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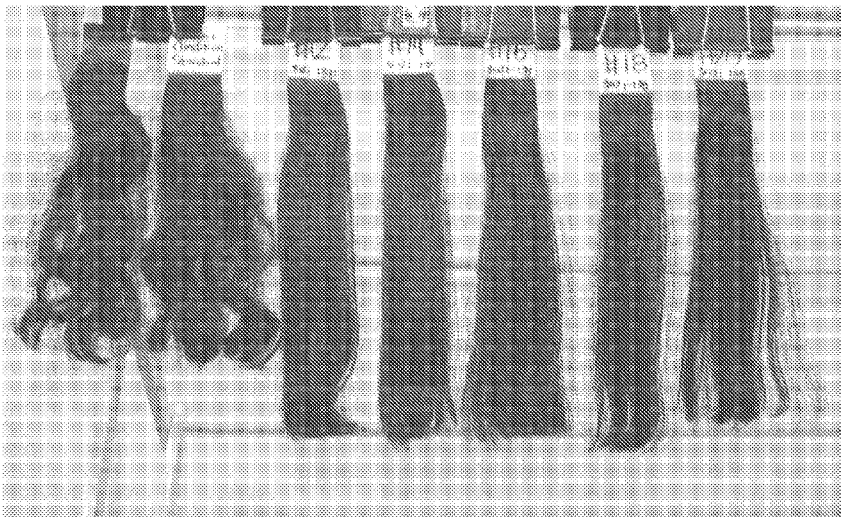
(54) **Title**: HAIR STYLING METHOD

FIG. 1



(57) **Abstract**: Provided is a method for styling hair that includes contacting the hair with a compositions that includes a poly(vinylamine-vinylformamide) copolymer and conditioning agents, applying heat to the hair in an amount effective to at least semi-permanently style the hair, and styling the hair. The method of the present invention promotes improved hair styling properties such as improved curl retention or straightness retention, e.g., under conditions of high relative humidity and temperature. The method can be used for semi-permanently straightening or curling the hair.

HAIR STYLING METHOD

BACKGROUND OF THE INVENTION

[0001] Hair styling or hair setting compositions are widely used by consumers in the cosmetic industry to retain a particular shape or style of the hair. Hair styling compositions can assist in manipulating or styling the hair, providing temporary benefits in holding the shape of the hairstyle (fixing) and/or maintaining the shine or appearance (grooming, restyling) of the hair, e.g., in the evening, during the day, between hair washing periods, or between subsequent hair setting procedures.

[0002] Various methods are used to measure the efficacy of a hair-styling composition. One method commonly employed to objectively test the efficacy of hair styling compositions involves measuring curl retention under humid conditions. Another method involves semi-permanent hair straightening using a flat iron followed by several wash-out steps. Additional methods of subjective evaluation may be employed that include, for examples: visual and tactile sensory methods (e.g., by visual examination and touching) for characteristics such as appearance (shine, cleanliness, naturalness of appearance and texture), feel (stiffness, tackiness, softness), curl memory (bounce, and restylability), straightness memory (flatness), ease of combing and brushing the hair, residue (flaking), static, smoothness, and the like. Also of importance are the aesthetic characteristics and appearance provided by hair styling compositions before, during, and after application to hair. Preferably, the product viscosity should be non-runny to avoid dripping during application. The product should be easy to spread, have a smooth texture, a non-tacky feel, and be able to dry relatively quickly on the hair.

[0003] Of further importance is the ability of hair styling compositions to control hair "frizz," which generally causes hair to become unmanageable and appear undisciplined. Frizz can become a problem when hair is exposed to higher humidity, e.g., a relative humidity of about 80% or more. The problem can worsen in people with curly hair, either naturally or "permed," leading to what many have termed a "bad hair day." In such a case, hair loses its natural shape and/or its curl definition. Hair is often subjected to a wide variety of stresses that can cause damage to the hair, resulting in frizz. These include shampooing, rinsing, drying, heating, combing, styling, perming, coloring, exposure to the elements, and the like. Such stresses can leave the hair in a dry, rough, lusterless, or frizzy condition, which

can be caused, e.g., by repeated abrasion of the hair surface and removal of the hair's natural oils and other natural conditioning and moisturizing components. Additionally, hair is often subjected to weather-related stresses, e.g., sunlight, wind, and changes in temperature and humidity, which can cause hair frizz and other conditions considered by consumers to be cosmetically undesirable.

[0004] Hair-setting compositions that include one or more hair-setting polymers to impart styling and/or fixative properties have been disclosed. For example, U.S. Patent No. 4,713,236 describes compositions that include amine-containing polymers and copolymers that contain a primary pendant amine group, for imparting conditioning properties to hair. U.S. Patent Nos. 5,478,553 and 5,632,977 describe hair fixative compositions containing polymeric n-vinyl formamide and methods of treating hair. U.S. Patent No. 6,800,302 describes compositions comprising hydrocarbon substituted monosaccharides that can be heat activated for durable non-permanent shaping of keratinous fibers. A "Brazilian" hair straightening treatment has also been described that requires the use of a formaldehyde solution in conjunction with a flat iron.

[0005] Providing hair styling compositions that exhibit good high humidity curl and/or straightness retention while maintaining desirable subjective properties, e.g., smooth texture, curl memory, bounce, naturalness of appearance, etc., has been difficult to achieve with conventional hair-setting compositions. There is an ongoing need for hair styling compositions that provide high humidity curl and/or straightness retention, as well as desirable subjective properties. The present invention provides such compositions and associated methods of use.

BRIEF SUMMARY OF THE INVENTION

[0006] The present invention provides a method for styling hair, which method includes contacting the hair with a composition comprising a hair styling effective amount of a poly(vinylamine-vinylformamide) copolymer, applying heat to the hair in an amount effective to at least semi-permanently style the hair, and styling to at least semi-permanently style the hair.

