypropyltrimonium chloride, supplied as Jaguar C-17S (100%wt. active)</td>
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<tr>
<td>sodium laureth sulfate (70%)</td>
<td>sodium laureth sulfate (70%wt active), supplied as Texapon N-70 NA</td>
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<tr>
<td>glycol distearate</td>
<td>glycol distearate (100%wt. active), supplied as Alkamuls EGDS 515/v</td>
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<tr>
<td>glycol monostearate</td>
<td>glycol monostearate (100%wt. active), supplied as Mackester GSV</td>
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</tr>
<tr>
<td>sulfo succinate (40%)</td>
<td>disodium oleamid MIPA sulfo succinate (40%wt. active), supplied as Mackanate OPSV</td>
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<td></td>
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</tr>
<tr>
<td>salicylic acid</td>
<td>salicylic acid (100%wt. active), laboratory grade</td>
<td></td>
<td></td>
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<tr>
<td>citric acid (anhy.)</td>
<td>anhydrous citric acid (100%wt. active), laboratory grade</td>
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</tr>
<tr>
<td>propylene glycol</td>
<td>propylene glycol (100%wt. active), laboratory grade</td>
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</tr>
</tbody>
</table>
The compositions of Table 1 were produced by the following general protocol.

A first pre-mixture is made by dispersing, using a motor driven stirrer, in a suitably sized vessel (e.g., a laboratory beaker) the sodium cososulfate into a quantity of the d.i. water which was heated to 70°C. Thereafter was added the tetrasodium etilylenediaminetetraacetic acid and stirring continued until it is fully dissolved. Subsequently, under continued stirring was added the war hydroxy propyl tried ammonium chloride and mixing continued until a homogenous, uniform composition was.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Composition</th>
<th>Supplier / Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>climbazole</td>
<td>climbazole (100%wt. active), supplied as Crinipan AD</td>
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<tr>
<td>cocamidopropyl betaine (30%)</td>
<td>cocamidopropyl betaine (30%wt. active), supplied as Empigen BS/FA</td>
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<tr>
<td>Polyquaternium-10</td>
<td>Polyquaternium-10 (97%wt. active) supplied as UCARE™ LR-30M</td>
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</tr>
<tr>
<td>glycerin</td>
<td>glycerin (100%wt. active), supplied as Pricerine 9091253*</td>
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<tr>
<td>amodimethiconel*</td>
<td>amodimethicone/Laureth-7/ water ((avg.) 7.5%wt. active), supplied as SME 253</td>
<td></td>
</tr>
<tr>
<td>amine functionalised dimethicone**</td>
<td>PEG-40/PPG-8 methylaminopropyl/hydropropyl dimethicone, ((avg.) 32.5%wt. active), supplied as Silsoft A+</td>
<td></td>
</tr>
<tr>
<td>preservative</td>
<td>supplied as Kathon CG, described to be a mixture containing methylchloroisothiazolinone/ methylisothiazolinone, used &quot;as supplied&quot; from its supplier</td>
<td></td>
</tr>
<tr>
<td>fragrance</td>
<td>fragrance, used &quot;as supplied&quot;, a proprietary composition of its supplier</td>
<td></td>
</tr>
<tr>
<td>polyoxyethylene ether</td>
<td>PPG-12-Buteth-16 (100%wt. active) supplied as UCON 50-HB-660 (ex. DOW Chem. Co.)</td>
<td></td>
</tr>
<tr>
<td>d. i. water</td>
<td>deionized water</td>
<td></td>
</tr>
</tbody>
</table>

amodimethicone* = disclosed by its supplier to comprise; 5-10% w/w amodimethicone (CAS 71750-79.3), 1-5% w/w C11-C15 Pareth-7 (CAS 84133-50-6); 1-5% w/w Laureth-9 (CAS 68551-12-2); 1-5% w/w glycerine (CAS 56-81-5), 1-5% w/w. Trideceth-12 (CAS 24938-91-8), and 60-65% w/w of water (CAS 7732-18-5).

amine functionalized dimethicone** = disclosed by its supplier to comprise: 25-40% w/w of PEG-40/PPG-8 methylaminopropyl/hydropropyl dimethicone copolymer (CAS 177771-32-3) 25-40% w/w of glycerine (CAS 56-81-5); 10-15% w/w. of dipropylene glycol (CAS 25265-71-8) and 20 - 30% w/w of water (CAS 7732-18-5).
produced. Next, under increased shear mixing conditions was added a sodium lauryl sulfate surfactant and mixing continued until is fully dissolved. Next, under continued stirring, were added the glycol monostearate. and the glycol monostearate. Mixing continued until a well mixed, homogenous composition was produced.

