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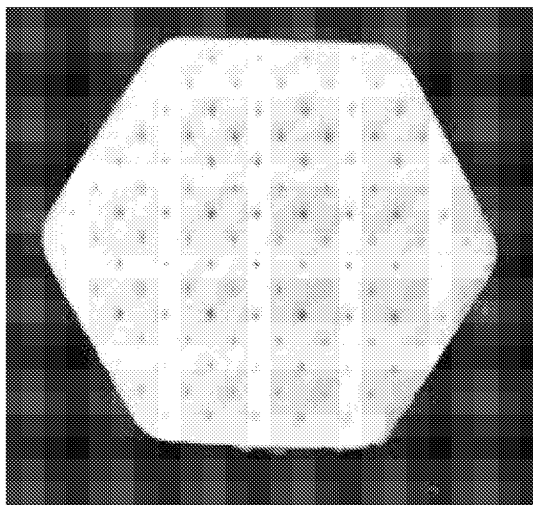


FIG. 3

(57) Abstract: Disclosed is a dissolvable solid cleansing article comprising: a) from about 1% to about 60%, by weight on a dry article basis, of a polymeric structurant; b) from about 5% to about 90%, by weight on a dry article basis, of a surfactant system comprising a sulfonate-containing anionic surfactant; wherein the article contains less than 5% of glutamate anionic surfactant; and wherein the article is substantially free of sulfate-based surfactants. The dissolvable solid article of the present disclosure can provide reduced precipitation, especially when such dissolvable solid shampoo articles are used with hard water.

DISSOLVABLE SOLID CLEANSING ARTICLES CONTAINING SULFONATE-CONTAINING ANIONIC SURFACTANTS

FIELD OF THE INVENTION

5 The present disclosure relates to A dissolvable solid cleansing article comprising: a) from about 1% to about 60%, by weight on a dry article basis, of a polymeric structurant; b) from about 5% to about 90%, by weight on a dry article basis, of a surfactant system comprising a sulfonate-containing anionic surfactant; wherein the article contains less than 5% of glutamate anionic surfactant; and wherein the article is substantially free of sulfate-based surfactants. The
10 dissolvable solid article disclosed herein can provide reduced precipitation, especially when such dissolvable solid shampoo articles are used with hard water.

BACKGROUND OF THE INVENTION

 Many personal care and other consumer products, including shampoos, in the market today
15 are sold in liquid form. While widely used, liquid products often have tradeoffs in terms of packaging, storage, transportation, and convenience of use. For example, these products are generally formulated with a substantial amount of a liquid, such as water (e.g., ~80% or more), preservatives, and stabilizers, that add significant bulk and translates to inefficient, costly shipping and storage. Also, liquid personal care products can be difficult to use in terms of controlling
20 dosage and the delivery of the product.

 In order to overcome some of these drawbacks, it can be desirable to formulate personal care products as solid articles, such as fibrous articles. Fibrous articles can be desirable because the articles can quickly dissolve into a smooth composition. Fibrous articles that are shampoos can provide consumer acceptable amount of lather.

25 Also, there has been a need for personal care products which are substantially free of sulfate-based surfactants.

 For example, US20210401677A1 discloses a dissolvable solid fibrous shampoo article comprising a plurality of fibrous elements comprising: a polymeric structurant; from 20% to about 70%, by weight on a dry article basis, of a surfactant system comprising: from about 35% to about
30 90%, by weight of the surfactant system on a dry article basis, of a primary anionic surfactant; and a co-surfactant;
 wherein the surfactant system is substantially free of sulfate-based surfactants.
US20210401677A1 also discloses in Examples, such dissolvable solid fibrous shampoo article

comprising approximately 36-39% of Disodium cocoyl glutamate as the primary anionic surfactant. However, the present inventors has found that there is a need to improve consumer usage feel in such dissolvable solid shampoo article comprising Disodium cocoyl glutamate, especially when such dissolvable solid shampoo articles are used with hard water.

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SUMMARY OF THE INVENTION

The present disclosure is directed to a dissolvable solid shampoo article comprising:

a. from about 1% to about 60%, by weight on a dry article basis, of a polymeric structurant;

10 b. from about 5% to about 90%, by weight on a dry article basis, of a surfactant system comprising a sulfonate-containing anionic surfactant;

wherein the article contains less than 5%, preferably less than 3% of glutamate anionic surfactant, more preferably wherein the article is substantially free of glutamate anionic surfactant; and wherein the article is substantially free of sulfate-based surfactants.

15 It has been surprisingly found by the present inventors that disodium cocoyl glutamate forms deposits on hair, especially contained in dissolvable solid shampoo articles at a higher level, and especially when such dissolvable solid shampoo articles are used with hard water. Not being limited to the theory, it is believed that when dissolving such dissolvable solid shampoo articles on hands, the level of surfactants get higher than the level in conventional liquid shampoos, the
20 formation of deposits may become obvious in such dissolvable solid shampoo articles compared to conventional liquid shampoos.

The dissolvable solid article can provide reduced formation of deposit/precipitation, thus, provide improved consumer usage feel. It has been surprisingly found by the present inventors that, by the use of sulfonate-containing anionic surfactant, especially sulfonate anionic surfactant,
25 the dissolvable solid article can provide reduced precipitation even when such dissolvable solid articles are used with hard water, yet can provide improved consumer usage feel and/or reduced deposits on hair when the dissolvable solid article are shampoo products. Such improved consumer usage feel include, for example, improved clean feeling, reduced coated or residue feeling, and/or improved smooth feeling.

30 Additionally, the dissolvable solid article may allow a wider pH range during its manufacturing.

Also, in some embodiments using a sultaine surfactant as a co-surfactant, the article provides further reduced precipitation in hard water and also provides better/faster dryness during

manufacturing, compared to other amphoteric or zwitterionic surfactants such as betaine and amphotacetate.

Further, in some embodiments, the article is substantially free of surfactants containing -COOH group, and such articles provide further reduced precipitation in hard water.

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BRIEF DESCRIPTION OF THE DRAWINGS

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter of the present invention, it is believed that the invention can be more readily understood from the following description taken in connection with the accompanying drawings, in which:

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FIG. 1 is a schematic representation of an example of a process for making fibrous elements; and

FIG. 2 is a schematic representation of an example of a die with a magnified view used in the process of FIG. 1.

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FIG. 3 is an example of a fibrous article containing filaments.

DETAILED DESCRIPTION OF THE INVENTION

Definitions

“Dissolvable” means that the Dissolvable Solid article is completely soluble in water, or it provides a uniform dispersion upon mixing in water according to the Hand Dissolution Test, described hereafter. The Dissolvable Solid article can have a hand dissolution value of from about 1 to about 30 strokes, alternatively from about 2 to about 25 strokes, alternatively from about 3 to about 20 strokes, and alternatively from about 4 to about 15 strokes, as measured by the Hand Dissolution Method.

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“Fibrous article” as used herein means a structure that comprises one or more fibrous elements and optionally, one or more particles and/or coatings. In one example, a fibrous article means an association of fibrous elements and optionally, particles and/or coatings that together form a structure, such as a unitary structure, capable of performing a function.

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FIG. 3 is an example of a fibrous article containing filaments.

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The fibrous articles may be homogeneous or may be layered. If layered, the fibrous articles may comprise at least two and/or at least three and/or at least four and/or at least five layers, for example one or more fibrous element layers, one or more particle layers and/or one or more fibrous element/particle mixture layers. A layer may comprise a particle layer within the fibrous article or

between fibrous element layers within a fibrous article. A layer comprising fibrous elements may sometimes be referred to as a ply. A ply may be a fibrous article which may be homogeneous or layered as described herein.

In one example, a single-ply fibrous article or a multi-ply fibrous article comprising one or more fibrous article plies may exhibit a basis weight of less than 5000 g/m² as measured according to the Basis Weight Test Method described herein. In one example, the single- or multi-ply fibrous article may exhibit a basis weight of greater than 10 g/m² to about 5000 g/m² and/or greater than 10 g/m² to about 3000 g/m² and/or greater than 10 g/m² to about 2000 g/m² and/or greater than 10 g/m² to about 1000 g/m² and/or greater than 20 g/m² to about 800 g/m² and/or greater than 30 g/m² to about 600 g/m² and/or greater than 50 g/m² to about 500 g/m² and/or greater than 100 g/m² to about 800 g/m² and/or greater than 200 g/m² to about 600 g/m² as measured according to the Basis Weight Test Method.

In one example, the fibrous article can be a “unitary fibrous article.” “Unitary fibrous article” as used herein is an arrangement comprising a plurality of two or more and/or three or more fibrous elements that are inter-entangled or otherwise associated with one another to form a fibrous article. The unitary fibrous article can optionally contain particles. A unitary fibrous article may be one or more plies within a multi-ply fibrous article. In one example, a unitary fibrous article may comprise three or more different fibrous elements. In another example, a unitary fibrous article may comprise two different fibrous elements, for example a co-formed fibrous article, upon which a different fibrous element is deposited to form a fibrous article comprising three or more different fibrous elements.

“Article” as used herein refers to a consumer use unit, a consumer unit dose unit, a consumer use saleable unit, a single dose unit, or other use form comprising a unitary fibrous article and/or comprising one or more fibrous articles.

“By weight on a dry filament basis” means that the weight of the filament measured immediately after the filament has been conditioned in a conditioned room at a temperature of 22 °C ± 2 °C and a relative humidity of 42% ± 4% for 2 hours. Similarly, “by weight on a dry fibrous element basis” or “by weight on a dry fibrous article basis” means the weight of the fibrous element or structure after the fibrous element has been conditioned in a conditioned room at a temperature of 22 °C ± 2 °C and a relative humidity of 42% ± 4% for 2 hours.

“Fibrous element” as used herein means an elongate particulate having a length greatly exceeding its average diameter, i.e., a length to average diameter ratio of at least about 10. A

fibrous element may be a filament or a fiber. In one example, the fibrous element can be a single fibrous element rather than a yarn comprising a plurality of fibrous elements.

The fibrous elements may be spun from a filament-forming composition also referred to as fibrous element-forming compositions via suitable spinning process operations, such as meltblowing, spunbonding, electro-spinning, and/or rotary spinning.

The fibrous elements may be monocomponent and/or multicomponent. For example, the fibrous elements may comprise bicomponent fibers and/or filaments. The bicomponent fibers and/or filaments may be in any form, such as side-by-side, core and sheath, islands-in-the-sea and the like.

“Filament” as used herein means an elongate particulate as described above that exhibits a length of greater than or equal to 5.08 cm (2 in.) and/or greater than or equal to 7.62 cm (3 in.) and/or greater than or equal to 10.16 cm (4 in.) and/or greater than or equal to 15.24 cm (6 in.). Filaments are typically considered continuous or substantially continuous in nature. Filaments are relatively longer than fibers. Non-limiting examples of filaments include meltblown and/or spunbond filaments. Non-limiting examples of polymers that can be spun into filaments include natural polymers, such as starch, starch derivatives, cellulose, such as rayon and/or lyocell, and cellulose derivatives, hemicellulose, hemicellulose derivatives, and synthetic polymers including, but not limited to thermoplastic polymer filaments, such as polyesters, nylons, polyolefins such as polypropylene filaments, polyethylene filaments, and biodegradable thermoplastic fibers such as polylactic acid filaments, polyhydroxyalkanoate filaments, polyesteramide filaments and polycaprolactone filaments.

“Fiber” as used herein means an elongate particulate as described above that exhibits a length of less than 5.08 cm (2 in.) and/or less than 3.81 cm (1.5 in.) and/or less than 2.54 cm (1 in.).

Fibers are typically considered discontinuous in nature. Non-limiting examples of fibers include staple fibers produced by spinning a filament or filament tow and then cutting the filament or filament tow into segments of less than 5.08 cm (2 in.) thus producing fibers.

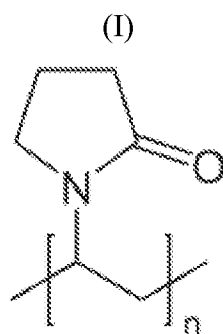
In one example, one or more fibers may be formed from a filament, such as when the filaments are cut to shorter lengths (such as less than 5.08 cm in length). Thus, in one example, the present disclosure also includes a fiber made from a filament, such as a fiber comprising one or more polymeric structurants and one or more other ingredients, such as surfactants and high melting point fatty materials. Therefore, references to filament and/or filaments herein also include fibers made from such filament and/or filaments unless otherwise noted. Fibers are typically

considered discontinuous in nature relative to filaments, which are considered continuous in nature.

“Filament-forming composition” and/or “fibrous element-forming composition” as used herein means a composition that can be suitable for making a fibrous element such as by meltblowing and/or spunbonding. The filament-forming composition comprises one or more polymeric structurant that exhibit properties that make them suitable for spinning into a fibrous element. In addition, the filament-forming composition may comprise one or more polar solvents, such as water, into which one or more, for example all, of the polymeric structurant and/or one or more, for example all, of surfactants are dissolved and/or dispersed prior to spinning a fibrous element, such as a filament from the filament-forming composition. In one example, a filament made from a filament-forming composition is such that one or more actives, for example one or more active agents, may be present in the filament rather than on the filament, such as a coating composition comprising one or more active agents, which may be the same or different from the active agents in the fibrous elements and/or particles.

In one example, one or more additives, such as active agents, may be present in the fibrous element and one or more additional additives, such as active agents, may be present on a surface of the fibrous element. In another example, a fibrous element may comprise one or more additives, such as active agents, that are present in the fibrous element when originally made, but then bloom to a surface of the fibrous element prior to and/or when exposed to conditions of intended use of the fibrous element.

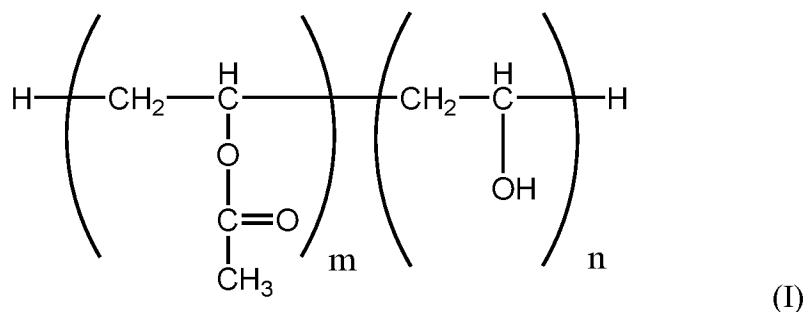
As used herein, “vinyl pyrrolidone copolymer” (and “copolymer” when used in reference thereto) refers to a polymer of the following structure (I):



In structure (I), n is an integer such that the polymeric structurant has the degree of polymerization such that it possesses characteristics described herein. For purposes of clarity, the use of the term “copolymer” is intended to convey that the vinyl pyrrolidone monomer can be copolymerized with other non-limiting monomers such as vinyl acetate, alkylated vinyl pyrrolidone, vinyl caprolactam,

vinyl valerolactam, vinyl imidazole, acrylic acid, methacrylate, acrylamide, methacrylamide, dimethacrylamide, alkylaminomethacrylate, and alkylaminomethacrylamide monomers.

As used herein, “vinyl acetate-vinyl alcohol copolymer” (and “copolymer” when used in reference thereto) refers to a polymer of the following structure (I):



In structure (I), m and n are integers such that the polymeric structurant has the degree of polymerization and percent alcohol characteristics described herein. For purposes of clarity, this use of the term “copolymer” is intended to convey that the partially hydrolyzed polyvinyl acetate comprises vinyl alcohol and vinyl acetate units. As discussed below, the polymeric structurant is routinely prepared by polymerizing vinyl acetate monomer followed by hydrolysis of some of the acetate groups to alcohol groups, as opposed to polymerization of vinyl acetate and vinyl alcohol monomer units (due in-part to the instability of vinyl alcohol).

“Conditions of intended use” as used herein means the temperature, physical, chemical, and/or mechanical conditions that a fibrous element and/or particle and/or fibrous article is exposed to when the fibrous element and/or particle and/or fibrous article is used for one or more of its designed purposes. For instance, if a fibrous element and/or a particle and/or a fibrous article comprising a fibrous element is designed to be used by a human as a shampoo for hair care purposes, the conditions of intended use will include those temperature, chemical, physical and/or mechanical conditions present during the shampooing of the human’s hair. Likewise, if a fibrous element and/or a particle and/or a fibrous article comprising a fibrous element is designed to be used in a dishwashing operation, by hand or by a dishwashing machine, the conditions of intended use will include the temperature, chemical, physical and/or mechanical conditions present in a dishwashing water and/or dishwashing machine, during the dishwashing operation.

