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(54) **TISSUE PAPER WITH PROTRUDING
LOTION DEPOSITS**

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(57) **ABSTRACT**

A paper tissue and products made from paper tissue, such as paper handkerchiefs, facial tissues, bath and cosmetic tissues, paper tissue wipes of any kinds and the like. The invention also relates to tissue paper including deposits of lotions on the surface of the tissue paper that protrude a significant height above the average plan of the tissue.

FIGURES :

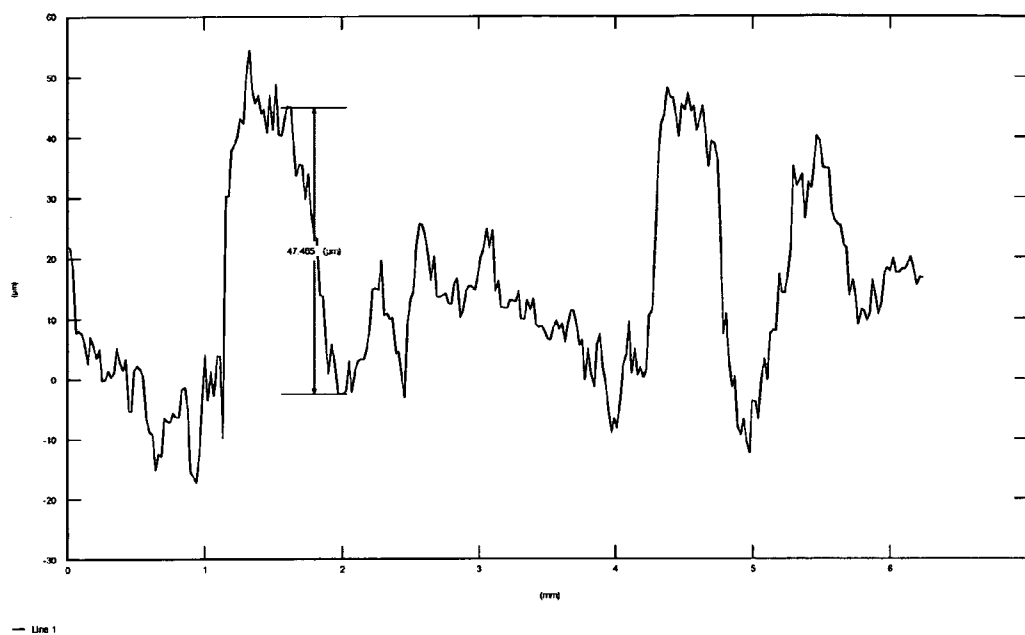


Figure 1

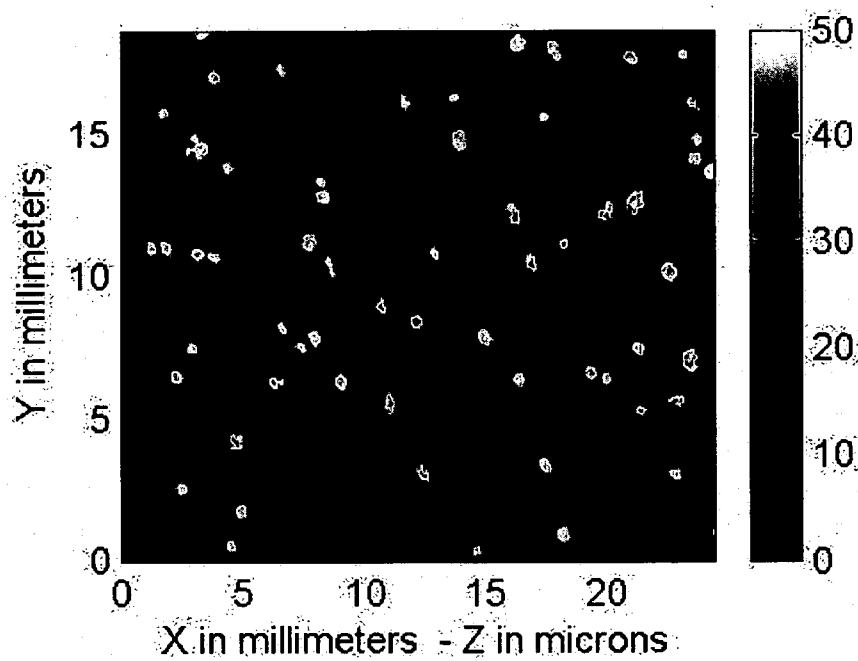


Figure 2

TISSUE PAPER WITH PROTRUDING LOTION DEPOSITS

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application Ser. No. 60/565,104 filed on Apr. 23, 2004.