A second pre-mixture was formed by dispensing to a further mixing vessel (e.g, a further laboratory beaker) was added the propylene glycol, and under stirring conditions the mixing vessel was heated to about 50°C-55°C. Thereafter, and under constant stirring was added the clmibazole, which was allowed to dissolve until the mixture was dissolved, thereafter was added the salicylic acid, and stirring continued until the mixture was homogenous. The temperature of the second pre-mixture was maintained at 50°C-55°C.

To the contents of the first pre-mixture which was held at a temperature of 50°C-55°C was added the second pre-mixture also at a temperature of 50°C-55°C, and the resultant composition was stirred, and allowed to cool.

To a further laboratory vessel (e.g, a further laboratory beaker) was added the balance of the d.i. water, and under high-speed mixing conditions was added the Polyquaternium-10, and mixing continued until a uniform composition, preferably a transparent or clear gel was formed. This composition was added under stirring conditions to the combined first pre-mixture and second pre-mixture, was continued until the resultant mixture was fully dissolved. Thereafter, as the resultant mixture continued to cool to a temperature of 40°C, under continuous stirring conditions was added the cocoaraidopropyl betaine surfactant, which was mixed until the resultant mixture was homogenous. Subsequently were added the remaining constituents except for the fragrance, which was only added after the resultant mixture was at a temperature of not more than 40°C, at which point the fragrance could be added without unduly affecting the ultimate fragrance profile. The pH of the composition was then tested, if necessary adjusted by the addition of a minor amount of an acid, e.g, such as citric acid, or an aqueous citric acid solution under stirring conditions, such that the a target pH (e.g, pH of about 5.5) Also, the viscosity the composition was evaluated, and if necessary a minor amount of the polyoxyethylene ether was added to adjust the viscosity to a target viscosity, (e.g, about 9000 -13000 cPs, measured at 20°C, using a LVT sp#63 at 6 rpm).
The resultant, final compositions were allowed to cool to room temperature (e.g. 20°C-25°C) and thereafter were stored in sealed containers (e.g. glass jars with screw cap lids) until used in one or more of the following tests.

5 Testing Protocol:

Compositions of Table 1, as well as the Control composition, were evaluated for "wet combing" and "dry combing" technical performance.

The "Control" composition was similar to the composition according to E5, but in which (i) the amount of the sodium cocosulfate (95) was 4.0%wt., instead of 2.4%wt, (ii) the amount of Polyquaternium-10 was 0.25%wL, instead of 0.10%wt (iii) and additionally 3.5%wt. of disodium oleamido MIPA suifosuccinate (40% wt active) was present. This Control composition exhibited a cationic guar total amine functionalized silicone compound(s) ratio of 0.76:1 and a total polymer amount (the total amount of cationic guar and PQ10): total amine functionalized silicone compound(s) ratio of 1.23:1.

10 Initial Preparation of Hair Samples:

The sample substrates used in the evaluation were natural hair tresses (ex. International Hair Importers, Glendaie, NY 11385, USA) which were approximately 6 inches in length, had a mass of 2 - 8 grams, and were described to be virgin straight Indian hair. Each of these tresses was first preheated as indicated in the following steps.

