

HAIR CONDITIONING COMPOSITIONS

The present invention relates to compositions for application to and care of human hair. More particularly, it relates to improved compositions for conditioning hair.

Products which improve the appearance, feel, and manageability of hair have gained increasing acceptance and popularity with consumers. The utility of such compositions is particularly important with the use of such hair treatments as permanent waving, dyeing, teasing, and bleaching. The physical condition of hair can also be affected by atmospheric conditions, such as sunlight, which may cause photo-catalyzed oxidation. These factors may result in hair with poor texture, which is difficult to manage and comb, whether wet or dry.

Accordingly, compositions which "condition" hair generally improve the manageability, appearance and feel of hair, as by reducing dry static and increasing the ease of combing both wet and dry hair. Such conditioning products are well known. Some are "rinse-type" products which are applied and rinsed off the hair, while others are "deep conditioners" which are allowed to remain on the hair for extended periods of time. Many conditioning products contain long chain quaternary ammonium compounds combined with fatty materials, such as fatty alcohols. Such compositions are disclosed, for example, in U.S. Patent 3,155,591, Hilfer, issued November 3, 1964 and U.S. Patent 4,269,824, Villamarin, et al., issued May 26, 1981. While such products have particularly good cosmetic in-use and rheologic characteristics, they may leave the hair greasy or oily, and subject to resoiling with dirt and sebum. These undesirable characteristics are, unfortunately, related to the conditioning benefit, since such products (as they are known in the art) inherently lead to deposition of both vehicle and conditioning active materials on the hair.

A variety of compositions have been developed which attempt to provide good conditioning benefits while maintaining acceptable

cosmetic in-use and rheologic characteristics. In particular, volatile silicone oils are well known for use in conditioning products. For example, British Patent Specification 1,598,567, Lewis, et al., published September 23, 1981, discloses hair conditioners containing volatile silicones and certain surfactants. (An essential feature of these compositions is their freedom from fatty materials and quaternary ammonium compounds.) British Patent Specification 999,222, published July 21, 1965, discloses organo-silicone polymers in water-alcohol mixtures for use as hair conditioners. U.S. Patent 4,374,825, Bolich, et al., issued February 22, 1983, discloses conditioners containing hydrocarbon or silicone conditioning agents, certain nonionic water-soluble thickening agents, and a cationic conditioning agent. U.S. Patent 4,387,090, Bolich, issued June 7, 1983, discloses conditioning compositions containing volatile hydrocarbon or silicone conditioning agents and certain polymeric thickening agents. U.K. Patent Application 2,066,659, Abe, published July 15, 1981, discloses conditioning hair rinse compositions comprising quaternary ammonium salts, silicone materials, and propylene glycol.

It has now been discovered that hair conditioning formulations containing a dimethicone copolyol and a silicone conditioning agent, in a gel vehicle comprising a lipid material and a cationic surfactant, have improved hair care benefits while maintaining excellent in-use characteristics. In particular, such compositions exhibit lower resoiling of hair after use than similar compositions that do not contain the dimethicone copolyol. Thus, such products provide excellent conditioning benefits with low resoiling, while maintaining preferred rheology.

The present invention provides a hair conditioning composition comprising:

- (a) from 0.1% to 10% by weight of a silicone conditioning agent selected from unsubstituted polydimethylsiloxanes and vinyl, phenyl, carboxy, alkoxy, mercapto, alkyl and amino substituted polydimethylsiloxanes;

- (b) from 0.01% to 10% by weight of one or more polyalkyleneoxide modified dimethylpolysiloxanes;
- (c) a gel-type vehicle comprising from 0.1% to 10% by weight of a lipid vehicle material and from 0.05% to 5% by weight of a cationic surfactant vehicle material, the cationic surfactant vehicle comprising one or more cationic surfactants containing amino or quaternary ammonium hydrophilic moieties; and
- (d) water

Preferably, the lipid vehicle materials are fatty alcohols or fatty esters.

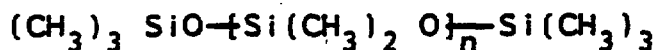
These products are preferably used as rinse-type conditioners, the compositions being used for conditioning hair by applying the compositions to freshly shampooed hair and rinsing the composition from the hair.

All percentages herein are by weight of total composition. Preferably, the lipid vehicle material is incorporated at levels of from 1% to 3% and the cationic surfactant vehicle material is incorporated at levels of from 0.2% to 3%. The silicone conditioning agent is preferably incorporated at levels of from 0.25% to 1.5%, and the polyalkyleneoxide modified dimethylpolysiloxane is preferably incorporated at levels of from 0.1% to 2.0%. Preferably the lipid vehicle material contains carbon chains of from 12 to 18 carbon atoms in length and the cationic material also contains carbon chains of from 12 to 18 carbon atoms in length.

