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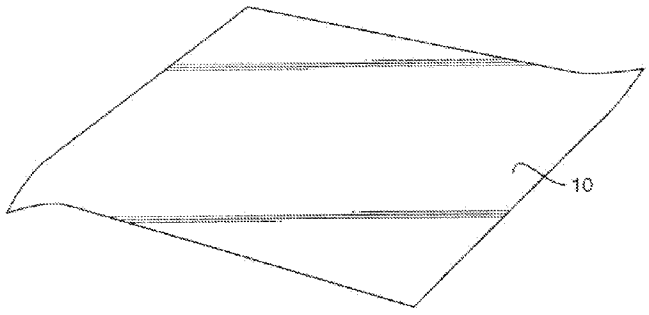

FIG. 1

(57) Abstract: Delivery compositions and substrates for imparting a volatile active agent to a surface are disclosed herein. To achieve the delivery of the volatile component, a delivery composition of a polymer network and a volatile component incorporated into the polymer network to stabilize the volatile for extended periods of time. The delivery composition may also be present on a substantially dry substrate to deliver the active agent. The dry substrate may be selected from facial tissue, bath tissue, paper towel, or dinner napkin. The substantially dry substrate may also be reusable.

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Active Agent Containing Polymer Network Delivery Composition and Articles Using the Same

BACKGROUND

Cleansing household and personal care products have been used for numerous years. In recent years, however, consumers have begun demanding more out of household and personal care products. For example, a new trend has emerged in the consumer market where consumers are expressing a growing demand for "natural" products. These consumers are willing to pay a premium for these natural compounds but finding natural compounds that are safe, efficacious and stable presents a problem. Additionally, consumers want products that perform more tasks, such as cleaning or disinfecting, better or more efficiently.

Currently, one such natural active agent that has been identified to provide such is thymol, which is an active constituent of thyme. Thyme contains a large concentration of volatile oil. The primary component of that oil is thymol. Thymol, a monoterpene phenol derivative of cymene, is extracted from the culinary plant thyme as a white substance of pleasant aromatic odor and strong antiseptic properties. The potent antimicrobial activity and origins of this compound make it ideal for disinfectant applications. It is an EPA-registered disinfectant and is used with various consumer products. It is also commonly used to treat fungal infections such as athlete's foot. Thymol is an effective antimicrobial agent with proven efficacy against yeast, mold and mycobacteria.

With all of its positive attributes however, a problem exists with thymol and other active agents. Many active agents such as thymol are extremely volatile compounds that are not easily stabilized and which tend to flash or volatilize off the substrate and lose efficacy over time. Use of volatile active agents on a dry wipe typically show no efficacy as the active agent volatilized off the substrate and was unavailable for efficacious action.

Therefore, a need exists for a delivery composition that will stabilize and allow the incorporation of volatile active agents. A need also exists to provide a

substrate with a delivery composition incorporated within to provide the beneficial effect of the volatile active agents.

SUMMARY

Generally, compositions and substrates for imparting a volatile active agent to a surface are disclosed herein. The delivery composition for delivering the active agent includes a polymer network, and a volatile active agent entrapped within the polymer network. Typically, the volatile active agent is thymol. The active agent may be present in an amount from about 0.01% (by weight of the delivery composition) to about 60% by weight of the delivery composition.

The polymer network may contain a polymer selected from polyvinyl chloride, polyurethane, polyethylene, polypropylene, polydiallydimethylammonium chloride, hydrophilic polysaccharides, polylactic acid, polyvinyl alcohol, polyvinylpyrrolidone, acrylates, gums, rubber, silicone, cyanoacrylate, calcium alginate, starch polymers, cellulose, and combinations thereof. Desirably, the polymer network is selected from a polypropylene glycol-51/saturated methylene diphenyldiisocyanate monomer coplymer, a polypropylene glycol-12/saturated methylene diphenyldiisocyanate monomer copolymer, and a polyethylene glycol-18/saturated methylene diphenyldiisocyanate monomer copolymer.

In another embodiment, the polymer network may be formed by adding a polymer to a restructuring agent. To prepare this type of polymer network, a mixture of a restructuring agent, acetone, and the active agent, thymol, is prepared. A polymer, such as polystyrene, may then be added and mixed with the restructuring agent and active agent until homogeneous to create the polymer network. The restructuring agent, acetone, is allowed to evaporate off and the remaining polymer network with entrapped thymol was collected.

Desirably, the delivery composition may be formulated within an anhydrous carrier.

The delivery composition may further contain a skin benefit agent selected from the group consisting of a surfactant, a quaternary ammonium material, a particulate, a rheology modifier, a humectant, a moisturizer, a film former, a slip

modifier, a surface modifier, a skin protectant, a sunscreen, and combinations thereof.

The delivery composition may also be present on a substantially dry substrate to deliver the active agent. The dry substrate may be selected from facial tissue, bath tissue, paper towel, or dinner napkin. The substantially dry substrate may also be reusable.

BRIEF DESCRIPTION OF THE DRAWINGS

The above aspects and other features, aspects, and advantages of the present invention will become better understood with regard to the following description, appended claims, and accompanying drawings in which:

Figure 1 is a perspective view of one embodiment of a dry substrate product made with the delivery composition described herein.

Figure 2 is a cross-sectional view of the dry substrate product illustrated in Figure 1.

Figure 3 is a cross-sectional view of another embodiment of a dry substrate product made with the delivery composition described herein.

Figure 4 is a perspective view of one embodiment of a spirally wound paper towel product with the delivery composition described herein.

Repeated use of reference characters in the specification and drawings is intended to represent the same or analogous features or elements of the invention in different embodiments.

DETAILED DESCRIPTION

It is to be understood by one of ordinary skill in the art that the present discussion is a description of exemplary embodiments only, and is not intended as limiting the broader aspects of the present invention, which broader aspects are embodied in the exemplary construction.

The present disclosure generally relates to compositions and substrates for imparting a volatile active agent to a surface. To achieve the delivery of the volatile

active agent, a delivery composition of a polymer network and a volatile active agent incorporated into the polymer network to stabilize the volatile active agent for extended periods of time.

An operative delivery composition contains a polymer network, and an effective amount of at least one active agent. The polymer network will dissolve when added to a triggering agent, water, to trigger and release an effective amount of active agent onto the desired region of a surface or skin.