All handling of the hair tresses was done manually with non-sterile latex gloved hands in order to ensure that there is no transfer of any residues, such as soils or oil from the hands to the hair tress being treated. First, a small glass dish (crystallizing dish) which was added hot tap water (at approx. 42°C +/- 2°C) from a local municipal water supply in northern Bergen County, NJ, USA. The individual hair tress was then at least partially immersed into the water for 30 seconds, after which he wedged hair tress was withdrawn, and excess water was pressed out by hand. Subsequently, 1 ml of a 10%wt dilution of sodium laureth sulfate, an anionic surfactant dispersed in deionized water was applied to a 1 inch part of the hair tress, and immediately thereafter using only the gloved fingers of the hand, the said solution was interspersed and distributed amongst individual hairs of the tress by the application of 20 strokes of the fingers in a "root-to-tip" direction.
The hereafter the tress was then rinsed in a stream of running tap water which was slightly warmer (24°C +/- 2°C) than room temperature, to ensure that virtually all of the sodium laurate sulfate had been flushed out from the hair tress. This took approximately 1 minute of time. Next, the individual hair tress was dried by blotting between two paper towels to remove the bulk of the moisture present in the hair tress. Thereafter, the hair tress was allowed to dry overnight (at least 8 hours) at room temperature (approx. 22°C +/- 2°C).

Subsequently the hair tresses used for evaluation of a formulation of Table 1, were prepared for the "wet combing” and "dry combing” in which the foregoing treatment steps were repeated with the exception that in place of the 1 mi of a 10%wt. dilution of sodium laurate sulfate in deionized water, instead was used one of the compositions as described in Table 1. The treated, dried individual hair tresses were then subjected to the following "dry combing" and "wet combing” tests.

"Dry Combing”

Prior to the dry combing testing, the previously prepared dried hair tresses were equilibrated at 25°C at 50% relative humidity for a time period of 72 hours prior to the dry combing steps.

For the dry combing, the equipment used included a Dia-Stron Miniature Tensile Tester (ex. Dia-Stron Ltc., Andover, UK) in a humidity control chamber at 50% relative humidity, at room temperature (20-25 °C) The crib in further utilized a UV 1000 control unit combing box and UvWin software (ex. PG instruments Ltd., Alma Park, Leicestershire LE17 5BH, United Kingdom) was utilized in the test. For each composition tested (Control, and E1 - E6) three replicates were tested. Prior to testing, each dry tress was initially combed 5 times per side to straighten the individual hairs comprised in each tress, and then the tress was affixed to the combing apparatus. The combing apparatus had standard 13 tooth comb (ACE brand) having an overall length of about 7 inches, having combing teeth of approximately 1 inch in length, and 1/16 inch in width, each tooth separated from adjoining teeth by a space of about 1/16 inch. Testing was performed at 25°C at 50% relative humidity; and a new comb was used for each new-tress tested. At the start of the test the UV 1000 control unit combing box and UvWin
software were initiated, and the tress was combed 6 times during which data (work required) was collected and analyzed by the UvWm software. The tress was contacted by the comb by several teeth at about the mid-point of the comb at a section of about ¾ of an inch. At each combing stroke through the hair tuft, data was collected indicative of the work required (reported in Joules) expended for each combing stroke. Each tuft was combed six times in this manner, and the results of the dry combing are reported below on Table C.

An average value of work required was derived from the data as follows. For each individual hair tuft tested, data regarding the first stroke of the comb was discarded, the rationale being that this first stroke removed any residual tangles or irregularities in the hair tuft which might have been imparted when the hair tuft was affixed within the combing apparatus. For each hair tuft the total work for each of the 2nd through 6th strokes were collected, and averaged as is reported on Table DC. This calculation was performed for each of the three replicates which had been treated by a single composition. Thereafter these three averaged values from the individual tufts were themselves averaged to provide an overall average work (in Joules) which was correlated to a particular tested composition. The results of the dry combing are also graphically represented on Fig. 1.
<table>
<thead>
<tr>
<th>Composition</th>
<th>Control</th>
<th>Control</th>
<th>Control</th>
<th>E1</th>
<th>E1</th>
<th>E1</th>
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<th>E2</th>
<th>E2</th>
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<td>0.156</td>
<td>0.057</td>
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<td>0.048</td>
<td>0.037</td>
<td>0.040</td>
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<td>0.081</td>
<td>0.090</td>
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<td>0.157</td>
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<td>0.056</td>
<td>0.052</td>
<td>0.039</td>
<td>0.059</td>
<td>0.050</td>
<td>0.113</td>
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<td>0.061</td>
<td>0.051</td>
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<tr>
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<tr>
<td>stroke 3</td>
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<td>0.062</td>
<td>0.069</td>
<td>0.113</td>
<td>0.101</td>
<td>0.132</td>
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<td>0.129</td>
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<td>0.032</td>
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<td>0.137</td>
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<td>0.049</td>
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<tr>
<td>of replicate</td>
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<td>0.117</td>
<td>0.121</td>
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<td>0.133</td>
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<tr>
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<td>(Joules)</td>
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</tbody>
</table>
"Wet Combining"

