

CONDITIONING SHAMPOO COMPOSITIONS

TECHNICAL FIELD

5 The present invention relates to conditioning shampoos containing silicone materials and alkyl ethoxylated phosphoric acid monoesters.

BACKGROUND OF THE INVENTION

10 Human hair becomes soiled due to its contact with the surrounding atmosphere and, to a greater extent, with sebum secreted by the head. The build up of the sebum causes the hair to have a dirty feel and an unattractive appearance. This requires that the hair be shampooed with frequent regularity.

15 Shampooing the hair cleans by removing excess soil and sebum. However, the shampooing process has disadvantages in that it leaves the hair in a wet, tangled and generally unmanageable state. Furthermore, when the just-washed hair is combed it develops a high electrostatic charge. This high electrostatic charge causes what is known as "fly-away" hair. That is, the
20 individual strands of hair repel each other causing an unkept appearance. A variety of approaches have been developed to alleviate the after-shampoo problems. These range from the inclusion of hair conditioning aids in shampoos to post-shampoo application of hair conditioners, i.e., hair rinses. Hair rinses
25 typically work by depositing a cationic or polymeric material onto the hair. However, such solutions have not been fully satisfactory. For one thing, hair rinses are generally liquid in nature and must be applied in a separate step following the shampooing, left on the hair for a length of time, and rinsed with fresh
30 water. This, of course, is time consuming and inconvenient.

 While shampoos which contain conditioning aids have been disclosed, they have not been totally satisfactory for a variety of reasons. There are compatibility problems between good cleaning anionic surfactants and the conditioning agents which are generally
35 cationic. To alleviate this undesirable interaction, other

surfactants, such as nonionics, amphoteric and zwitterionics, were examined by workers in the field.

5 The use of these non-anionic surfactants solved many of the compatibility problems but still did not provide complete answers in all areas. For instance, none of these approaches effectively solved the problem of "fly-away" hair caused by electrostatic charge. It clearly would be highly desirable to be able to formulate a shampoo which provides both effective cleaning and hair conditioning benefits.

10 Silicones in shampoo compositions have been disclosed as conditioning agents in a number of different publications. See, for example, U.S. Patent 2,826,551, issued March 11, 1958 to Geen; U.S. Patent 3,969,500, issued June 22, 1976 to Drakoff; U.S. Patent 4,364,837, issued December 21, 1982 to Pader; and
15 British Patent 849,433, published September 28, 1960 to Woolston. While these patents disclose silicone-containing shampoo compositions, they do not provide totally satisfactory products. One problem is that of keeping a dispersed, silicone material suspended and the total product stable during the extended
20 periods of storage required in commerce. A variety of materials such as methyl cellulose have been included in silicone-containing shampoos for purposes of thickening and stabilization, but are ineffective for stabilizing shampoo compositions containing most silicone compounds such as polydimethylsiloxane.

25 Phosphate esters have been disclosed as surfactants in shampoo compositions. See, for example, U.S. Patent 4,209,449, issued June 24, 1980, to Mayhew et al., and, Japanese Patent Application SHO 58-191,578, published October 13, 1983. One reference in particular, U.S. Patent 4,479,893, issued October
30 30, 1984 to Hirota et al., discloses the addition of low levels of phosphate esters to a shampoo composition containing various silicone derivatives. However, the shampoo compositions disclosed therein, which contain certain silicone derivatives such as polydimethylsiloxane, are not stable. It has been discovered that
35 when certain specific phosphate esters and specific silicone derivatives are used in conjunction with a group of defined

suspending agents, stable conditioning shampoos are obtained. Additionally, these same shampoos provide unexpected superior antistatic and conditioning benefits.

5 It is therefore an object of the present invention to provide a stable conditioning shampoo, containing silicones and very low levels of phosphate esters, which provides good hair cleaning and improved hair care benefits.

It is a further object of this invention to provide such a conditioning shampoo which prevents fly-away hair.

10 Unless otherwise indicated, all percentages and ratios herein are by weight.

SUMMARY OF THE INVENTION

The present invention relates to a shampoo composition comprising:

- 15 (a) from 5% to 60% of a synthetic surfactant selected from the group consisting of anionic surfactants, nonionic surfactants, zwitterionic surfactants, amphoteric surfactants, and mixtures thereof;
- 20 (b) from 0.01% to 10% of a dispersed silicone polymer having a molecular weight of from 300 to 1,000,000 and a viscosity of from 2 to 20,000,000 centistokes at 25°C, which is selected from the group consisting of polydimethylsiloxanes, polydiphenylsiloxanes, and mixtures thereof;
- 25 (c) from 0.1% to 5.0% of an alkyl ethoxylated phosphoric acid monoester selected from the group consisting of trideceth-6-phosphate, laureth-3-phosphate, laureth-4-phosphate, laureth-5-phosphate, oleth-3-phosphate, their salts, and mixtures thereof;
- 30 (d) from 0.5% to 5% of a suspending agent selected from the group consisting of xanthan gum, ethylene glycol esters of a fatty acid having from 16 to 22 carbon atoms, alkanol amides of fatty acids having from 16 to
- 35

22 carbon atoms, alkyl dimethyl amine oxides having from 16 to 22 carbon atoms, and mixtures thereof; and

(e) from 29% to 94% of water.