Silicone Conditioning Agent

5 The compositions of the present invention include one or more silicone-containing materials which impart conditioning benefits to human hair when applied in the present compositions. (As used herein, the term "silicone conditioning agent" refers to such silicone conditioning materials, singly or in combination.) Non-volatile silicones are preferred.

10 Preferred silicone conditioning agents include the linear polydimethylsiloxanes of the general formula:



15 wherein n is from 1 to 15,000, preferably from 20 to 7000. The polydimethylsiloxanes for use herein are unsubstituted or are vinyl, phenyl, carboxy, alkoxy, mercapto, alkyl, or amino substituted. Particularly preferred silicone conditioning agents include the unsubstituted and the amino or alkoxy substituted linear
20 polydimethylsiloxanes, and mixtures thereof.

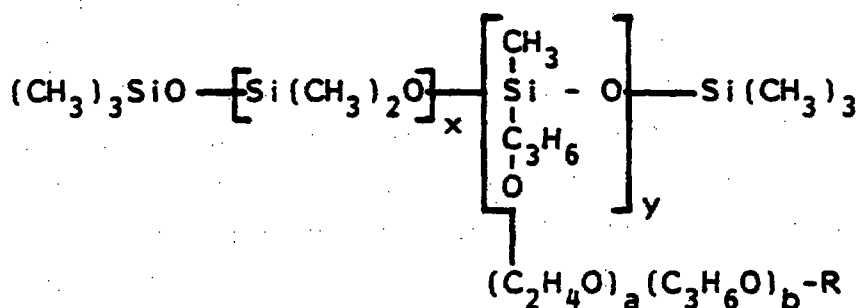
Examples of silicone oils useful in the present invention include Dow Corning 200 Fluid and Dow Corning Q2-8075 Aminofunctional Fluid (manufactured by the Dow Corning
25 Corporation); Silicone Copolymer F-755 (manufactured by SWS Silicones Corp.), and SE 76 Silicone Gum (manufactured by General Electric). Polydimethylsiloxane conditioning agents are also disclosed in the following documents;

30 U.S. Patent 4,387,097, Bolich, Jr., issued June 7, 1983;

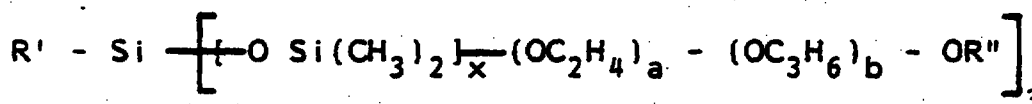
EP-A-152194; British Specification 2,066,659, Abe, published July 15, 1981; Wendel, et al, "Organofunctional Silicones for Personal Care Applications", 98 Cosmetics & Toiletries 103-106 (1983); and Todd, et al., "Volatile Silicone
35 Fluids for Cosmetics", 91 Cosmetics & Toiletries 27-32 (1976).

Dimethicone Copolyol

The compositions of the present invention also contain one or more polyalkylene oxide modified dimethylpolysiloxanes (sometimes herein referred to as a "dimethicone copolyol") which acts as a antiresoiling agent. These dimethicone copolyols reduce deposition of the vehicle materials (lipid vehicle materials and/or cationic surfactant vehicle materials) on the hair. The dimethicone copolyols include the polyalkylene oxide modified dimethylpolysiloxanes of the following formulae:



and



wherein R is hydrogen, an alkyl group having from 1 to 12 carbon atoms, an alkoxy group having from 1 to 6 carbon atoms or a hydroxyl group; R' and R'' are alkyl groups having from 1 to 12 carbon atoms; x is an integer of from 1 to 100, preferably from 20 to 30; y is an integer of 1 to 20, preferably from 2 to 10; and a and b are integers of from 0 to 50, preferably from 20 to 30.

Dimethicone copolyols among those useful herein are disclosed in the following patent documents;

U.S. Patent 4,122,029, Gee, et al., issued October 24, 1978; U.S. Patent 4,265,878, Keil, issued May 5, 1981; and U.S.