[0007] The present invention also provides a method for straightening hair, the method comprising contacting hair with a composition comprising a hair styling effective amount of a poly(vinylamine-vinylformamide) copolymer, applying heat to the hair at a temperature of

at least about 100° C for at least about 1 second, and applying a straight surface against the hair to at least semi-permanently straighten the hair.

[0008] The present invention further provides a method for curling hair, the method comprising contacting the hair with an effective amount of a composition comprising a hair styling effective amount of a poly(vinylamine-vinylformamide) copolymer, applying heat to the hair at a temperature of at least about 100° C for at least about 1 second, and applying a curved surface against the hair to at least semi-permanently curl the hair.

[0009] The present invention provides a method for styling hair, which method includes contacting the hair with a composition comprising a hair styling effective amount of a poly(vinylamine-vinylformamide) copolymer, subsequently, contacting the hair with a composition comprising a conditioning agent, applying heat to the hair in an amount effective to at least semi-permanently style the hair, and styling to at least semi-permanently style the hair.

[0010] The present invention also provides a method for straightening hair, the method comprising contacting hair with a composition comprising a hair styling effective amount of a poly(vinylamine-vinylformamide) copolymer, subsequently, contacting the hair with a composition comprising a conditioning agent, applying heat to the hair at a temperature of at least about 100° C for at least about 1 second, and applying a straight surface against the hair to at least semi-permanently straighten the hair.

[0011] The present invention further provides a method for curling hair, the method comprising contacting the hair with an effective amount of a composition comprising a hair styling effective amount of a poly(vinylamine-vinylformamide) copolymer, subsequently, contacting the hair with a composition comprising a conditioning agent, applying heat to the hair at a temperature of at least about 100° C for at least about 1 second and applying a curved surface against the hair to at least semi-permanently curl the hair.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 shows virgin hair tresses that have been treated by a method of the present invention and the affects of five shampoo/conditioner treatments on the tresses.

[0013] FIG. 2 shows bleached hair tresses that have been treated by a method of the present invention and the affects of five shampoo/conditioner treatments on the tresses.

DETAILED DESCRIPTION OF THE INVENTION

[0014] In accordance with the present invention, keratinous fibers such as mammalian (e.g., human) hair are treated with a composition that includes an effective amount of one or more poly(vinylamine-vinylformamide) copolymers and an optional carrier. The effective amount used preferably includes an amount that is effective to retain hair-styling, such as e.g., curl retention or straightness retention, through at least three washing cycles. Preferably the carrier used in the composition is an aqueous carrier. The hair can be contacted with the composition for any effective amount of time, e.g. from about 1 minute to about 30 minutes, from about 1 minutes to about 20 minutes, or from about 5 minutes to about 10 minutes. The hair can than be optionally treated with a composition comprising a conditioning agent. The treated hair, i.e., hair treated with the poly(vinylamine-vinylformamide) copolymer composition either alone or in combination with a conditioning composition, has heat applied in an amount effective to at least semi-permanently style the hair, e.g., to provide curl retention or straightness retention in the styled hair after at least three washing cycles. The heat can be applied under conditions set forth in greater detail below. The treated hair can then be styled using any suitable method to at least semi-permanently style the hair, including conventional styling methods. Preferably, the styling comprises curling the hair or straightening the hair; even more preferably, the styling comprises straightening the hair.

[0015] The poly(vinylamine-vinylformamide) copolymer composition used in accordance with the method of present invention preferably includes one or more poly(vinylamine-vinylformamide) copolymers as a styling polymer. In some embodiments, the composition used in accordance with the method of the present invention can include one or more linear poly(vinylamine-vinylformamide) copolymers, a polyvinylpyrrolidone polymer, and an aqueous carrier. The poly(vinylamine-vinylformamide) copolymer is preferably present in the composition in a hair-styling effective amount, e.g., in an amount effective to promote at least about 50% curl retention in the hair after about 2 hours under conditions of about 90% relative humidity and a temperature of about 75° F [24° C], when the composition is applied to mammalian hair. Suitable poly(vinylamine-vinylformamide) copolymers can be obtained, e.g., by partial hydrolysis of a polyvinylformamide, to produce one or more copolymers that contain vinylamine and vinylformamide monomeric units. Poly(vinylamine-vinylformamide) copolymers, which can be used as a styling polymer in the composition, include the polymers contained in products sold under the trademark LUPAMIN®, which are sold by BASF and

are supplied as aqueous solutions containing linear poly(vinylamine-vinylformamide) copolymers . The polymers in LUPAMIN® are prepared by polymerization of vinylformamide followed by partial hydrolysis of the polyvinylformamide. Exemplary poly(vinylamine-vinylformamide) copolymers, which can be used in the composition, include the polymers contained in LUPAMIN® 9095, LUPAMIN® 9050, LUPAMIN® 9030, LUPAMIN® 9010, LUPAMIN® 5095 and LUPAMIN® 1595.

[0016] The digits used in conjunction with the LUPAMIN® product name correspond to the molecular weight and the extent of hydrolysis of the polymer. The first two (i.e., first and second) digits in the product name correspond to the polymer molecular weight. For instance, the first two digits in LUPAMIN® 9095, LUPAMIN® 9050, LUPAMIN® 9030 and LUPAMIN® 9010, i.e., "90," are indicative of the molecular weight of the polymer. The average molecular weights of exemplary polymers and other properties associated with corresponding LUPAMIN® products, as published in BASF's technical bulletins, are summarized below in Table A.