5 The preferred silicone polymer is polydimethylsiloxane. The preferred phosphate esters are laureth-3-phosphate, laureth-4-phosphate, laureth-5-phosphate and oleth-3-phosphate. The preferred suspending agents are xanthan gum and ethylene glycol distearate. Most preferred compositions include the above
10 materials along with an anionic surfactant.

DETAILED DESCRIPTION OF THE INVENTION

The components of the present invention are described, in detail, below.

Surfactant

15 An essential component of the present compositions is a surfactant. The surfactant, which may be selected from any of a wide variety of synthetic anionic, amphoteric, zwitterionic and nonionic surfactants, preferably anionic surfactants, is present at a level of from 5% to 60%, preferably from 10%
20 to 30%, most preferably from 10% to 22%, of the shampoo composition.

The preferred surfactants for the shampoos of the present invention are the synthetic anionic surfactants which have good cleaning and good lathering qualities. Most preferred are the
25 alkyl sulfates. Synthetic anionic surfactants can be exemplified by the alkali metal salts of organic sulfuric reaction products having in their molecular structure an alkyl radical containing from 8 to 22 carbon atoms and a sulfonic acid or sulfuric acid ester radical (included in the term alkyl is the alkyl
30 portion of higher acyl radicals). Preferred anionic surfactants are the sodium, ammonium, potassium or triethanolamine alkyl sulfates, especially those obtained by sulfating the higher alcohols (C_8 - C_{18} carbon atoms), sodium coconut oil fatty acid monoglyceride sulfates and sulfonates; sodium or potassium salts of sulfuric acid
35 esters of the reaction product of 1 mole of a higher fatty alcohol (e.g., tallow or coconut oil alcohols) and 1 to

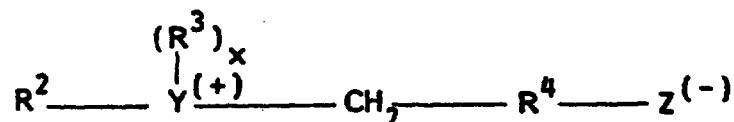
12 moles of ethylene oxide; sodium or potassium salts of alkyl phenol ethylene oxide ether sulfate with 1 to 10 units of ethylene oxide per molecule and in which the alkyl radicals contain from 8 to 12 carbon atoms, sodium alkyl glyceryl ether sulfonates; the reaction product of fatty acids having from 10 to 22 carbon atoms esterified with isethionic acid and neutralized with sodium hydroxide; water soluble salts of condensation products of fatty acids with sarcosine; and other known in the art. These anionic surfactants are further described in Cosmetics: Science and Technology, 2nd Ed. Vol. 11, pp. 88-94.

Specific examples of preferred alkyl sulfates for use herein include ammonium lauryl sulfate, ammonium laureth sulfate, triethanolamine lauryl sulfate, triethanolamine laureth sulfate, monoethanolamine lauryl sulfate, monoethanolamine laureth sulfate, diethanolamine lauryl sulfate, diethanolamine laureth sulfate, sodium lauric monoglyceride sulfate, sodium lauryl sulfate, sodium laureth sulfate, potassium lauryl sulfate, potassium laureth sulfate, lauryl sarcosine, cocoyl sarcosine, ammonium cocoyl sulfate, sodium cocoyl sulfate, potassium cocoyl sulfate, diethanolamine cocoyl sulfate, monoethanolamine cocoyl sulfate and mixtures thereof. More preferred are ammonium lauryl sulfate, ammonium laureth sulfate, triethanolamine lauryl sulfate and triethanolamine laureth sulfate and mixtures thereof. Most preferred are ammonium lauryl sulfate and ammonium laureth sulfate.

Other suitable synthetic anionic surfactants are the aryl alkyl sulfonates, where the alkyl radical contain from about 8 to about 22 carbon atoms. The preferred aryl alkyl sulfonates are sodium tridecyl benzene sulfonate and sodium dodecyl benzene sulfonate and mixtures thereof. Mixtures of the preferred alkyl sulfates and aryl alkyl sulfonates are also suitable herein.

Other surfactants useful in the present invention are the zwitterionic, amphoteric and nonionic surfactants. Zwitterionic surfactants can be broadly described as derivatives of aliphatic quaternary ammonium, phosphonium, and sulfonium compounds, in which the aliphatic substituents can be straight chain or

branched, and wherein one of the aliphatic substituents contains from 8 to 18 carbon atoms and one contains an anionic water-solubilizing group, e.g., carboxy, sulfonate, sulfate, phosphate, or phosphonate. A general formula for these compounds is:



wherein R^2 comprises an alkyl, alkenyl, or hydroxy alkyl radical of from 8 to 18 carbon atoms, from 0 to 10 ethylene oxide moieties and from 0 to 1 glyceryl moiety; Y is selected from the group consisting of nitrogen, phosphorus, and sulfur atoms; R^3 is an alkyl or monohydroxyalkyl group containing 1 to 3 carbon atoms; x is 1 when Y is a sulfur atom and 2 when Y is a nitrogen or phosphorus atom; R^4 is an alkylene or hydroxyalkylene of from 0 to 4 carbon atoms, and Z is a radical selected from the group consisting of carboxylate, sulfonate, sulfate, phosphonate, and phosphate groups.