Exemplary materials for use as a polymer network include, but are not limited to, polycarboxylic acid polymers and copolymers including polyacrylic acids, acetal polymers and copolymers, acrylate and methacrylate polymers and copolymers, cellulosic polymers and copolymers, including cellulose acetates, cellulose nitrates, cellulose propionates, cellulose acetate butyrates, cellophanes, rayons, rayon triacetates, cellulose ethers, polyoxymethylene polymers and copolymers, polyimide polymers and copolymers, polysulfone polymers and copolymers, resins including alkyl resins, phenolic resins, urea resins, melamine resins, epoxy resins, allyl resins and epoxide resins, polycarbonates, polyacrylonitriles, polyvinylpyrrolidones, anhydride polymers and copolymers including maleic anhydride polymers, polymers and copolymers of vinyl monomers including polyvinyl alcohols, polyvinyl halides such as polyvinyl chlorides, ethylene-vinylacetate copolymers, polyvinylidene chlorides, polyvinyl ethers such as polyvinyl methyl ethers, polystyrenes, styrene-butadiene copolymers, acrylonitrile-styrene copolymers, acrylonitrile-butadiene-styrene copolymers, styrene-butadiene-styrene copolymers and styrene-isobutylene-styrene copolymers, polyvinyl ketones, polyvinylcarbazoles, and polyvinyl esters such as polyvinyl acetates; polybenzimidazoles; ionomers, polyalkyl oxide polymers and copolymers, glycosaminoglycans, polyesters, polyether polymers and copolymers, polyisocyanates, polyolefin polymers and copolymers, including polyalkylenes such as polypropylenes, polyethylenes, polybutylenes, poly-4-methyl-pen-1-enes, ethylene-alpha-olefin copolymers, ethylene-methyl methacrylate copolymers and ethylene-vinyl acetate copolymers, fluorinated polymers and copolymers, including polytetrafluoroethylenes, poly(tetrafluoroethylene-co-hexafluoropropene), modified ethylene-tetrafluoroethylenecopolymers, and polyvinylidene fluorides, silicone

polymers and copolymers, polyurethanes, p-xylene polymers, polyiminocarbonates, copoly(ether-esters), polyphosphazines, polyalkylene oxalates, polyoxaamides and polyoxaesters, polyorthoesters; biopolymers, such as polypeptides, proteins, polysaccharides and fatty acids and esters thereof, and combinations thereof. Desirably, the polymer network is selected from a polypropylene glycol-51/saturated methylene diphenyldiisocyanate monomer copolymer, a polypropylene glycol-12/saturated methylene diphenyldiisocyanate monomer copolymer, and a polyethylene glycol-18/saturated methylene diphenyldiisocyanate monomer copolymer.

The polymer network layers can be formed using various known processes. For example, the polymer network layers can be formed using solvent-based techniques in which the polymer is first dissolved in a solvent, after which the polymer solution is used to form the matrix portion. In this exemplary aspect, the active agents may be provided within the polymer and solvent mixture in dissolved form or within a particulate suspension and be loaded as the polymer network layers are formed.

In another embodiment, the polymer network may be formed by adding a polymer to a restructuring agent. To prepare this type of polymer network, a mixture of a restructuring agent, and the active agent, thymol, is prepared. Exemplary restructuring agents, include, but are not limited to acetone, ethanol, isopropyl alcohol, methylethyl ketone, limonene, and combinations thereof. A polymer, such as polystyrene, may then be added and mixed with the restructuring agent and active agent until homogeneous to create the polymer network. The restructuring agent, acetone, is allowed to evaporate off and the remaining polymer network with entrapped thymol was collected.

Typically, the delivery compositions comprise a polymer network in an amount of from about 25% (by weight of the delivery composition) to about 99.99% (by weight of the delivery composition), more typically from about 30% (by weight of the delivery composition) to about 99.9% (by weight of the delivery composition), and more typically from about 40% (by weight of the delivery composition) to about 99% (by weight of the delivery composition).

As described above, the polymer network encapsulates a volatile active agent. In exemplary embodiments, the active agents disposed within the polymer matrix are disinfectants, antibiotic agents, anti-proliferative agents, anti-inflammatory agents, alcohols, metal salts, innate immunity enhancers, anti-quorumsensing compounds, anti-protozoics, pesticides, preservatives, botanical oils, botanical extracts, and combinations thereof that could be directed to combat bacteria, viruses, protozoans, and/or fungi, or treat another medical condition. Suitable volatile active agents include, but are not limited to, essential oils, alcohols, and retinoids.

Desirably, the active agent may be an essential oil derived from 100% natural fats and oils that are derived from natural plant sources. Suitable natural fats or oils can include citrus oil, olive oil, avocado oil, apricot oil, babassu oil, borage oil, camellia oil, canola oil, castor oil, coconut oil, corn oil, cottonseed oil, evening primrose oil, green tea oil, hydrogenated cottonseed oil, hydrogenated palm kernel oil, jojoba oil, maleated soybean oil, meadowfoam seed oil, palm kernel oil, peanut oil, rapeseed oil, grapeseed oil, safflower oil, sweet almond oil, tall oil, lauric acid, palmitic acid, stearic acid, linoleic acid, stearyl alcohol, lauryl alcohol, myristyl alcohol, behenyl alcohol, rose hip oil, calendula oil, chamomile oil, eucalyptus oil, juniper oil, sandalwood oil, tea tree oil, sunflower oil, soybean oil, thyme oil, peppermint oil, spearmint oil, basil oil, anise oil, menthol, camphor, turpentine oil, ylang ylang oil, rosemary oil, lavender oil, sandalwood oil, cinnamon oil, marojoram oil, cajuput oil, lemongrass oil, orange oil, grapefruit oil, lemon oil, fennel oil, ginger oil, marjoram oil, pine oil, clove oil, oregano oil, rosewood oil, sage oil, parsley oil, myrrh oil, mugwort oil, elderberry oil, cedarwood oil, and combinations thereof.

More desirably, the active agent may be the volatile disinfectant, thymol. Thymol is an effective antimicrobial agent with proven efficacy against yeast, mold and mycobacteria.

Other active agents that may also be useful with the delivery agent include, but are not to be limited to, a-pinene, b-pinene, sabinene, myrcene, a-phellandrene, a-terpinene, limonene, 1,8-cineole, y-terpinene, p-cymene,

terpinolene, linalool, terpinen-4-ol, a-terpineol, carvone, myrcene, caryophyllene, menthol, citronellal, geranyl acetate, nerol, geraniol, neral, citral, and combinations thereof.

An effective amount of an active agent would be at an amount necessary within the composition to produce the desired end benefit upon delivery to the surface. Typically, the delivery compositions comprise the active agent in an amount of from about 0.01% (by weight of the delivery composition) to about 60% (by weight of the delivery composition), more typically from about 0.1% (by weight of the delivery composition) to about 60% (by weight of the delivery composition), and more typically from about 0.1% (by weight of the delivery composition) to about 10% (by weight of the delivery composition).

Use of a polymer network to encapsulate the volatile active agent also allows the active agent to have more affinity to the sheet than the surface with which it is interacting. The polymer network entraps the active agent within its matrix. The polymer network is entangled within the fiber network of the sheet. Therefore, since the active agent is bound within the polymer matrix which is thusly bound to the sheet, it has more affinity for the sheet than for the surface.

Also, in order to diffuse to the surface, the active agent would have to work its way out of the polymer entanglement which also slows any activity with the surface that it is being wiped on. If the polymer is not water soluble, then there would be no driving force to release the thymol from the sheet and thymol is not water soluble by itself.