“Active agent” as used herein means an additive that produces an intended effect in an environment external to a fibrous element and/or a particle and/or a fibrous article comprising a fibrous element, such as when the fibrous element and/or a particle and/or fibrous article is exposed to conditions of intended use of the fibrous element and/or a particle and/or a fibrous article comprising a fibrous element. In one example, an active agent comprises an additive that treats a

surface, including a soft surface (i.e., hair, skin). In another example, an active agent comprises an additive that creates a chemical reaction (i.e., foaming, fizzing, coloring, warming, cooling, lathering, disinfecting and/or clarifying and/or chlorinating, such as in clarifying water and/or disinfecting water and/or chlorinating water). In yet another example, an active agent comprises an additive that treats an environment (i.e., deodorizes, purifies, perfumes). In one example, the active agent is formed in situ, such as during the formation of the fibrous element and/or particle containing the active agent, for example the fibrous element and/or particle may comprise a dissolvable polymer (e.g., starch) and/or a surfactant (e.g., anionic surfactant), which may create a polymer complex or coacervate that functions as the active agent used to treat the hair and/or scalp. In one example, the active agent can include all compositions in the melt, fibrous elements, and/or fibrous article other than the polymeric structurant, including, but not limited to the surfactants and additives.

“Treats” as used herein with respect to treating a surface means that the active agent provides a benefit to a surface or environment. Treats includes regulating and/or immediately improving a surface’s, cleanliness, smell, purity and/or feel. In one example treating in reference to treating a keratinous tissue (for example skin and/or hair) surface means regulating and/or immediately improving the keratinous tissue’s cosmetic appearance and/or feel. For instance, “regulating skin, hair, or nail (keratinous tissue) condition” includes: thickening of skin, hair, or nails (e.g., building the epidermis and/or dermis and/or sub-dermal [e.g., subcutaneous fat or muscle] layers of the skin, and where applicable the keratinous layers of the nail and hair shaft) to reduce skin, hair, or nail atrophy, increasing the convolution of the dermal-epidermal border (also known as the rete ridges), preventing loss of skin or hair elasticity (loss, damage and/or inactivation of functional skin elastin) such as elastosis, sagging, loss of skin or hair recoil from deformation; melanin or non-melanin change in coloration to the skin, hair, or nails such as under eye circles, blotching (e.g., uneven red coloration due to, e.g., rosacea) (hereinafter referred to as “red blotchiness”), sallowness (pale color), discoloration caused by telangiectasia or spider vessels, and graying hair.

“Weight ratio” as used herein means the ratio between two materials on their dry basis.

“Water-soluble material” as used herein means a material that is miscible in water. In other words, a material that is capable of forming a stable (does not separate for greater than 5 minutes after forming the homogeneous solution) homogeneous solution with water at ambient conditions.

“Water-insoluble” as used herein is meant that the material, particle, and/or substrate that does not dissolve in or readily break apart upon immersion in water. In some instances, water-insoluble materials swell when exposed to water.

“Ambient conditions” as used herein means $22\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and a relative humidity of $42\% \pm 4\%$.

As used herein, “molecular weight” or “M.Wt.” refers to the weight average molecular weight unless otherwise stated. Molecular weight is measured using industry standard method, gel permeation chromatography (“GPC”).

“Length” as used herein, with respect to a fibrous element, means the length along the longest axis of the fibrous element from one terminus to the other terminus. If a fibrous element has a kink, curl or curves in it, then the length is the length along the entire path of the fibrous element from one terminus to the other terminus.

“Diameter” as used herein, with respect to a fibrous element, is measured according to the Diameter Test Method described herein. In one example, a fibrous element exhibits a diameter of less than $100\text{ }\mu\text{m}$ and/or less than $75\text{ }\mu\text{m}$ and/or less than $50\text{ }\mu\text{m}$ and/or less than $25\text{ }\mu\text{m}$ and/or less than $20\text{ }\mu\text{m}$ and/or less than $15\text{ }\mu\text{m}$ and/or less than $10\text{ }\mu\text{m}$ and/or less than $6\text{ }\mu\text{m}$ and/or greater than $1\text{ }\mu\text{m}$ and/or greater than $3\text{ }\mu\text{m}$.

“Triggering condition” as used herein in one example means anything, as an act or event, that serves as a stimulus and initiates or precipitates a change in the fibrous element and/or particle and/or fibrous article, such as a loss or altering of the fibrous element’s and/or fibrous article’s physical structure and/or a release of an additive, such as an active agent therefrom. In another example, the triggering condition may be present in an environment, such as water, when a fibrous element and/or particle and/or fibrous article is added to the water. In other words, nothing changes in the water except for the fact that the fibrous element and/or fibrous article is added to the water.

“Morphology changes” as used herein with respect to a fibrous element’s and/or particle’s morphology changing means that the fibrous element experiences a change in its physical structure. Non-limiting examples of morphology changes for a fibrous element and/or particle include dissolution, melting, swelling, shrinking, breaking into pieces, exploding, lengthening, shortening, and combinations thereof. The fibrous elements and/or particles may completely or substantially lose their fibrous element or particle physical structure, or they may have their morphology changed or they may retain or substantially retain their fibrous element or particle physical structure as they are exposed to conditions of intended use.

“By weight on a dry fibrous element basis” and/or “by weight on a dry fibrous article basis” means the weight of the fibrous element and/or particle and/or fibrous article, respectively, measured immediately after the fibrous element and/or particle and/or fibrous article, respectively, has been conditioned in a conditioned room at a temperature of $22\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and a relative humidity of $42\% \pm 4\%$ for 2 hours. In one example, by weight on a dry fibrous element basis and/or dry fibrous article basis means that the fibrous element and/or particle and/or fibrous article comprises less than 20% and/or less than 15% and/or less than 10% and/or less than 7% and/or less than 5% and/or less than 3% and/or to 0% and/or to greater than 0% based on the dry weight of the fibrous element and/or particle and/or fibrous article of moisture, such as water, for example free water, as measured according to the Water Content Test Method described herein.

“Total level” as used herein, for example with respect to the total level of one or more active agents present in the fibrous element and/or particle and/or fibrous article, means the sum of the weights or weight percent of all of the subject materials, for example active agents. In other words, a fibrous element and/or particle and/or fibrous article may comprise 25% by weight on a dry fibrous element basis and/or dry fibrous article basis of an anionic surfactant, 15% by weight on a dry fibrous element basis and/or dry fibrous article basis of a nonionic surfactant, 10% by weight of a chelant on a dry fibrous element basis and/or dry fibrous article basis, and 5% by weight of a perfume a dry fibrous element basis and/or dry fibrous article basis so that the total level of active agents present in the fibrous element and/or particle and/or fibrous article is greater than 50%; namely 55% by weight on a dry fibrous element basis and/or dry fibrous article basis.

“Fibrous article product” as used herein means a solid form, for example a rectangular solid, sometimes referred to as a sheet, that comprises one or more active agents, for example a hair care active agent, a shampoo active agent, a conditioning active agent, and mixtures thereof. In one example, a fibrous article product comprises one or more surfactants, one or more enzymes (such as in the form of an enzyme prill), one or more perfumes and/or one or more suds suppressors. In another example, a fibrous article product comprises a builder and/or a chelating agent. In another example, a fibrous article product comprises a bleaching agent (such as an encapsulated bleaching agent).

“Associate,” “Associated,” “Association,” and/or “Associating” as used herein with respect to fibrous elements and/or particle means combining, either in direct contact or in indirect contact, fibrous elements and/or particles such that a fibrous article is formed. In one example, the associated fibrous elements and/or particles may be bonded together for example by adhesives and/or thermal bonds. In another example, the fibrous elements and/or particles may be associated

with one another by being deposited onto the same fibrous article making belt and/or patterned belt.

“Ply” or “Plies” as used herein means an individual fibrous article optionally to be disposed in a substantially contiguous, face-to-face relationship with other plies, forming a multiple ply fibrous article. It is also contemplated that a single fibrous article can effectively form two “plies” or multiple “plies”, for example, by being folded on itself.

The term “free of” as used herein means that the melt composition, or the fibrous elements, or the fibrous article, comprises 0% of an ingredient by total weight of the composition, or by total weight of the fibrous article, or by total weight of the article, thus no detectable amount of the stated ingredient.

The term “substantially free of” as used herein means less than 1%, less than 0.8%, less than 0.5%, less than 0.3%, less than 0.1%, or less than an immaterial amount of a stated ingredient by total weight of the melt composition, or by total weight of the fibrous elements, or by total weight of the fibrous article.

As used herein, the articles “a” and “an” when used herein, for example, “an anionic surfactant” or “a fiber” is understood to mean one or more of the material that is claimed or described.

As used herein, the terms “include,” “includes,” and “including,” are meant to be non-limiting.

All percentages and ratios are calculated by weight unless otherwise indicated. All percentages and ratios are calculated based on the total composition unless otherwise indicated.

It should be understood that every maximum numerical limitation given throughout this specification includes every lower numerical limitation, as if such lower numerical limitations were expressly written herein. Every minimum numerical limitation given throughout this specification will include every higher numerical limitation, as if such higher numerical limitations were expressly written herein. Every numerical range given throughout this specification will include every narrower numerical range that falls within such broader numerical range, as if such narrower numerical ranges were all expressly written herein.

Unless otherwise noted, all component or composition levels are in reference to the active level of that component or composition, and are exclusive of impurities, for example, residual solvents or by-products, which may be present in commercially available sources.

Dissolvable solid article

The dissolvable solid shampoo article comprising:

- a. from about 1% to about 60%, by weight on a dry article basis, of a polymeric structurant;
- b. from about 5% to about 90%, by weight on a dry article basis, of a surfactant system comprising a sulfonate-containing anionic surfactant;

wherein the article contains less than 5%, preferably less than 3% of glutamate anionic surfactant, more preferably wherein the article is substantially free of glutamate anionic surfactant; and

wherein the article is substantially free of sulfate-based surfactants.

The dissolvable solid shampoo article can be in any form, as long as its dissolvable. For example, the dissolvable solid shampoo article can be dissolvable solid shampoo fibrous article explained below in detail. Preferably such fibrous article comprises a plurality of fibrous elements, wherein the plurality of fibrous elements are intertangled or otherwise associated with one another to form the fibrous article. Preferably such fibrous elements are homogeneous.

Alternatively, the dissolvable solid shampoo articles can be those having porous structure, such as those described in US20210354901 A1, and especially those characterized by a Percent Open Cell Content of from 80% to 100% by a method defined in US20210354901 A1.

Fibrous article

The fibrous article can comprise a plurality of fibrous elements, for example a plurality of filaments. The fibrous article can include: fibrous elements containing a polymeric structurant, a surfactant system, and optionally an additive that can be in the fibrous elements or a coating.

The filament can be homogenous.

In one example, the fibrous article comprises a plurality of identical or substantially identical from a compositional perspective of fibrous elements. In another example, the fibrous article may comprise two or more different fibrous elements. Non-limiting examples of differences in the fibrous elements may be physical differences such as differences in diameter, length, texture, shape, rigidity, elasticity, and the like; chemical differences such as crosslinking level, solubility, melting point, T_g, active agent, polymeric structurant, color, level of active agent, basis weight, level of polymeric structurant, presence of any coating on fibrous element, biodegradable or not, hydrophobic or not, contact angle, and the like; differences in whether the fibrous element loses

its physical structure when the fibrous element is exposed to conditions of intended use; differences in whether the fibrous element's morphology changes when the fibrous element is exposed to conditions of intended use; and differences in rate at which the fibrous element releases one or more of its active agents when the fibrous element is exposed to conditions of intended use.

5 In one example, two or more fibrous elements and/or particles within the fibrous article may comprise different active agents. This may be the case where the different active agents may be incompatible with one another, for example an anionic surfactant (such as a shampoo active agent) and a cationic surfactant (such as a hair conditioner active agent).

10 In another example, the fibrous article may exhibit different regions, such as different regions of basis weight, density and/or caliper. In yet another example, the fibrous article may comprise texture on one or more of its surfaces. A surface of the fibrous article may comprise a pattern, such as a non-random, repeating pattern. The fibrous article may be embossed with an emboss pattern. In another example, the fibrous article may comprise apertures. The apertures may be arranged in a non-random, repeating pattern.

15 In one example, the fibrous article exhibits a thickness of greater than 0.01 mm and/or greater than 0.05 mm and/or greater than 0.1 mm and/or to about 100 mm and/or to about 50 mm and/or to about 20 mm and/or to about 10 mm and/or to about 5 mm and/or to about 2 mm and/or to about 0.5 mm and/or to about 0.3 mm as measured by the Thickness Test Method described herein.

20 For fibrous articles, the structure can comprise a significant number of dissolvable fibers with an average diameter less than about 150 micron, alternatively less than about 100 micron, alternatively less than about 10 micron, and alternatively less than about 1 micron with a relative standard deviation of less than 100%, alternatively less than 80%, alternatively less than 60%, alternatively less than 50%, such as in the range of 10% to 50%, for example. As set forth herein,
25 the significant number means at least 10% of all the dissolvable fibers, alternatively at least 25% of all the dissolvable fibers, alternatively at least 50% of all the dissolvable fibers, alternatively at least 75% of all the dissolvable fibers. The significant number may be at least 99% of all the dissolvable fibers. Alternatively, from about 50% to about 100% of all the dissolvable fibers may have an average diameter less than about 10 micron. The dissolvable fibers produced by the
30 method of the present disclosure can have a significant number of dissolvable fibers with an average diameter less than about 1 micron, or sub-micron fibers. In an embodiment, fibrous article may have from about 25% to about 100% of all the dissolvable fibers with an average diameter less than about 1 micron, alternatively from about 35% to about 100% of all the dissolvable fibers

with an average diameter less than about 1 micron, alternatively from about 50% to about 100% of all the dissolvable fibers with an average diameter less than about 1 micron, and alternatively from about 75% to about 100% of all the dissolvable fibers with an average diameter less than about 1 micron.

5 The article can be characterized in one aspect by its Specific Surface Area. The article can have a Specific Surface Area of from about 0.03 m²/g to about 0.25 m²/g, alternatively from about 0.035 m²/g to about 0.22 m²/g, alternatively from about 0.04 m²/g to about 0.19 m²/g, and alternatively from about 0.045 m²/g to about 0.16 m²/g.

10 The structure can be a flat, flexible structure in the form of a pad, a strip, or tape and having a thickness of from about 0.5 mm to about 10 mm, alternatively from about 1 mm to about 9 mm, alternatively from about 2 mm to about 8 mm, and alternatively from about 3 mm to about 7 mm as measured by the below methodology. The Structure can be a sheet having a thickness from about 5mm to about 6.5mm. Alternatively, two or more sheets are combined to form a Structure with a thickness of about 5mm to about 10mm.

15 The structure can have a basis weight of from about 200 grams/m² to about 2,000 grams/m², alternatively from about 400 g/m² to about 1,200 g/m², alternatively from about 600 g/m² to about 2,000 g/m², and alternatively from about 700 g/m² to about 1,500 g/m².

20 The structure can have a dry density of from about 0.08 g/cm³ to about 0.40 g/cm³, alternatively from about 0.08 g/cm³ to about 0.38 g/cm³, alternatively from about 0.10 g/cm³ to about 0.25 g/cm³, and alternatively from about 0.12 g/cm³ to about 0.20 g/cm³.

Non-limiting examples of other fibrous articles suitable herein are disclosed in U.S. Pat. Nos. 8,980,816 and 9,139,802, U.S. Pub. No. 2013/0171421, and U.S. App. No. 16/912,876 are hereby incorporated by reference.

25 Fibrous Elements

The fibrous element, such as a filament and/or fiber, comprises one or more polymeric structurants. In addition to the polymeric structurants, the fibrous element may further comprise a surfactant system and optional ingredients including relatively high weight average molecular weight cationic polymers. Examples of fibrous elements can be found at U.S. Pat. App. 30 16/431,115, incorporated by reference.

Polymeric Structurant

The dissolvable article and/or fibrous elements can contain from about 1% to 90%, alternatively 10% to about 80%, alternatively from about 20% to about 70%, alternatively from

about 30% to about 65%, alternatively from about 35% to about 60%, alternatively from about 20% to about 40%, of a polymeric structurant by weight on a dry fibrous element basis and/or a dry dissolvable article basis.

Non-limiting examples of polymeric structurant materials include water-soluble polymers.

5 The water-soluble polymers may be synthetic or natural original and may be chemically and/or physically modified. The polar solvent-soluble polymers may exhibit a weight average molecular weight of from about 10,000 g/mol to about 40,000,000 g/mol, preferably from about 20,000 g/mol to about 30,000,000 g/mol, more preferably from about 35,000 g/mol to about 20,000,000 g/mol, even more preferably from about 40,000 g/mol to about 5,000,000 g/mol, most preferably from
10 about 40,000 g/mol to about 500,000 g/mol.