Preferred zwitterionic surfactants include:

4-[N,N-di(2-hydroxyethyl)-N-octadecylammonio]-butane-1-carboxylate;

5-[S-3-hydroxypropyl-S-hexadecylsulfonio]-3-hydroxypentane-1-sulfate;

3-[N,N-dimethyl-N-hexadecylammonio]propane-1-sulfonate;

3-[N,N-dimethyl-N-hexadecylammonio]-2-hydroxypropane-1-sulfonate;

4-[N,N-di(2-hydroxyethyl)-N-(2-hydroxydodecyl)ammonio]-butane-1-

carboxylate; 3-[S-ethyl-S-(3-dodecoxy-2-hydroxypropyl)sulfonio]-propane-1-phosphate;

3-[P,P-dimethyl-P-dodecylphosphonio]-propane-1-phosphonate; and 5-[N,N-di(3-hydroxypropyl)-N-hexadecylammonio]-2-hydroxy-pentane-1-sulfate.

Other zwitterionic surfactants, such as betaines, are also useful in the present invention. Examples of betaines useful

herein include the higher alkyl betaines, such as coco dimethyl carboxymethyl betaine, lauryl dimethyl carboxymethyl betaine, lauryl dimethyl alpha-carboxyethyl betaine, cetyl dimethyl carboxymethyl betaine, lauryl bis-(2-hydroxyethyl) carboxy methyl betaine, 5 stearyl bis-(2-hydroxypropyl) carboxymethyl betaine, oleyl dimethyl gamma-carboxyethyl betaine, and lauryl bis-(2-hydroxypropyl) alpha-carboxyethyl betaine.

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Examples of amphoteric surfactants which are useful in the shampoo compositions of the present invention can be broadly described as derivatives of aliphatic secondary and tertiary amines in which the aliphatic substituents can be straight chain or 15 branched chain and wherein one of the aliphatic substituents contains from 8 to 18 carbon atoms and one contains an anionic water solubilizing group, e.g., carboxy, sulfonate, sulfate, phosphate, or phosphonate. Examples of compounds falling within this class of surfactants include sodium 3-dodecylaminopropionate, sodium 3-dodecylaminopropane sulfonate, N-alkyltaurines 20 such as the one prepared by reacting dodecylamine with sodium isethionate according to the teaching of U.S. Patent 2,658,072 to Kosmin, issued November 3, 1983, and the products sold under the trade name "Miranol (RTM)" and described in U.S. Patent 2,528,378 to Monnheimer, issued October 31, 1950. 25

Nonionic surfactants, which are preferably used in combination with an anionic, amphoteric or zwitterionic surfactant, can be 30 broadly defined as compounds produced by the condensation of alkylene oxide groups (hydrophilic in nature) with an organic hydrophobic compound, which may be aliphatic or alkyl aromatic in nature. Examples of classes of nonionic surfactants are:

35 1. The polyethylene oxide condensates of alkyl phenols, e.g., the condensation products of alkyl phenols having an alkyl

group containing from 6 to 12 carbon atoms in either a straight chain or branched chain configuration with ethylene oxide, the said ethylene oxide being present in amounts equal to 10 to 60 moles of ethylene oxide per mole of alkyl phenol. The alkyl substituent in such compounds may be derived from polymerized propylene, diisobutylene, octane, or nonane, for example. Preferred surfactants from the class include decyl phenol ethoxylate and dodecyl phenol ethoxylate.

2. Those derived from the condensation of ethylene oxide with the product resulting from the reaction of propylene oxide and ethylene diamine products which may be varied in composition depending upon the balance between the hydrophobic and hydrophilic elements which is desired. For example, compounds containing from 40% to 80% polyoxyethylene by weight and having a molecular weight of from 5,000 to 11,000 resulting from the reaction of ethylene oxide groups with a hydrophobic base comprising the reaction product of ethylene diamine and excess propylene oxide, said base having a molecular weight of the order of 2,500 to 3,000 are satisfactory.

3. The condensation product of aliphatic alcohols having from 8 to 18 carbon atoms, in either straight chain or branched chain configuration, with ethylene oxide, e.g., a coconut alcohol ethylene oxide condensate having from 10 to 30 moles of ethylene oxide per mole of coconut alcohol, the coconut alcohol fraction having from 10 to 14 carbon atoms. Suitable examples include decyl ethoxylate and dodecyl ethoxylate.

4. Long-chain tertiary amine oxides corresponding to the following general formula:



wherein R_1 comprises an alkyl, alkenyl or monohydroxy alkyl radical of from 8 to 18 carbon atoms, from 0 to 10 ethylene oxide moieties, and from 0 to 1 glyceryl moiety, and R_2 and R_3 contain from 1 to 3 carbon atoms and from 0 to 1 hydroxy group, e.g., methyl, ethyl,

propyl, hydroxy ethyl, or hydroxy propyl radicals. The arrow in the formula is a conventional representation of a semipolar bond. Examples of amine oxides suitable for use in this invention include dimethyl-dodecylamine oxide, oleyldi(2-hydroxyethyl) amine oxide, dimethyloctylamine oxide, dimethyl-decylamine oxide, dimethyltetradecylamine oxide, 3,6,9-trioxaheptadecyldiethylamine oxide, di(2-hydroxyethyl)-tetradecylamine oxide, 2-dodecoxy-ethyl dimethylamine oxide, 3-dodecoxy-2-hydroxypropyldi(3-hydroxypropyl)amine oxide, dimethylhexadecylamine oxide.