Prior to the wet combing testing, the dried hair tresses were equilibrated at 25°C at 50% relative humidity for a time period of 72 hours prior to the wet combing steps.

For the wet combing, the same equipment as was used in the "wet combing" testing was used, and testing proceeded under the same environmental conditions. The crib in further utilized a UV 1000 control unit combing box and UvWin software (ex. PG Instruments Ltd., Alma Park, Leicestershire LE17 5BH, United Kingdom) was utilized in the test. For the wet combing, a conventional 13 tooth comb (ACE brand) having an overall length of about 7 inches, having combing teeth of approximately 1 inch in length, and 1/16 inch in width, each tooth separated from adjoining teeth by a space of about 1/16 inch was utilized. For each composition tested (Control, and E1 - E6) three replicates were tested. Prior to testing, each wet tress was initially combed 5 times per side to straighten the hairs.

A large container (e.g. a bucket) was filled with room temperature water (approx. 25°C). Absorbent paper towels were placed in apparatus in which the hair tresses were combined to absorb water tailing away from a wet tress. Each tress was initially wetted under stream of room temperature water, and each tress was thoroughly wetted in the stream of water, patted several times with the fingers of a hand to ensure that the water entered the tress and wetted it thoroughly. A front side of the tress was combed 5 times, then the tress was returned to the stream of running water for between 5 - 15 seconds, then withdrawn and the back side of the tress was combed 5 times, then the tress was again returned to the stream of running water for between 5 - 15 second. Next, the tress was dipped in the water of the large container 3 times, and then the tress was attached to the combing apparatus. As described above with reference to the "dry combing" protocol, the UV 1000 control unit combing box and UvWin software were initiated, and the tress was combed 6 times during which data was collected and analyzed by the UvWin software. Again, testing was done at 25°C at 50% relative humidity; and a new comb was used for each new tress tested. The tress was contacted by the comb by several teeth at about the mid-point of the comb at a section of about ¾ of an inch. At the start of
the test the UV 1000 control unit combing box and UvWin software were initiated, and the tress was combed 6 times during which data (work required) was collected and analyzed by the UvWin software. At each combing stroke through the hair tuft, data was collected indicative of the work required (Joules) expended for each combing stroke. Each tuft was combed six times in this manner, and the results of the wet combing are reported below on Table C.

An average value of work required was derived from the data as follows. For each individual hair tuft tested, data regarding the first stroke of the comb was discarded, the rationale being that this first stroke removed any residual tangles or irregularities in the hair tuft which might have been imparted when the hair tuft was affixed within the combing apparatus. For each hair tuft the total work for each of the 2<sup>nd</sup> through 6<sup>th</sup> strokes were collected, and averaged as is reported on Table WC. This calculation was performed for each of the three replicates which had been treated by a single composition. Thereafter these three averaged values of the individual tufts were themselves averaged to provide an overall average work (in Joules) which was correlated to a particular tested composition. The results of the wet combing are also graphically represented on Fig. 2.
<table>
<thead>
<tr>
<th>Composition</th>
<th>Control</th>
<th>Control</th>
<th>Control</th>
<th>E1</th>
<th>E1</th>
<th>E1</th>
<th>E2</th>
<th>E2</th>
<th>E3</th>
<th>E3</th>
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<td>0.159</td>
<td>0.080</td>
<td>0.128</td>
<td>0.130</td>
<td>0.164</td>
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<td>0.069</td>
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<td>0.133</td>
<td>0.208</td>
<td>0.110</td>
<td>0.091</td>
<td>0.116</td>
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<td>0.152</td>
<td>0.095</td>
<td>0.106</td>
<td>0.116</td>
<td>0.155</td>
<td>0.304</td>
<td>0.134</td>
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<td>0.133</td>
<td>0.131</td>
<td>0.105</td>
<td>0.148</td>
<td>0.230</td>
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<td>0.084</td>
<td>0.077</td>
<td>0.124</td>
<td>0.169</td>
<td>0.107</td>
<td>0.122</td>
<td>0.118</td>
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**average work of replicate (Joules)**