The one or more polymeric structurants comprise one or more polyvinyl alcohols. The one or more polyvinyl alcohols may exhibit a weight average molecular weight of from about 10,000 g/mol to about 40,000,000 g/mol, alternatively from about 20,000 g/mol to about 30,000,000 g/mol, alternatively from about 35,000 g/mol to about 20,000,000 g/mol, alternatively from about
15 40,000 g/mol to about 5,000,000 g/mol, alternatively from about 40,000 g/mol to about 500,000 g/mol.

The one or more polymeric structurant materials may comprise two or more polyvinyl alcohols. One of the two or more polyvinyl alcohols may exhibit a weight average molecular weight of from about 10,000 g/mol to about 100,000 g/mol, alternatively from about 20,000 g/mol to about 50,000 g/mol, alternatively from about 25,000 g/mol to about 45,000 g/mol, and the other
20 of two or more polyvinyl alcohols may exhibit a weight average molecular weight of from about 105,000 g/mol to about 40,000,000 g/mol, preferably from about 110,000 g/mol to about 20,000,000 g/mol, more preferably from about 120,000 g/mol to about 500,000 g/mol.

Non-limiting examples of polymeric structurant include water-soluble hydroxyl polymers,
25 water-soluble thermoplastic polymers, water-soluble biodegradable polymers, water-soluble non-biodegradable polymers, and mixtures thereof.

The one or more polymeric structurant materials may further comprise starch. Preferably, the one or more fibrous-element forming polymeric structurant materials may comprise one or more polyvinyl alcohols and starch.

30 The one or more polymeric structurant materials may further comprise carboxymethyl cellulose. The one or more polymeric structurant materials may comprise one or more polyvinyl alcohols and carboxymethyl cellulose.

Surfactant system comprising sulfonate-containing anionic surfactant

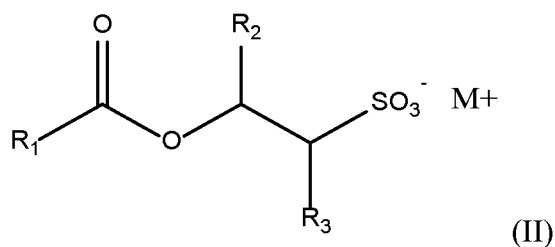
The dissolvable article and/or fibrous elements can contain from about 10% to about 90%, alternatively from about 20% to about 80%, alternatively from about 30% to about 75%, and alternatively from about 40% to about 70%, from about 45% to about 65%, of a surfactant system on by weight on a dry fibrous element basis and/or a dry dissolvable article basis

The surfactant system comprises sulfonate-containing anionic surfactant. The dissolvable article and/or fibrous elements can contain from about 10% to about 50%, preferably from about 20% to about 45%, more preferably from about 30% to about 40% of the sulfonate-containing anionic surfactant, on by weight on a dry fibrous element basis and/or a dry dissolvable article basis

Preferably, the sulfonate-containing anionic surfactant is selected from the group consisting of sulfonate anionic surfactants, taurate anionic surfactants, isethionate anionic surfactants, sulfosuccinate anionic surfactants, sulfoacetate anionic surfactants, and mixtures thereof. More preferably, the sulfonate-containing anionic surfactant is selected from the group consisting of sulfonate anionic surfactants, taurate anionic surfactants, isethionate anionic surfactants, and mixtures thereof. Still more preferably, the sulfonate-containing anionic surfactant is selected from the group consisting of sulfonate anionic surfactants. Also preferably, the sulfonate-containing anionic surfactant is free of -COOH group.

The sulfonate anionic surfactants may be selected from the group consisting of alpha olefin sulfonates such as those having C8-30, preferably C10-24, more preferably C12-22 alpha olefin group, linear alkylbenzene sulfonates such as those having C6-30, preferably C8-24, more preferably C8-22 linear alkyl group, hydroxypropylsulfonate, and mixtures thereof.

The isethionate surfactant are, for example, according to the general formula (II):



wherein R₁ can be a saturated or unsaturated, straight or branched, alkyl or alkenyl chain with from 6 to 30 carbon atoms, alternatively from 8 to 22 carbon atoms, alternatively from 9 to 18 carbon atoms, R₂ and R₃ are each independently H or (C₁-C₄) alkyl, alternatively wherein (C₁-C₄) alkyl can be methyl, and M⁺ can be an alkali metal, alternatively lithium, sodium, potassium; or M⁺ can

be an alkali-earth metal, alternatively magnesium; or M^{+} can be an ammonium or a substituted ammonium cation.

The isethionate surfactant may be selected from the group consisting of sodium lauroyl isethionate, sodium lauroyl methyl isethionate, sodium oleoyl isethionate, sodium oleoyl methyl isethionate, sodium stearoyl isethionate, sodium stearoyl methyl isethionate, sodium myristoyl isethionate, sodium myristoyl methyl isethionate, sodium palmitoyl isethionate, sodium palmitoyl methyl isethionate, sodium cocoyl isethionate, sodium cocoyl methyl isethionate, a blend of stearic acid and sodium cocoyl isethionate, ammonium cocoyl isethionate, ammonium cocoyl methyl isethionate, and mixtures thereof.

The isethionate surfactant may be selected from the group consisting of sodium lauroyl isethionate, sodium lauroyl methyl isethionate, sodium oleoyl isethionate, sodium stearoyl isethionate, sodium myristoyl isethionate, sodium palmitoyl isethionate, sodium cocoyl isethionate, ammonium cocoyl isethionate, and mixtures thereof.

The isethionate surfactant may be selected from the group consisting of sodium lauroyl isethionate, sodium lauroyl methyl isethionate, sodium stearoyl isethionate, sodium myristoyl isethionate, sodium cocoyl isethionate, ammonium cocoyl isethionate, and mixtures thereof.

The isethionate surfactant may be selected from the group consisting of sodium lauroyl isethionate, sodium cocoyl isethionate, ammonium cocoyl isethionate, and mixtures thereof.

Corresponding commercial products are available, for example, from the company Innospec under the trade name “Iselux[®]” and from Clariant or Uniquema under the trade names “Hostapon[®]” or “Arlatone[®]”. Examples of other commercial fatty acyl isethionates that may be used can be Hostapon[®] surfactants from Clariant such as for sodium cocoyl isethionate: Hostapon[®] SCI-85C, Hostapon[®] SCI-78C, or a blend of stearic acid with sodium cocoyl isethionate: Hostapon[®] SCI-65C. Examples of other commercial fatty acyl isethionates that may be used can be “Jordapon[®]” surfactants from BASF such as Jordapon[®] CI prill or Jordapon[®] CI65; and sodium cocoyl isethionate from Yongan Daily Chemical Co. such as YA-SCI-85[®] or YA-SCI-65[®].

The sulfoacetate surfactant may be selected from the group consisting of sodium lauryl sulfoacetate, ammonium lauryl sulfoacetate, and mixture thereof.

Glutamate anionic surfactant.

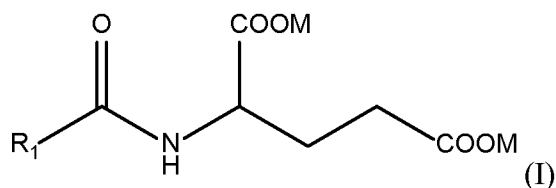
The article contains less than 5%, preferably less than 3% of glutamate anionic surfactant, by weight on a dry fibrous element basis and/or a dry dissolvable article basis.

More preferably the article is substantially free of glutamate anionic surfactant.

The term “substantially free of” as used herein means less than 1%, less than 0.8%, less than 0.5%, less than 0.3%, less than 0.1%, or less than an immaterial amount of a stated ingredient by total weight of the article.

The term “free of” as used herein means that the article comprises 0% of a stated ingredient
5 by total weight of the article, thus no detectable amount of the stated ingredient.

Glutamate surfactant according to the general formula (I):



wherein R₁ can be saturated or unsaturated, straight, or branched alkyl or alkenyl chain with from 5 to 20 carbon atoms, alternatively with from 7 to 17 carbon atoms, alternatively with from 9 to
10 13 carbon atoms; and M can be H, ammonium, triethanolammonium (TEA), sodium or potassium and mixtures thereof.

Non-limiting examples of glutamate surfactants can include sodium cocoyl glutamate, disodium cocoyl glutamate, potassium cocoyl glutamate, dipotassium cocoyl glutamate, ammonium cocoyl glutamate, diammonium cocoyl glutamate, sodium lauroyl glutamate, disodium
15 lauroyl glutamate, potassium lauroyl glutamate, dipotassium lauroyl glutamate, sodium capryloyl glutamate, disodium capryloyl glutamate, potassium capryloyl glutamate, dipotassium capryloyl glutamate, sodium undecylenoyl glutamate, disodium undecylenoyl glutamate, potassium undecylenoyl glutamate, dipotassium undecylenoyl glutamate, disodium hydrogenated tallowoyl glutamate, sodium stearoyl glutamate, disodium stearoyl glutamate, potassium stearoyl glutamate,
20 dipotassium stearoyl glutamate, sodium myristoyl glutamate, disodium myristoyl glutamate, potassium myristoyl glutamate, dipotassium myristoyl glutamate, sodium cocoyl/hydrogenated tallowoyl glutamate, sodium cocoyl/palmoyl/sunfloweroyl glutamate, sodium hydrogenated tallowoyl glutamate, sodium olivoyl glutamate, disodium olivoyl glutamate, sodium palmoyl glutamate, disodium palmoyl glutamate, TEA-cocoyl glutamate, TEA-hydrogenated tallowoyl
25 glutamate, TEA-lauroyl glutamate, and mixtures thereof.

Substantially free of sulfate-based surfactants.

The article is substantially free of sulfate-based surfactant.

The term “substantially free of” as used herein means less than 1%, less than 0.8%, less
30 than 0.5%, less than 0.3%, less than 0.1%, or less than an immaterial amount of a stated ingredient by total weight of the article.

The term “free of” as used herein means that the article comprises 0% of a stated ingredient by total weight of the article, thus no detectable amount of the stated ingredient.

Such sulfate-based surfactants include alkyl sulfate and alkyl ether sulfates. Such alkyl ether sulfate may include alkyl glyceryl ether sulfates. Such sulfate-based surfactants do not include conventional sulfate salts such as sodium sulfate.

Exemplary sulfate-based surfactants include ammonium lauryl sulfate, ammonium laureth sulfate, triethylamine lauryl sulfate, triethylamine laureth sulfate, triethanolamine lauryl sulfate, triethanolamine laureth sulfate, monoethanolamine lauryl sulfate, monoethanolamine laureth sulfate, diethanolamine lauryl sulfate, diethanolamine laureth sulfate, lauric monoglyceride sodium sulfate, sodium lauryl sulfate, sodium laureth sulfate, potassium lauryl sulfate, potassium laureth sulfate, ammonium cocoyl sulfate, ammonium lauroyl sulfate, sodium cocoyl sulfate, sodium lauroyl sulfate, potassium cocoyl sulfate, potassium lauryl sulfate, triethanolamine lauryl sulfate, triethanolamine lauryl sulfate, monoethanolamine cocoyl sulfate, monoethanolamine lauryl sulfate, and combinations thereof.

Substantially free of surfactants containing -COOH group.

The article is substantially free of surfactants containing -COOH group.

The term “substantially free of” as used herein means less than 1%, less than 0.8%, less than 0.5%, less than 0.3%, less than 0.1%, or less than an immaterial amount of a stated ingredient by total weight of the article.

The term “free of” as used herein means that the article comprises 0% of a stated ingredient by total weight of the article, thus no detectable amount of the stated ingredient.

Other surfactants (Co-surfactant)

The surfactant system can contain other surfactants than those listed above. Such other surfactants are, for example, amphoteric surfactants, zwitterionic surfactants, nonionic surfactants, additional anionic surfactants other than those listed above, and mixtures thereof. Preferably, the co-surfactants are selected from the group consisting of amphoteric surfactant, zwitterionic surfactant, and mixtures thereof. More preferably, the co-surfactant is a sultaine surfactant, in view of reduced precipitation in hard water and also providing better/faster dryness during manufacturing, compared to other amphoteric or zwitter ionic surfactants such as betaine and amphoacetate. Preferably, the sultaine surfactant is free of -COOH group.

The total level of the co-surfactant can be from about 0.5% to about 50%, alternatively from about 2% to about 30%, alternatively from about 5% to about 25%, alternatively from about 7% to about 20%, by weight of dry fibrous element basis and/or a dry dissolvable solid article basis.

5 The total level of the amphoteric surfactant may be from about 0.5% to about 25%, preferably from about 2% to about 20% by weight of dry fibrous element basis and/or a dry dissolvable solid article basis.

10 The total level of the zwitterionic surfactant may be from about 0.5% to about 25%, preferably from about 2% to about 20% by weight of dry fibrous element basis and/or a dry dissolvable solid article basis.

Suitable amphoteric or zwitterionic surfactants can include those described in U.S. Patent No. 5,104,646 and U.S. Patent No. 5,106,609.

15 Amphoteric surfactants can include those that can be broadly described as derivatives of aliphatic secondary and tertiary amines in which an aliphatic radical can be straight or branched chain and wherein an aliphatic substituent can contain from 8 to 18 carbon atoms such that one carbon atom can contain an anionic water solubilizing group, e.g., carboxy, sulfonate, phosphate, or phosphonate. Examples of compounds falling within this definition can be sodium 3-dodecylaminopropionate, sodium 3-dodecylaminopropane sulfonate, N-alkyltaurines such as the one prepared by reacting dodecylamine with sodium isethionate according to the teaching of U.S. Patent No. 2,658,072, N-higher alkyl aspartic acids such as those produced according to the teaching of U.S. Patent No. 2,438,091, and products described in U.S. Patent No. 2,528,378.

20 The amphoteric surfactant described herein may be selected from the group consisting of sodium lauroamphoacetate, sodium cocoamphoacetate, disodium lauroamphodiacetate, disodium cocodiamphoacetate, and mixtures thereof.

25 Zwitterionic surfactants suitable for use in the co-surfactants of the one or more active agents described herein may include those that are broadly described as derivatives of aliphatic quaternary ammonium, phosphonium, and sulfonium compounds, in which the aliphatic radicals can be straight or branched chains, and wherein one of the aliphatic substituents can contain from 8 to 18 carbon atoms and one can contain an anionic group, e.g., carboxy, sulfonate, phosphate, or phosphonate.

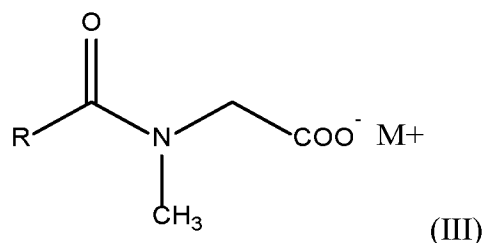
30 Hence, the one or more surfactants of the one or more active agents may comprise at least an amphoteric or zwitterionic surfactant selected from the group consisting of cocamidopropyl betaine, lauramidopropyl betaine, coco-betaine, lauryl betaine, lauryl hydroxysultaine,

cocamidopropyl hydroxysultaine, coco-hydroxysultaine, coco-sultaine, lauryl sultaine, sodium cocoamphoacetate, disodium cocoamphodiaceate, sodium lauroamphoacetate, disodium lauroamphodiaceate, lauramine oxide, lauryl hydroxysultaine, and mixtures thereof.

Examples of betaine zwitterionic surfactants may include coco dimethyl carboxymethyl betaine, cocoamidopropyl betaine (CAPB), coco-betaine, lauryl amidopropyl betaine (LAPB), oleyl betaine, lauryl dimethyl carboxymethyl betaine, lauryl dimethyl alpha-carboxyethyl betaine, cetyl dimethyl carboxymethyl betaine, lauryl bis-(2-hydroxyethyl) carboxymethyl betaine, stearyl bis-(2-hydroxypropyl) carboxymethyl betaine, oleyl dimethyl gamma-carboxypropyl betaine, lauryl bis-(2-hydroxypropyl)alpha-carboxyethyl betaine, and mixtures thereof. Examples of sulfobetaines may include coco dimethyl sulfopropyl betaine, stearyl dimethyl sulfopropyl betaine, lauryl dimethyl sulfoethyl betaine, lauryl bis-(2-hydroxyethyl) sulfopropyl betaine, and mixtures thereof.

The additional anionic surfactant may be selected from the group consisting of an a sarcosinate surfactant, a glycinate surfactant, an alanate surfactant, a glucose carboxylate surfactant, an alkyl ether carboxylate surfactant, and mixtures thereof. Each anionic surfactant just listed above will be described in more details below.