Table A

	Lupamin® 9095	Lupamin® 9030	Lupamin® 9010	Lupamin® 5095	Lupamin® 1595
Form	Liquid	Liquid	Liquid	Clear Pale Yellow Liquid	Clear Pale Yellow Liquid
Density (g/mL)	1.08	1.08	1.08	1.08	1.08
% Solids (wt%)	20-22%	16-18%	13-15%	21-24%	28-32%
% Polymer (wt%)	6-8	10-12	12-14*	8-12	9-11
Ave. Molecular Weight (g/mol)	340,000	340,000	340,000	45,000	<10,000
Viscosity (mPas at 20ºC)	>5000	<5000	<5000	<1000	<1000
pH	7-9	7-9	7-9	7-9	7-9

*estimated based on solids content, hydrolysis index and polymer content relative to total solids reported for other LUPAMIN® products

LUPAMIN® 9050 is believed to have a molecular weight of 340,000 based on the molecular weights reported in BASF's technical bulletins for LUPAMIN® 9095, 9030 and 9010. LUPAMIN® 9050 is believed to have a solids content of about 16-19 wt% based on the results of solids testing performed on a product sample and solids content reported for LUPAMIN® 9095, 9030 and 9010. LUPAMIN® 9050 is estimated to have a poly(vinylamine-vinylformamide) copolymer content (i.e., polymer content) of about 9-12 wt% based on solids testing, and reported solids and polymer content for other LUPAMIN® products.

[0017] The last two (i.e., third and fourth) digits used in conjunction with the LUPAMIN® product name represent the degree of hydrolysis, which corresponds to the percent of the formamide functional groups in the polymer that have been hydrolyzed and converted into vinylamine units. For instance, the last two digits in LUPAMIN® 9095, i.e., "95," indicate the degree of hydrolysis, i.e., that the polymer is about 95% hydrolyzed (or greater than 90% hydrolyzed as noted in BASF's technical bulletins for Lupamin® 5095 and Lupamin® 1595). Thus, the polymers contained in LUPAMIN® 9095, LUPAMIN® 5095 and LUPAMIN® 1595 are believed to contain about 95% vinylamine monomeric units (vinylamine monomers) and about 5% vinylformamide monomeric units (vinylformamide monomers). By contrast, LUPAMIN® 9050 is believed to contain about 50% vinylamine monomers and about 50% vinylformamide monomers, LUPAMIN® 9030 is believed to contain about 30% vinylamine monomers and about 70% vinylformamide monomers, and LUPAMIN® 9010 is believed to contain about 10% vinylamine monomers and about 90% vinylformamide monomers.

[0018] The poly(vinylamine-vinylformamide) copolymer composition used in accordance with the method of the present invention also can include two or more poly(vinylamine-vinylformamide) copolymers. In some embodiments, combinations of two or more poly(vinylamine-vinylformamide) copolymers have been found to promote unexpectedly superior high humidity curl retention properties. In one embodiment, the composition used in accordance with the method of the present invention includes at least one high molecular weight poly(vinylamine-vinylformamide) copolymer and at least one low molecular weight poly(vinylamine-vinylformamide) copolymer. As used herein, a high molecular weight poly(vinylamine-vinylformamide) copolymer refers to a poly(vinylamine-vinylformamide)

copolymer with an average molecular weight greater than about 100,000 g/mole and a low molecular weight poly(vinylamine-vinylformamide) copolymer refers to a poly(vinylamine-vinylformamide) copolymer with an average molecular weight of about 100,000 g/mole or less.

[0019] The high molecular weight poly(vinylamine-vinylformamide) copolymer can include, e.g., at most about 95% vinylamine monomers (e.g., about 95% vinylamine monomers and about 5% vinylformamide monomers), at most about 50% vinylamine monomers (e.g., about 50% vinylamine monomers and about 50% vinylformamide monomers), at most about 30% vinylamine monomers (e.g., about 30% vinylamine monomers and about 70% vinylformamide monomers), or at most about 10% vinylamine monomers (e.g., about 10% vinylamine monomers and about 90% vinylformamide monomers). Suitable high molecular weight poly(vinylamine-vinylformamide) copolymers include, for example, LUPAMIN® 9095, LUPAMIN® 9050, LUPAMIN® 9030 and LUPAMIN® 9010 polymers. The low molecular weight poly(vinylamine-vinylformamide) copolymer can include, e.g., at most about 95% vinylamine monomers (e.g., about 95% vinylamine monomers and about 5% vinylformamide monomers). Suitable low molecular weight poly(vinylamine-vinylformamide) copolymers include, e.g., LUPAMIN® 5095 and LUPAMIN® 1595 polymers.

[0020] The poly(vinylamine-vinylformamide) copolymer can be present in the composition in an amount of, e.g., from about 0.01 wt% to about 90 wt%, e.g., from about 0.01 wt% to about 50 wt%, e.g., from about 0.01 wt% to about 30 wt%, e.g., from about 0.01 wt% to about 20 wt%, e.g., from about 0.01 wt% to about 10 wt%, e.g., from about 0.1 wt% to about 20 wt%, e.g., from about 0.1 wt% to about 15 wt%, e.g., from about 0.1 wt% to about 10 wt%, e.g., from about 1 wt% to about 8 wt%, e.g., from about 2 wt% to about 7 wt%, e.g., from about 4 wt% to about 6 wt%, based on the total weight of the composition. In some embodiments, the poly(vinylamine-vinylformamide) copolymer composition contains from about 4 wt% to about 6 wt% of one or more poly(vinylamine-vinylformamide) copolymers, based on the total weight of the composition. In some embodiments. The poly(vinylamine-vinylformamide) copolymer utilizes LUPAMIN® 9095 as the poly(vinylamine-vinylformamide) copolymer.

[0021] The conditioning composition used in accordance with the method of the present invention preferably includes a conditioning agent. Suitable conditioning agents can include,

for example, one or more silicones. Exemplary silicones include volatile silicones, and for example, include cyclohexasiloxane and cyclopentasiloxane.