Patent 4,421,769, Dixon, et al., issued December 20, 1983. Such dimethicone copolyol materials are also disclosed, in hair compositions, in British Patent Application 2,066,659, Abe, published July 15, 1981 and Canadian

5 Patent 727,588, Kuehns, issued February 8, 1966.

Commercially available dimethicone copolyols, useful herein, include Silwet Surface Active Copolymers (manufactured by the Union Carbide Corporation); Dow Corning Silicone Surfactants (manufactured by the Dow Corning Corporation); Silicone Copolymer F-754 (manufactured by SWS Silicones Corp.); and Rhodorsil 70646 Fluid (manufactured by Rhone Poulenc, Inc.). Dow Corning 190 Silicone Surfactant is a preferred dimethicone copolyol.

Vehicle Materials

15 The present invention includes a gel-type vehicle for the silicone conditioning agents. The vehicle comprises two essential components: a lipid vehicle material and a cationic surfactant vehicle material. Such gel-type vehicles are generally described in the following documents;

20 Barry, "The Self Bodying Action of the Mixed Emulsifier Sodium Dodecyl Sulfate/Cetyl Alcohol", 28 J. of Colloid and Interface Science 82-91 (1968); Barry, et al., "The Self-Bodying Action of Alkyltrimethylammonium Bromides/Cetostearyl Alcohol Mixed Emulsifiers; Influence of Quaternary Chain Length", 35 J. of Colloid and Interface Science 689-708 (1971); and Barry, et al., "Rheology of Systems Containing Cetomacrogol 1000 - Cetostearyl Alcohol, I. Self Bodying Action", 38 J. of Colloid and Interface Science 616-625 (1972).

30 Lipid vehicle material:

The vehicles of the present invention incorporate one or more lipid materials, (herein referred to as comprising a "lipid vehicle material", singly or in combination) which are essentially water-insoluble, and contain hydrophobic and hydrophilic
35 moieties. Lipid vehicle materials include naturally or

synthetically-derived acids, acid derivatives, alcohols, esters, ethers, ketones, and amides with carbon chains of from 12 to 22, preferably from 16 to 18, carbon atoms in length. Fatty alcohols and fatty esters are preferred; fatty alcohols are particularly preferred.

Lipid vehicle materials among those useful herein are disclosed in Bailey's Industrial Oil and Fat Products, (3d edition, D. Swern, ed. 1979) (incorporated by reference herein). Fatty alcohols included among those useful herein are disclosed in the following documents; U.S.

Patent 3,155,591, Hilfer, issued November 3, 1964; U.S. Patent 4,165,369, Watanabe, et al., issued August 21, 1979; U.S. Patent 4,269,824, Villamarin, et al., issued May 26, 1981; British Specification 1,532,585, published November 15, 1978; and Fukushima, et al., "The Effect of Cetostearyl Alcohol in Cosmetic Emulsions", 98 Cosmetics & Toiletries 89-102 (1983). Fatty esters included among those useful herein are disclosed in U.S. Patent 3,341,465, Kaufman, et al., issued September 12, 1967.

Preferred esters for use herein include cetyl palmitate and glycerolmonostearate. Cetyl alcohol and stearyl alcohol are preferred alcohols. A particularly preferred lipid vehicle material is comprised of a mixture of cetyl alcohol and stearyl alcohol containing from 55% to 65% (by weight of mixture) of cetyl alcohol.

Cationic surfactant vehicle material:

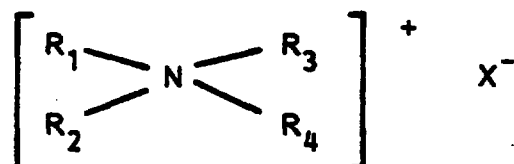
The gel-type vehicle of the present invention includes one or more cationic surfactants, herein referred to as comprising (either singly or in combination) a "cationic surfactant material". Such surfactants contain amino or quaternary ammonium hydrophilic moieties which are positively charged when dissolved in the aqueous composition of the present invention. Cationic surfactant vehicle materials among those useful herein are disclosed in the

following documents;

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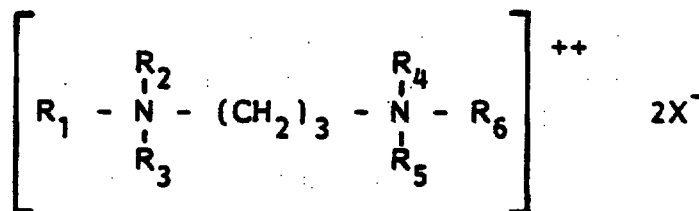
Publishing Co., McCutcheon's, Detergents & Emulsifiers, (North American edition 1979); Schwartz, et al., Surface Active Agents, Their Chemistry and Technology, New York: Interscience Publishers, 1949; U.S. Patent 3,155,591, Hilfer, issued November 3, 1964; U.S. Patent 3,929,678, Laughlin, et al., issued December 30, 1975; U.S. Patent 3,959,461, Bailey, et al., issued May 25, 1976; and U.S. Patent 4,387,090, Bolich, Jr., issued June 7, 1983.