FIELD OF THE INVENTION

[0002] The present invention relates to paper tissues, and products made from paper tissues. More particularly, the present invention relates to a tissue including lotion deposits having a significant height above the average plane of the tissue surface.

BACKGROUND OF THE INVENTION

[0003] Paper tissues sometimes called paper webs or sheets, tissues, tissue layers, paper plies or paper tissue webs, and products made there from, such as paper handkerchiefs, paper kitchen towel or bath tissue, toilet paper or facial tissues, find extensive use in modern society and are well known in the art.

[0004] Paper tissues are generally made by the layering of cellulose fibers, in a wet form, onto a screen, with the addition of various additives or other ingredients, followed by a drying step. Other process steps, before, during or after the above-mentioned paper making steps are targeted at giving the desired properties to the tissue. Converting steps are aimed at creating a finished product from the paper tissue(s).

[0005] Products made from paper tissues can be made by the association of multiple layers of paper tissues, also called plies, or can comprise a single paper tissue layer (single ply products). Those plies can be combined and held together in multiple ways to form the finished product, for example by embossing of the multi-ply structure or/and by gluing. The finished products are herein referred to as paper tissue products. Finished products made of more than one ply have internal tissue (or ply) surfaces, inwardly orientated, and 2 external surfaces, outwardly orientated.

[0006] It has long been recognised that important physical attributes of these paper tissues are their strength and thickness/bulkiness, their softness and smoothness, and their absorbency. Softness and smoothness relate to the tactile sensation perceived by the consumer when holding a particular product, rubbing it across the skin, or crumpling it within the hands.

[0007] Relatively thick and yet soft disposable paper products, namely in the form of paper handkerchiefs, are known. For example, Tempo™, sold by The Procter & Gamble Company, is a multi-ply paper product experienced as thick and soft and having a caliper of about 0.3 mm. A high caliper conveys the idea of high dry and wet strength to the consumer. A high wet strength, also referred to as wet burst strength, in particular prevents tearing or bursting which for a paper handkerchief in turn results in contamination of the user's hand with mucus or other body fluids. A common way to enhance the smoothness of the tissue surface is to calender the material. Another way to improve the sensation of smoothness perceived by the users of paper tissue products,

such as handkerchiefs, is to complement the composition of the paper tissue with some additives during the paper-making phase and/or during the converting phase. Those additives can have the effect of smoothening the paper tissue in a way that makes the user feel it more soft or smooth. Alternatively or additionally some additives have an effect on the skin of the user touching or using the paper tissue product, e.g. smoothening of the skin, hydration of the skin. This later effects are usually obtained through a partial transfer of the additives onto the skin during usage, thus prolonging the effect of the additives on the skin beyond the period of contact between the paper-tissue product and skin.

[0008] Smoothening lotions are usually of hydrophobic nature or contain hydrophobic compounds. The presence of the lotion at the surface of the paper tissue can have adverse effects on the properties of the paper tissue: First, the masking of the hydrophilic tissue surface by an hydrophobic lotion can reduce the absorbency of tissue or the speed of absorbency. This present a undesirable effect for the user. For example, one a paper handkerchief, the nasal mucus can take a longer time to be absorbed by a lotioned paper tissue than by a non lotioned one. Second, the lotion can migrate from tissue the surface thru the paper tissue structure making the paper tissue less hydrophilic and making less lotion available at the surface to deliver the smoothening benefits to the skin. A traditional way to respond to that expected migration of the lotion over time is to use a relatively high amount of lotion to insure a certain availability of the lotion on the surface of the tissue, even after extended storage. In turn this creates an excess of lotion on the freshly produced paper tissues thus triggering a negative greasy feeling during use (and reducing further more the absorbency of the paper tissue). Third, lotions that are coating the fibers are less susceptible to be released by the tissue during use and thus less transferable to the skin of the user. Further yet, there is an economic advantage at utilizing a reduced amount of lotion of the tissues, due to the relatively high cost of the lotion raw materials.