5. Long-chain tertiary phosphine oxides corresponding to the following general formula:



wherein R comprises an alkyl, alkenyl or monohydroxyalkyl radical ranging from 8 to 18 carbon atoms in chain length, from 0 to 10 ethylene oxide moieties and from 0 to 1 glyceryl moiety and R' and R'' are each alkyl or monohydroxyalkyl groups containing from 1 to 3 carbon atoms. The arrow in the formula is a conventional representation of a semipolar bond. Examples of suitable phosphine oxides include: dodecyldimethylphosphine oxide, tetradecyldimethylphosphine oxide, tetradecylmethylethylphosphine oxide, 3,6,9,-trioxaoctadecyldimethylphosphine oxide, cetyldimethylphosphine oxide, 3-dodecoxy-2-hydroxypropyldi(2-hydroxyethyl) phosphine oxide, stearyldimethylphosphine oxide, cetyl-ethylpropylphosphine oxide, oleyldiethylphosphine oxide, dodecyldiethylphosphine oxide, tetradecyldiethylphosphine oxide, dodecyldipropylphosphine oxide, dodecyldi(hydroxymethyl)-phosphine oxide, dodecyldi(2-hydroxyethyl)phosphine oxide, tetradecylmethyl-2-hydroxypropylphosphine oxide, oleyldimethylphosphine oxide, and 2-hydroxydodecyldimethylphosphine oxide.

6. Long-chain dialkyl sulfoxides containing one short-chain alkyl or hydroxy alkyl radical of 1 to 3 carbon atoms (usually methyl) and one long hydrophobic chain which comprise alkyl, alkenyl, hydroxy alkyl, or keto alkyl radicals containing from 8 to 20 carbon atoms, from 0 to 10 ethylene oxide moieties and from 0 to 1 glyceryl moiety.

Examples include octadecyl methyl sulfoxide, 2-ketotridecyl methyl sulfoxide, 3,6,9,-trioxaoctadecyl-2-hydroxyethyl sulfoxide, dodecyl methyl sulfoxide, oleyl 3-hydroxypropyl sulfoxide, tetradecyl methyl sulfoxide, 3-methoxytridecyl methyl sulfoxide, 3-hydroxytridecyl methyl sulfoxide, and 3-hydroxy-4-dodecoxybutyl methyl sulfoxide.

Many additional nonsoap surfactants useful in the present invention are described in McCutcheon's, Detergents and Emulsifiers, 1985 Annual, published by Allured Publishing Corporation, pp. 74-305.

Silicone Materials

The silicone materials used in the present invention are polydimethylsiloxanes, polydiphenyl siloxanes and mixtures thereof of defined molecular weight and viscosity.

These silicone materials, when combined with the phosphate esters of the present invention, impart unexpectedly improved hair care benefits, such as excellent static reduction, hair softness, manageability, wet and dry combing and silky feeling.

The silicone material is dispersed into the shampoo matrix and is present in the compositions of the present invention at a level of from 0.1% to 10.0%, preferably from 0.5% to 5.0%. As used herein, the term polymer also includes oligomers and copolymers.

The silicone materials used herein have a molecular weight ranging from 300 to 1,000,000 and viscosity of from 2 to 20,000,000 centistokes at 25°C. The viscosity can be measured by means of a glass capillary viscometer as set forth in Dow Corning Corporate Test Method CTM0004, July 20, 1970.

Silicone fluids preferably have a molecular weight ranging from 300 to 150,000 and a viscosity ranging from

2 to 100,000 centistokes at 25°C; and more preferably a molecular weight of from 2,000 to 100,000 and a viscosity ranging from 20 to 40,000 centistokes at 25°C. Most preferred are the polydimethylsiloxanes and polydi-
5 phenylsiloxanes having viscosities of 350 to 30,000 centistokes at 25°C. These siloxanes are available, for example, from the General Electric Company or from Dow Corning as 556 Cosmetic Grade Fluid. "Silicone gum" materials denote the polydiorganosiloxanes described above having a mass molecular weight
10 of from 200,000 to 1,000,000. These silicone gums can be used alone, or in combination with silicone fluids. The most preferred embodiment consists of a combination of silicone gum and fluid materials in a gum: fluid weight ratio ranging from 1:2 to 2:1.

15 References disclosing suitable silicone materials include U.S. Patent 2,826,551 issued March 11, 1958, Geen; U.S. Patent 3,964,500, issued June 22, 1976, Drakoff; U.S. Patent 4,364,837, issued December 21, 1982, Pader; and British Patent 849,433, published September 28, 1960, Woolston.

20 Silicon Compounds, pp 181-217, distributed by Petrarch Systems, Inc., 1984 also provides a very good listing of the silicone materials described herein.

Phosphate Esters

25 The phosphate esters used in the present invention are certain alkyl ethoxylated phosphoric acid monoesters and their salts.

The problem with depositing antistatic compositions on hair from shampoos containing anionic surfactants has been that an
30 inadequate amount of the antistatic agent has deposited on hair to solve the static charge problem. The phosphate esters of the present invention are believed to complex with divalent or trivalent metal ions (e.g. Ca^{2+} and Mg^{2+}) in tap water during the shampoo washing and rinsing process. These complexes precipi-
35 tate during this process and deposit on the hair.