Among the quaternary ammonium-containing cationic surfactant materials useful herein are those of the general formula:



wherein R_1 is hydrogen, an aliphatic group of from 1 to 22 carbon atoms, or an aromatic, aryl or alkylaryl group having from 12 to 22 carbon atoms; R_2 is an aliphatic group having from 1 to 22 carbon atoms; R_3 and R_4 are each alkyl groups having from 1 to 3 carbon atoms, and X is an anion selected from halogen, acetate, phosphate, nitrate and alkylsulfate radicals. The aliphatic groups may contain, in addition to carbon and hydrogen atoms, ether linkages, and other groups such as amido groups.

Other quaternary ammonium salts useful herein are of the formula:



wherein R_1 is an aliphatic group having from 16 to 22 carbon atoms, R_2 , R_3 , R_4 , R_5 and R_6 are selected from hydrogen and alkyl having from 1 to 4 carbon atoms, and X is an ion selected from halogen, acetate, phosphate, nitrate and alkyl sulfate radicals. Such quaternary ammonium salts include tallow propane diammonium dichloride.

Preferred quaternary ammonium salts include dialkyl-dimethylammonium chlorides, wherein the alkyl groups have from 12 to 22 carbon atoms and are derived from long-chain fatty acids, such as hydrogenated tallow fatty acid. (Tallow fatty acids give rise to quaternary compounds wherein R_1 and R_2 have predominately from 16 to 18 carbon atoms.) Examples of quaternary ammonium salts useful in the present invention include ditallowdimethyl ammonium chloride, ditallowdimethyl ammonium methyl sulfate, dihexadecyl dimethyl ammonium chloride, di- (hydrogenated tallow) dimethyl ammonium chloride, dioctadecyl dimethyl ammonium chloride, dieicosyl dimethyl ammonium chloride, didocosyl dimethyl ammonium chloride, di(hydrogenated tallow) dimethyl ammonium acetate, dihexadecyl dimethyl ammonium chloride, dihexadecyl dimethyl ammonium acetate, ditallow dipropyl ammonium phosphate, ditallow dimethyl ammonium nitrate, di-(coconutalkyl) dimethyl ammonium chloride, and stearyl dimethyl benzyl ammonium chloride. Ditallow dimethyl ammonium chloride, dicetyl dimethyl ammonium chloride, stearyl dimethyl benzyl ammonium chloride and cetyl trimethyl ammonium chloride are preferred quaternary ammonium salts useful herein. Di-(hydrogenated tallow) dimethyl ammonium chloride is a particularly preferred quaternary ammonium salt.

Salts of primary, secondary and tertiary fatty amines are also preferred cationic surfactant vehicle materials. The alkyl groups of such amines preferably have from 12 to 22 carbon atoms, and may be substituted or unsubstituted. Secondary and tertiary amines are preferred, tertiary amines are particularly preferred. Such amines, useful herein, include stearamido propyl dimethyl amine, diethyl amino ethyl stearamide, dimethyl stearamine, dimethyl soyamine, soyamine, myristyl amine, tridecyl amine, ethyl stearylamine, N-tallowpropane diamine, ethoxylated (5 moles E.O.) stearylamine, dihydroxy ethyl stearylamine, and arachidylbehenylamine. Suitable amine salts include the halogen, acetate, phosphate, nitrate, citrate, lactate and alkyl sulfate salts. Such salts include stearylamine hydrochloride, soyamine

chloride, stearylamine formate and N-tallowpropane diamine di-
chloride and stearamidopropyl dimethylamine citrate. Cationic
amine surfactants included among those useful in the present
invention are disclosed in U.S. Patent 4,275,055, Nachtigal, et
5 al., issued June 23, 1981.

Non-Essential Components

The compositions of this invention preferably contain optional
components which may modify the physical and performance
characteristics of the conditioning product. Such components
10 include additional surfactants, salts, buffers, thickeners,
solvents, opacifiers, pearlescent aids, preservatives, fragrance,
colorants, dyes, pigments, chelators, sunscreens, vitamins, and
medicinal agents. Optional components that are among those
useful herein are disclosed in U.S. Patent 4,387,090, Bolich, Jr.,
15 issued June 7, 1983.