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**average work of all replicates (Joules)**

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<td>E5</td>
<td>E6</td>
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<td>0.049</td>
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<td>0.084</td>
<td>0.133</td>
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<tr>
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<td>0.104</td>
<td>0.091</td>
<td>0.086</td>
<td>0.078</td>
<td>0.096</td>
<td>0.080</td>
<td>0.099</td>
<td>0.152</td>
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</tr>
<tr>
<td>stroke 5</td>
<td>0.095</td>
<td>0.100</td>
<td>0.148</td>
<td>0.082</td>
<td>0.076</td>
<td>0.095</td>
<td>0.086</td>
<td>0.127</td>
<td>0.129</td>
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<tr>
<td>stroke 6</td>
<td>0.086</td>
<td>0.110</td>
<td>0.090</td>
<td>0.101</td>
<td>0.059</td>
<td>0.099</td>
<td>0.093</td>
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<tr>
<td>average work of replicate (Joules)</td>
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<td>0.094</td>
<td>0.114</td>
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<td>0.101</td>
<td>0.117</td>
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<tr>
<td>average work of all replicates (Joules)</td>
<td>0.106</td>
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<td>0.125</td>
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With reference now to Figs. 1 and 2, surprisingly it was observed that excellent wet combing and dry combing characteristics were achieved by the inventive compositions each of which exhibited cationic guar total amine functionalized silicone compound(s) ratios and/or a total polymer amount (the total amount of cationic guar and PQ10): total amine functionalized silicone compound(s) ratios lesser than that of the Control composition, which inventive compositions featured reduced "work" (in Joules) which suggested improved lubricity was imparted to the hair tufts, notwithstanding the fact that overall net reduced amounts of cationic guar, amine functionalized silicone compound(s) and PQ10 were applied to the hair. Particular attention is directed to Example compositions E4, E5 of Table 1. Such reduced deposition is particularly advantageous from a consumer standpoint, and such is achieved without any increase in the required work for "wet combing" and/or "dry combing".

**Silicone Deposit ion:**

Further samples of treated, dried individual hair tresses which were prepared according to the protocol described above were analyzed for the amount of silicone which was actually deposited. These results were obtained by the use of a gas chromatograph and a quantitative analytical technique and the results provided an indication of silicone deposition on the tested tufts. The results are reported on the following Table S, which indicate the amount (in parts per million; ppm) of the silicone deposited on each of the hair tufts prepared for the "wet combing" and "dry combing" tests previously described.

<table>
<thead>
<tr>
<th>Table S</th>
<th>ppm of deposited silicone units</th>
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<tr>
<td>Control</td>
<td>0.026</td>
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<tr>
<td>E1</td>
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<tr>
<td>E2</td>
<td>0.014</td>
</tr>
<tr>
<td>E2</td>
<td>0.0137</td>
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<td>E3</td>
<td>0.0166</td>
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</table>
As seen on Table S, two replicates of treated hair tufts were evaluated for the actual deposition of silicone units retained upon the hair. The "silicone units" of Table S refers to the actual amount (in ppm) of a silicone polymer or copolymer (e.g. amodimethicone, methylaminopropyl/hydropropyl dimethicone) present in the source materials/preparations provided from the source materials of the amine functionalized silicone compound(s) to the composition deposited and retained on the hair, prior to being subjected to the further protocols of the "wet combing" or "dry combing" protocols previously described.