The phosphate esters are believed to provide their antistatic efficacy via a triboelectric phenomenon. When hair is combed or brushed, electrons pass from the hair to the nylon comb or brush. This causes positive static charge generation on the hair. 5 The magnitude of this effect is increased at low relative humidities. The phosphate esters of the present invention are believed to have a higher electron affinity than both hair and nylon combs and brushes. When these phosphate esters are deposited onto hair through the present shampoo composition, the net transfer of 10 electrons is reduced, thereby eliminating static charge build up.

These phosphate esters are present in the shampoo composition at a level of from 0.1% to 5.0%, preferably from 0.4% to 2.0%.

The alkyl ethoxylated phosphate monoesters useful in the 15 present invention are trideceth-6-phosphate which is commercially available from GAF Corporation as GAFAC RS-610, laureth-4-phosphate and laureth-5-phosphate, also available from GAF Corporation as GAF RD-510, oleth-3-phosphate available from Croda Inc. as Crodafos (RTM) N-3 and laureth-3-phosphate available 20 from Cyclo Chemical Corporation as cyclophos PL 3 and their salts. Suitable salts of these esters include, for example, sodium, potassium, ammonium, magnesium, lithium, monoethanolamine, diethanolamine and triethanolamine. Most preferred are laureth-3-phosphate, laureth-4-phosphate, 25 laureth-5-phosphate and oleth-3-phosphate.

The above-described phosphate esters can be used singly, or as mixtures of two or more.

References disclosing suitable alkyl ethoxylated phosphate monoesters include U.S. Patent 4,479,893 to Hirota et al., filed 30 October 30, 1984, and McCutcheon's Functional Materials, 1985 Annual, published by Allured Publishing Corporation, pp. 26-34.

Suspending Agent

The suspending agent used in the present compositions is selected from certain ethylene glycol esters, alkanolamides, amine oxides, xanthan gum and mixtures thereof. The ethylene glycol esters are

esters of fatty acids having from 16 to 22 carbon atoms. Examples of these ethylene glycol esters include ethylene glycol monopalmitate, ethylene glycol dipalmitate, ethylene glycol monostearate and ethylene glycol distearate. Preferred are the ethylene glycol stearates, both mono- and distearate. Most preferred is ethylene glycol distearate. Other suspending agents used herein are alkanol amides of fatty acids having from 16 to 22 carbon atoms, preferably 16 to 18 carbon atoms. Preferred alkanol amides are stearic monoethanolamide, stearic diethanolamide, stearic monoisopropanolamide and stearic diisopropanol amide.

Still other suitable suspending agents are alkyl dimethyl amine oxides having from 16 to 22 carbon atoms such as stearyl dimethyl amine oxide.

The suspending agent is present at a level of from 0.5% to 5.0%, preferably from 0.5% to 3.0%, of the shampoo compositions. The suspending agent serves to assist in suspending the silicone material in the shampoo and give pearlescence to the product. Mixtures of suspending agents are also suitable for use in the compositions of this invention.

Water

Water is the last essential component of the present invention. It is generally present at a level of from 29% to 94%, preferably from 60% to 85%, of the shampoo composition.

Optional Components

The shampoos herein can contain a variety of optional components frequently included in shampoos suitable for rendering such compositions more acceptable. Such conventional optional ingredients are well-known to those skilled in the art and are used at their art-established levels. Such ingredients include, for example, preservatives, such as benzyl alcohol, methyl paraben, propyl paraben and imidazolidinyl urea; cationic surfactants, such as cetyl trimethyl ammonium chloride, lauryl trimethyl ammonium chloride, tricetyl methyl ammonium chloride, stearyldimethyl benzyl ammonium chloride, and di(partially hydrogenated tallow) dimethylammonium chloride; thickeners and viscosity modifiers, such as a diethanolamide of a long-chain fatty acid (e.g., PEG^(RTM)/3 lauramide), block polymers of ethylene oxide and propylene oxide, such as Pluronic^(RTM) F88 offered by BASF Wyandotte, sodium chloride, ammonium xylene sulfonate, sodium sulfate, polyvinyl alcohol, and ethyl alcohol; pH adjusting agents, such as citric acid, succinic acid, phosphoric acid, sodium hydroxide, sodium carbonate; perfumes; dyes; and, sequestering agents, such as disodium ethylenediamine tetraacetate.

Suspending agents, in addition to the xanthan gum and long chain acyl derivatives described above, can also be used in the present invention. Such suspending agents can be any of a variety of expandable three layer clays. Preferably these clays have an ion exchange capacity of at least about 50 meq/100 g. of clay and more preferably, at least about 60 meq/100 g. of clay. The three-layer expandable clays used herein are classified geologically as smectites. Such smectite clays are described in Grim, Clay Mineralogy (2nd Ed.) pp. 77-79 (1968), Van Olphen, An Introduction to Clay Colloid Chemistry, (2nd Ed.) pp. 64-76 (1977).

The smectite clay minerals that are preferred for use in the

present invention are montmorillonites, hectorites and saponites (most preferably hectorites) in which the counter ions are predominantly sodium, potassium, calcium, magnesium, lithium, and the like (preferably sodium, lithium and magnesium).