The sarcosinate surfactant may have the general formula (III):



wherein R can be a saturated or unsaturated, straight, or branched alkyl or alkenyl, alternatively alkyl chain with 7 to 17 carbon atoms, alternatively with 9 to 13 carbon atoms and M^+ can be H, a sodium, potassium, ammonium or triethanolammonium cation.

The sarcosinate surfactant may be selected from the group consisting of sodium lauroyl sarcosinate, sodium cocoyl sarcosinate, sodium myristoyl sarcosinate, TEA-cocoyl sarcosinate, ammonium cocoyl sarcosinate, ammonium lauroyl sarcosinate, dimer dilinoleyl bis-lauroyl glutamate/lauroyl sarcosinate, disodium lauroamphodiaceate, lauroyl sarcosinate, isopropyl lauroyl sarcosinate, potassium cocoyl sarcosinate, potassium lauroyl sarcosinate, sodium cocoyl sarcosinate, sodium lauroyl sarcosinate, sodium myristoyl sarcosinate, sodium oleyl sarcosinate,

sodium palmitoyl sarcosinate, TEA-cocoyl sarcosinate, TEA-lauroyl sarcosinate, TEA-oleoyl sarcosinate, TEA-palm kernel sarcosinate, and mixtures thereof.

Alternatively, the sarcosinate surfactant may be selected from the group consisting of sodium lauroyl sarcosinate, sodium myristoyl sarcosinate, sodium cocoyl sarcosinate, and mixtures thereof.

The glycinate surfactant may be selected from the group consisting of sodium cocoyl glycinate, sodium lauroyl glycinate, and mixture thereof.

The alaninate surfactant may be selected from the group consisting of sodium cocoyl alaninate, sodium lauroyl alaninate, sodium N-dodecanoyl-L-alaninate, and mixture thereof.

The sulfosuccinate surfactant may be selected from the group consisting of disodium N-octadecyl sulfosuccinate, disodium lauryl sulfosuccinate, diammonium lauryl sulfosuccinate, sodium lauryl sulfosuccinate, disodium laureth sulfosuccinate, tetrasodium N-(1,2-dicarboxyethyl)-N-octadecyl sulfosuccinate, diamyl ester of sodium sulfosuccinic acid, dihexyl ester of sodium sulfosuccinic acid, dioctyl esters of sodium sulfosuccinic acid, and mixtures thereof.

The glucose carboxylate surfactant may be selected from the group consisting of sodium lauryl glucoside carboxylate, sodium cocoyl glucoside carboxylate, and mixtures thereof.

The alkyl ether carboxylate surfactant may be selected from the group consisting of sodium laureth-4 carboxylate, laureth-5 carboxylate, laureth-13 carboxylate, sodium C12-13 pareth-8 carboxylate, sodium C12-15 pareth-8 carboxylate and mixtures thereof.

The anionic surfactant being not a glutamate surfactant may comprise a lactate or lactylate. Non-limiting example of lactates can include sodium lactate. Non-limiting examples of lactylates can include sodium lauroyl lactylate, sodium cocoyl lactylate, and mixture thereof.

In that case, alkyl can be defined as a saturated or unsaturated, straight, or branched alkyl chain with 6 to 30 carbon atoms, alternatively with 8 to 22 carbon atoms, alternatively with 9 to 18 carbon atoms. In that case, acyl can be defined as of formula $R-C(O)-$, wherein R can be a saturated or unsaturated, straight, or branched alkyl or alkenyl, alternatively alkyl chain with 6 to 30 carbon atoms, alternatively with 8 to 22 carbon atoms, alternatively with 9 to 18 carbon atoms.

The alkyl glucoside may be selected from the group consisting of decyl glucoside, cocoyl glucoside, lauroyl glucoside, and mixtures thereof.

The acyl glucamide may be selected from the group consisting of lauroyl/myristoyl methyl glucamide, capryloyl/capryloyl methyl glucamide, cocoyl methyl glucamide and mixtures thereof.

Alternatively, the non-ionic surfactant may be selected from the group consisting of cocoamide monoethanolamine, lauramide monoethanolamine, cocoyl glucoside, lauroyl glucoside, decyl glucoside, and mixtures thereof.

5 Cationic Polymers

The solid dissolvable article can contain from about 0.05% to about 5% cationic polymer, from about 0.1% to about 2% cationic polymer, from about 0.2% to about 1.5% cationic polymer, from about 0.3% to about 1.0% cationic polymer, from about 0.4% to about 0.75% cationic polymer, by weight on a dry fibrous element basis and/or a dry dissolvable solid article basis.

10 The cationic polymers can have a weight average molecular weight from about 500,000 g/mol to about 2.5 million g/mol, alternatively from about 500,000 g/mol to about 2 million g/mol, alternatively from about 500,000 g/mol to about 1.5 million, alternatively about 500,000 g/mol to about 1 million as measured by gel permeation chromatography. The cationic polymers can have a weight average molecular weight greater than 500,000 g/mol, alternatively greater than 1 million
15 g/mol as measured by gel permeation chromatography.

The cationic polymers can have a weight average charge density greater than 0.2 meq/g, alternatively greater than 0.4 meq/g, alternatively 0.6 meq/g, alternatively 0.8 meq/g, alternatively 1 meq/g, alternatively 1.2 meq/g, alternatively 1.5 meq/g, alternatively 2 meq/g, alternatively greater than 3 meq/g, alternatively greater than 5 meq/g. The cationic polymers can have a weight
20 average charge density from about 0.4 meq/g to about 5 meq/g, alternatively from about 1 meq/g to about 3 meq/g, alternatively from about 1 meq/g to about 2.5 meq/g as measured according to the Charge Density Test Method.

Cationic Guar Polymer

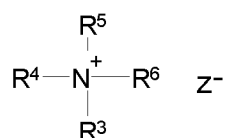
25 The cationic polymer can be (a) a cationic guar polymer. Cationic guar polymers are cationically substituted galactomannan (guar) gum derivatives. Guar gum for use in preparing these guar gum derivatives is typically obtained as a naturally occurring material from the seeds of the guar plant. The guar molecule itself is a straight chain mannan, which is branched at regular intervals with single membered galactose units on alternative mannose units. The mannose units
30 are linked to each other by means of α (1-4) glycosidic linkages. The galactose branching arises by way of an α (1-6) linkage. Cationic derivatives of the guar gums are obtained by reaction between the hydroxyl groups of the polygalactomannan and reactive quaternary ammonium

compounds. The degree of substitution of the cationic groups onto the guar structure should be sufficient to provide the requisite cationic charge density described above.

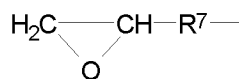
The cationic guar polymer can have a weight average M.Wt. of less than 2.2 million g/mol, or from about 150 thousand g/mol to about 2 million g/mol, or from about 200 thousand to about 1.9 million g/mol, or from about 300 thousand to about 1.8 million g/mol, or from about 400 thousand to about 1.7 million g/mol, or from about 500,000 g/mol to about 1.6 million g/mol. The cationic guar polymer can have a weight average M.Wt. of greater than about 150,000 g/mol, alternatively greater than about 1 million g/mol, alternatively greater than about 1.5 million g/mol, alternatively greater than about 2 million g/mol, and alternatively greater than about 2.5 million g/mol.

The cationic guar polymer can have a weight average charge density of from about 0.2 meq/g to about 2.2 meg/g, or from about 0.3 meq/g to about 2.0 meg/g, or from about 0.4 meq/g to about 1.9 meg/g, or from about 0.5 meq/g to about 1.8 meg/g, or from about 0.6 meq/g to about 1.7 meg/g, or from about 0.6 meq/g to about 1.5 meq/g, or from about 0.6 meq/g to about 1.3 meg/g, and/or from about 0.7 meq/g to about 1.0 meg/g.

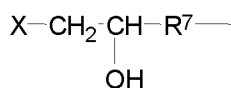
The cationic guar polymer may be formed from quaternary ammonium compounds. The quaternary ammonium compounds for forming the cationic guar polymer can conform to the general formula 1:



wherein where R^3 , R^4 and R^5 are methyl or ethyl groups; R^6 is either an epoxyalkyl group of the general formula 2:

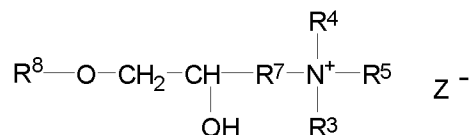


or R^6 is a halohydrin group of the general formula 3:

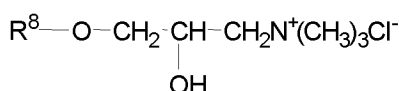


wherein R^7 is a C_1 to C_3 alkylene; X is chlorine or bromine, and Z is an anion such as Cl^- , Br^- , I^- or HSO_4^- .

The cationic guar polymer can conform to the general formula 4:



wherein R^8 is guar gum; and wherein R^4 , R^5 , R^6 and R^7 are as defined above; and wherein Z is a halogen. The cationic guar polymer can conform to Formula 5:



5

Suitable cationic guar polymers can include cationic guar gum derivatives, such as guar hydroxypropyltrimonium chloride. The cationic guar polymer is a guar hydroxypropyltrimonium chloride. Specific examples of guar hydroxypropyltrimonium chlorides include the Jaguar[®] series commercially available from Rhone-Poulenc Incorporated, for example Jaguar[®] C-500, commercially available from Rhodia. Jaguar[®] C-500 has a charge density of 0.8 meq/g and a weight average molecular weight of 500,000 g/mol. Another guar hydroxypropyltrimonium chloride with a charge density of about 1.1 meq/g and a weight average molecular weight of about 500,000 g/mol is available from Ashland. A further guar hydroxypropyltrimonium chloride with a charge density of about 1.5 meq/g and a weight average molecular weight of about 500,000 g/mole is available from Ashland.

15

Other suitable guar hydroxypropyltrimonium chloride are: Hi-Care 1000, which has a charge density of about 0.7 meq/g and a weight average molecular weight of about 600,000 g/mole is available from Rhodia; N-Hance 3269 and N-Hance 3270, which have a charge density of about 0.7 meq/g and a weight average molecular weight of about 425,000 g/mol are available from Ashland; N-Hance 3271 which has a charge density of about 0.7 meq/g and a weight average molecular weight of about 500,000 g/mol and is available from Ashland; BF-13, which is a borate (boron) free guar of charge density of about 1.1 meq/g and weight average molecular weight of about 800,000 and BF-17, which is a borate (boron) free guar of charge density of about 1.7 meq/g and M. W.t of about 800,000 both available from Ashland; N-Hance CG17 has a charge density of about 1.0 meq/g and a weight average molecular weight of about 1,600,000 g/mol and is available from Ashland; and N-Hance 3196 has a charge density of about 0.7 meq/g and a weight average molecular weight of 1,700,000 g/mol and is available from Ashland.

25

Cationic Synthetic Polymer

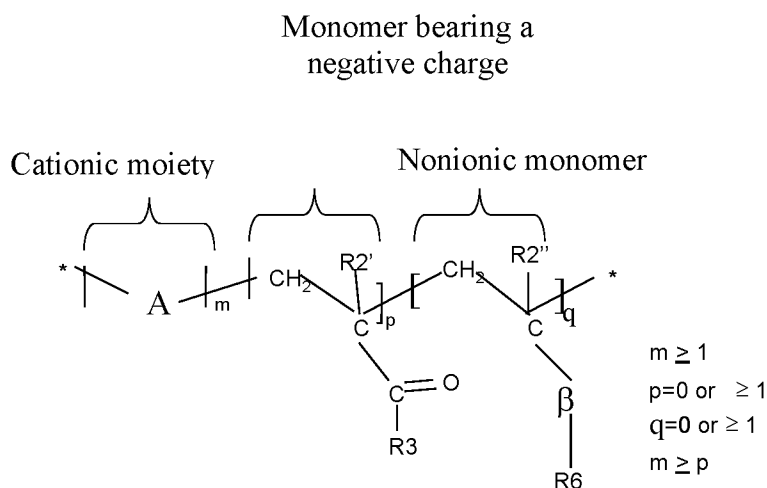
The cationic polymer can be (b) a cationic synthetic polymer, wherein the cationic synthetic polymer can have a weight average M.Wt. of from about 1,000 g/mol to about 2.0 million g/mol, and wherein the cationic guar polymer can have a charge density of from about 2 meq/g to about 10 meq/g.

The cationic synthetic polymers may be formed from

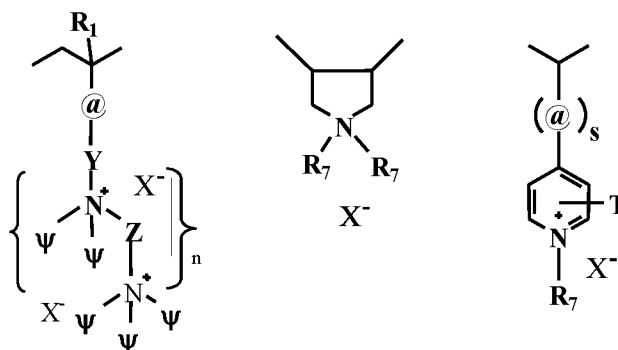
- i) one or more cationic monomer units, and optionally
- ii) one or more monomer units bearing a negative charge, and/or
- iii) a nonionic monomer,

wherein the subsequent charge of the copolymer is positive. The ratio of the three types of monomers is given by “m”, “p” and “q” where “m” is the number of cationic monomers, “p” is the number of monomers bearing a negative charge and “q” is the number of nonionic monomers

The cationic polymers can be water soluble or dispersible, non-crosslinked, and cationic synthetic polymers having the following structure:



where A, may be one or more of the following cationic moieties:



where @ = amido, alkylamido, ester, ether, alkyl or alkylaryl;

where Y = C1-C22 alkyl, alkoxy, alkylidene, alkyl or aryloxy;

where □ = C1-C22 alkyl, alkyloxy, alkyl aryl or alkyl arylox;

where Z = C1-C22 alkyl, alkyloxy, aryl or aryloxy;

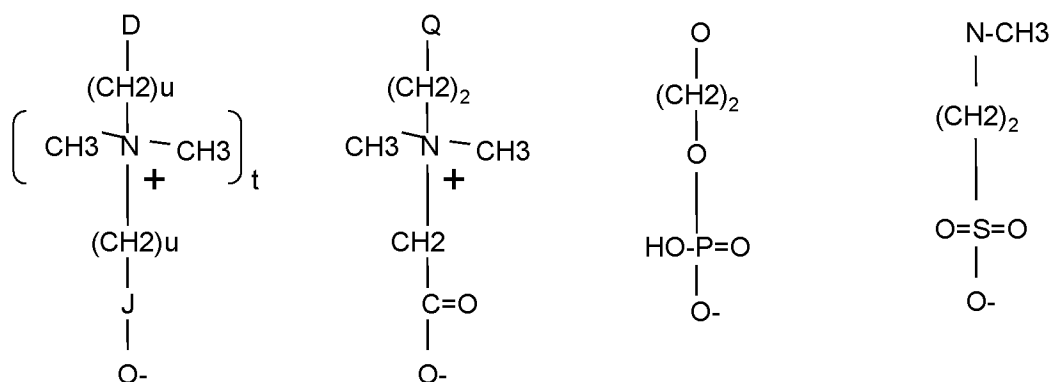
5 where R1 = H, C1-C4 linear or branched alkyl;

where s = 0 or 1, n = 0 or □ 1;

where T and R7 = C1-C22 alkyl; and

where X- = halogen, hydroxide, alkoxide, sulfate or alkylsulfate.

Where the monomer bearing a negative charge is defined by R2' = H, C1-C4 linear or
10 branched alkyl and R3 as:



where D = O, N, or S;

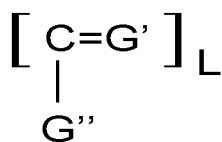
where Q = NH₂ or O;

where u = 1-6;

15 where t = 0-1; and

where J = oxygenated functional group containing the following elements P, S, C.

Where the nonionic monomer is defined by R2'' = H, C1-C4 linear or branched alkyl, R6 = linear or branched alkyl, alkyl aryl, aryl oxy, alkyloxy, alkylaryl oxy and □ is defined as



; and

20 where G' and G'' are, independently of one another, O, S or N-H and L = 0 or 1.

Examples of cationic monomers include aminoalkyl (meth)acrylates, (meth)aminoalkyl (meth)acrylamides; monomers comprising at least one secondary, tertiary, or quaternary amine function, or a heterocyclic group containing a nitrogen atom, vinylamine or ethylenimine;

diallyldialkyl ammonium salts; their mixtures, their salts, and macromonomers deriving from therefrom.