[0022] The conditioning agents in the condition composition can be present in an amount of, e.g., from about 0.1 wt% to about 90 wt%, e.g., from about 0.1 wt% to about 80 wt%, e.g., from about 0.1 wt% to about 70 wt%, e.g., from about 0.1 wt% to about 60 wt%, e.g., from about 0.1 wt% to about 50 wt%, e.g., from about 0.5 wt% to about 60 wt%, e.g., from about 1 wt% to about 60 wt%, e.g., from about 10 wt% to about 60 wt%, e.g., from about 20 wt% to about 60 wt%, e.g., from about 30 wt% to about 50 wt%, based on the total weight of the conditioning composition. In some embodiments, the conditioning composition contains from about 40 wt% to about 50 wt% of one or more conditioning agents, based on the total weight of the conditioning composition. In some embodiments, the conditioning compositions utilize a combination of cyclohexasiloxane and cyclopentasiloxane as the conditioning agents.

[0023] Either composition, i.e., the poly(vinylamine-vinylformamide) copolymer composition and/or the conditioning composition, used in accordance with the method of the present invention can include polyvinylpyrrolidone (PVP), which has been found to provide the hair with good styling performance and desirable subjective properties such as, e.g., gloss, low flaking and smooth texture, without sacrificing high humidity curl retention or resistance to frizz. The composition can include polyvinylpyrrolidone in an amount of, e.g., from about 0.01 wt% to about 20 wt%, e.g., from about 0.05 wt% to about 15 wt%, e.g., from about 0.1 wt% to about 10 wt%, e.g., from about 0.1 wt% to about 5 wt%, e.g., from about 0.1 wt% to about 1 wt%, or, e.g., from about 0.5 wt% to about 1 wt%.

[0024] Either composition used in accordance with the method of the present invention can further include one or more additional ingredients such as, for example, a conditioning agent, a film former or modifier (in addition to PVP), a thickener, a surfactant, an emollient, an emulsifier, a propellant, a fatty alcohol, and the like, and combinations thereof. The composition preferably exists in the form of a mousse or a gel.

[0025] Suitable additional film formers beyond PVP can include, e.g., vinylpyrrolidone copolymers, cationic cellulose derivatives, polyurethanes, acrylates/hydroxyester acrylate copolymer, celluloses and polysaccharide gums and their derivatives and the like, and combinations thereof. Either composition used in accordance with the method of the present invention can include one or more additional film formers in an amount of e.g., from about 0.01 wt% to about 10 wt%, e.g., from about 0.05 wt% to about 5 wt%, or, e.g., from about

0.1 wt% to about 5 wt%. Suitable film forming polymers also can include, e.g., one or more nonionic copolymers of N-vinylpyrrolidone, methacrylamide, and N-vinylimidazole.

[0026] Suitable film forming polymers also can include, e.g., one or more copolymers of vinylpyrrolidone and dimethylaminoethyl methacrylate(s). Either composition used in accordance with the method of the present invention can include one or more film forming vinylpyrrolidone copolymers in an amount of, e.g., from about 0.01 wt% to about 15 wt%, e.g., from about 0.05 wt% to about 10 wt%, e.g., or from about 0.1 wt% to about 10 wt%. Exemplary film forming vinylpyrrolidone copolymers include LUVISET® CLEAR, available from BASF, and VP/dimethylaminoethyl methacrylate copolymer 845-G available from International Specialty Products.

[0027] Suitable film formers further can include, e.g., cationic cellulose derivatives. Either composition can include one or more cationic cellulose derivatives in an amount of, e.g., from about 0.01 wt% to about 10 wt%, e.g., from about 0.02 wt% to about 5 wt%, or, e.g., from about 0.05 wt% to about 5 wt%. A preferred class of cationic cellulose derivatives includes copolymers of a hydroxyethylcellulose and diallyldimethyl ammonium chloride. An exemplary cationic cellulose derivative is polyquaternium-4, a copolymer of cellulose, 2-hydroxyethyl ether and diallyldimethyl ammonium chloride. Polyquaternium-4 is the active ingredient in products marketed under the names CELQUAT® H-100 and CELQUAT® L-200 available from Akzo Nobel. It will be appreciated that some film formers, e.g., CELQUAT® H-100 may also function as conditioning agents.

[0028] Suitable film modifiers can include, for example, one or more aminosilicones, one or more PEG-n dimethicones, one or more PEG-n/PPG-n dimethicones, one or more cyclomethicones, one or more plasticizers (e.g., glycols, glycol ethers, glycerine), and the like, and combinations thereof. Suitable dimethicones can include polyethylene/propylene glycol derivatives of dimethicone containing an average of n moles of ethylene/propylene oxide, e.g., where n is in the range of about 3 to about 20. An exemplary PEG-n/PPG-n dimethicone includes a PEG-18/PPG-18 dimethicone, available from Dow Corning under the trade name DC-190. Either composition used in accordance with the method of the present invention can include one or more film modifiers in an amount, e.g., from about 0.01 wt% to about 10 wt%, e.g., from about 0.02 wt% to about 5 wt%, or, e.g., from about 0.05 wt% to about 5 wt%.

[0029] Suitable thickeners can include, e.g., one or more associative and non-associative thickeners, one or more polysaccharides, polysaccharide derivatives, gums (e.g., guar gum, xanthan gum), and the like, and combinations thereof. Suitable associative thickeners can include, e.g., acrylates/beheneth-25 acrylate copolymers, polyether-1/1,3-butylene glycol blends, and combinations thereof. Either composition used in accordance with the method of the present invention can include one or more thickeners in an amount of, e.g., from about 0.01 wt% to about 15 wt%, e.g., from about 0.05 wt% to about 8.0 wt%, or, e.g., from about 0.1 wt% to about 3.0 wt%. Exemplary thickeners include TINOVIS® GTC, available from Ciba Specialty Chemicals, PURE THIX® HH, available from Southern Clay.

[0030] Suitable fatty alcohols in either composition used in accordance with the method of the present invention can include linear or branched, saturated or unsaturated C_8-C_{24} fatty alcohol. The fatty alcohols can be selected from the group consisting of myristyl alcohol, cetyl alcohol, stearyl alcohol, oleyl alcohol, behenyl alcohol, or the like, and mixtures thereof. The fatty alcohols can be present in any suitable amount.