5 Prior to their incorporation into the shampoo compositions, it is preferred that the clay be totally hydrated. Hydration takes place by any of a variety of methods known in the art, such as immersing the clay in water, thus permitting the clay to absorb the water. Other methods for hydrating clay are described in
10 Grimshaw, The Chemistry and Physics of Clay, pp. 525-27 (1971)

Such ingredients generally are used individually at a level of from about 0.01% to about 10%, preferably from 0.5% to 5.0%, by weight of the composition.

15 The pH of the present compositions is not critical and may be in the range of from 2 to 10.

The shampoos of the present invention can be made by any of a variety of methods known in the prior art such as first hydrating the clay in water under agitation and then mixing it
20 and the other materials together and heating to about 72°C. The mixture is mixed thoroughly for about 10 minutes at the 72°C temperature before being pumped through a high shear mill and then through a heat exchanger to cool it to about 27°C.

The high shear mill is used to provide adequate dispersion
25 of the clay and silicone materials. This is achieved by having the average particle size of the clay and silicone material preferably be about 100 microns or less.

The present compositions are used in a conventional manner for cleaning hair. From 0.1g to 10g of a composition
30 is applied to hair that has been wetted, generally with water, worked through the hair and then rinsed out.

TEST METHODS

The Static Fly Test is used to measure the amount of charge generated on a hair swatch from combing with a plastic/nylon
35 comb. Static control is believed to be an important part of the manageability delivered by hair care products. Hair swatches are prepared and tested in the following manner.

Static Fly Test

1. Swatch Preparation

5 The standard swatch consists of 4 grams of hair approximately 9.5 inches (24 cm) long. The swatch is clamped at the root end using two brass clamps such that 8 inches (20 cm) of hair are combable. The hair above the clamps is glued with Ducol^(RTM) Cement (available from Davcon Corporation, Danvers, MA 01923) to minimize hair loss during combing.

10 Three of these swatches are wet thoroughly with tap water adjusted to 100°F (38°C). 0.4 cc of the shampoo to be tested is applied to each swatch and worked completely through the hair. The shampoo is lathered for 30 seconds while working the lather out by hand. This process is repeated two times such that two washings and rinses have taken place.

15 The swatches are then hung on a rack and dried at 80°C (28°C) and 20% relative humidity for 16 hours.

Each dry swatch is then combed with 3 strokes in order to remove any tangles. Any charge on the swatch is neutralized by using a Zerostat^(RTM) gun (Model #3 obtained from Discwasher Corp.). In general, the swatch is neutralized after the trigger of the Zerostat^R gun has been depressed 2 or 3 times.

2. Static Measurement

A Faraday^(RTM) cage was used to determine the static charge of the hair swatches.

25 The Faraday cage apparatus is constructed of inner and outer cylinders made of stainless steel connected by a 1 micro-Farad capacitor. The dimensions of the inner cylinder are 9 inches (23 cm) in diameter by 14 inches (36 cm) in height. The dimensions of the outer cylinder are 12 inches (30 cm) in diameter by 14 inches (36 cm) in height. The bottom of the inner cylinder is insulated from the bottom of the outer cylinder. The voltage across the capacitor is measured by a 600A electrometer (obtained from Keithley Instruments, Cleveland, Ohio).

35 The hair swatch to be tested is touched against the inner cylinder of the Faraday cage. If the charge is not zero, the

swatch is again neutralized by repeating the above procedure with the Zerostat^R gun.

The neutral hair swatch is combed by hand ten times at a steady, consistent combing speed and pressure. After combing, the swatch is touched against the inner cylinder and the static voltage is measured by the electrometer.

3. Wet Combing Test

This test is used to determine the ease of combing freshly shampooed wet hair.

This test was carried out according to the method set forth in J. Soc. Cosmet. Chem., Vol. 27, pp 379-398 with the following modifications:

1. A Schaevitz load cell, Model PTO-G1000 was used in place of the Instron Model Metric Table Model, TM-M; and

2. The hair swatches were prepared as described above for the Static Fly Test.

Control Composition

A shampoo composition which contained neither silicone nor phosphate ester materials (A) and shampoo compositions of the prior art as disclosed in U.S. Patent 4,479,893 (B, C and D) were made by combining the following components:

	<u>Component</u>	<u>Weight %</u>			
		<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
	Ammonium lauryl sulfate	12.0	15.0	15.0	15.0
25	Ammonium laureth-3-sulfate	4.0	-	-	-
	Ammonium xylene sulfonate	1.4	-	-	-
	Xanthan gum	0.5	-	-	-
	Ethylene glycol distearate	1.5	-	-	-
	Cocoamide MEA	1.0	-	-	-
30	Cetearyl alcohol	0.5	-	-	-
	Polyether modified siloxane ¹	-	1.0	-	3.0
	Polyether modified siloxane ²	-	-	1.0	-
	Tricetylmethylammonium chloride	0.5	-	-	-
	Laureth-3-phosphate	-	1.0	1.0	1.0
35	Perfume and minor ingredients	1.2	-	-	-
	Water	77.4	83.0	83.0	81.0

¹ polyether modified siloxane obtained from Dow Corning Corporation as DC-190 Dimethicone Copolyol.