Further examples of cationic monomers include dimethylaminoethyl (meth)acrylate, dimethylaminopropyl (meth)acrylate, ditertiobutylaminoethyl (meth)acrylate, 5 dimethylaminomethyl (meth)acrylamide, dimethylaminopropyl (meth)acrylamide, ethylenimine, vinylamine, 2-vinylpyridine, 4-vinylpyridine, trimethylammonium ethyl (meth)acrylate chloride, trimethylammonium ethyl (meth)acrylate methyl sulphate, dimethylammonium ethyl (meth)acrylate benzyl chloride, 4-benzoylbzyl dimethylammonium ethyl acrylate chloride, trimethyl ammonium ethyl (meth)acrylamido chloride, trimethyl ammonium propyl 10 (meth)acrylamido chloride, vinylbenzyl trimethyl ammonium chloride, diallyldimethyl ammonium chloride.

Suitable cationic monomers include those which comprise a quaternary ammonium group of formula $-NR_3^+$, wherein R, which is identical or different, represents a hydrogen atom, an alkyl group comprising 1 to 10 carbon atoms, or a benzyl group, optionally carrying a hydroxyl group, 15 and comprise an anion (counter-ion). Examples of anions are halides such as chlorides, bromides, sulphates, hydrosulphates, alkylsulphates (for example comprising 1 to 6 carbon atoms), phosphates, citrates, formates, and acetates.

Suitable cationic monomers include trimethylammonium ethyl (meth)acrylate chloride, trimethylammonium ethyl (meth)acrylate methyl sulphate, dimethylammonium ethyl 20 (meth)acrylate benzyl chloride, 4-benzoylbzyl dimethylammonium ethyl acrylate chloride, trimethyl ammonium ethyl (meth)acrylamido chloride, trimethyl ammonium propyl (meth)acrylamido chloride, vinylbenzyl trimethyl ammonium chloride.

Additional suitable cationic monomers include trimethyl ammonium propyl (meth)acrylamido chloride.

25 Examples of monomers bearing a negative charge include alpha ethylenically unsaturated monomers comprising a phosphate or phosphonate group, alpha ethylenically unsaturated monocarboxylic acids, monoalkylesters of alpha ethylenically unsaturated dicarboxylic acids, monoalkylamides of alpha ethylenically unsaturated dicarboxylic acids, alpha ethylenically unsaturated compounds comprising a sulphonic acid group, and salts of alpha ethylenically 30 unsaturated compounds comprising a sulphonic acid group.

Suitable monomers with a negative charge include acrylic acid, methacrylic acid, vinyl sulphonic acid, salts of vinyl sulfonic acid, vinylbenzene sulphonic acid, salts of vinylbenzene sulphonic acid, alpha-acrylamidomethylpropanesulphonic acid, salts of alpha-

acrylamidomethylpropanesulphonic acid, 2-sulphoethyl methacrylate, salts of 2-sulphoethyl methacrylate, acrylamido-2-methylpropanesulphonic acid (AMPS), salts of acrylamido-2-methylpropanesulphonic acid, and styrenesulphonate (SS).

Examples of nonionic monomers include vinyl acetate, amides of alpha ethylenically unsaturated carboxylic acids, esters of an alpha ethylenically unsaturated monocarboxylic acids with an hydrogenated or fluorinated alcohol, polyethylene oxide (meth)acrylate (i.e. polyethoxylated (meth)acrylic acid), monoalkylesters of alpha ethylenically unsaturated dicarboxylic acids, monoalkylamides of alpha ethylenically unsaturated dicarboxylic acids, vinyl nitriles, vinylamine amides, vinyl alcohol, vinyl pyrrolidone, and vinyl aromatic compounds.

Suitable nonionic monomers include styrene, acrylamide, methacrylamide, acrylonitrile, methylacrylate, ethylacrylate, n-propylacrylate, n-butylacrylate, methylmethacrylate, ethylmethacrylate, n-propylmethacrylate, n-butylmethacrylate, 2-ethyl-hexyl acrylate, 2-ethyl-hexyl methacrylate, 2-hydroxyethylacrylate and 2-hydroxyethylmethacrylate.

The anionic counterion (X⁻) in association with the cationic synthetic polymers may be any known counterion so long as the polymers remain soluble or dispersible in water, in the hair care composition, or in a coacervate phase of the hair care composition, and so long as the counterions are physically and chemically compatible with the essential components of the hair care composition or do not otherwise unduly impair product performance, stability or aesthetics. Non limiting examples of such counterions include halides (e.g., chlorine, fluorine, bromine, iodine), sulfate and methylsulfate.

The cationic synthetic polymer can have a weight average M.Wt. of from about 1,500 g/mol to about 1.8 million g/mol, or from about 2,000 g/mol to about 1.7 million g/mol, or from about 3,000 g/mol to about 1.6 million g/mol, or from about 4,000 g/mol to about 1.5 million g/mol, or from about 5,000 g/mol to about 1.6 million g/mol, or from about 6,000 g/mol to about 1.5 million g/mol, or from about 7,000 g/mol to about 1.4 million g/mol, or from about 8,000 g/mol to about 1.4 million g/mol, or from about 9,000 g/mol to about 1.3 million g/mol, or from about 10,000 g/mol to about 1.2 million g/mol or from about 11,000 g/mol to about 1.1 million g/mol, or from about 25,000 g/mol to about 750,000 g/mol, or from about 50,000 g/mol to about 500,000 g/mol, or from about 75,000 g/mol to about 300,000 g/mol, and/or from about 100,000 g/mol to about 200,000 g/mol.

The cationic synthetic polymer can have a weight average charge density of from about 2.2 meq/g to about 9.5 meg/g, or from about 2.5 meq/g to about 8 meg/g, or from about 3 meq/g to

about 8 meq/g, or from about 3.5 meq/g to about 7.5 meq/g, and/or from about 4 meq/g to about 7 meq/g.

The cationic synthetic polymer can comprise polydiallyldimethylammonium chloride (polyDADMAC). PolyDADMAC is also known as polyquaternium-6. Specific examples of polyDADMAC are Mirapol® 100 series from Solvay, Merquat™ 100 series from Lubrizol and Salcare® SC 30 from BASF. For example, Mirapol® 100s has a charge density of 6.2 meq/g and a weight average molecular weight of 150,000 g/mol, is available from Solvay.

The hair care composition may further comprise (c) a cationic non-guar galactomannan polymer, (d) a cationic starch polymer, (e) a cationic copolymer of acrylamide monomers and cationic monomers, (f) a cationic cellulose polymer or (g) a mixture of such polymers.

Cationic Non-Guar Galactomannan Polymers

The cationic polymer can be a galactomannan polymer derivative having a mannose to galactose ratio of between 5:1 and 1:1 on a monomer to monomer basis, the galactomannan polymer derivative selected from the group consisting of a cationic galactomannan polymer derivative and an amphoteric galactomannan polymer derivative having a net positive charge. As used herein, the term "cationic galactomannan" refers to a galactomannan polymer to which a cationic group is added. The term "amphoteric galactomannan" refers to a galactomannan polymer to which a cationic group and an anionic group are added such that the polymer has a net positive charge.

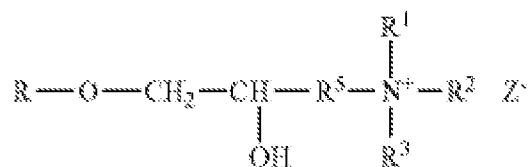
Galactomannan polymers are present in the endosperm of seeds of the Leguminosae family. Galactomannan polymers are made up of a combination of mannose monomers and galactose monomers. The galactomannan molecule is a straight chain mannan branched at regular intervals with single membered galactose units on specific mannose units. The mannose units are linked to each other by means of β (1-4) glycosidic linkages. The galactose branching arises by way of an α (1-6) linkage. The ratio of mannose monomers to galactose monomers varies according to the species of the plant and also is affected by climate. Non Guar Galactomannan polymer derivatives can have a ratio of mannose to galactose of greater than 2:1 on a monomer to monomer basis. Suitable ratios of mannose to galactose can be greater than about 3:1, and the ratio of mannose to galactose can be greater than about 4:1. Analysis of mannose to galactose ratios is well known in the art and is typically based on the measurement of the galactose content.

The gum for use in preparing the non-guar galactomannan polymer derivatives is typically obtained as naturally occurring material such as seeds or beans from plants. Examples of various

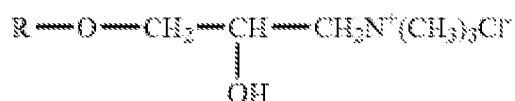
non-guar galactomannan polymers include but are not limited to Tara gum (3 parts mannose/1 part galactose), Locust bean or Carob (4 parts mannose/1 part galactose), and Cassia gum (5 parts mannose/1 part galactose).

The galactomannan polymer derivative can be a cationic derivative of the non-guar galactomannan polymer, which is obtained by reaction between the hydroxyl groups of the polygalactomannan polymer and reactive quaternary ammonium compounds. Suitable quaternary ammonium compounds for use in forming the cationic galactomannan polymer derivatives include those conforming to the general formulas 1-5, as defined above.

Cationic non-guar galactomannan polymer derivatives formed from the reagents described above are represented by the general formula 6:



wherein R is the gum. The cationic galactomannan derivative can be a gum hydroxypropyltrimethylammonium chloride, which can be more specifically represented by the general formula 7:



The galactomannan polymer derivative can be an amphoteric galactomannan polymer derivative having a net positive charge, obtained when the cationic galactomannan polymer derivative further comprises an anionic group.

The cationic non-guar galactomannan can have a ratio of mannose to galactose that is greater than about 4:1..

(d) Cationically Modified Starch Polymer

The cationic polymer can be water-soluble cationically modified starch polymers. As used herein, the term "cationically modified starch" refers to a starch to which a cationic group is added prior to degradation of the starch to achieve a relatively small weight average molecular weight, or wherein a cationic group is added after modification of the starch to achieve a desired weight average molecular weight. The definition of the term "cationically modified starch" also includes

amphoterically modified starch. The term "amphoterically modified starch" refers to a starch hydrolysate to which a cationic group and an anionic group are added.

The starch polymers can be those chemically modified by the addition of amino and/or ammonium groups into the starch molecules. Non-limiting examples of these ammonium groups may include substituents such as hydroxypropyl trimmonium chloride, trimethylhydroxypropyl ammonium chloride, dimethylstearylhydroxypropyl ammonium chloride, and dimethyldodecylhydroxypropyl ammonium chloride. See Solarek, D. B., Cationic Starches in Modified Starches: Properties and Uses, Wurzburg, O. B., Ed., CRC Press, Inc., Boca Raton, Fla. 1986, pp 113-125. The cationic groups may be added to the starch prior to degradation to a relatively small weight average molecular weight or the cationic groups may be added after such modification.

The cationically modified starch polymers can generally have a degree of substitution of a cationic group from about 0.1 to about 7. As used herein, the "degree of substitution" of the cationically modified starch polymers is an average measure of the number of hydroxyl groups on each anhydroglucose unit which is derivatized by substituent groups. Since each anhydroglucose unit has three potential hydroxyl groups available for substitution, the maximum possible degree of substitution is 3. The degree of substitution is expressed as the number of moles of substituent groups per mole of anhydroglucose unit, on a molar average basis. The degree of substitution may be determined using proton nuclear magnetic resonance spectroscopy ("¹H NMR") methods well known in the art. Suitable ¹H NMR techniques include those described in "Observation on NMR Spectra of Starches in Dimethyl Sulfoxide, Iodine-Complexing, and Solvating in Water-Dimethyl Sulfoxide", Qin-Ji Peng and Arthur S. Perlin, Carbohydrate Research, 160 (1987), 57-72; and "An Approach to the Structural Analysis of Oligosaccharides by NMR Spectroscopy", J. Howard Bradbury and J. Grant Collins, Carbohydrate Research, 71, (1979), 15-25.

The source of starch before chemical modification can be chosen from a variety of sources such as tubers, legumes, cereal, and grains. Non-limiting examples of this source starch may include corn starch, wheat starch, rice starch, waxy corn starch, oat starch, cassaya starch, waxy barley, waxy rice starch, glutenous rice starch, sweet rice starch, amioca, potato starch, tapioca starch, oat starch, sago starch, sweet rice, or mixtures thereof.

Cationically modified starch polymers can be selected from degraded cationic maize starch, cationic tapioca, cationic potato starch, and mixtures thereof.

The starch, prior to degradation or after modification to achieve a relatively small weight average molecular weight, may comprise one or more additional modifications. For example, these

modifications may include cross-linking, stabilization reactions, phosphorylations, and hydrolyzations. Stabilization reactions may include alkylation and esterification.

The cationically modified starch polymers may be incorporated into the composition in the form of hydrolyzed starch (e.g., acid, enzyme, or alkaline degradation), oxidized starch (e.g.,
5 peroxide, peracid, hypochlorite, alkaline, or any other oxidizing agent), physically/mechanically degraded starch (e.g., via the thermo-mechanical energy input of the processing equipment), or combinations thereof.

An optimal form of the starch is one which is readily soluble in water and forms a substantially clear (% Transmittance ≥ 80 at 600 nm) solution in water. The transparency of
10 the composition is measured by Ultra-Violet/Visible (UV/VIS) spectrophotometry, which determines the absorption or transmission of UV/VIS light by a sample, using a Gretag Macbeth Colorimeter Color i 5 according to the related instructions. A light wavelength of 600 nm has been shown to be adequate for characterizing the degree of clarity of cosmetic compositions.

Suitable cationically modified starch for use in compositions is available from known
15 starch suppliers. Nonionic modified starch that could be further derivatized to a cationically modified starch as is known in the art can be suitable. Other suitable modified starch starting materials may be quaternized, as is known in the art, to produce the cationically modified starch polymer suitable for use in the invention.

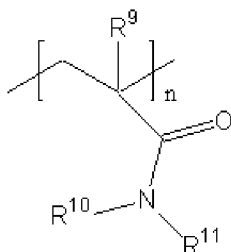
Starch Degradation Procedure: A starch slurry is prepared by mixing granular starch in
20 water. The temperature is raised to about 35°C. An aqueous solution of potassium permanganate is then added at a concentration of about 50 ppm based on starch. The pH is raised to about 11.5 with sodium hydroxide and the slurry is stirred sufficiently to prevent settling of the starch. Then, about a 30% solution of hydrogen peroxide diluted in water is added to a level of about 1% of peroxide based on starch. The pH of about 11.5 is then restored by adding additional sodium
25 hydroxide. The reaction is completed over about a 1 to about 20 hour period. The mixture is then neutralized with dilute hydrochloric acid. The degraded starch is recovered by filtration followed by washing and drying.

Cationic copolymer of an Acrylamide Monomer and a Cationic Monomer

30 The cationic polymer can be a cationic copolymer of an acrylamide monomer and a cationic monomer. The cationic copolymer can be a synthetic cationic copolymer of acrylamide monomers and cationic monomers.