The compositions of the present invention may contain
optional surfactant materials, at levels such that the total level of
surfactant present in the composition (including the essential
cationic surfactant vehicle material, described above) is from
20 0.05% to 5%. These optional surfactant materials may
be anionic, nonionic or amphoteric, such as cetareth-20,
steareth-20, sorbitan monoesters, sodium tallow alkylsulfate and
tallow betaine. Optional surfactant materials are described in the
following documents;

25 M. C. Publishing Co., McCutcheon's Detergents & Emulsifiers,
(North American edition, 1979); Schwartz, et al., Surface Active
Agents, Their Chemistry and Technology (1949); and U.S. Patent
3,929,678, Laughlin, et al., issued December 30, 1975.

Preferred optional surfactant materials, useful herein, are
30 nonionic. Such surfactants are most commonly produced by the
condensation of an alkylene oxide (hydrophilic in nature) with an
organic hydrophobic compound, which is usually aliphatic or alkyl
aromatic in nature. The length of the hydrophilic or poly-
alkylene moiety which is condensed with any particular
35 hydrophobic compound can be readily adjusted to yield a
water-soluble compound having the desired degree of balance

between hydrophilic and hydrophobic elements. Such nonionic surfactants include polyethylene oxide condensates of alkyl phenols, condensation products of aliphatic alcohols with ethylene oxide, condensation products of ethylene oxide with a hydrophobic base formed by condensation of propylene oxide with propylene glycol, and condensation products of ethylene oxide with the product resulting from the reaction of propylene oxide and ethylene diamine. Another variety of nonionic surfactant is the non-polar nonionic, typified by the amine oxide surfactants. Preferred nonionic surfactants include cetareth-20, steareth-20 and ceteth-2.

Salts and buffers may also be added in order to modify the product rheology. For example, salts such as potassium chloride and sodium chloride, may be added at levels of from 0.001% to 1%. Buffers, such as citrate or phosphate buffers, may also be used. Preferably the pH of the present compositions modified to a pH of from 3 to 10, preferably from 3 to 7.

Optional components may be incorporated which provide additional conditioning benefits. For example, proteins may be added at levels of from 0.1% to 10%. Cationic proteins may also serve as surfactant vehicle materials, in the present invention.

Thickening agents are also preferred optional components useful in the present invention. Such thickeners include nonionic thickening agents, incorporated at levels from 0.1% to 8%. Such agents are polymers which exhibit viscosities exceeding 20 Pa.s (200 poises) at low shear (about 10^{-2} sec⁻¹). Included among such polymers are polyoxyethylene, guar gum, methylcellulose, methyl hydroxy propyl cellulose, polypropyl cellulose, polypropyl hydroxy ethyl cellulose, hydroxy ethyl cellulose, starches and starch derivatives, and mixtures thereof. Nonionic thickening agents are disclosed in U.S. Patent 4,472,375 Bolich, et al., filed October 1, 1982.

Methods of Manufacture

The conditioning compositions of the instant invention can be prepared by methods well known in the art. Specific procedures for forming compositions may vary, however, depending upon such factors as the particular components used and the product rheology that is desired.

In general, compositions may be made by simple admixture of components into heated water, cooling, and milling. While the aqueous bulk mixture is generally maintained, during the initial admixture of components, at a temperature above the melting point of the highest-melting component, the temperature may have to be reduced before adding volatile or other temperature-sensitive components. Certain components may be premixed and then added to the aqueous batch mixture. For example, formulation of conditioning compositions containing high molecular weight silicone conditioning agents may be facilitated by premixing the silicone conditioning agent with a volatile silicone oil.

Methods of Use

The hair conditioning compositions of the present invention are preferably used as a rinse on freshly shampooed hair. Preferably all shampoo is rinsed from the hair prior to application of the conditioning product.

In use, from 1g to 60g, preferably, from 5g to 30g of the composition are applied. The product is preferably allowed to remain on the hair for a time up to about 5 minutes.

The following non-limiting examples illustrate the compositions, processes, and uses of the present invention.