² polyether modified siloxane obtained from General Electric as GE SF-1188 Dimethicone Copolyol.

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The following Examples describe and demonstrate the compositions, the benefits, and the method for using the present invention.

EXAMPLES I-VI

10 The following compositions are representative of the present invention.

	<u>Component</u>	<u>Weight %</u>					
		<u>I</u>	<u>II</u>	<u>III</u>	<u>IV</u>	<u>V</u>	<u>VI</u>
	Ammonium lauryl sulfate	12.0	12.0	12.0	12.0	8.0	10.0
15	Ammonium laureth-3-sulfate	4.0	4.0	4.0	4.0	4.0	9.0
	Ammonium xylene sulfonate	1.4	1.4	1.4	1.4	2.5	2.0
	Xanthan gum	0.5	0.5	0.5	0.5	1.0	0.75
	Ethylene glycol distearate	1.5	1.5	1.5	1.5	2.5	2.0
	Cocoamide MEA	1.0	1.0	1.0	1.0	1.0	2.0
20	Cetearyl alcohol	0.5	0.5	0.5	0.5	0.75	0.1
	Polydimethylsiloxane fluid ¹	1.8	1.8	1.8	1.8	2.0	1.5
	Polydimethylsiloxane gum ²	1.2	1.2	1.2	1.2	1.0	0.5
	Tricetylmethylammonium chloride	0.5	0.5	0.5	0.5	0.75	0.25
	Laureth-4-phosphate	2.0	-	-	-	2.5	2.0
25	Oleth-3-phosphate	-	2.0	-	-	-	-
	Laureth-3-phosphate	-	-	1.5	1.0	-	-
	Perfume and minor ingredients	1.2	1.2	1.2	1.2	1.2	1.2
	Water	72.4	72.4	72.9	73.4	72.8	68.7

30 ¹ polydimethylsiloxane fluid with a viscosity of 350 centistokes and a molecular weight of 13,650.

² polydimethylsiloxane gum with a viscosity of 2,000,000 and a molecular weight of 400,000.

35 The siloxane gum and siloxane fluid are combined and agitated slowly in a Read^R standard mixture (available from Teledyne-Read Company) until the gum is fully dispersed into the fluid.

The silicone mixture, surfactant mixture and the remaining components are then blended together in a Tekmar^R Mill set at 70 for 2 minutes at 70°C. The resulting shampoo is stable for long periods of time at temperatures up to about 120°F (49°C).

5 1g of this shampoo composition is added to hair which has been wetted with water, worked through the hair and rinsed out. The washed hair exhibits reduced electrostatic charge, improved wet and dry combability, softness and manageability.

10 Substantially similar results are obtained when the surfactant mixture of ammonium lauryl sulfate and ammonium laureth-3-sulfate is replaced, in whole or in part, with an equivalent amount of any of the following surfactants used individually or in mixtures: potassium lauryl sulfate, potassium laureth sulfate, sodium lauryl sulfate, sodium laureth sulfate, triethanolamine lauryl sulfate,
15 triethanolamine laureth sulfate, sodium tridecyl benzene sulfonate and sodium dodecyl benzene sulfonate.

20 Substantially similar results are also obtained when the polydimethylsiloxane fluid and gum mixture of Examples I-VI is replaced in whole or in part with an equivalent amount of polydiphenylsiloxane fluid, polydiphenylsiloxane gum or mixtures thereof.

25 Substantially similar results are also obtained when the phosphate esters of Examples I-VI are replaced, in whole or in part, with an equivalent amount of laureth-5-phosphate, trideceth-6-phosphate or mixtures thereof.

EXAMPLE VII

30 This example demonstrates the reduction of electrostatic charge in hair after it is washed with the shampoo of the present invention. The shampoos of Examples I-III were made and tested against the control shampoo compositions (A-D). Using the static fly test described above, a set of three hair swatches were washed in each shampoo and the static voltage determined.

The voltage data presented below are an average of two trials (3 swatches each) of each shampoo.

<u>Set #</u>	<u>Shampoo</u>	<u>Voltage (Volts)</u>
1	Control A	0.46 ± 0.05
2	Control B	0.39 ± 0.05
3	Control C	0.53 ± 0.05
5 4	Control D	0.80 ± 0.10
5	Shampoo of Example I	0.08 ± 0.05
6	Shampoo of Example II	0.12 ± 0.05
7	Shampoo of Example III	0.12 ± 0.05

10 The data presented in the first four entries (sets 1-4) show that the hair washed in the control shampoos had a relatively high electrostatic charge, such a high charge will cause "fly-away" hair.

15 The data presented in the last three entries (sets 5-7) demonstrate that the hair washed with shampoo compositions of the present invention have substantially reduced electrostatic charge. Therefore, hair washed in these shampoo compositions will show relatively little "fly-away" hair.

EXAMPLE VIII

20 This example demonstrates the improved wet combability imparted to hair by the shampoo of the present invention.

Using the wet combing test described above, the shampoo of Example IV was made and tested against control shampoo compositions B and D. The force values presented in the table below are an average of twelve swatches.

<u>Shampoo</u>	<u>Force (grams)</u>
Control B	6000 ± 1400
Control D	4700 ± 630
Shampoo of Example IV	3300 ± 670

30 These data demonstrate that the shampoo of the present invention increases the ease of wet hair combing when compared to the shampoo compositions of the prior art.