The analysis reported on Table S clearly indicates that the actual amount of silicone units from the amine functionalized silicone compound(s) as retained as deposits on the hair tufts, were reduced as compared to the "Control" compositions. Yet when these results are considered in conjunction with Fig. 1 and Fig. 2 and with the data of foregoing Tables DC and WC, such results indicate that unexpected improvements in "wet combing" and "dry combing" are provided by the compositions of the present invention which had either comparable, or in many cases reduced amounts of work required as compared to the "Control" compositions, notwithstanding the substantially reduced amounts of silicone units actually present on the hair tufts. Such demonstrates that excellent "wet combing" and "dry combing" characteristics, both important consumer benefits, are supplied by the inventive compositions which notwithstanding the relatively reduced amounts of polymers (viz., cationic guar hydroxypropyltrimonium chloride and Polyquaternium-10) as compared to the comparative composition.
Claims:

1. A hair treatment composition, preferably a shampoo composition, which necessarily comprises: a PQ10 polymer, a cationic guar gum, and at least one amine functionalized silicone compound which may be provided in an emulsion or microemulsion composition, wherein the foregoing constituents are present in one (preferably two, and especially preferably three or more) of the following ratios (wt%:wt%):
   (i) cationic guar:PQ10 ratio of 0.1-10:1 (preferably 0.25-9:1);
   (ii) a total polymer amount (the total amount of cationic guar and PQ10): total amine functionalized silicone compound(s) ratio of 0.25 - 1.5:1 (preferably 0.4-1.3:1);
   (iii) a cationic guar:total amine functionalized silicone compound(s) ratio of 0.001-1:1 (preferably 0.025-0.85:1),
   (iv) a PQ10: total amine functionalized silicone compound(s) ratio of 0.01-1:1 (preferably 0.05-0.75:1).

2. A hair treatment composition according to claim 1, in which the PQ10 polymer is characterized by exhibiting a molecular weight which in a 2% aqueous solution exhibits a viscosity of 300 - 500 mPa.s, and further which polymer contains at least 1.5% nitrogen.

3. A hair treatment composition according to any preceding claim, in which the amine functionalized silicone compound comprises at least one amodimethicone compound.

4. A hair treatment composition according to any preceding claim, which further necessarily additionally require a surfactant system which includes at least one, but preferably at least two or more anionic sulfate surfactant compounds.
5. A hair treatment composition according to claim 4, which composition includes a
ternary surfactant system having: at least one fatty acid sulfate surfactant compound, (e.g., preferably, a sodium cocosulfate compound) at least one fatty acid ether sulfate surfactant compound (e.g., preferably, sodium lauryl ether sulfate compound; sodium laureth sulfate) and at least one betaine surfactant compound (e.g. preferably, cocoamidopropyl betaine).

6. A hair treatment composition according to claim 5, wherein the total amount of the ternary surfactant system relative to the total polymer amount (the total amount of cationic guar and PQ10) is present within the following ratios (wt%:wt%): 20-80:1, preferably 25-70:1.

7. A hair treatment composition according to any preceding claim wherein the PQ10 polymer exhibits a viscosity of 300 - 500 cP.s as a 2% aqueous solution, and contains at least about 1.5% nitrogen.

8. A method for producing hair treatment compositions which may provide improved wet combing and/or dry combing characteristics, the method comprising the step of:

   including within the hair treatment composition a PQ10 polymer, a cationic guar gum, and at least one amine functionalized silicone compound which may be provided in an emulsion or microemulsion composition, wherein the foregoing constituents are present in one (preferably two, and especially preferably three or more) of the following ratios (wt%:wt%):

   (i) cationic guar:PQ10 ratio of 0.1-10:1 (preferably 0.25-9:1);

   (ii) a total polymer amount (the total amount of cationic guar and PQ10): total amine functionalized silicone compound(s) ratio of 0.25 - 1.5:1 (preferably 0.4-1.3:1);

   (iii) a cationic guartotal amine functionalized silicone compound(s) ratio of 0.001-1:1 (preferably 0.025-0.85:1),
(iv) a PQ10: total amine functionalized silicone compound(s) ratio of 0.01-1 :1
(preferably 0.05-0.75:1), as described in claim 1.
### A. CLASSIFICATION OF SUBJECT MATTER

INV. A61Q5/02 A61K8/73 A61K8/898

ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

| A61K | A61Q |

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C.

See patent family annex.

### Date of the actual completion of the international search

14 September 2015

### Date of mailing of the international search report

25/09/2015

### Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Yon, Jean-Michel
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