The delivery composition may also contain a trigger control agent to control the speed at which the delivery vehicle is dissolved or to control the rate at which the active agent is delivered from the delivery composition. Trigger control agents could include, but are not limited to, a trigger control agent selected from gums, cellulosics, starches, clays, acrylate based agents, colloidal (fumed silica, gel silica), fatty acids and their salts, fatty alcohols, fatty esters, butters, natural waxes (vegetable derived), synthetic waxes (petroleum derived), silicone waxes, silicone crosspolymers, or beeswax such that the delivery composition is substantially thickened and the expelling agent, active agent and colorant are adequately

suspended throughout the carbohydrate matrix. The trigger control agent acts to slow the release of the composition when water is used as the triggering agent.

Various other agents could be incorporated within this composition to facilitate the expelling process, converting process, stability of the composition, etc. and these various other agents are known in the art.

For example, an accelerant may be used to facilitate quicker utilization of the active agent by the user like allowing the active agent to penetrate the skin faster. Suitable accelerants include, but are not limited to, glycols such as propylene, butylene, hexylene, pentylene, caprylyl, and the like; glycol derivatives such as ethoxydiglycol, ethylhexyl glycerin, glyceryl caprylate, glyceryl caprate; dimethyl isosorbide, and combinations thereof.

An effective amount of an accelerant would be at an amount necessary within the composition to produce the desired end benefit by facilitating quicker utilization of the active agent by the user, such as allowing the active agent to penetrate the skin faster. Typically, the delivery compositions comprise the accelerant in an amount of from about 0.01% by weight of the delivery composition to about 10% by weight of the delivery composition, more typically from about 0.1% by weight of the delivery composition to about 10% by weight of the delivery composition.

Other suitable agent(s) would allow for easier metering of a very small quantity of active agents unto the product when the composition is placed on the product during converting.

The delivery composition may be formulated with one or more conventional pharmaceutically-acceptable and compatible carrier materials to form a personal care delivery composition. The personal care delivery composition may take a variety of forms including, without limitation, aqueous solutions, gels, balms, lotions, suspensions, creams, milks, salves, ointments, sprays, foams, solid sticks, aerosols, and the like. The carrier is preferably anhydrous such that the carrier has typically less than 15% water present, more typically less than 10% water present, and even more typically less that 5% water present. Use of an anhydrous carrier avoids activating the water-triggerable matrix and releasing the active agents or

expelling agents entrapped therein. The anhydrous carrier could include but not be limited to one or blends of the following ingredient types: fatty acids, fatty alcohols, surfactants, emollients, moisturizers, humectants, natural oils (vegetable derived), synthetic oils (petroleum derived), silicone oils, cosmetic emollient oils (including esters, ethers, hydrocarbons, etc.) as described below.

Examples of such suitable agents include emollients, sterols or sterol derivatives, natural and synthetic fats or oils, viscosity enhancers, rheology modifiers, polyols, surfactants, alcohols, esters, silicones, clays, starch, cellulose, particulates, moisturizers, film formers, slip modifiers, surface modifiers, skin protectants, humectants, sunscreens, and the like.

Thus, the delivery compositions may further optionally include one or more emollients, which typically act to soften, soothe, and otherwise lubricate and/or moisturize the skin. Suitable emollients that can be incorporated into the compositions include oils such as petrolatum based oils, petrolatum, mineral oils, alkyl dimethicones, alkyl methicones, alkyldimethicone copolyols, phenyl silicones, alkyl trimethylsilanes, dimethicone, dimethicone crosspolymers, cyclomethicone, lanolin and its derivatives, glycerol esters and derivatives, propylene glycol esters and derivatives, alkoxylated carboxylic acids, alkoxylated alcohols, and combinations thereof.

Ethers such as eucalyptol, ceteraryl glucoside, dimethyl isosorbic polyglyceryl-3 cetyl ether, polyglyceryl-3 decyltetradecanol, propylene glycol myristyl ether, and combinations thereof, can also suitably be used as emollients.

The delivery composition may include one or more emollients in an amount of from about 0.01% (by weight of the delivery composition) to about 70% (by weight of the delivery composition), more desirably from about 0.05% (by weight of the delivery composition) to about 50% (by weight of the delivery composition), and even more desirably from about 0.1% (by weight of the delivery composition) to about 40% (by weight of the delivery composition). In instances wherein the composition is used in combination with a wet wipe, the composition may include an emollient in an amount of from about 0.01% (by weight of the delivery composition) to about 20% (by weight of the delivery composition), more desirably

from about 0.05% (by weight of the delivery composition) to about 10% (by weight of the delivery composition), and more typically from about 0.1% (by weight of the delivery composition) to about 5% (by weight of the delivery composition).

Optionally, one or more viscosity enhancers may be added to the personal care composition to increase the viscosity, to help stabilize the composition, such as when the composition is incorporated into a personal care product, thereby reducing migration of the composition and improve transfer to the skin. Suitable viscosity enhancers include polyolefin resins, lipophilic/oil thickeners, polyethylene, silica, silica silylate, silica methyl silylate, colloidal silicone dioxide, cetyl hydroxy ethyl cellulose, other organically modified celluloses, PVP/decane copolymer, PVM/MA decadiene crosspolymer, PVP/eicosene copolymer, PVP/hexadecane copolymer, clays, carbomers, acrylate based thickeners, surfactant thickeners, and combinations thereof.

The delivery composition may desirably include one or more viscosity enhancers in an amount of from about 0.01% (by weight of the delivery composition) to about 25% (by weight of the delivery composition), more desirably from about 0.05% (by weight of the delivery composition) to about 10% (by weight of the delivery composition), and even more desirably from about 0.1% (by weight of the delivery composition) to about 5% (by weight of the delivery composition).

The delivery composition may optionally further contain rheology modifiers. Rheology modifiers may help increase the melt point viscosity of the composition so that the composition readily remains on the surface of a personal care product.

Suitable rheology modifiers include combinations of alpha-olefins and styrene alone or in combination with mineral oil or petrolatum, combinations of di-functional alpha-olefins and styrene alone or in combination with mineral oil or petrolatum, combinations of alpha-olefins and isobutene alone or in combination with mineral oil or petrolatum, ethylene/propylene/styrene copolymers alone or in combination with mineral oil or petrolatum, humectant/ethylene/styrene copolymers alone or in combination with mineral oil or petrolatum, ethylene/vinyl acetate copolymers, polyethylene polyisobutylenes, polyisobutenes, polyisobutylene, dextrin palmitate, dextrin palmitate ethylhexanoate, stearoyl inulin, stearalkonium

bentonite, distearadimonium hectorite, and stearalkonium hectorite, styrene/butadiene/styrene copolymers, styrene/isoprene/styrene copolymers, styrene-ethylene/humectant-styrene copolymers, styrene-ethylene/propylene-styrene copolymers, (styrene-butadiene) n-polymers, (styrene-isoprene) n-polymers, styrene-butadiene copolymers, and styrene-ethylene/propylene copolymers and combinations thereof. Specifically, rheology enhancers such as mineral oil and ethylene/propylene/styrene copolymers, and mineral oil and humectant/ethylene/styrene copolymers are particularly desirable.