[0031] Suitable emulsifiers in either composition used in accordance with the method of the present invention can include stearamidopropyl dimethylamine, glyceryl esters, particularly those with an HLB value of about 3 to about 4, for example, about 3.5 to about 4.0 (such as glyceryl stearate), or the like, and mixtures thereof. The emulsifier can be present in any suitable amount.

[0032] Suitable emollients in either composition used in accordance with the method of the present invention can include an alkyl (C_{12} – C_{15}) benzoate. Either of the compositions used in accordance with the method of the present invention can include, for example, from about 0.01 wt% to about 15 wt% of an emollient, e.g., from about 0.1 wt% to about 10 wt%, e.g., from about 1 wt% to about 5 wt%, based on the total weight of the composition. In some embodiments, the alkyl (C_{12} – C_{15}) benzoate is present in the conditioning composition.

[0033] The carriers in either of the compositions used in accordance with the method of the present invention can comprise any suitable carrier taken alone or in any suitable combination. Suitable carriers can include, for example, aqueous carriers that can include any suitable quantity of water, e.g., from about 25 wt% to about 97 wt% water, from about 30% to about 95% water, or from about 40 wt% to about 60 wt%. Suitable carriers can include solvents such as alcohols, polyols, or mixtures thereof. Exemplary alcohols include methanol, ethanol, propanol, and butanol. Exemplary polyols include polyalkyl glycols such as ethylene glycol, propylene glycol, butylene glycol, and glycerine. In some embodiments,

the carrier is water alone. In some embodiments, the carriers include aqueous solutions of solvents that can be present in either composition used in accordance with the method of the present invention, e.g. in an amount of from about 25 wt% to about 97 wt% solvent, from about 30 wt% to about 95 wt% solvent, or from about 40 wt% to about 60 wt% solvent.

[0034] Suitable additional conditioning agents can include, for example, one or more amphoteric copolymers, one or more amphoteric terpolymers, one or more cationic conditioners and the like, and combinations thereof. Suitable conditioning agents can include amphoteric terpolymers of acrylic acid, diallyl dimethyl ammonium chloride, and acrylamide. Either composition used in accordance with the method of the present invention can include one or more additional conditioning agents in an amount, e.g., from about 0.01 wt% to about 20 wt%, e.g., from about 0.01 wt% to about 15 wt%, or, e.g., from about 0.05 wt% to about 10 wt%. An exemplary conditioning agent is polyquaternium-39, sold under the trade name MERQUAT® PLUS 3330, available from Nalco Co. Other exemplary products that may serve as conditioning agents include polyquaternium-4 and/or VP/dimethylaminoethyl methacrylate copolymer 845-G.

[0035] Suitable surfactants can include, e.g., one or more anionic, nonionic, cationic, and amphoteric surfactants, with nonionic, cationic, and amphoteric surfactants being preferred. Exemplary surfactants include PPG-5/Ceteth 20, Oleth-20, polysorbate-20, and cocamidopropyl betaine. Either composition used in accordance with the method of the present invention can include one or more surfactants in an amount, e.g., from about 0.01 wt% to about 20 wt%, e.g., from about 0.01 wt% to about 15 wt%, or, e.g., from about 0.05 wt% to about 10 wt% of one or more surfactants.

[0036] Either composition used in accordance with the method of the present invention can include other components that may be suitable for use in conventional hair styling compositions such as, e.g., conventional hair fixative, hair setting and/or hair grooming gels, rinses, emulsions (oil-in-water, water-in-oil or multiphase), lotions, creams, pomades, sprays (pressurized or non-pressurized), spritzes, mousses, foams, conditioners, and solids (e.g., as sticks, semisolids and the like).

[0037] If desired, either composition used in accordance with the method of the present invention can include a propellant, e.g., for dispensing the composition (e.g., in the form of a mousse or gel). Either composition can include one or more propellants in an amount, e.g., from about 0.01 wt% to about 20 wt%, e.g., from about 0.01 wt% to about 15 wt%, or, e.g.,

from about 0.05 wt% to about 10 wt% of one or more propellants. Exemplary propellants include propane, butane, and mixtures thereof.

[0038] In some embodiments, the hair-styling method of the present invention exhibits at least semi-permanent hair straightening after at least about three wash cycles comprising shampoo and conditioner treatments and after exposure for over about 12 hours to a high humidity environment, conditions including 90% Relative Humidity and a temperature of about 75° F [24° C].

[0039] In accordance with the method of the present invention, the keratinous fibers may be styled in any suitable manner. In addition, either composition can be applied in any suitable manner, e.g., by working the composition through the hair, e.g., with the hands and fingers or with a suitable implement such as, e.g., a comb or brush, to ensure uniform coverage. In some embodiments, the hair may be optionally, partially dried after applying the poly(vinylamine-vinylformamide) copolymer composition and then an additional conditioner composition may be optionally contacted with the hair before drying or shaping steps.

[0040] In accordance with the present invention, heat is applied to hair treated with the composition comprising the poly(vinylamine-vinylformamide) copolymer or hair treated with the composition comprising the poly (vinylamine-vinylformamide) copolymer and the composition comprising the conditioning agent. The heat is applied in amount effective to at least semi-permanently style the hair, and the hair is accordingly styled at least semi-permanently. An effective amount of heat may be applied by contacting the hair with a styling device (e.g., a flat iron, curling iron, curlers, etc.) at a temperature (e.g., the surface temperature of the portion of the device that contacts the hair) of at least about 100° C for an effective time period. If a styling device is used, the temperature of the device preferably ranges from about 190° C to about 240° C, from about 200° C to about 240° C, or from about 200° C to about 230° C. In some embodiments, heat is applied to the hair with a styling device at a temperature of about 225° C [438° F]. The heat can be applied for an effective time period, for example, by contacting a section of hair with a device for an appropriate length of time (e.g., for at least about 1 second). The heat also can be applied for an effective time period, for example, by passing or drawing a device (e.g., a flat iron) through a section of hair (e.g., lengthwise, e.g., with a combing motion through the hair while the styling surface of the device remains in contact with at least a portion of the hair during each pass) at an appropriate rate, e.g., for from about 2 seconds to about 10 seconds. It will be appreciated

that the time period required for contacting the hair with a heat-styling device, to semi-permanently style hair in accordance with the invention, can depend on a number of factors. Such factors can include, e.g., the nature and extent of chemical treatment on the hair, the type and condition of hair involved, the length of the hair (which, of course, may impact the rate and length of time required for each pass for certain styling devices), the temperature of the device, the nature of the device, and other factors. A suitable heat-styling method is disclosed in US 2007/0280896, which discloses a method for straightening hair by passing a flat iron at 193° C over the hair at least three times for 6-7 seconds each pass.