The cationic copolymer can comprise:

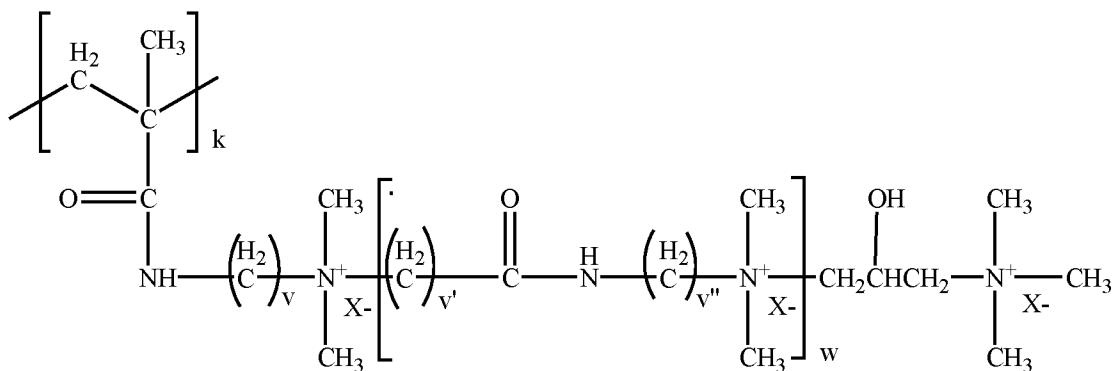
(i) an acrylamide monomer of the following Formula AM:



5 Formula AM

Where R⁹ is H or C₁₋₄ alkyl; and R¹⁰ and R¹¹ are independently selected from the group consisting of H, C₁₋₄ alkyl, CH₂OCH₃, CH₂OCH₂CH(CH₃)₂, and phenyl, or together are C₃₋₆cycloalkyl; and

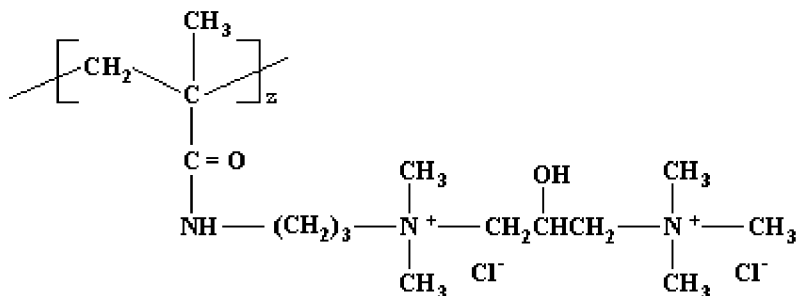
(ii) a cationic monomer conforming to Formula CM:



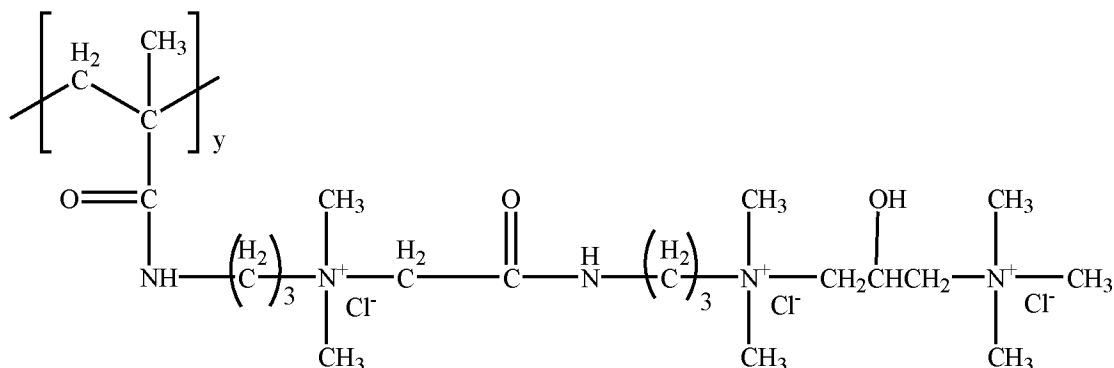
Formula CM

Where $k = 1$, each of v , v' , and v'' is independently an integer of from 1 to 6, w is zero or an integer of from 1 to 10, and X^- is an anion.

The cationic monomer can conform to Formula CM and where $k = 1$, $v = 3$ and $w = 0$, $z = 1$ and X^- is Cl^- to form the following structure:



The above structure may be referred to as diquat. The cationic monomer can conform to Formula CM and wherein v and v'' are each 3, $v' = 1$, $w = 1$, $y = 1$ and X^- is Cl^- , such as:



5 The above structure may be referred to as triquat.

The acrylamide monomer can be either acrylamide or methacrylamide.

The cationic copolymer (b) can be AM: TRIQUAT which is a copolymer of acrylamide and 1,3-Propanediaminium, N-[2-[[[dimethyl[3-[(2-methyl-1-oxo-2-propenyl)amino]propyl]ammonio]acetyl]amino]ethyl]2-hydroxy-N,N,N',N',N'-pentamethyl-,
10 trichloride. AM: TRIQUAT is also known as polyquaternium 76 (PQ76). AM: TRIQUAT may have a charge density of 1.6 meq/g and a M.Wt. of 1.1 million g/mol.

The cationic copolymer can be an acrylamide monomer and a cationic monomer, wherein the cationic monomer is selected from the group consisting of: dimethylaminoethyl (meth)acrylate, dimethylaminopropyl (meth)acrylate, ditertiobutylaminoethyl (meth)acrylate,
15 dimethylaminomethyl (meth)acrylamide, dimethylaminopropyl (meth)acrylamide; ethylenimine, vinylamine, 2-vinylpyridine, 4-vinylpyridine; trimethylammonium ethyl (meth)acrylate chloride, trimethylammonium ethyl (meth)acrylate methyl sulphate, dimethylammonium ethyl (meth)acrylate benzyl chloride, 4-benzoylbzyl dimethylammonium ethyl acrylate chloride, trimethyl ammonium ethyl (meth)acrylamido chloride, trimethyl ammonium propyl
20 (meth)acrylamido chloride, vinylbenzyl trimethyl ammonium chloride, diallyldimethyl ammonium chloride, and mixtures thereof.

The cationic copolymer comprises a cationic monomer selected from the group consisting of: cationic monomers include trimethylammonium ethyl (meth)acrylate chloride, trimethylammonium ethyl (meth)acrylate methyl sulphate, dimethylammonium ethyl
25 (meth)acrylate benzyl chloride, 4-benzoylbzyl dimethylammonium ethyl acrylate chloride, trimethyl ammonium ethyl (meth)acrylamido chloride, trimethyl ammonium propyl (meth)acrylamido chloride, vinylbenzyl trimethyl ammonium chloride, and mixtures thereof.

The cationic copolymer can be water-soluble. The cationic copolymer can be formed from (1) copolymers of (meth)acrylamide and cationic monomers based on (meth)acrylamide, and/or hydrolysis-stable cationic monomers, (2) terpolymers of (meth)acrylamide, monomers based on cationic (meth)acrylic acid esters, and monomers based on (meth)acrylamide, and/or hydrolysis-stable cationic monomers. Monomers based on cationic (meth)acrylic acid esters may be cationized esters of the (meth)acrylic acid containing a quaternized N atom. Cationized esters of the (meth)acrylic acid containing a quaternized N atom can be quaternized dialkylaminoalkyl (meth)acrylates with C1 to C3 in the alkyl and alkylene groups. The cationized esters of the (meth)acrylic acid containing a quaternized N atom are selected from the group consisting of: ammonium salts of dimethylaminomethyl (meth)acrylate, dimethylaminoethyl (meth)acrylate, dimethylaminopropyl (meth)acrylate, diethylaminomethyl (meth)acrylate, diethylaminoethyl (meth)acrylate; and diethylaminopropyl (meth)acrylate quaternized with methyl chloride. The cationized esters of the (meth)acrylic acid containing a quaternized N atom can be dimethylaminoethyl acrylate, which may be quaternized with an alkyl halide, or with methyl chloride or benzyl chloride or dimethyl sulfate (ADAME-Quat). The cationic monomer when based on (meth)acrylamides can be quaternized dialkylaminoalkyl(meth)acrylamides with C1 to C3 in the alkyl and alkylene groups, or dimethylaminopropylacrylamide, which is quaternized with an alkyl halide, or methyl chloride or benzyl chloride or dimethyl sulfate.

The cationic monomer based on a (meth)acrylamide is a quaternized dialkylaminoalkyl(meth)acrylamide with C1 to C3 in the alkyl and alkylene groups. The cationic monomer based on a (meth)acrylamide is dimethylaminopropylacrylamide, which is quaternized with an alkyl halide, especially methyl chloride or benzyl chloride or dimethyl sulfate.

The cationic monomer is a hydrolysis-stable cationic monomer. Hydrolysis-stable cationic monomers can be, in addition to a dialkylaminoalkyl(meth)acrylamide, all monomers that can be regarded as stable to the OECD hydrolysis test. The cationic monomer is hydrolysis-stable, and the hydrolysis-stable cationic monomer is selected from the group consisting of: diallyldimethylammonium chloride and water-soluble, cationic styrene derivatives.

The cationic copolymer is a terpolymer of acrylamide, 2-dimethylammoniummethyl (meth)acrylate quaternized with methyl chloride (ADAME-Q) and 3-dimethylammoniumpropyl(meth)acrylamide quaternized with methyl chloride (DIMAPA-Q). The cationic copolymer is formed from acrylamide and acrylamidopropyltrimethylammonium chloride, wherein the acrylamidopropyltrimethylammonium chloride has a charge density of from about 1.0 meq/g to about 3.0 meq/g.

The cationic copolymer is a trimethylammoniopropylmethacrylamide chloride-N-Acrylamide copolymer, which is also known as AM: MAPTAC. AM: MAPTAC may have a charge density of about 1.3 meq/g and a M.Wt. of about 1.1 million g/mol. The cationic copolymer is AM: ATPAC. AM: ATPAC may have a charge density of about 1.8 meq/g and a M.Wt. of about 1.1 million g/mol.

Cationic cellulose polymers

Suitable cationic cellulose polymers are salts of hydroxyethyl cellulose reacted with trimethyl ammonium substituted epoxide, referred to in the industry (CTFA) as Polyquaternium 10 and available from Dow/ Amerchol Corp. (Edison, N.J., USA) in their Polymer LR, JR, and KG series of polymers. Other suitable types of cationic cellulose include the polymeric quaternary ammonium salts of hydroxyethyl cellulose reacted with lauryl dimethyl ammonium-substituted epoxide referred to in the industry (CTFA) as Polyquaternium 24. These materials are available from Dow/ Amerchol Corp. under the tradename Polymer LM-200. Other suitable types of cationic cellulose include the polymeric quaternary ammonium salts of hydroxyethyl cellulose reacted with lauryl dimethyl ammonium-substituted epoxide and trimethyl ammonium substituted epoxide referred to in the industry (CTFA) as Polyquaternium 67. These materials are available from Dow/ Amerchol Corp. under the tradename SoftCAT Polymer SL-5, SoftCAT Polymer SL-30, Polymer SL-60, Polymer SL-100, Polymer SK-L, Polymer SK-M, Polymer SK-MH, and Polymer SK-H.

Extensional Aids

The fibrous elements can contain extensional aids. Non-limiting examples of extensional aids can include polymers, other extensional aids, and combinations thereof.

In one example, the extensional aids have a weight average molecular weight of at least about 500,000 Da. The weight average molecular weight of the extensional aid is from about 500,000 Da to about 25,000,000 Da, alternatively from about 800,000 Da to about 22,000,000 Da, alternatively from about 1,000,000 Da to about 20,000,000 Da, and alternatively from about 2,000,000 Da to about 15,000,000 Da. The relatively high weight average molecular weight extensional aids can be preferred in some examples of the invention due to the ability to increase extensional melt viscosity and reducing melt fracture.

The extensional aid, when used in a meltblowing process, can be added to the composition in an amount effective to visibly reduce the melt fracture and capillary breakage of fibers during the spinning process such that substantially continuous fibers having relatively consistent diameter

can be melt spun. Regardless of the process employed to produce fibrous elements and/or particles, the extensional aids, when used, can be present from about 0.001% to about 10%, by weight on a dry fibrous element basis and/or dry fibrous article basis, in one example, and in another example from about 0.005 to about 5%, by weight on a dry fibrous element basis and/or dry fibrous article basis, in yet another example from about 0.01 to about 1%, by weight on a dry fibrous element basis and/or dry fibrous article basis, and in another example from about 0.05% to about 0.5%, by weight on a dry fibrous element basis and/or dry fibrous article basis.

Non-limiting examples of polymers that can be used as extensional aids can include alginates, carrageenans, pectin, chitin, guar gum, xanthum gum, agar, gum arabic, karaya gum, tragacanth gum, locust bean gum, alkylcellulose, hydroxyalkylcellulose, carboxyalkylcellulose, and mixtures thereof.

Nonlimiting examples of other extensional aids can include modified and unmodified polyacrylamide, polyacrylic acid, polymethacrylic acid, polyvinyl alcohol, polyvinylacetate, polyvinylpyrrolidone, polyethylene vinyl acetate, polyethyleneimine, polyamides, polyalkylene oxides including polyethylene oxide, polypropylene oxide, polyethylenepropylene oxide, and mixtures thereof.

Optional Ingredients

The article can optionally comprise from about 1 wt.% to about 25 wt.% plasticizer, in one embodiment from about 3 wt. % to about 20 wt.% plasticizer, in one embodiment from about 5 wt.% to about 15 wt.% plasticizer.

When present in the articles, non-limiting examples of suitable plasticizing agents include polyols, copolyols, polycarboxylic acids, polyesters and dimethicone copolyols.

Examples of useful polyols include, but are not limited to, glycerin, diglycerin, propylene glycol, ethylene glycol, butylene glycol, pentylene glycol, cyclohexane dimethanol, hexane diol, polyethylene glycol (200-600), sugar alcohols such as sorbitol, manitol, lactitol, isosorbide, glucamine, N-methylglucamine and other mono- and polyhydric relatively low weight average molecular weight alcohols (e.g., C₂-C₈ alcohols); mono di- and oligo-saccharides such as fructose, glucose, sucrose, maltose, lactose, and high fructose corn syrup solids and ascorbic acid.

Examples of polycarboxylic acids include, but are not limited to citric acid, maleic acid, succinic acid, polyacrylic acid, and polymaleic acid.

Examples of suitable polyesters include, but are not limited to, glycerol triacetate, acetylated-monoglyceride, diethyl phthalate, triethyl citrate, tributyl citrate, acetyl triethyl citrate, acetyl tributyl citrate.

5 Examples of suitable dimethicone copolyols include, but are not limited to, PEG-12 dimethicone, PEG/PPG-18/18 dimethicone, and PPG-12 dimethicone.

Other suitable plasticizers include, but are not limited to, alkyl and allyl phthalates; naphthalates; lactates (e.g., sodium, ammonium and potassium salts); sorbeth-30; urea; lactic acid; sodium pyrrolidone carboxylic acid (PCA); sodium hyaluronate or hyaluronic acid; soluble collagen; modified protein; monosodium L-glutamate; alpha & beta hydroxyl acids such as
10 glycolic acid, lactic acid, citric acid, maleic acid and salicylic acid; glyceryl polymethacrylate; polymeric plasticizers such as polyquaterniums; proteins and amino acids such as glutamic acid, aspartic acid, and lysine; hydrogen starch hydrolysates; other relatively low weight average molecular weight esters (e.g., esters of C₂-C₁₀ alcohols and acids); and any other water soluble plasticizer known to one skilled in the art of the foods and plastics industries; and mixtures thereof.
15 EP 0283165 B1 discloses suitable plasticizers, including glycerol derivatives such as propoxylated glycerol.

The article may comprise other optional ingredients that are known for use or otherwise useful in compositions, provided that such optional materials are compatible with the selected essential materials described herein, or do not otherwise unduly impair product performance.

20 Such optional ingredients are most typically those materials approved for use in cosmetics and that are described in reference books such as the CTFA Cosmetic Ingredient Handbook, Second Edition, The Cosmetic, Toiletries, and Fragrance Association, Inc. 1992.

Emulsifiers suitable as an optional ingredient herein include mono- and di-glycerides, fatty alcohols, polyglycerol esters, propylene glycol esters, sorbitan esters and other emulsifiers known
25 or otherwise commonly used to stabilize air interfaces, as for example those used during preparation of aerated foodstuffs such as cakes and other baked goods and confectionary products, or the stabilization of cosmetics such as hair mousses.

Further non-limiting examples of such optional ingredients include preservatives, perfumes or fragrances, coloring agents or dyes, conditioning agents, hair bleaching agents, thickeners,
30 moisturizers, emollients, pharmaceutical actives, vitamins or nutrients, sunscreens, deodorants, sensates, plant extracts, nutrients, astringents, cosmetic particles, absorbent particles, adhesive particles, hair fixatives, fibers, reactive agents, skin lightening agents, skin tanning agents, anti-dandruff agents, perfumes, exfoliating agents, acids, bases, humectants, enzymes, suspending

agents, hair colorants, hair perming agents, pigment particles, anti-acne agents, anti-microbial agents, sunscreens, tanning agents, exfoliation particles, effervescent agglomerated particle and particles containing carbonate salts sodium bicarbonate, hair growth or restorer agents, insect repellents, shaving lotion agents, co-solvents or other additional solvents, and similar other materials. Further non-limiting examples of optional ingredients include encapsulated perfumes, such as by β -cyclodextrins, polymer microcapsules, starch encapsulated accords and combinations thereof.

Suitable conditioning agents can optionally be added to the articles and can include high melting point fatty materials and silicone conditioning agents. Suitable materials are discussed in US 2008/0019935, US 2008/0242584 and US 2006/0217288.

Methods of Use

The compositions described herein may be used for cleaning, conditioning, and/or treating hair, hair follicles, and/or skin including the scalp. The method for treating these consumer substrates may comprise the steps of: a) applying an effective amount of the article to the hand, b) wetting the article with water to dissolve the solid, c) applying the dissolved material to the target consumer substrate to form a lather to clean and optionally condition, and d) rinsing the diluted treatment composition from the consumer substrate. These steps can be repeated as many times as desired to achieve the desired cleansing and or treatment benefit.

A method useful for providing a benefit to hair, hair follicles, and/or skin including the scalp, includes the step of applying a composition according to the first embodiment to these target consumer substrates in need of regulating.