The delivery composition can suitably include one or more rheology modifiers in an amount of from about 0.1% (by weight of the delivery composition) to about 5% (by weight of the delivery composition).

The delivery composition may optionally further contain humectants. Examples of suitable humectants include glycerin, glycerin derivatives, sodium hyaluronate, betaine, amino acids, glycosaminoglycans, honey, sorbitol, glycols, polyols, sugars, hydrogenated starch hydrolysates, salts of PCA, lactic acid, lactates, and urea. A particularly preferred humectant is glycerin. The delivery composition may suitably include one or more humectants in an amount of from about 0.05% (by weight of the delivery composition) to about 25% (by weight of the delivery composition).

The delivery composition of the disclosure may optionally further contain film formers. Examples of suitable film formers include lanolin derivatives (e.g., acetylated lanolins), superfatted oils, cyclomethicone, cyclopentasiloxane, dimethicone, synthetic and biological polymers, proteins, quaternary ammonium materials, starches, gums, cellulosics, polysaccharides, albumen, acrylates derivatives, IPDI derivatives, and the like. The composition of the present disclosure may suitably include one or more film formers in an amount of from about 0.01% (by weight of the delivery composition) to about 20% (by weight of the delivery composition).

The delivery composition may optionally further contain slip modifiers. Examples of suitable slip modifiers include bismuth oxychloride, iron oxide, mica, surface treated mica, ZnO, ZrO_2, silica, silica silyate, colloidal silica, attapulgite,

sepiolite, starches (i.e. corn, tapioca, rice), cellulosics, nylon-12, nylon-6, polyethylene, talc, styrene, polystyrene, polypropylene, ethylene/acrylic acid copolymer, acrylates, acrylate copolymers (methylmethacrylate crosspolymer), sericite, titanium dioxide, aluminum oxide, silicone resin, barium sulfate, calcium carbonate, cellulose acetate, polymethyl methacrylate, polymethylsilsequioxane, talc, tetrafluoroethylene, silk powder, boron nitride, lauroyl lysine, synthetic oils, natural oils, esters, silicones, glycols, and the like. The composition of the present disclosure may suitably include one or more slip modifiers in an amount of from about 0.01% (by weight of the delivery composition) to about 20% (by weight of the delivery composition).

The delivery composition may also further contain surface modifiers. Examples of suitable surface modifiers include silicones, quaternium materials, powders, salts, peptides, polymers, clays, and glyceryl esters. The composition of the present disclosure may suitably include one or more surface modifiers in an amount of from about 0.01% (by weight of the delivery composition) to about 20% (by weight of the delivery composition).

The delivery composition may also further contain skin protectants. Examples of suitable skin protectants include ingredients referenced in SP Monograph (21 CFR part 347). Suitable skin protectants and amounts include those set forth in SP Monograph, Subpart B – Active Ingredients Sec 347.10: (a) Allantoin, 0.5 to 2%, (b) Aluminum hydroxide gel, 0.15 to 5%, (c) Calamine, 1 to 25%, (d) Cocoa butter, 50 to 100%, (e) Cod liver oil, 5 to 13.56%, in accordance with 347.20(a)(1) or (a)(2), provided the product is labeled so that the quantity used in a 24-hour period does not exceed 10,000 U.S.P. Units vitamin A and 400 U.S.P. Units cholecalciferol, (f) Colloidal oatmeal, 0.007% minimum; 0.003% minimum in combination with mineral oil in accordance with § 347.20(a)(4), (g) Dimethicone, 1 to 30%, (h) Glycerin, 20 to 45%, (i) Hard fat, 50 to 100%, (j) Kaolin, 4 to 20%, (k) Lanolin, 12.5 to 50%, (l) Mineral oil, 50 to 100%; 30 to 35% in combination with colloidal oatmeal in accordance with § 347.20(a)(4), (m) Petrolatum, 30 to 100%, (o) Sodium bicarbonate, (q) Topical starch, 10 to 98%, ® White petrolatum, 30 to 100%, (s) Zinc acetate, 0.1 to 2%, (t) Zinc carbonate, 0.2 to 2%, (u) Zinc oxide, 1 to 25%.

The delivery composition may also further contain sunscreens. Examples of suitable sunscreens include aminobenzoic acid, avobenzone, cinoxate, dioxybenzone, homosalate, menthyl anthranilate, octocrylene, octinoxate, octisalate, oxybenzone, padimate O, phenylbenzimidazole sulfonic acid, sulisobenzone, titanium dioxide, trolamine salicylate, zinc oxide, and combinations thereof. Other suitable sunscreens and amounts include those approved by the FDA, as described in the Final Over-the-Counter Drug Products Monograph on Sunscreens (Federal Register, 1999:64:27666-27693), herein incorporated by reference, as well as European Union approved sunscreens and amounts.

The delivery composition may also further contain quaternary ammonium materials. Examples of suitable quaternary ammonium materials include polyquaternium-7, polyquaternium-10, benzalkonium chloride, behentrimonium methosulfate, cetrimonium chloride, cocamidopropyl pg-dimonium chloride, guar hydroxypropyltrimonium chloride, isostearamidopropyl morpholine lactate, polyquaternium-33, polyquaternium-60, polyquaternium-79, quaternium-18 hectorite, quaternium-79 hydrolyzed silk, quaternium-79 hydrolyzed soy protein, rapeseed amidopropyl ethyldimonium ethosulfate, silicone quaternium-7, stearalkonium chloride, palmitamidopropyltrimonium chloride, butylglucosides, hydroxypropyltrimonium chloride, laurdimoniumhydroxypropyl decylglucosides chloride, and the like. The composition of the present disclosure may suitably include one or more quaternary materials in an amount of from about 0.01% (by weight of the delivery composition) to about 20% (by weight of the delivery composition).

The delivery composition may optionally further contain surfactants. Examples of suitable additional surfactants include, for example, anionic surfactants, cationic surfactants, amphoteric surfactants, zwitterionic surfactants, non-ionic surfactants, and combinations thereof. Specific examples of suitable surfactants are known in the art and include those suitable for incorporation into personal care compositions and wipes. The composition of the present disclosure may suitably include one or more surfactants in an amount of from about 0.01% (by weight of the delivery composition) to about 20% (by weight of the delivery composition).

The delivery composition may also further contain additional emulsifiers. As mentioned above, the natural fatty acids, esters and alcohols and their derivatives, and combinations thereof, may act as emulsifiers in the composition. Optionally, the composition may contain an additional emulsifier other than the natural fatty acids, esters and alcohols and their derivatives, and combinations thereof. Examples of suitable emulsifiers include nonionics such as polysorbate 20, polysorbate 80, anionics such as DEA phosphate, cationics such as behentrimonium methosulfate, and the like. The composition of the present disclosure may suitably include one or more additional emulsifiers in an amount of from about 0.01% (by weight of the delivery composition) to about 20% (by weight of the delivery composition).