[0041] The styling thus can include contacting the hair with a shaped surface so as to manipulate the hair to conform to the shape of the surface. If desired, heat can be applied directly to the hair by contacting the hair with a heated shaped surface, which can also be used to style and manipulate the hair to conform to the shape of the surface. Thus, in some embodiments, the shaped surface is heated and the heat is applied to the hair with the shaped surface. If desired, the heat application and styling can be performed simultaneously. Heat can also be applied via an indirect heat source such as, for example, blow dryers, hood dryers, hating caps, steamers, and combinations thereof. In some embodiments, it can be desirable to use a combination of direct and indirect heat sources. When using a shaped surface, a straight surface may be used for straightening hair and a curved surface may be used for curling hair, or a combination of such surfaces may be used, if desired. Preferably, the heat can be applied in multiple stages or passes. Such stages or passes can include applying heat to the hair and styling as described herein at least two times, e.g., so as to apply heat and to manipulate the hair to conform to the shape of a surface with intermediate removal of the heat source between stages or passes. Thus, in some embodiments, the heat application and styling are performed two or more times. In other embodiments, the heat application and styling are performed three or more times. For example, when using a flat iron to straightening the hair, two passes of the iron over (against) the hair can be performed, and in some instances three passes of the iron over (against) the hair can be performed.

[0042] The present invention further provides a method of straightening hair, which preferably includes contacting hair with a composition comprising a hair styling effective amount of a poly(vinylamine-vinylformamide) copolymer, applying heat to the hair at a temperature of at least about 100° C for at least about 1 second and applying a straight surface against the hair to at least semi-permanently straighten the hair.

[0043] The present invention further provides a method of curling hair, the method comprising contacting the hair with an effective amount of a composition comprising a hair straightening effective amount of a poly(vinylamine-vinylformamide) copolymer, applying heat to the hair at a temperature of at least about 100° C for at least about 1 second and applying a curved surface against the hair to at least semi-permanently curl the hair.

[0044] The present invention further provides a method of straightening hair, which preferably includes contacting hair with a composition comprising a hair styling effective amount of a poly(vinylamine-vinylformamide) copolymer, contacting the hair with a conditioner composition, and applying heat to the hair at a temperature of at least about 100° C for at least about 1 second and applying a straight surface against the hair to at least semi-permanently straighten the hair.

[0045] The present invention further provides a method of curling hair, the method comprising contacting the hair with an effective amount of a composition comprising a hair straightening effective amount of a poly(vinylamine-vinylformamide) copolymer, contacting the hair with a conditioner composition, and applying heat to the hair at a temperature of at least about 100° C for at least about 1 second and applying a curved surface against the hair to at least semi-permanently curl the hair.

[0046] The following examples further illustrate the invention but, of course, should not be construed as in any way limiting its scope.

EXAMPLE 1

[0047] This example demonstrates a method for styling hair and assessing the straightening benefits of solutions containing different amounts of poly(vinylamine-vinylformamide) copolymer in comparison to untreated hair. Four different solutions of poly(vinylamine-vinylformamide) copolymer were prepared using Lupamin® 9095 at concentrations of 5 wt%, 10 wt%, 20 wt%, and 30 wt%. The solutions were then evaluated in this example by a screening method for semi-permanent hair straightening 1 inch [2.5 cm] tresses that was conducted in three phases, which included (1) obtaining tresses, (2) applying hair-straightening treatment compositions, and (3) washing out the tresses.

[0048] In the first phase, dry curly hair tresses were obtained from International Hair Importers. The hair tresses were formed into 7 inch [17.8 cm] lengths cut in 1 inch [2.5 cm] wide swatches.

[0049] In the second phase, the tresses were contacted with a composition comprising a poly(vinylamine-vinylformamide) copolymer and an aqueous carrier using 5mL of the testing solution for 5 minutes. After contacting the hair tresses with the compositions, the tresses were blown dry for one minute until the free moisture was gone, i.e. to about 80% dryness. A ceramic flat iron was applied to the hair tress at a temperature of about 438° F [225° C] with three passes at a rate of about 5 seconds per pass on a quarter section of the tress with a combing stroke after each pass followed by three passes on the whole tress. The hair tresses were then allowed to hang at room temperature for a set time period at a minimum 48 hours.

[0050] In the third phase, the straightened hair tresses were washed out with warm tap water at approximately 35-40° C flowing at about 0.7 gallons/minute [2650 cc/minute]. Then about 0.6 mL of a commercial shampoo was applied and distributed onto the tresses from top to bottom rubbing the product down and up three times on each side (front/back) with about a 1 minute contact time. The tresses were placed in the palm on one hand and then rinsed for about 30 seconds. Similarly, about 1 mL of a commercial conditioner was applied onto the tresses from top to bottom and distributed by rubbing the conditioner down and up three times on each side (front/back) with about a 1 minute contact time. The tresses were rinsed again for about 30 seconds under warm tap water. The tresses were then blown dry completely and left to hang for a minimum of 6 hours. The tresses were then subjected to five and ten more washes that repeated the wash described above when the hair was dry.