EXAMPLE I

A hair conditioner, according to the present invention, was made comprising:

	<u>Component</u>	<u>Weight %</u>
5	Dow Corning Q2-8075 ¹	0.50
	Dow Corning 190 Silicone Surfactant ²	0.50
	cetyl alcohol	1.13
	stearyl alcohol	0.75
	Adogen 442 - 100P ³	1.05
10	Cetareth-20 ⁴	0.35
	glycerol monostearate	0.25
	Lexamine S-13 ⁵	0.50
	fragrance	0.25
	citric acid	0.13
15	preservative	0.03
	distilled water	94.56
	¹ : trimethylsilylamodimethicone, sold by Dow Corning Corporation	
	² : dimethicone copolyol, sold by Dow Corning Corporation	
	³ : di(hydrogenated tallow) dimethyl ammonium chloride, sold by	
20	Sherex Chemical Company, Inc.	
	⁴ : ethoxylated cetostearyl alcohol	
	⁵ : stearamido propyl dimethyl amine, sold by Inolex Corporation	

All materials, except the preservative and fragrance, were added to the distilled water, maintained at a temperature of from 65°C to 74°C. This mixture was then stirred for 15 minutes. After the solution was cooled to approximately 49°C, the fragrance and preservative were added. The mixture was then cooled to approximately 38°C and milled under high shear for approximately 2 minutes using a conventional milling apparatus.

Approximately 20 g. of the hair conditioning product thus formed is applied to freshly shampooed and rinsed hair. The composition is then spread over the hair and allowed to stand for approximately 1 minute. Thereafter, the product is rinsed from the hair, leaving the hair with conditioning benefits.

EXAMPLE II

A hair conditioner, according to the present invention, was made comprising:

	<u>Component</u>	<u>Weight %</u>
5	stearoxy dimethicone	1.00
	dimethicone oil (12,500 cs)	1.00
	Silwet L-7002 ¹	1.00
	cetearyl alcohol	3.00
	stearyl dimethyl benzyl ammonium chloride	2.00
10	hydroxy ethyl cellulose	0.50
	Peptin 2000 ²	0.50
	Panthenol ³	0.50
	fragrance	0.50
	titanium dioxide	0.10
15	phosphoric acid	0.05
	preservative	0.05
	colorant	0.05
	distilled water	89.75
	¹ : dimethicone copolyol, sold by Union Carbide Corporation	
20	² : hydrolyzed animal protein, sold by Geo. A. Hormel & Co.	
	³ : pantothenyl alcohol, provitamin of the B-complex vitamin pantothenic acid, sold by Hoffman-LaRoche, Inc.	

A conditioning product was made, as comprised above, in a manner similar to that described in Example I. This product, when applied to hair, is useful as a conditioner.

EXAMPLE III

A hair conditioner, according to the present invention, is made comprising:

	<u>Component</u>	<u>Weight %</u>
30	D ₅ cyclomethicone	8.00
	dimethicone oil	1.00
	Silwet L-720*	2.00
	cetyl palmitate	1.00
	glycerol monostearate	3.00
35	dicetyldimonium chloride	2.00

perfume	0.50
colorant	0.11
preservative	0.03
distilled water	82.36

5 *: dimethicone copolyol, sold by Union Carbide Corporation

A conditioning product, as comprised above, is made in a manner similar to that described in Example I. This product, when applied to human hair, is useful as a hair conditioner.

EXAMPLE IV

10 A hair conditioner, according to the present invention, was made comprising:

	<u>Component</u>	<u>Weight %</u>
	dimethicone oil (12,500 cs)	1.00
	Rhodorsil (RTM) 70646 Fluid*	1.00
15	cetyl alcohol	1.50
	stearyl alcohol	1.50
	Lexamine S-13	1.00
	ceteth-20	0.20
	fragrance	0.50
20	citric acid	0.20
	preservative	0.03
	distilled water	93.07

*: dimethicone copolyol, sold by Rhone-Poulenc, Inc.

25 A hair conditioning product was made, as comprised above, in a manner similar to that described in Example I. This product, when applied to human hair, is useful as a conditioner.

In the above example, stearylamine, diethylaminopropyl stearamide, dimethyl stearamine, tridcylamine, ethyl stearamine, N-tallowpropane diamine, myristylamine, ethoxylated stearylamine, 30 dihydroxyethyl stearylamine and arachidylbehenylamine are substituted, respectively, for the Lexamine S-13 stearamidopropyl dimethylamine, with substantially similar results.