The delivery composition may additionally include adjunct components conventionally found in pharmaceutical compositions in their art-established fashion and at their art-established levels. For example, the compositions may contain additional compatible pharmaceutically active materials for combination therapy, such as antimicrobials, antioxidants, anti-parasitic agents, antipruritics, antifungals, antiseptic actives, biological actives, astringents, keratolytic actives, local anesthetics, anti-stinging agents, anti-reddening agents, skin soothing agents, and combinations thereof. Other suitable additives that may be included in the compositions of the present disclosure include colorants, deodorants, fragrances, perfumes, emulsifiers, anti-foaming agents, lubricants, natural moisturizing agents, skin conditioning agents, skin protectants and other skin benefit agents (e.g., extracts such as aloe vera and anti-aging agents such as peptides), solvents, solubilizing agents, suspending agents, wetting agents, humectants, preservatives, pH adjusters, buffering agents, dyes and/or pigments, and combinations thereof.

The delivery composition may also be used in combination with a product, such as a personal care product. More particularly, the polymer entrapped volatile component may be incorporated into a composition that may be incorporated into or onto a substrate, such as a wipe substrate, an absorbent substrate, a fabric or cloth substrate, or a tissue substrate, among others. For example, the compositions may be incorporated into personal care products, such as wipes,

absorbent articles, bath tissues, cloths, and the like. More particularly, the polymer entrapped volatile component-containing composition may be incorporated into wipes such as wet wipes, dry wipes, hand wipes, face wipes, cosmetic wipes, and the like, or absorbent articles, such as diapers, training pants, adult incontinence products, feminine hygiene products, and the like. Desirably, the polymer entrapped volatile component may be incorporated onto a dry substrate. The dry substrate may be prepared by applying a composition containing a polymer entrapped volatile component of the present disclosure onto a wipe substrate by any suitable means (e.g., by spraying, impregnating, etc.). The composition may comprise 100% polymer entrapped volatile component, or alternately, the composition may be present in the composition in combination with a carrier and/or other skin benefit agent, as described herein. In embodiments where the composition used to prepare the dry wipe comprises water or moisture, the resulting treated substrate is then dried so that the wipe comprises less than about 10% by weight of the substrate moisture content, and a dry wipe is produced. The treated substrate can be dried by any means known to those skilled in the art including, for example by use of convection ovens, radiant heat sources, microwave ovens, forced air ovens, and heated rollers or cans, or combinations thereof.

As used interchangeably herein, the terms “dry substrate” and “substantially dry substrate”, mean a wipe that includes less than about 10% by weight of the substrate moisture content. Specifically, a “dry substrate” can be a facial tissue, bath tissue, paper towel, dinner napkin, or the like. The tissue products of this invention can be one-ply, two-ply, three-ply or more. In all cases, the composition is applied to one or both outer surfaces of the product after the product has been dried. The composition can be applied after the plies are brought together or prior to bringing the plies together. The individual plies can be layered or blended, (homogeneous) creped or uncreped, throughdried or wet-pressed. Alternately, materials suitable for the substrate of the wipes are well know to those skilled in the art, and are typically made from a fibrous sheet material which may be either woven or nonwoven. For example, suitable materials for use in the wipes may include nonwoven fibrous sheet materials which include meltblown, coform,

air-laid, bonded-carded web materials, hydroentangled materials, and combinations thereof. Such materials can be comprised of synthetic or natural fibers, or a combination thereof. Typically, the wipes of the present disclosure define a basis weight of from about 25 grams per square meter to about 120 grams per square meter and desirably from about 40 grams per square meter to about 90 grams per square meter.

Specifically, the delivery composition can be present on an exterior surface of a tissue product **10** as shown on **Fig. 1**. Alternatively, the delivery composition can be incorporated into the tissue product in a manner so that substantially none of the delivery composition is present on the exterior surfaces. For instance, referring to **Fig. 2**, a tissue product **20** is shown that is comprised of a first tissue web **22** laminated to a second tissue web **24**. As shown, positioned in between the first tissue web **22** and the second tissue web **24** is a delivery composition **26** made in accordance with the present disclosure. By locating the delivery composition **26** in between the tissue webs, the delivery composition is substantially prevented from being transferred to a user's skin. When the tissue product **20**, however, is held against the skin, moisture from the skin will be absorbed by the delivery composition **26** through the tissue webs thus triggering the polymer network and releasing the active agent. The presence of moisture will cause the delivery agent to provide the activated response from the active agent to the skin of the user.

In one specific embodiment the product is a facial tissue comprising three or more plies, two outer plies and one or more interior plies. The delivery composition is applied to at least one of the one or more interior plies. In another embodiment, the tissue product is a facial tissue comprising two plies, comprising two outer facing surfaces and two oppositely facing inner surfaces. The delivery composition is applied to one or both of the oppositely facing inner surfaces. In another embodiment, the product is a multi-ply tissue product where the delivery composition is applied selectively to the inner portion of the multi-ply product so as to minimize blocking.

In this manner, other beneficial compositions may be applied to the exterior surface of the tissue product and used in conjunction with the delivery composition **26**. For example, in one embodiment, a lotion that is intended to moisturize the skin can be present on at least one exterior surface of the tissue product and may work in conjunction with the delivery composition. In this manner, the tissue product **20** can not only provide an active agent to the user, but can also transfer a moisturizer to the skin.

In addition to lotions, any other suitable composition may also be applied to the exterior surface. For instance, in one embodiment, various softening agents may be present on the exterior surfaces of the tissue product. One example of a softening agent may comprise a polysiloxane.

In addition to a 2-ply product as shown in **Fig. 2**, other tissue products that may be made in accordance with the present disclosure can include more than two plies. For example, a 3-ply tissue product **30** is illustrated in **Fig. 3**. As shown, the tissue product **30** includes a middle tissue web **34** laminated to outer tissue webs **32** and **36**. In accordance with the present disclosure, a delivery composition is located in between the first tissue web **32** and the middle tissue web **34**. A delivery composition **40** is also positioned in between the middle tissue web **34** and the second outer tissue web **36**.

In an alternative embodiment, the delivery composition of the present disclosure can also be present on one or more exterior surfaces of a dry substrate product. For instance, referring to **Fig. 4**, in one embodiment the delivery composition can be applied to an exterior surface of a paper towel product **50**. As shown, the paper towel product **50** comprises a spirally wound product containing individual tissue sheets **52** separated by perforation lines **54**. The tissue sheets can include a first exterior surface **56** and a second exterior surface **58**. Each tissue sheet may comprise a single ply product or a multi-ply product. In accordance with the present disclosure, the delivery composition may be present on the first exterior surface **56**, on the second exterior surface **58**, on both exterior surfaces, or between multiple plies. When the paper towel **20** is used to pick up a wet spill such as water on a surface, the wet spill will be absorbed by the delivery

composition **26** thus triggering the polymer network and releasing the active agent. The presence of water will cause the delivery composition to provide the activated purpose of an active agent to the surface.