[0051] The tresses were contacted with the various compositions as summarized in Table B below. The method using the poly(vinylamine-vinylformamide) copolymer compositions resulted in improved hair styling and maintained straighter hair throughout the screening method as compared to the control hair tresses without any solution.

Table B

Test #	After straightening treatment	1 shampoo cycle	5 shampoo cycles (Rank 1-most straight, 6-least	5 Shampoo/ Conditioner cycles	10 shampoo cycles
#1. 10 wt% Lupamin® 9095	Tresses somewhat stiff	Feel improved, no stiffness. After drying, tresses are still straight	3	All straight	N/A
#2. 20 wt% Lupamin® 9095	Tresses stiff	Feel improved, no stiffness. After drying, tresses are still straight	1	All straight	Wavy, curls came somewhat back
#3. 30 wt% Lupamin® 9095	Tresses stiff	Feel improved, no stiffness. After drying, tresses are still straight	2	All straight	N/A
#4. 5 wt% Lupamin® 9095	No stiff feel, smooth and easy comb thru	After drying, tresses are still straight	4	Wavy, curls somewhat came back	N/A
#5. Control No solution	No stiff feel, smooth and easy comb thru	After drying, tresses are still straight	6	Curls came back	

EXAMPLE 2

[0052] This example demonstrates a method for styling hair and assessing the styling benefits of poly(vinylamine-vinylformamide) copolymer composition and a conditioning composition. The compositions were evaluated in this example by a screening method for semi-permanent hair straightening 1 inch [2.5 cm] tresses that was conducted in three phases, which included (1) obtaining tresses, (2) applying hair-straightening treatment compositions, and (3) washing out the tresses.

[0053] In the first phase, dry curly hair tresses were obtained from International Hair Importers. The hair tresses were formed into 7 inch [17.8 cm] lengths cut in 1 inch [2.5 cm] wide swatches.

[0054] In the second phase, the tresses were washed out with warm tap water at approximately 35-40° C flowing at about 0.7 gallons/minute [2650 cc/minute]. Then about 0.6 mL of a commercial shampoo was applied and distributed onto the tresses from top to bottom rubbing the product down and up three times on each side (front/back) with about a 1 minute contact time. The tresses were placed in the palm on one hand and then rinsed for about 30 seconds and towel dried. The tresses were contacted with a poly(vinylamine-vinylformamide) copolymer composition containing about 5 wt% Lupamin® 9095, about 50 wt% denatured alcohol (i.e., ethanol), and the balance being de-ionized water. After contacting the hair tresses with the composition for a time period of about 10 minutes, the tresses were blown dry for up to three minutes until the free moisture was gone, i.e. to about 80% dryness. The tresses were then sprayed with a conditioning composition containing about 44 wt% of a combination of cyclohexasiloxane and cyclopentasiloxane, about 51.9 wt% denatured alcohol (i.e., ethanol), about 3.9 wt % of alkyl ($C_{12} - C_{15}$) benzoate, and about 0.2 wt% fragrance. A ceramic flat iron was then applied to the hair tress at a nominal temperature of about 225° C [438° F] with two passes at a rate of about 10 seconds per pass per quarter section with a combing stroke after each pass and a final pass three passes over the whole tress. Then the hair fibers were detangled by combing through the whole tress, and the flat iron was applied again with two more passes with a comb through after each pass in order to obtain styled and straightened hair tresses. The hair tresses were then allowed to hang at room temperature for a set time period at a minimum 24 hours.

[0055] In the third phase, the straightened hair tresses were washed out with warm tap water at approximately 35-40° C flowing at about 0.7 gallons/minute [2650 cc/minute]. Then about 1 cc of a commercial shampoo was applied and distributed onto the tresses from top to bottom rubbing the product down and up three times on each side (front/back) with about a 1 minute contact time. The tresses were placed in the palm on one hand and then rinsed for about 30 seconds. Similarly, about 1 cc of a commercial conditioner was applied onto the tresses from top to bottom and distributed by rubbing the conditioner down and up three times on each side (front/back) with about a 1 minute contact time. The tresses were rinsed again for about 30 seconds under warm tap water. The tresses were then hung to air dry. The

tresses were then subjected to four more washes that repeated the wash described above when the hair was dry.

[0056] The method using the poly(vinylamine-vinylformamide) copolymer compositions in combination with the conditioning composition maintained straightened hair that lasted through five shampoo/conditioner treatments. As seen in FIG. 1 and FIG. 2, the method of styling in Example 2, provided results in which the hair tresses maintained the styling, i.e., straightening, that lasted through five shampoo/conditioner treatments.

[0057] All references, including publications, patent applications, and patents, cited herein are hereby incorporated by reference to the same extent as if each reference were individually and specifically indicated to be incorporated by reference and were set forth in its entirety herein.

[0058] The use of the terms "a" and "an" and "the" and similar referents in the context of describing the invention (especially in the context of the following claims) are to be construed to cover both the singular and the plural, unless otherwise indicated herein or clearly contradicted by context. The terms "comprising," "having," "including," and "containing" are to be construed as open-ended terms (*i.e.*, meaning "including, but not limited to,") unless otherwise noted. Recitation of ranges of values herein are merely intended to serve as a shorthand method of referring individually to each separate value falling within the range, unless otherwise indicated herein, and each separate value is incorporated into the specification as if it were individually recited herein. All methods described herein can be performed in any suitable order unless otherwise indicated herein or otherwise clearly contradicted by context. The use of any and all examples, or exemplary language (*e.g.*, "such as") provided herein, is intended merely to better illuminate the invention and does not pose a limitation on the scope of the invention unless otherwise claimed. No language in the specification should be construed as indicating any non-claimed element as essential to the practice of the invention.