CLAIMS

1. A shampoo composition comprising:
 - (a) from 5% to 60% of a synthetic surfactant selected from the group consisting of anionic surfactants, nonionic surfactants, zwitterionic surfactants, amphoteric surfactants, and mixtures thereof;
 - (b) from 0.01% to 10% of a dispersed silicone polymer having a molecular weight of from 300 to 1,000,000 and a viscosity of from 2 to 20,000,000 centistokes at 25°C; selected from the group consisting of polydimethylsiloxanes, polydiphenylsiloxanes, and mixtures thereof;
 - (c) from 0.1% to 5.0% of an alkyl ethoxylated phosphoric acid monoester selected from the group consisting of trideceth-6-phosphate, laureth-3-phosphate, laureth-4-phosphate, laureth-5-phosphate, oleth-3-phosphate, their salts, and mixtures thereof;
 - (d) from 0.5% to 5% of a suspending agent selected from the group consisting of xanthan gum, ethylene glycol esters of a fatty acid having from 16 to 22 carbon atoms, alkanol amides of fatty acids having from 16 to 22 carbon atoms, alkyl dimethyl amine oxides having from 16 to 22 carbon atoms, and mixtures thereof; and
 - (e) from 29% to 94% of water.
2. A shampoo composition according to Claim 1 comprising from 0.5% to 5.0% of the silicone polymer component.
3. A shampoo composition according to Claim 2 wherein the surfactant component is selected from the group consisting of



anionic surfactants, zwitterionic surfactants, amphoteric surfactants, and mixtures thereof.

4. A shampoo composition according to Claim 3 which comprises from 0.4% to about 2.0% of the alkyl ethoxylated phosphoric acid monoester component.

5. A shampoo composition according to Claim 4 wherein the suspending agent component is selected from the group of consisting of xanthan gum, ethylene glycol esters of a fatty acid having from 16 to 22 carbon atoms, and mixtures thereof.

6. A shampoo composition according to Claim 5 wherein the silicone component ^{comprises} ~~is~~ polydimethylsiloxane.

5 7. A shampoo composition according to Claim 6 wherein the alkyl ethoxylated phosphoric acid monoester component is selected from the group consisting of laureth-3-phosphate, laureth-4-phosphate, laureth-5-phosphate, oleth-3-phosphate, their salts, and mixtures thereof.

8. A shampoo composition according to Claim 7 wherein the surfactant component is an anionic surfactant.

9. A shampoo composition according to Claim 8 which comprises from 10% to 30% of the surfactant component.

10. A shampoo composition according to Claim 9 which comprises from 10% to 22% of the surfactant component and from 60% to 85% of water.

5 11. A shampoo composition according to Claim 10 wherein the surfactant component is selected from the group consisting of ammonium lauryl sulfate, ammonium laureth sulfate, triethanolamine lauryl sulfate, triethanolamine laureth sulfate, monoethanolamine lauryl sulfate, monoethanolamine laureth sulfate, diethanolamine



10 lauryl sulfate, diethanolamine laureth sulfate, sodium lauric monoglyceride sulfate, sodium lauryl sulfate, sodium laureth sulfate, potassium lauryl sulfate, potassium laureth sulfate, lauryl sarcosine, cocoyl sarcosine, ammonium cocoyl sulfate, sodium cocoyl sulfate, potassium cocoyl sulfate, diethanolamine cocoyl sulfate, monoethanolamine cocoyl sulfate, sodium tridecyl benzene sulfonate, sodium dodecyl benzene sulfonate, and mixtures thereof.

5 12. A shampoo composition according to Claim 11 wherein the surfactant component is selected from the group consisting of ammonium lauryl sulfate, ammonium laureth sulfate, triethanolamine lauryl sulfate, triethanolamine laureth sulfate, sodium tridecyl benzene sulfonate, sodium dodecyl benzene sulfonate, and mixtures thereof.

13. A shampoo composition according to Claim 12 wherein the silicone polymer component is fluid having a molecular weight of from 300 to 150,000 and a viscosity of from 2 to 100,000 centistokes at 25°C.

14. A shampoo composition according to Claim 13 wherein the silicone polymer fluid has a molecular weight of from 2,000 to 100,000 and a viscosity ranging from 20 to 40,000 centistokes at 25°C.

15. A shampoo composition according to Claim 12 wherein the silicone polymer component is a mixture of a silicone gum and a silicone fluid having a gum: fluid weight ratio of from 1:2 to 2:1.

16. A shampoo composition according to Claim 15 wherein both the silicone gum material and the silicone fluid material are polydimethylsiloxanes.

17. A shampoo composition according to Claim 14 wherein the silicone polymer fluid component is polydimethylsiloxane



having a viscosity ranging from 350 to 30,000 centistokes at 25°C.

18. A shampoo composition according to Claim 16 wherein the suspending agent component is selected from the group consisting of ethylene glycol distearate, xanthan gum, and mixtures thereof.

19. A shampoo composition according to Claim 17 wherein the suspending agent component is selected from the group consisting of ethylene glycol distearate, xanthan gum, and mixtures thereof.

20. A shampoo composition according to Claim 6 wherein the suspending agent component is selected from the group consisting of ethylene glycol distearate, xanthan gum, and mixtures thereof.

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