Applying the delivery composition to a dry substrate product as shown in **Fig. 2** may provide various unexpected benefits and advantages. For example, the delivery composition may provide a disinfectant active agent, such as thymol, incorporated within the material. Thus, the disinfectant is stored within the paper towel allowing the consumer to reuse the substrate without fear of odor-causing or harmful microorganisms. Furthermore, a more naturally derived chemistry such as thymol is perceived as safer and earth-friendly by consumers.

The dry substrate may contain the composition in an add-on amount of composition of from about 40% (by weight of the treated substrate) to about 250% (by weight of the treated substrate), more typically from about 75% (by weight of the treated substrate) to about 150% (by weight of the treated substrate) and more typically about 100% (by weight of the treated substrate).

Upon wetting the substantially dry substrate or upon contact with water, such as a wet countertop or skin, the polymer entrapped volatile component-containing composition dissolves to release the expelling agent and active agent.

Alternatively, the polymer entrapped volatile component-containing composition is a liquid composition that may be used in combination with a wipe substrate to form a wet wipe, or may be a wetting composition for use in combination with a dispersible wet wipe.

Other modifications and variations to the present invention may be practiced by those of ordinary skill in the art without departing from the spirit and scope of the present invention, which is more particularly set forth in the appended claims. It is understood that aspects of the various embodiments may be interchanged in whole or in part. In the event of inconsistencies or contradictions between the incorporated references and this application, the information present in this application shall prevail. The preceding description, given by way of example in order to enable one of ordinary skill in the art to practice the claimed invention, is

not to be construed as limiting the scope of the invention, which is defined by the claims and all equivalents thereto.

EXAMPLES

Comparative Examples: Thymol incorporated directly onto a substrate

In this experiment, thymol was mixed with alcohol and placed onto a coform substrate. The resultant wipe was tested for zone of inhibition and found to be unstable for extended periods of time.

Five sections of coform material approximately 17 cm by 17 cm were prepared and weighed to determine the amount of thymol needed for loading of thymol at a weight percent of 0.3%, 0.6% and 1%. The determined quantity of thymol to provide thymol as a percentage was placed in an excess (39 grams) of ethanol to be dissolved. The coform substrates were placed into a plastic bag and the ethanol/thymol mixture was added. Using a cylindrical glass jar rolled on the outside of the sealed plastic bag, the sheets were rolled to evenly express the liquid throughout the coform squares.

The coform was then removed from the bag and placed in a fume hood to allow the ethanol to evaporate off. The remaining dry sheets containing thymol were removed from the hood after one hour and placed in a dry plastic bag. Samples were aged 7 days and tested for anti-bacterial activity.

To determine the anti-bacterial activity of the samples after 7 days, the shake flask test of ASTM E2149 - 01 “Standard Test Method for Determining the Antimicrobial Activity of Immobilized Antimicrobial Agents Under Dynamic Contact Conditions” was used. Approximately 1 gram samples of thymol-treated and untreated coform substrates were placed in individual capped flasks containing approximately 10^5 CFU of a *Staphylococcus aureus* (ATCC #6538) in phosphate buffered saline. Flasks were shaken at maximum speed on a wrist-action shaker for 1 hour. As can be seen in Table 1 below, the anti-bacterial activity was determined according to ASTM protocol. No meaningful reduction was observed for any thymol-treated or untreated samples. The active agent thymol has volatilized off of the sample within the 7 day time period.

Thymol % Add-on to Sample	Log_{10} Reduction of Bacteria
1% Thymol	No Reduction
0.6% Thymol	No Reduction
0.3% Thymol	No Reduction
0.0% Thymol	No Reduction

Table 1. Log_{10} Reduction of Staphylococcus aureus (ATCC #6538) after 1 hour exposure to 7 day old sample in ASTM E2149-01

To further show that the samples with thymol incorporated directly on the substrate lost all efficacy, zone of inhibition testing was also completed. The samples prepared above were cut into 10 mm-diameter circular sections of thymol-treated and untreated material. These samples were placed on a freshly streaked sample of staphylococcus aureus on trypticase soy agar. After 24 hours incubation at 37°C, plates were measured for zones of inhibitions surrounding the samples. To calculate the zone of inhibition, the test material was brought into contact with a known population of test microorganisms on an agar plate for a specified period of time. At the end of the contact time the area of inhibited colony formation around the test material was measured. The size of this area of no growth was a measure of leaching of the antimicrobial agent from the test material. In this procedure, the test material was cut into small discs and placed on an agar plate evenly spread with a test microorganism. The plates were incubated for 24 hours at ideal growth conditions. Following incubation, the diameter of the circle of no growth around the disc was measured. The zone of inhibition was reported as the difference between the sample disc diameter and the average of the measured no growth zone diameters.

Materials and Reagents

- Microorganisms: frozen stock of *Staphylococcus aureus* (ATCC *6538*).
- Mueller-Hinton agar (MHA) plates or equivalent plated media. Prepare following manufacturer's directions. Store at 4 ± 2°C. Alternatively pre-made plates can be utilized.
- Mueller-Hinton broth (MHB) or equivalent liquid media. Prepare following manufacturer's directions. Store at 4 ± 2°C. Alternately pre-made media can be utilized.

- Sterile cotton swabs or equivalent.
- Sterile forceps.
- Positive control disc: Vanocymicin susceptibility discs (6 mm), 30 µg/disc (BD and Company; Sparks, Maryland).
- Test material, cut into 8 mm discs.
- Calipers or other measuring device.
- Other ancillary lab supplies.

Preparation

Supply Set-up

1. Label growth media plates appropriately for testing codes.

2. Sterilize test material discs with UV exposure in Laminar flow hood for 15 minutes (both sides of disc), if required.

Inoculum

1. Take appropriate measures to ensure culture purity.

2. *Staphylococcus aureus* (ATCC *6538*) is inoculated from an overnight plate or MHB into 5 ml of sterile MHB in a 35°C incubator for 18 - 24 hrs.

3. The overnight culture is then adjusted using MHB to the 0.5 McFarland barium sulphate standards (1 x 10^8 CFU/ml) or approximately 0.15 OD with a 0.2 cm light path at 660 nanometer.

4. Discard the cell suspension if it is not used within 30 to 60 minutes after preparation.

Zone of Inhibition Bioassay Procedure

1. Pre-warm, to room temperature, MHA plates. The number of plates required per strain will depend on the number of test materials to be tested and their anticipated zone inhibition diameters; discs should be placed on plates so that zones of inhibition do not overlap.

2. The surface of the plates should be dry. If not, dry the plates (with lids ajar) in a 35°C incubator for 20 - 30 minutes just prior to inoculation. There should be no visible droplets of moisture on the surface of the agar or on the lids of the plates when they are inoculated.

3. Moisten a sterile applicator swab in the standardized cell suspension and express any excess moisture by rotating the swab against the glass above the liquid in the tube. Inoculate the entire surface of each plate, inoculating the surface completely in three different directions to ensure uniform growth.