[0009] Accordingly, there is a need to provide a paper tissue exhibiting, a relatively high amount of lotion available at the surface of the tissue in the form of discrete deposits protruding a significant height from the surface of the tissue.

[0010] Further, there is a need for improved smoothening benefits of the tissue, improved absorbency of paper tissues, and improved transferability of the lotion to the users skin, without having one improvement being detrimental to the other.

SUMMARY OF THE INVENTION

[0011] In order to solve the issues related to the prior art, the present invention provides a paper tissue having first and second opposed surfaces wherein the tissue includes a lotion on at least one surface of the paper tissue. The lotion is present in substantially discrete protruding deposits on the first surface, wherein the paper tissue has a bulk of equal or less than 5.2 cm³/g of tissue wherein the protruding deposits have an average height of at least 30 μm.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 is a representation of the elevations at the surface of the tissue of example 1. The tissue is treated with 2.1 g/sqm of lotion.

[0013] FIG. 2 is a representation of the tissue surface of tissue example 1, treated with the formulation of example 1 at 2.1 g/sqm, showing the height of the protruding deposits in grey values. White areas are protruding.

DETAILED DESCRIPTION OF THE INVENTION

[0014] The present invention provides a paper tissue exhibiting a high level of surface smoothness and softness, high absorbency, a high strength and a high bulkiness. These apparently competing characteristics have been combined by following the concept of the present invention.

[0015] A "lotion" a composition added to the tissue preferably at the converting phase in order to improved its softness/smoothness and have smoothening effect on the skin. Some of the lotion can transfer from the tissue to the user's skin upon use of the paper tissue article. It thus induces a longer term smoothening effect on the skin. Lotion can be called alternatively smoothening or softening lotion or composition.

[0016] The lotion may comprise softening/debonding agents, emollients, immobilizing agents and mixtures thereof. Suitable softening/debonding agents include quaternary ammonium compounds, polysiloxanes, and mixtures thereof. Suitable emollients include propylene glycol, glycerine, triethylene glycol, spermaceti or other waxes, petrolatum fatty acids, fatty alcohols and fatty alcohol ethers having from 12 to 28 carbon atoms in their fatty acid chain, mineral oil, namely silicone oil e.g. dimethicone and isopropyl palmitat, and mixtures thereof. Suitable immobilizing agents include waxes, fatty alcohols, fatty acids, e.g. ceresin wax, microcrystalline wax, petroleum waxes, fisher tropsh waxes, paraffin waxes, stearyl alcohol and paraffins, polyhydroxy fatty acid esters, polyhydroxy fatty acid amides, and mixtures thereof. In most cases the lotions contain at least one immobilizing agent and an emollient. Lotions can be emulsions or dispersions. Other optional components include perfumes, antibacterial actives, antiviral actives, disinfectants, pharmaceutical actives, film formers, deodorants, opacifiers, astringents, solvents and the like. Particular examples of lotion components include camphor, thymol, menthol, chamomile extracts, aloe vera, calendula officinalis.

[0017] "Protruding deposit" means a protruding deposit is defined as a deposition of lotion on the paper tissue that protrudes (in some embodiments, at least 25 micrometers) above the average plane of the tissue surface.

[0018] "Average height of protruding deposits" means average of the height of each data point (provided by the method described thereafter) that are at least 25 micrometers above the average plane of the tissue surface.

[0019] The terms "paper tissue", "paper tissue web", "tissue web", "tissue", "paper" and "web" are used interchangeably in this document. The present invention is useful with tissue paper in general, including but not limited to conventionally felt-pressed tissue paper; high bulk pattern densified tissue paper; and high bulk, uncompacted tissue paper and through-air dried paper. The tissue paper can be of a homogeneous or multi-layered construction; and tissue paper products made therefrom can be of a single-ply or multi-ply construction. The tissue paper preferably has a basis weight