EXAMPLE V

A hair conditioner, according to the present invention, was made comprising:

	<u>Component</u>	<u>Weight %</u>
5	D ₅ cyclomethicone	2.00
	SE-76 Silicone Gum ¹	0.15
	Silicone Copolymer F-755 ²	0.50
	Dow Corning 190 Silicone Surfactant	0.50
	cetyl alcohol	1.25
10	stearyl alcohol	1.25
	Adogen 442	0.75
	Lexamine S-13	0.75
	hydroxyethyl cellulose	0.50
	fragrance	0.25
15	citric acid	0.13
	preservative	0.03
	distilled water	91.94

¹: dimethicone gum, sold by General Electric

²: stearoxy dimethicone, sold by SWS Silicones Corporation

20 A hair conditioning product was made in a manner similar to that described in Example I, except for processing of the cyclo-methicone/dimethicone gum materials. These silicone agents were premixed under heat and agitation to form a gum solution. The gum solution was added to the conditioning product batch mix
25 after the batch solution was cooled to approximately 48°C. The final product, when applied to human hair, is useful as a conditioning agent.

In the above example ditallow dimethyl ammonium chloride, stearyl trimethyl ammonium chloride, cetyl trimethyl ammonium
30 chloride, distearyl dimethyl ammonium chloride, dicetyl dimethyl ammonium chloride and ditallow dipropyl ammonium phosphate are substituted, respectively, for the Adogen 442 di(hydrogenated tallow) dimethyl ammonium chloride, with substantially similar results.

EXPERIMENT I

Four formulations were prepared which had the same composition as the products described in Example I, but with the following variation in levels of silicone materials present.

Composition	<u>Weight %</u>	
	silicone conditioning active	dimethicone copolyol
A	0	0
B	0	0.5
C	0.5	0
D	0.5	0.5

(To the extent that these compositions contained levels of silicone conditioning active or dimethicone copolyol lower than in Composition D, the amount of water was increased.) Each of these compositions was applied to hair switches in order to determine the levels of vehicle materials and silicone-containing materials that remained on the hair after rinsing.

Specifically, 20 switches of hair, weighing 4 grams and approximately 203 mm long, were prepared by stripping in a 90:10 mixture of methylene chloride and methanol, for one hour. The switches were then washed with a conventional shampoo for 30 seconds, rinsed for 30 seconds, shampooed again for 30 seconds, and finally rinsed for 60 seconds.

The shampoo/rinse/shampoo/rinse sequence was then repeated. One of Compositions A, B, C or D was then applied to each switch of hair. (A total of 5 switches were used to evaluate each composition.) The respective test composition was dispersed thoroughly throughout each switch, and then the switches were rinsed for 30 seconds. (Gloves were worn throughout the treatment procedure, and changed between each product treatment.) The switches were then air dried.

Samples were cut from each dried switch, placed in tared vials, and weighed. Ten milliliters of a suitable solvent, such as

a 90:10 methylene chloride/methanol solvent mix, were added to each vial, and the vials agitated for approximately 18 hours. The extracted solution was then filtered and placed in tared vial. The level of cationic surfactant was then determined using High Performance Liquid Chromatography. The amount of silicone-containing material was determined using Atomic Adsorption Spectroscopy.

The following table presents the levels (in micrograms per milligram of hair) of cationic surfactant and silicone-containing material present in the switches treated with each Composition.

TABLE I

<u>Composition</u>		<u>cationic</u> <u>surfactant</u>	<u>silicone-containing</u> <u>material</u>
	A	0.307	--
15	B	0.196	0*
	C	0.286	0.19
	D	0.176	0.18

*less than the 0.02 $\mu\text{g}/\text{mg}$ minimum detection level

The levels of cationic surfactant vehicle material deposited from Compositions B and D (containing a dimethicone copolyol) were significantly different than the levels deposited from Compositions A and C (without the silicone copolymer), at a 95% confidence level ($\text{LSD}=0.070$). This data thus demonstrates that the dimethicone copolyols of the present invention significantly reduce the levels of cationic surfactant vehicle material deposited on hair during use. This data also shows that the dimethicone copolyol material is not, itself, deposited in significant amounts. Therefore, this data demonstrates that the dimethicone copolyol reduces undesirable deposition of vehicle materials on treated hair without significantly reducing the deposition of the silicone conditioning agent.

EXPERIMENT II

Four formulations (A, B, C and D) were made, each composed identically to those tested in Experiment I. The compositions were applied to hair switches. After the switches were soiled with synthetic sebum, the switches were then graded by expert judges in order to determine the cleanliness/dirtiness of the switches.

In particular, 48 switches of hair were prepared by rinsing each for 15 seconds at approximately 38°C, washed for 30 seconds using a conventional shampoo, rinsing for 30 seconds, and then soaking for one hour using a 90:10 methylene chloride/methanol mixture.