[0059] Preferred embodiments of this invention are described herein, including the best mode known to the inventors for carrying out the invention. Variations of those preferred embodiments may become apparent to those of ordinary skill in the art upon reading the foregoing description. The inventors expect skilled artisans to employ such variations as appropriate, and the inventors intend for the invention to be practiced otherwise than as specifically described herein. Accordingly, this invention includes all modifications and

equivalents of the subject matter recited in the claims appended hereto as permitted by applicable law. Moreover, any combination of the above-described elements in all possible variations thereof is encompassed by the invention unless otherwise indicated herein or otherwise clearly contradicted by context.

CLAIMS:

1. A method for styling hair, the method comprising contacting the hair with a composition comprising a hair styling effective amount of a poly(vinylamine-vinylformamide) copolymer, applying heat to the hair in an amount effective to at least semi-permanently style the hair, and styling to at least semi-permanently style the hair.

2. The method of claim 1, wherein the heat is applied at a temperature of at least about 100° C for at least about 1 second.

3. The method of claim 2, wherein the heat is applied at a temperature of from about 190° C to about 240° C for at least about 1 second.

4. The method of anyone of claims 2-3, wherein the heat is applied for about 10 seconds.

5. The method of claim 1, wherein the hair is contacted with the composition for from about 1 minute to about 20 minutes.

6. The method of claim 1, wherein the styling comprises straightening the hair.

7. The method of claim 1, wherein the styling comprises curling the hair.

8. The method of claim 1, wherein the styling comprises contacting the hair with a shaped surface so as to manipulate the hair to conform to the shape of the surface.

9. The method of claim 8, wherein the shaped surface is heated and the heat is applied to the hair with the shaped surface.

10. The method of anyone of claims 8-9, wherein the shaped surface comprises a straight surface for straightening the hair, a curved surface for curling the hair, or a combination thereof.

11. The method of anyone of claims 8-9, wherein the shaped surface is selected from flat iron surfaces, curling iron surfaces, hair curlers, hair straighteners, hair rollers, and combinations thereof.

12. The method of claim 1, wherein the heat is applied via an indirect heat source.

13. The method of claim 12, wherein the indirect heat source is selected from blow dryers, hood dryers, heating caps, steamers, and combinations thereof.

14. The method of claim 1, wherein the heat is applied via an indirect heat source and the styling comprises contacting the hair with a shaped surface so as to manipulate the hair to conform to the shape of the surface.

15. The method of claim 1, wherein the composition is substantially free of carbohydrates or analogues thereof.

16. The method of claim 1, wherein the composition comprises from about 2 wt% to about 50 wt% of the poly(vinylamine-vinylformamide) copolymer.

17. The method of claim 16, wherein the composition comprises from about 4 wt% to about 30 wt% of the poly(vinylamine-vinylformamide) copolymer.

18. The method of claim 1, wherein the composition further comprises an aqueous carrier.

19. The method of anyone of claims 1 or 18, wherein the composition further comprises a solvent.

20. The method of claim 19, wherein the solvent is selected from the group consisting of alcohols, polyols, and combinations thereof.

21. The method of claim 20, wherein the solvent comprises an alcohol.

22. The method of claim 21, wherein the alcohol is ethanol.

23. The method of claim 20, wherein the solvent comprises a polyol.

24. The method of claim 23, wherein the polyol is selected from the group consisting of ethylene glycol, propylene glycol, butylene glycol, glycerine, and combinations thereof.

25. The method of claim 1, wherein the composition further comprises a polyvinylpyrrolidone.

26. The method of claim 1, wherein the poly(vinylamine-vinylformamide) copolymer comprises a high molecular weight poly(vinylamine-vinylformamide) copolymer.

27. The method of claim 26, wherein the high molecular weight poly(vinylamine-vinylformamide) copolymer comprises at most about 95 mol% vinylamine monomers.

28. The method of claim 27, wherein the high molecular weight poly(vinylamine-vinylformamide) copolymer comprises at most about 50 mol% vinylamine monomers.

29. The method of claim 1, wherein the poly(vinylamine-vinylformamide) copolymer comprises a high molecular weight poly(vinylamine-vinylformamide) copolymer, a low molecular weight poly(vinylamine-vinylformamide) copolymer, or a combination thereof.

30. The method of claim 1, wherein the composition is in the form of a mousse or a gel.

31. The method of claim 1, wherein the heat application and styling occur simultaneously.

32. The method of anyone of claims 8-9, wherein the heat application and styling are performed two or more times.

33. The method of claim 32, wherein the heat application and styling are performed three or more times.

34. The method of claim 1, further comprising the step of contacting the hair with a conditioning composition.

35. The method of claim 34, wherein the conditioning composition comprises a silicone.

36. The method of claim 35, wherein the silicone is a cyclomethicone.

37. The method of claim 34, wherein the conditioning composition comprises an alcohol.

38. A method for straightening hair, the method comprising contacting hair with a composition comprising a hair styling effective amount of a poly(vinylamine-vinylformamide) copolymer, and contacting the hair with a styling device comprising at least one flat surface at a temperature of at least about 100° C for at least about 1 second to at least semi-permanently straighten the hair.

39. The method of claim 38, further comprising the step of contacting the hair with a conditioning composition.

40. The method of claim 34, wherein the conditioning composition comprises a silicone.

41. The method of claim 35, wherein the silicone is a cyclomethicone.

42. The method of claim 34, wherein the conditioning composition comprises an alcohol.

43. A method for curling hair, the method comprising contacting the hair with an effective amount of a composition comprising a hair straightening effective amount of a poly(vinylamine-vinylformamide) copolymer, and contacting hair with a styling device comprising at least one curved surface at a temperature of at least 100° C for at least about 1 second to at least semi-permanently curl the hair.

44. A method for straightening hair, the method comprising contacting hair with a composition comprising a hair styling effective amount of a poly(vinylamine-vinylformamide) copolymer, contacting the hair with a conditioning composition, and contacting the hair with a styling device comprising at least one flat surface at a temperature of at least about 100° C for at least about 1 second to at least semi-permanently straighten the hair.

FIG. 1

FIG. 2