It is recommended that cotton swabs with wooden handles be used for this procedure. Swabs made of synthetic materials do not soak up sufficient suspension to inoculate the entire surface of the plate. Swabs with plastic handles bend when excess suspension is being expressed and may splatter liquid out of the tube.

4. Repeat step 3 to inoculate additional plates as needed.

5. Store the inoculated plates at room temperature for 10 - 15 minutes to allow the medium to absorb the moisture from the inoculum.

6. Apply discs of test material to the surface of the inoculated medium with a sterile forceps and tap them to ensure that they are in complete contact with the agar surface. A positive control (vancomycin disc) and negative control (uncoated disc) should be used on each plate.

7. Invert the inoculated plates and incubate them at 35°C for 18 - 24 hours.

8. Examine the plates from the back, viewed against a black background and illuminated with reflected light. With calipers, measure the diameter of each zone of inhibition to the nearest whole millimeter.

Calculation

Zone of Inhibition = diameter of no growth area - diameter of disc

As can be seen in Table 1 below, no meaningful reduction was observed for any thymol-treated or untreated samples. The active agent thymol has volatilized off of the samples including thymol within the 7 day time period, losing all efficacy.

Thymol % Add-on to Sample	Observed Zone of Inhibition (mm)
1% Thymol	0 mm
0.6% Thymol	0 mm
0.3% Thymol	0 mm
0.0% Thymol	0 mm

Table 2. Zone of Inhibition Results of 7 day old sample plated with Staphylococcus aureus (ATCC #6538)

Example 1

First, exemplary Delivery Compositions A and B were created. Thymol was placed into a glass container. Polypropylene glycol-12/saturated methylene diphenyldiisocyanate monomer copolymer (polyolprepolymer-2 commercially available from Barnet, Inc) was added to the thymol and mixed until homogenous. Table 3 below illustrates the weight percentages of Delivery Compositions A and B.

Example Composition	Thymol (wt. %)	Polymer Network (wt. %)
Delivery Composition A	10	90
Delivery Composition B	20	80

Table 3. Exemplary compositions

Approximately 1 ml of the Delivery Compositions was placed into an ependorf tube. A sample of filter paper circle with a diameter of 10 mm was added to the ependorf tube. The ependorf tube was vortexed until the filter paper samples were covered in Delivery Composition A and B. The samples of filter paper were removed from the ependorf tube and placed in the center of a trypticase soy agar plate inoculated with 100 ul of 10^8 cfu/ml *Staphylococcus aureus* (ATCC #6538). After 24 hours incubation at 37°C, a zone of inhibition for each sample was measured. The plate was left open to the air and left to interact with the air. At day 2, day 5 and day 7, the samples were tested for zone of inhibition. By leaving the delivery compositions to interact with the air, the reusability of the product was shown. Results can be found below in Table 4.

Example Composition	Zone of Inhibition (mm) – Day 0	Zone of Inhibition (mm) – Day 2	Zone of Inhibition (mm) – Day 5	Zone of Inhibition (mm) – Day 7
Delivery Comp. A	1	1	1	0.5
Delivery Comp. B	2	2.5	4	3

Table 4. Zone of Inhibition Results for Example 1

As can be seen by the results above in Table 4, Delivery Compositions A and B having thymol entrapped in polymer matrix retain the activity of the thymol to disinfect surfaces, even after a time period of 7 days.

Example 2

First, exemplary Delivery Composition C was created. To prepare Delivery Composition C, a mixture of 2 ml of acetone and 1 g of the active agent, thymol, was prepared. To this mixture, approximately, 1 g of polystyrene was added and mixed for 1-5 minutes until homogeneous and paste is formed to create the polymer network. The acetone was allowed to evaporate off for 10 minutes resulting in a polymer network having approximately 50% by weight of entrapped thymol. Delivery Composition C was then placed into an ependorf tube.

A sample of filter paper circle was added to an ependorf tube. The ependorf tube was vortexed until the filter paper samples are covered in Delivery Composition C. The sample of filter paper was removed from the ependorf tube and place in the center of a trypticase soy agar plate inoculated with 100 ul of 10^8 cfu/ml *Staphylococcus aureus* (ATCC #6538). After 24 hours incubation at 37°C, a zone of inhibition for each sample was measured. The plate was left open to the air and left to interact with the air. At day 2, day 5 and day 7, the sample was tested for zone of inhibition. By leaving the delivery compositions to interact with the air, the reusability of the product was shown.

Time	Zone of Inhibition (mm)
Day 1	25 mm
Day 2	20 mm
Day 5	24 mm
Day 7	25 mm

TABLE 5. Zone of Inhibition Results Example 2

Example 3

First, exemplary Delivery Composition D was created. To prepare Delivery Composition D, a mixture of 1 ml of acetone and 0.01 g of the active agent, thymol, was prepared in a small glass jar. To this mixture, approximately, 1 g of polystyrene was added and mixed for 1-5 minutes until homogeneous and paste is formed to create the polymer network. The acetone was allowed to evaporate off for 10 minutes resulting in a polymer network having approximately 1% by weight of entrapped thymol.

To illustrate the antibacterial efficacy of Delivery Composition D, 2 ml of 10^5 cfu/ml *Staphylococcus aureus* (ATCC #6538) was added to the jar. After 24 hours incubation at 37°C on a rotary shaker, 1.8 ml of Butterfield's buffer was added to the jar to extract the organism and the samples were plated for enumeration. The average reduction in bacteria for three samples of Delivery Composition D is illustrated in Table 6 below.

Sample	Avg CFU/mL recovered	Avg Log_{10} reduction (Avg % reduction)
Delivery Composition D	3.14×10^3	2.13

TABLE 6. Example 3 Results

Having described the disclosure in detail, it will be apparent that modifications and variations are possible without departing from the scope of the disclosure defined in the appended claims.

What is claimed is:

1. A delivery composition for delivering an active agent comprising:
a polymer network;
a volatile active agent entrapped within the polymer network; and
wherein the volatile active agent is present in an amount from about 0.01% (by weight of the delivery composition) to about 60% (by weight of the delivery composition).

2. The delivery composition of claim 1 wherein the volatile active agent is thymol.

3. The delivery composition of claim 1 wherein the volatile active agent is selected from disinfectants, antibiotic agents, anti-proliferative agents, anti-inflammatory agents, alcohols, metal salts, innate immunity enhancers, anti-quorumsensing compounds, anti-protozoics, pesticides, preservatives, botanical oils, botanical extracts, and combinations thereof.

4. The delivery composition of claim 1 wherein the polymer network comprises a material selected from polyvinyl chloride, polyolprepolymer, polyurethane, polyethylene, polypropylene, polydiallydimethylammonium chloride, rubber, silicone, cyanoacrylate, calcium alginate, starch polymers, cellulose, hydrophilic polysaccharides, polylactic acid, polyvinyl alcohol, polyvinylpyrrolidone, acrylates, gums, and combinations thereof.