Each switch was again rinsed for 15 seconds, washed for 30 seconds with a conventional shampoo, rinsed for 30 seconds, washed again for 30 seconds, and finally rinsed for 60 seconds. Thereafter, one of each of Composition A, B, C or D was applied to each switch, using 1 milliliter of product per gram of hair. Composition A (vehicle only) was applied to 18 switches, Composition D (of the present invention) was applied to 12 switches, and Compositions B and C were applied to 6 switches, each. The rinse formulations were then dispersed throughout their respective hair switches, and allowed to remain for 60 seconds. The switches were combed and rinsed for 60 seconds.

The switches were allowed to dry overnight and then weighed. A solution of synthetic sebum (containing materials corresponding to those found in natural sebum) was then sprayed on each switch until a predetermined weight of sebum was applied. The switches were then allowed to equilibrate at approximately 27°C and 80% relative humidity.

The switches were paired as detailed in Table II, below. Each pair of switches was then evaluated by ten expert judges, and rated on a scale ranging from "not soiled" to "heavily soiled". Higher scores indicated less soiled (cleaner) switches. The pairings and results are set forth below.

TABLE II

	<u>Pair</u>	<u>Compositions tested</u>	<u>Degree of Cleanliness</u>
	1	A - vehicle only	50
5		B - vehicle + dimethicone copolyol	57
	2	A - vehicle only	57
		C - vehicle + silicone conditioner	55
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	3	A - vehicle only	66
		D - present invention	75
15	4	C - vehicle + silicone conditioner	49
		D - present invention	63

The scores for Pairs 1, 3 and 4 reflect significant differences in cleanliness/soiling (between switches in each pair) at a 95% confidence level. This data thus demonstrates that the compositions of the present invention (such as Composition D) exhibit lower soiling of hair after use than similar compositions that do not contain dimethicone copolyol.

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CLAIMS

1. A hair conditioning composition, comprising:
 - (a) from 0.1% to 10% by weight of a silicone conditioning agent selected from unsubstituted polydimethylsiloxanes and vinyl, phenyl, carboxy, alkoxy, mercapto, alkyl and amino substituted polydimethylsiloxanes;
 - (b) from 0.01% to 10% by weight of one or more polyalkyleneoxide modified dimethylpolysiloxanes;
 - (c) a gel-type vehicle comprising from 0.1% to 10% by weight of a lipid vehicle material and from 0.05% to 5% by weight of a cationic surfactant vehicle material, the cationic surfactant vehicle comprising one or more cationic surfactants containing amino or quaternary ammonium hydrophilic moieties; and
 - (d) water
2. A conditioning composition according to Claim 1 wherein the lipid vehicle material is selected from fatty alcohols, fatty esters, and mixtures thereof.
3. A conditioning composition according to Claim 2 wherein the lipid vehicle material contains carbon chains of from 12 to 18 carbon atoms in length.
4. A conditioning composition according to any of Claims 1 to 3 wherein the cationic surfactant vehicle material contains carbon chains of from 12 to 18 carbon atoms in length.
5. A conditioning composition according to any of Claims 1 to 4 wherein the silicone conditioning agent has from 1 to 15,000 silicon atoms.



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6. A conditioning composition according to any of Claims 1 to 5 comprising from 0.1% to 2.0% by weight of the polyalkyleneoxide modified dimethylpolysiloxane.

7. A conditioning composition according to any of Claims 1 to 6 comprising from 0.25% to 1.5% by weight of the silicone conditioning agent.

8. A conditioning composition according to any of Claims 1 to 7 comprising from 1% to 3% by weight of the lipid vehicle material.

9. A conditioning composition according to any of Claims 1 to 8 comprising from 0.2% to 3% by weight of the cationic surfactant vehicle material.

10. A conditioning composition according to any of Claims 1 to 9 wherein the lipid vehicle material is selected from cetyl alcohol, stearyl alcohol, cetyl palmitate, glycerol monostearate, and mixtures thereof.

11. A conditioning composition according to any of Claims 1 to 10 wherein the surfactant vehicle material is di(hydrogenated tallow) dimethyl ammonium chloride.



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12. A conditioning composition according to any of Claims 1 to 11 wherein the silicone conditioning agent is selected from unsubstituted, amino substituted and alkoxy substituted polydimethyl siloxanes, and mixtures thereof.

13. A conditioning composition according to any of Claims 1 to 12 additionally comprising a surfactant material selected from anionic, nonionic and amphoteric surfactants.

14. A conditioning composition according to any of Claims 1 to 13 wherein the composition is buffered to a pH in the range of from 3 to 10.

15. A conditioning composition according to any of Claims 1 to 14 additionally comprising a nonionic polymeric thickener.