Alternatively, a useful method for regulating the condition of hair, hair follicles, skin, and/or skin including the scalp, includes the step of applying one or more compositions described herein to these target consumer substrates in need of regulation.

The amount of the composition applied, the frequency of application and the period of use will vary widely depending upon the purpose of application, the level of components of a given composition and the level of regulation desired. For example, when the composition is applied for whole body or hair treatment, effective amounts generally range from about 0.5 grams to about 10 grams, alternatively from about 1.0 grams to about 5 grams, and alternatively from about 1.5 grams to about 3 grams.

Product Types and Articles of Commerce

Non-limiting examples of products that utilize the dissolvable solid article include hand cleansing substrates, hair shampoo, hair conditioner or other hair treatment substrates, body cleansing substrates, shaving preparation substrates, personal care substrates containing
5 pharmaceutical or other skin care active, moisturizing substrates, sunscreen substrates, chronic skin benefit agent substrates (e.g., vitamin-containing substrates, alpha-hydroxy acid-containing substrates, etc.), deodorizing substrates, fragrance-containing substrates, and so forth.

Preferably, the dissolvable solid articles are cleansing articles including non-personal cleansing articles such as fabric and/or home cleansing articles; and personal cleansing articles
10 such as hand, body and/or facial cleansing articles, and shampoo articles. Among them, more preferred are personal cleansing articles such as hand, body and/or facial cleansing articles, and shampoo articles, and further preferred are shampoo articles in view of enjoying the benefit disclosed herein using the specific anionic surfactant and reducing glutamate surfactants, i.e., the benefit to provide improved consumer usage feel due to reduced formation of deposits on hair
15 cause by glutamate surfactants.

Described herein is an article of commerce comprising one or more dissolvable solid articles described herein, and a communication directing a consumer to dissolve the article and apply the dissolved mixture to hair, hair follicles, and/or skin including the scalp, to achieve a benefit to the target consumer substrate, a rapidly lathering foam, a rapidly rinsing foam, a clean
20 rinsing foam, a conditioning treatment and combinations thereof. The communication may be printed material attached directly or indirectly to packaging that contains the dissolvable solid article or on the dissolvable solid article itself. Alternatively, the communication may be an electronic or a broadcast message that is associated with the article of manufacture. Alternatively, the communication may describe at least one possible use, capability, distinguishing feature and/or
25 property of the article of manufacture.

Method for Making Fibrous Elements and Articles

The fibrous elements may be made by any suitable process. A non-limiting example of a suitable process for making the fibrous elements is described below.

30 In one example, as shown in FIGS. 1 and 2 a method 46 for making a fibrous element 32 comprises the steps of:

- a. providing a filament-forming composition 48; and

b. spinning the filament-forming composition 48, such as via a spinning die 50, into one or more fibrous elements 32, such as filaments.

As shown in FIG. 2, the spinning die 50 may comprise a plurality of fibrous element-forming holes 52 that include a melt capillary 54 encircled by a concentric attenuation fluid hole 56 through which a fluid, such as air, passes to facilitate attenuation of the filament-forming composition 48 into a fibrous element 32 as it exits the fibrous element-forming hole 52.

In one example, during the method for making fibrous elements, any volatile solvent, such as water, present in the filament-forming composition 48 is removed, such as by drying, as the fibrous element 32 is formed. In one example, greater than 30% and/or greater than 40% and/or greater than 50% and/or greater than 60% of the weight of the filament-forming composition's volatile solvent, such as water, is removed during the spinning step, such as by drying the fibrous element being produced.

In one example, when the fibrous element exits the fibrous element-forming hole 52, they are collected on a belt above a vacuum source called the forming zone. The fibrous elements can remain on the forming zone for the following times and temperatures: from about 150 °F (65.6 °C) to about 160 °F (71.1 °C) for about 50 to about 60 seconds and/or from about 170 °F (65.6 °C) to about 180 °F (82.2 °C) for about 30 to about 40 seconds and/or from about 200 °F (93.3 °C) to about 215 °F (101.7 °C) for about 5 to about 20 seconds.

In one example, to enable the balance of solvent evaporation, dwell time, and heat exposure it is apparent that melt spinning temperature could be from about 70 °F to about 95 °F while enabling drying with heat such as about 340 °F (171.1 °C) to about 350 °F (176.7 °C) for about 50 to about 60 seconds or from about 390 °F (198.9 °C) to about 400 °F (204 °C) for about 30 to about 40 seconds or 415 °F (212.8 °C) to 470 °F (243.3 °C) for about 5 to about 20 seconds.

The filament-forming composition is spun into one or more fibrous elements and/or particles by any suitable spinning process, such as meltblowing, spunbonding, electro-spinning, and/or rotary spinning. In one example, the filament-forming composition is spun into a plurality of fibrous elements and/or particles by meltblowing. For example, the filament-forming composition may be pumped from a tank to a meltblown spinnerette. Upon exiting one or more of the filament-forming holes in the spinnerette, the filament-forming composition is attenuated with air to create one or more fibrous elements and/or particles. The fibrous elements and/or particles may then be dried to remove any remaining solvent used for spinning, such as the water.

The fibrous elements and/or particles may be collected on a belt, such as a patterned belt to form a fibrous article comprising the fibrous elements and/or particles.

TEST METHODS

Unless otherwise specified, all tests described herein including those described under the Definitions section and the following test methods are conducted on samples that have been conditioned in a conditioned room at a temperature of $22\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and a relative humidity of $42\% \pm 4\%$ for a minimum of 2 hours prior to the test. The samples tested are “usable units.” “Usable units” as used herein means sheets, flats from roll stock, pre-converted flats, and/or single or multiply products. All tests are conducted under the same environmental conditions and in such conditioned room. Do not test samples that have defects such as wrinkles, tears, holes, and like. Samples conditioned as described herein are considered dry samples (such as “dry filaments”) for testing purposes. All instruments are calibrated according to manufacturer’s specifications.

Basis Weight Measurement

In general, basis weight of a material or article (including the dissolvable solid structure) is measured by first cutting the sample to a known area, using a die cutter or equivalent, then measuring & recording the weight of the sample on a top-loading balance with a minimum resolution of 0.01g, then finally by calculating the basis weight as follows:

Basis Weight (g/m^2) = weight of basis weight pad (g)

$$\text{Basis Weight } \left(\frac{\text{g}}{\text{m}^2} \right) = \frac{\text{Weight of pad (g)} \times 10,000 \frac{\text{cm}^2}{\text{m}^2}}{\text{area of pad (cm}^2\text{)}}$$

Suitable pad sample sizes for basis weight determination are $> 10\text{ cm}^2$ and should be cut with a precision die cutter having the desired geometry. If the dissolvable solid structure to be measured is smaller than 10 cm^2 , a smaller sampling area can be used for basis weight determination with the appropriate changes to calculation.

In the present examples, basis weight was calculated based on the full dissolvable solid structure having a known area of 17.28 cm^2 . Thus, the basis weight calculation becomes:

$$\text{Basis Weight } \left(\frac{\text{g}}{\text{m}^2} \right) = \frac{\text{Weight of pad (g)} \times 10,000 \frac{\text{cm}^2}{\text{m}^2}}{17.28\text{cm}^2}$$

Diameter Test Method

The diameter of a discrete fibrous element or a fibrous element within a fibrous article is determined by using a Scanning Electron Microscope (SEM) or an Optical Microscope and an image analysis software. A magnification of 200 to 10,000 times is chosen such that the fibrous

elements are suitably enlarged for measurement. When using the SEM, the samples are sputtered with gold or a palladium compound to avoid electric charging and vibrations of the fibrous element in the electron beam. A manual procedure for determining the fibrous element diameters is used from the image (on monitor screen) taken with the SEM or the optical microscope. Using a mouse and a cursor tool, the edge of a randomly selected fibrous element is sought and then measured across its width (i.e., perpendicular to fibrous element direction at that point) to the other edge of the fibrous element. A scaled and calibrated image analysis tool provides the scaling to get actual reading in μm . For fibrous elements within a fibrous article, several fibrous elements are randomly selected across the sample of the fibrous article using the SEM or the optical microscope. At least two portions of the fibrous article are cut and tested in this manner. Altogether at least 100 such measurements are made and then all data are recorded for statistical analysis. The recorded data are used to calculate average (mean) of the fibrous element diameters, standard deviation of the fibrous element diameters, and median of the fibrous element diameters.

Another useful statistic is the calculation of the amount of the population of fibrous elements that is below a certain upper limit. To determine this statistic, the software is programmed to count how many results of the fibrous element diameters are below an upper limit and that count (divided by total number of data and multiplied by 100%) is reported in percent as percent below the upper limit, such as percent below 1 micrometer diameter or %-submicron, for example. We denote the measured diameter (in μm) of an individual circular fibrous element as d_i .

In the case that the fibrous elements have non-circular cross-sections, the measurement of the fibrous element diameter is determined as and set equal to the hydraulic diameter which is four times the cross-sectional area of the fibrous element divided by the perimeter of the cross-section of the fibrous element (outer perimeter in case of hollow fibrous elements). The number-average diameter, alternatively average diameter is calculated as:

$$d_{num} = \frac{\sum_{i=1}^n d_i}{n}$$

Hand Dissolution Method

Materials Needed:

Fibrous articles to be tested: 3-5 fibrous articles (finished product samples) are tested so that an average of the number of strokes for each if the individual fibrous article samples is

calculated and recorded as the Average Hand Dissolution value for the fibrous article. For this method, the entire consumer saleable or consumer use fibrous article is tested. If the entire consumer saleable or consumer use fibrous article has a footprint greater than 50 cm², then first cut the fibrous article to have a footprint of 50 cm².

- 5 • Nitrile Gloves
- 10 cc syringe
- Plastic Weigh boat (~3in x 3in)
- 100 mL Glass beaker
- 10 • Water (City of Cincinnati Water or equivalent having the following properties: Total Hardness = 155mg/L as CaCO₂; Calcium content = 33.2 mg/L; Magnesium content = 17.5 mg/L; Phosphate content = 0.0462 mg/L). Water used is water 7 grains per gallon (gpg) hardness and 40°C +/- 5°C

Protocol:

- 15 • Add 80 mL of water to glass beaker.
- Heat water in beaker until water is at a temperature of 40°C +/- 5°C.
- Transfer 15 mL of the water from the beaker into the weigh boat via the syringe.
- Within 10 seconds of transferring the water to the weigh boat, place fibrous article sample in palm of gloved hand (hand in cupped position in non-dominant hand to hold fibrous
- 20 article sample).
- Using dominant hand, add water quickly from the weigh boat to the fibrous article sample and allow to immediately wet for a period of 5-10 seconds.
- Rub with opposite dominant hand (also gloved) in 2 rapid circular strokes.
- Visually examine the fibrous article sample in hand after the 2 strokes. If fibrous article
- 25 sample is completely dissolved, record number of strokes = 2 Dissolution Strokes. If not completely dissolved, rub remaining fibrous article sample for 2 more circular strokes (4 total) and observe degree of dissolution. If the fibrous article sample contains no solid pieces after the 2 additional strokes, record number of strokes = 4 Dissolution Strokes. If after the 4 strokes total, the fibrous article sample still contains solid pieces of un-dissolved
- 30 fibrous article sample, continue rubbing remaining fibrous article sample in additional 2 circular strokes and check if there are any remaining solid pieces of fibrous article sample after each additional 2 strokes until fibrous article sample is completely dissolved or until reaching a total of 30 strokes, whichever comes first. Record the total number of strokes.

Record 30 Dissolution Strokes even if solid fibrous article sample pieces remain after the maximum of 30 strokes.

- Repeat this process for each of the additional 4 fibrous article samples.
- Calculate the arithmetic mean of the recorded values of Dissolution Strokes for the 5 individual fibrous article samples and record as the Average Hand Dissolution Value for the fibrous article. The Average Hand Dissolution Value is reported to the nearest single Dissolution Stroke unit.

pH Test Method

The pH of a liquid composition is taken using a calibrated (according to the manufacturer's instructions) pH probe that is calibrated with 3 pH standards (4.0, 7.0, and 10.0). The pH is recorded to the tenth unit (i.e., 5.5).

Rheology Test Method

Discovery HR-3 Rheometer (TA Instruments®, Delaware, USA) equipped with a 40mm 2.002 degree cone plate, Peltier plate steel-106935 and a flat plate lower geometry equipped with a Peltier heating/cooling mechanism to control the temperature. Measurements are conducted by placing about 1 gram of the composition onto the lower plate geometry and lowering the upper plate geometry to a target gap of 60 microns, wiping away any excess of the respective fibrous element-forming composition to create an even surface flush with the edges of the upper and lower plate geometries. Data was collected at 25°C or 40°C as specified by performing an amplitude sweep with a oscillation Amplitude 1Hz, 6.366e^{-8} to $5.0\text{e}^{-4}\text{MPa}$ to obtain G' and G'' curves and a Flow Sweep 0.1 to 500 S^{-1} to obtain shear viscosity. G' , G'' numbers in the data table were taken from the 1st data points at the lowest Oscillation strain R (%) (in the flat range) and shear viscosity at shear rate of 0.1 s^{-1} .

Thickness Method

Thickness of a fibrous article is measured by cutting 5 samples of a fibrous article sample such that each cut sample is larger in size than a load foot loading surface of a VIR Electronic Thickness Tester Model II available from Thwing-Albert Instrument Company, Philadelphia, PA. Typically, the load foot loading surface has a circular surface area of about 3.14 in^2 . The sample is confined between a horizontal flat surface and the load foot loading surface. The load foot loading surface applies a confining pressure to the sample of 15.5 g/cm^2 . The thickness of each

sample is the resulting gap between the flat surface and the load foot loading surface. The thickness is calculated as the average thickness of the five samples. The result is reported in millimeters (mm).

5 Water Content Test Method

The water (moisture) content present in a fibrous element and/or particle and/or fibrous article is measured using the following Water Content Test Method. A fibrous element and/or particle and/or fibrous article or portion thereof (“sample”) in the form of a pre-cut sheet is placed in a conditioned room at a temperature of $22\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and a relative humidity of $42\% \pm 4\%$ for at least 24 hours prior to testing. Each fibrous article sample has an area of at least 4 square inches, but small enough in size to fit appropriately on the balance weighing plate. Under the temperature and humidity conditions mentioned above, using a balance with at least four decimal places, the weight of the sample is recorded every five minutes until a change of less than 0.5% of previous weight is detected during a 10-minute period. The final weight is recorded as the “equilibrium weight”. Within 10 minutes, the samples are placed into the forced air oven on top of foil for 24 hours at $22\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and a relative humidity of $42\% \pm 4\%$ for drying. After the 24 hours of drying, the sample is removed and weighed within 15 seconds. This weight is designated as the “dry weight” of the sample.

The water (moisture) content of the sample is calculated as follows:

$$20 \quad \% \text{ Water in sample} = 100\% \times \frac{(\text{Equilibrium weight of sample} - \text{Dry weight of sample})}{\text{Dry weight of sample}}$$

The % Water (moisture) in sample for 3 replicates is averaged to give the reported % Water (moisture) in sample. Report results to the nearest 0.1%.

25 EXAMPLES

The following are non-limiting examples of the shampoo compositions described herein. It will be appreciated that other modifications of the present invention within the skill of those in the art can be undertaken without departing from the spirit and scope of this invention.

All parts, percentages, and ratios herein are by weight unless otherwise specified. Some components may come from suppliers as dilute solutions. The amount stated reflects the weight percent of the added material, unless otherwise specified.