5. The delivery composition of claim 1 wherein the polymer network is selected from a polypropylene glycol-51/saturated methylene diphenyldiisocyanate monomer coplymer, a polypropylene glycol-12/saturated methylene diphenyldiisocyanate monomer copolymer, and a polyethylene glycol-18/saturated methylene diphenyldiisocyanate monomer copolymer.

6. The delivery composition of claim 1 wherein the polymer network is formed by adding polystyrene to a mixture of the active agent and a restructuring agent.

7. The delivery composition of claim 6 wherein the restructuring agent is acetone.

8. The delivery composition of claim 1 wherein the delivery composition is present in an anhydrous carrier.

9. The delivery composition of claim 1 further comprising a trigger control agent selected from gums, cellulosics, starches, clays, acrylate based compositions, colloidal, fatty acids and their salts, fatty alcohols, fatty esters, butters, natural waxes, synthetic waxes, silicone waxes, silicone crosspolymers, or beeswax, and mixtures thereof.

10. The delivery composition of claim 1 further comprising a skin benefit agent selected from the group consisting of a surfactant, quaternary ammonium material, a particulate, a rheology modifier, a humectant, a moisturizer, a film former, a slip modifier, a surface modifier, a skin protectant, a sunscreen, and combinations thereof.

11. A substantially dry substrate for delivering an active agent, the dry wipe comprising:

a substrate; and

the delivery composition of claim 1.

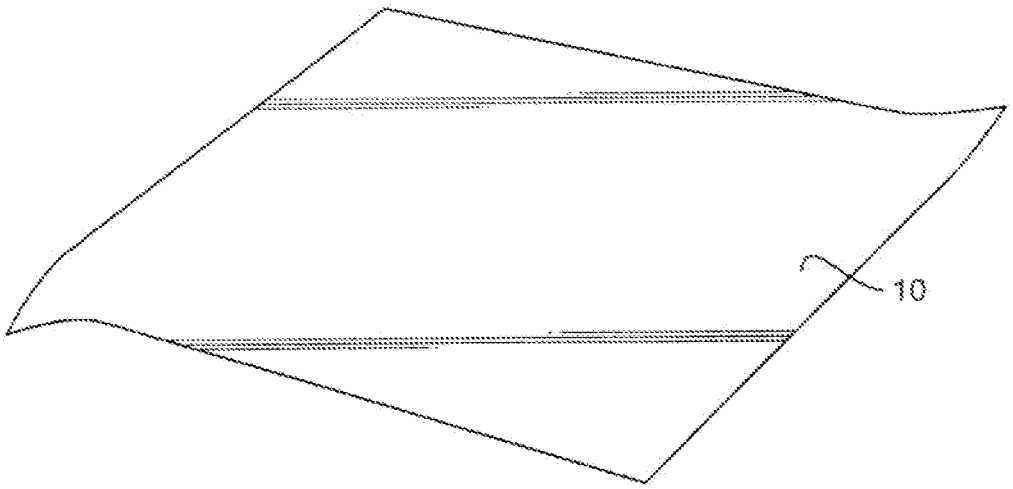

FIG. 1

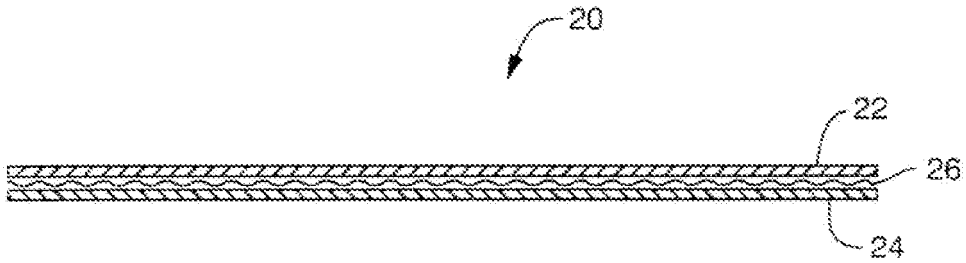

FIG. 2

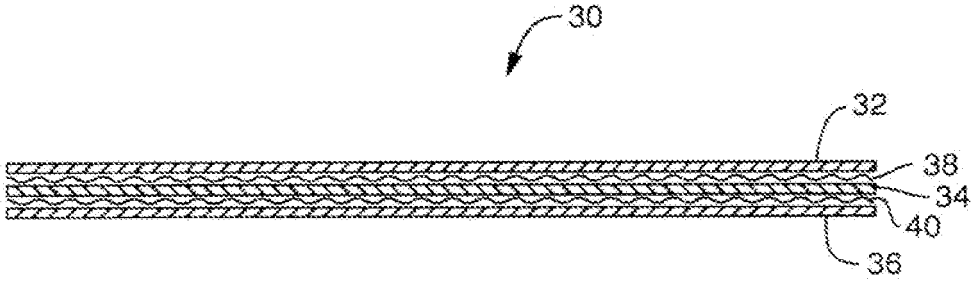

FIG. 3

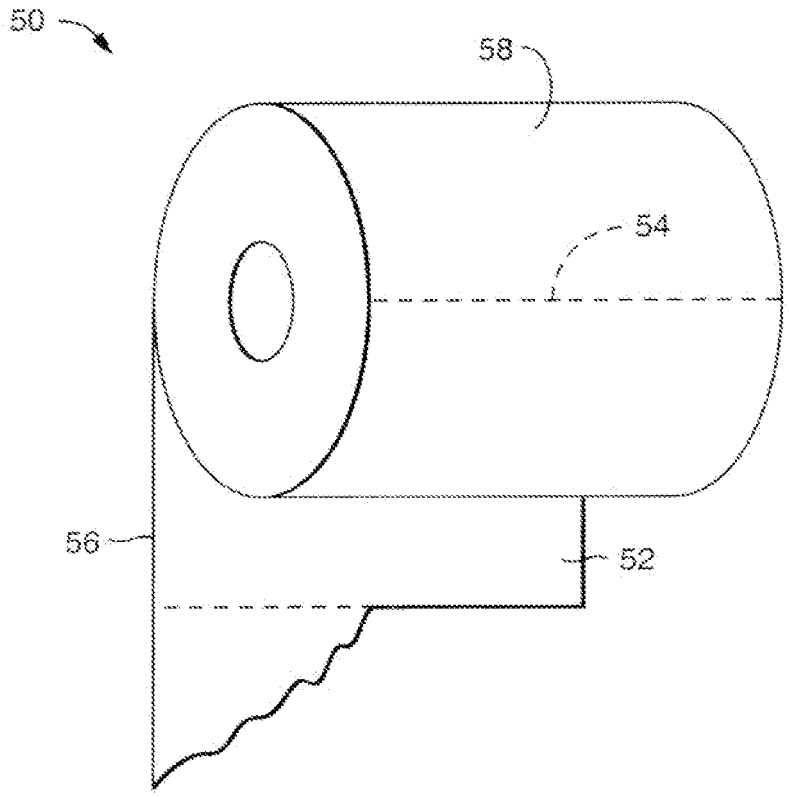

FIG. 4