Table 1: Dissolvable solid fibrous shampoo articles

	Comparative example (i), pH 7 when dissolved	Comparative example (ii), pH 6 when dissolved
Polyvinyl alcohol ¹	20.76	20.60
Disodium cocoyl Glutamate ²	32.75	32.47
Sodium Cocoyl Alaninate ³	7.99	7.92
EDTA ⁴	0.27	0.13
Lactic Acid ⁵	1.28	2.85
Polyquaternium-10 ⁶	1.20	1.19
Citric acid/Sodium Bicarbonate fizz-pp ⁷	25.17	25.53
Perfume	5.96	6.05
Silicone ⁸	4.17	4.23
Moisture	1.99	2.02
ppt with hard water	Yes	Yes

Table 2: Dissolvable solid fibrous shampoo articles

	A	B	C	D	E	F	G	H	I	J
Water Purified-PrimG	2.14	2.13	2.17	2.17	2.16	2.25	2.25	2.25	2.14	2.14
(Sodium C14,16) Alpha Olefine Sulfonate ⁹	25.89	25.76	26.21	26.27	27.06	28.40	28.64	28.30	25.89	25.89
(Sodium C14,16) Alpha Olefine Sulfonate ¹⁰	9.11	9.07	9.23	9.25	9.52	10.00	10.08	9.96	9.11	9.11
Laurylhydroxysultaine ¹ 1	9.65	9.60	9.77	9.79	10.08	5.29	0.00	10.55	9.65	9.65
Cocamidopropyl Betaine ¹²	0.00	0.00	0.00	0.00	0.00	5.40	10.89	0.00	0.00	0.00
Polyvinyl Alcohol ¹	23.34	23.20	23.62	23.68	21.96	22.50	21.96	22.78	23.34	23.34
Polyquaternium-10 ⁶	0.82	0.82	0.83	0.83	0.86	0.90	0.91	0.90	0.00	0.00

Hydroxypropyltrimonium Guar ¹³	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.99
POLYQUATERNIUM - 76 ¹⁴	0.17	0.17	0.17	0.17	0.18	0.19	0.19	0.19	0.17	0.00
Citric Acid ¹⁵	0.33	0.33	0.33	0.33	0.34	0.11	0.11	0.11	0.33	0.33
Citric acid/Sodium Bicarbonate fizz ⁷	16.43	16.35	16.63	15.95	16.55	13.50	13.50	13.50	16.43	16.43
Perfume	7.13	7.40	6.50	6.79	6.75	6.75	6.75	6.75	7.13	7.13
Silicone ⁸ -	4.99	5.18	4.55	4.76	4.72	4.73	4.73	4.73	4.99	4.99
Blue #1 ¹⁶					0.0004					
ppt with hard water	No	No	No	No	No	No	No	No	No	No

PPT with hard water

Formation of PPT (precipitation) is evaluated as visual inspection of samples. Samples are prepared by dissolving the dissolvable solid articles with hard water, at a weight ratio of 1:5 between article and hard water, and are ready for the evaluation of precipitation after 2 hours.

Dissolvable solid articles in Table 2 (also shown as A-J) are those of the present disclosure. The dissolvable solid articles of the present disclosure can provide reduced formation of precipitation, even when dissolved with a hard water. This benefit can be understood by a comparison of, for example, the dissolvable solid articles in Table 2 to the dissolvable solid articles in Table 1 (also shown as comparative examples (i) and (ii)).

Suppliers for raw materials for the Examples in Table 1 and Table 2:

- 50:50 blend of Poval 32-80 having a weight average MW of 170,000 and Poval 3-80 having a weight average MW of 25,000, from Kuraray®
- Eversoft™ UCS-50SG from Sino Lion™
- Eversoft ACS from Sino Lion
- Abbreviated
- Lactic Acid available as PURAC® HiPure 90 from Corbion®
- Polyquaternium-10, UCARE™ Polymer JR-30M from Amerchol®, MW of 2,000,000, CD of 1.25
- Citriccoat EP From Jungbunzlauer
- Silicone: Y-14945, amodimethicone, from Momentive®

9. Bio-Terge AS-40 HP from Stepan
10. Bio-Terge AS-90 Beads from Stepan
11. Mackam LHS from Solvay
12. Amphosol HCA-HP from Stepan
- 5 13. Jaguar C 500 from Solvay
14. Mirapol AT1 from Solvay
15. Citric acid from ADM
16. FD&C Blue #1 from Sensient

10 Combinations

1. A dissolvable solid cleansing article comprising:
 - a) from about 1% to about 60%, by weight on a dry article basis, of a polymeric structurant;
 - b) from about 5% to about 90%, by weight on a dry article basis, of a surfactant system comprising a sulfonate-containing anionic surfactant;wherein the article contains less than 5% of glutamate anionic surfactant; and wherein the article is substantially free of sulfate-based surfactants.
2. The article of the preceding feature, wherein the article comprises from about 10% to about 50%, preferably from about 20% to about 45%, more preferably from about 30% to about 40% of the sulfonate-containing anionic surfactant, of the sulfonate-containing anionic surfactant, by weight on a dry article basis.
3. The article of any of the preceding features, wherein the sulfonate-containing anionic surfactant is selected from the group consisting of sulfonate anionic surfactant, taurate anionic surfactant and isethionate anionic surfactant, sulfosuccinate anionic surfactant, sulfoacetate anionic surfactant, and mixtures thereof, preferably selected from the group consisting of sulfonate anionic surfactant, taurate anionic surfactant and isethionate anionic surfactant, and mixtures thereof, more preferably selected from the group consisting of sulfonate anionic surfactant.
4. The article of any of the preceding features, wherein the sulfonate-containing anionic surfactant is free of -COOH group.
5. The article of any of the preceding features, wherein the surfactant system comprises a co-surfactant selected from the group consisting of amphoteric surfactant, zwitterionic

surfactant, and mixtures thereof, preferably wherein the co-surfactant is a sultaine surfactant, and more preferably wherein the sultaine surfactant is free of -COOH group.

6. The article of any of the preceding features, wherein the article comprises from about 0.5% to about 50% of the co-surfactant, by weight on a dry article basis.

5 7. The article of any of the preceding features, wherein the article contains less than 3% of glutamate anionic surfactant, preferably wherein the article is substantially free of glutamate anionic surfactant.

8. The article of any of the preceding features, wherein the article is substantially free of surfactants containing -COOH group.

10 9. The article of any of the preceding features, wherein the polymeric structurant is selected from carboxymethyl cellulose, starch, polyvinyl alcohol, and combinations thereof.

10. The article of any of the preceding features, wherein the article is a dissolvable solid fibrous article comprising a plurality of fibrous elements, wherein the plurality of fibrous elements are intertangled or otherwise associated with one another to form the fibrous article, preferably wherein the fibrous elements are homogeneous.

11. The article of any of the preceding features, further comprising a cationic polymer selected from Polyquaternium-6, Polyquaternium-10, Polyquaternium-76, cationic guar, and combinations thereof.

20 12. The article of any of the preceding features, wherein the article comprises a hand dissolution value of less than 15 strokes, preferably less than 10 strokes according to the Hand Dissolution Test Method.

13. The article of any of the preceding features, wherein the article is a personal cleansing article, preferably a shampoo article.

25
The dimensions and values disclosed herein are not to be understood as being strictly limited to the exact numerical values recited. Instead, unless otherwise specified, each such dimension is intended to mean both the recited value and a functionally equivalent range surrounding that value. For example, a dimension disclosed as “40 mm” is intended to mean “about 40 mm.”

Every document cited herein, including any cross referenced or related patent or application and any patent application or patent to which this application claims priority or benefit thereof, is hereby incorporated herein by reference in its entirety unless expressly excluded or

otherwise limited. The citation of any document is not an admission that it is prior art with respect to any invention disclosed or claimed herein or that it alone, or in any combination with any other reference or references, teaches, suggests or discloses any such invention. Further, to the extent that any meaning or definition of a term in this document conflicts with any meaning or definition of the same term in a document incorporated by reference, the meaning or definition assigned to that term in this document shall govern.

While particular embodiments of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention. It is therefore intended to cover in the appended claims all such changes and modifications that are within the scope of this invention.

CLAIMS

What is claimed is:

1. A dissolvable solid cleansing article comprising:
 - a. from about 1% to about 60%, by weight on a dry article basis, of a polymeric structurant;
 - b. from about 5% to about 90%, by weight on a dry article basis, of a surfactant system comprising a sulfonate-containing anionic surfactant;wherein the article contains less than 5% of glutamate anionic surfactant; and wherein the article is substantially free of sulfate-based surfactants.
2. The article of any of the preceding claims, wherein the article comprises from about 10% to about 50%, preferably from about 20% to about 45%, more preferably from about 30% to about 40% of the sulfonate-containing anionic surfactant, of the sulfonate-containing anionic surfactant, by weight on a dry article basis.
3. The article of any of the preceding claims, wherein the sulfonate-containing anionic surfactant is selected from the group consisting of sulfonate anionic surfactant, taurate anionic surfactant and isethionate anionic surfactant, sulfosuccinate anionic surfactant, sulfoacetate anionic surfactant, and mixtures thereof, preferably selected from the group consisting of sulfonate anionic surfactant, taurate anionic surfactant and isethionate anionic surfactant, and mixtures thereof, more preferably selected from the group consisting of sulfonate anionic surfactant.
4. The article of any of the preceding claims, wherein the sulfonate-containing anionic surfactant is free of -COOH group.
5. The article of any of the preceding claims, wherein the surfactant system comprises a co-surfactant selected from the group consisting of amphoteric surfactant, zwitterionic surfactant, and mixtures thereof, preferably wherein the co-surfactant is a sultaine surfactant, and more preferably wherein the sultaine surfactant is free of -COOH group.

6. The article of any of the preceding claims, wherein the article comprises from about 0.5% to about 50% of the co-surfactant, by weight on a dry article basis.
7. The article of any of the preceding claims, wherein the article contains less than 3% of glutamate anionic surfactant, preferably wherein the article is substantially free of glutamate anionic surfactant.
8. The article of any of the preceding claims, wherein the article is substantially free of surfactants containing -COOH group.
9. The article of any of the preceding claims, wherein the polymeric structurant is selected from carboxymethyl cellulose, starch, polyvinyl alcohol, and combinations thereof.
10. The article of any of the preceding claims, wherein the article is a dissolvable solid fibrous article comprising a plurality of fibrous elements, wherein the plurality of fibrous elements are intertangled or otherwise associated with one another to form the fibrous article, preferably wherein the fibrous elements are homogeneous.
11. The article of any of the preceding claims, further comprising a cationic polymer selected from Polyquaternium-6, Polyquaternium-10, Polyquaternium-76, cationic guar, and combinations thereof.
12. The article of any of the preceding claims, wherein the article comprises a hand dissolution value of less than 15 strokes, preferably less than 10 strokes according to the Hand Dissolution Test Method.
13. The article of any of the preceding claims, wherein the article is a personal cleansing article, preferably a shampoo article.

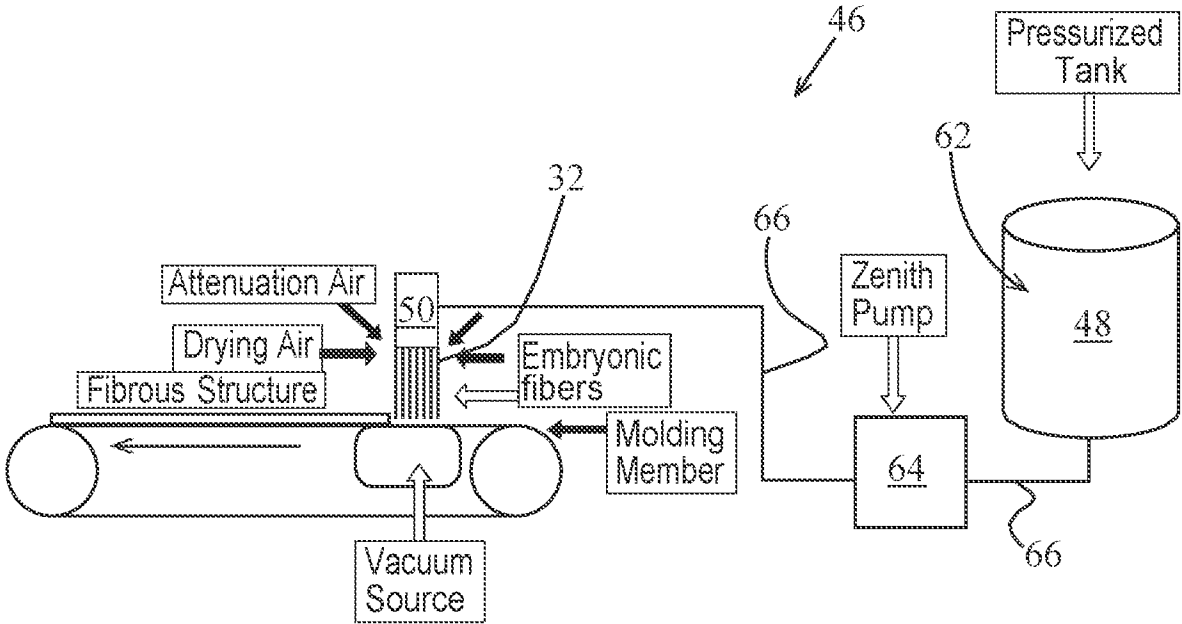


FIG. 1

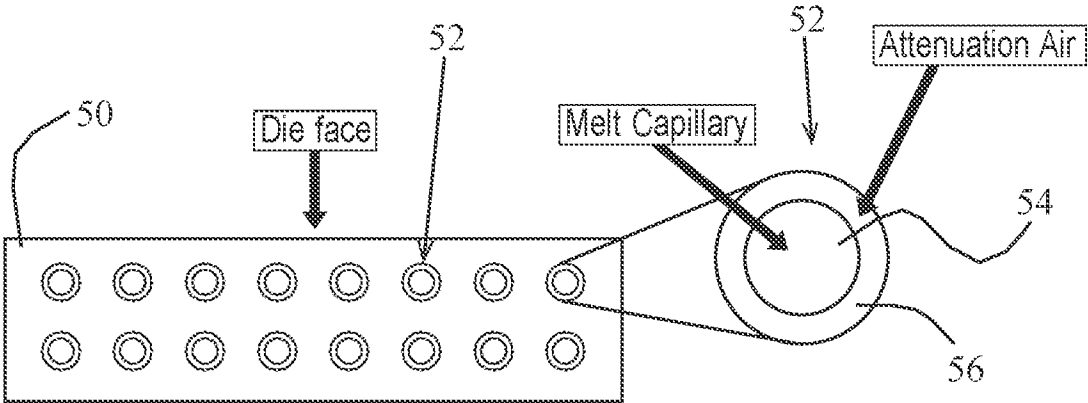


FIG. 2

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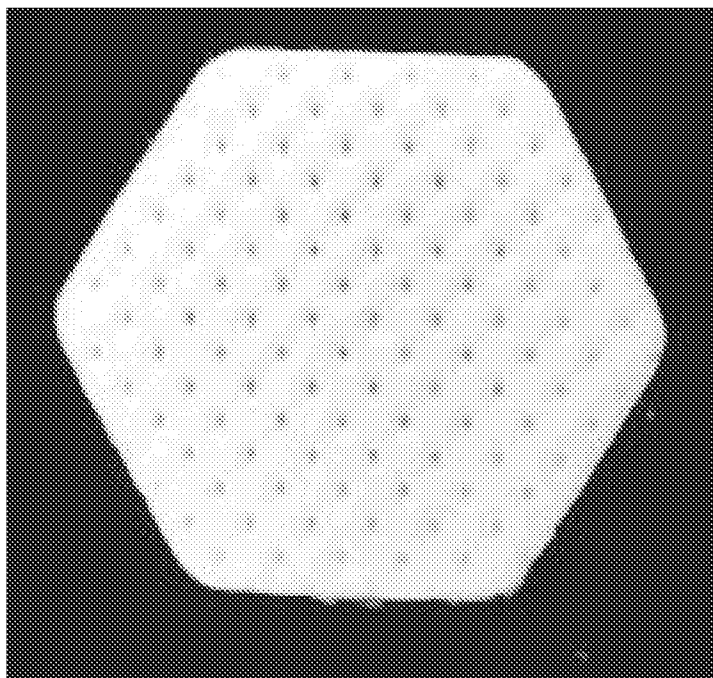


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2024/035933

A. CLASSIFICATION OF SUBJECT MATTER INV. A61K8/02 A61K8/46 A61K8/81 A61Q5/02 ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) A61K A61Q Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2021/261885 A1 (TIBBS KEVIN A [US] ET AL) 26 August 2021 (2021-08-26)	1-10, 12, 13
Y	claims 1, 30-32 paragraphs [0116], [0117], [0126], [0154] - [0155]	1-13
X	US 2011/136719 A1 (JALBERT LUC [CA] ET AL) 9 June 2011 (2011-06-09)	1-4, 7-10, 12, 13
Y	claims 1-10 paragraphs [0010], [0020]	1-13
X	US 2020/405587 A1 (SONG BRIAN XIAOQING [US] ET AL) 31 December 2020 (2020-12-31) claims 1-2, 6, 12-13 example 6; table 3 Comp. ex 1; table 4	1-13
- / - -		
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 30 September 2024		Date of mailing of the international search report 16/10/2024
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Briand, Benoit

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2024/035933

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DATABASE GNPD [Online] MINTEL; 21 December 2017 (2017-12-21), anonymous: "Soap Leaves", XP093208087, Database accession no. 5336785	1-4, 7-10,12, 13
Y	ingredients; the whole document -----	1-13
X	DATABASE GNPD [Online] MINTEL; 6 October 2011 (2011-10-06), anonymous: "Dishes & Hands Camp Soap Sheets", XP093208089, Database accession no. 1636025	1-4, 7-10,12, 13
Y	Ingredients; the whole document -----	1-13

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		WO 2020264574 A1	30-12-2020