of between about 10 g/m² and about 65 g/m², and bulk of about 5.2 cm³/g or less (preferably equal or less than 5.0 cm³/g). More preferably, the basis weight will be about 40 g/m² or less. Conventionally pressed tissue paper and methods for making such paper are well known in the art. Such paper is typically made by depositing a papermaking furnish on a foraminous forming wire, often referred to in the art as a Fourdrinier wire. Once the furnish is deposited on the forming wire, it is referred to as a web. The web is dewatered by pressing the web and drying at elevated temperature. The dewatered web is then further pressed and dried by a steam drum apparatus known in the art as a Yankee dryer. Applicable wood pulps include chemical pulps, such as Kraft, sulfite, and sulfate pulps, as well as mechanical pulps including, for example, groundwood, thermomechanical pulp and chemically modified thermomechanical pulp. In addition to papermaking fibers, the papermaking furnish used to make tissue paper structures can have other components or materials added thereto as can be or later become known in the art. The types of additives desirable will be dependent upon the particular end use of the tissue sheet contemplated. For example, in products such as toilet paper, paper towels, facial tissues and other similar products, high wet strength is a desirable attribute. Thus, it is often desirable to add to the papermaking furnish chemical substances known in the art as "wet strength" resins. A general dissertation on the types of wet strength resins utilized in the paper art can be found in TAPPI monograph series No. 29, Wet Strength in Paper and Paperboard, Technical Association of the Pulp and Paper Industry (New York, 1965). Paper tissue of the present invention can have a moisture content of between 0 and 20% (w/w) but it has been found that best results are obtained with a moisture level of at least 4% (w/w).

[0020] The paper tissue of the present invention can be formed from a unique layer of material or can be a multi-layered tissue paper web. The terms "multi-layered tissue paper web, multi-layered paper web, multi-layered web, multi-layered paper sheet and multi-layered paper product" are all used interchangeably in the art to refer to sheets of paper prepared from two or more layers of aqueous paper making furnishes which are preferable comprised of different fiber types, the fibers typically being relatively long softwood and relatively short hardwood fibers as used in tissue paper making. The layers are preferable formed from the deposition of separate streams of dilute fiber slurries upon one or more endless foraminous surfaces. If the layers are initially formed on separate foraminous surfaces, the layers can subsequently combined when wet to form a multi-layered tissue paper web.

[0021] The "paper tissue products" of this invention are the finished products such a kitchen towels or paper handkerchiefs, made out of one or multiple plies of the above described paper tissues. Each ply of a multiply paper product can be made of diverse material or been manufactured in diverse ways at the paper making or converting steps. As used herein, the term "single-ply tissue product" means that it is comprised of one ply of tissue; the ply can be substantially homogeneous in nature or it can be a multi-layered tissue paper web. As used herein, the term "multi-ply tissue product" means that it is comprised of more than one ply of tissue. The plies of a multi-ply tissue product can be substantially homogeneous in nature of they can be multi-layered tissue paper webs. "Lotion basis weight of the

protruding deposits” is the concentration of lotion, expressed in grams per square meter, within the protruding deposits of lotion on the tissue. This is an average value of the deposits measured. The lotion basis weight of the protruding deposits is determined as described in the method below.

[0022] “Density of the protruding deposits” is the average number of protruding lotion deposits per area of tissue, expressed in sqcm^{-1} .

[0023] “Lotion basis weight of the tissue” is the overall concentration of lotion, expressed in grams per square meter, of lotion on the tissue (also referred as total or overall basis weight or concentration). The basis weight can be measured by any standard method, e.g. solvent extraction, or deducted from the process conditions (amount of lotion deposited on the tissue divided by the total area of the tissue).

[0024] It is desirable to provide a smooth tissue that comprises a lotion able to be transferred easily into the skin of the tissue user. According to the present invention, the careful selection the distribution of the lotion on the tissue, as multitude of discrete deposits, can enhance the transferability of the lotion from the tissue onto the skin of the user. It is believed that protruding depositing having a significant height above the average plan of the tissue surface will have a higher transferability to the skin of the user and thus will contribute best to the general smoothness of the tissue. It has been found that deposits protruding at least $25\text{ }\mu\text{m}$ above the average plan of the tissue surface are most beneficial. Preferably the deposits protrude at least $30\text{ }\mu\text{m}$, $35\text{ }\mu\text{m}$ or at least $50\text{ }\mu\text{m}$. The beneficial effects have been best observed when the protruding deposits are applied on the tissue paper of limited bulk (i.e. less than $5.2\text{ cm}^3/\text{g}$, or $5.0\text{ cm}^3/\text{g}$).

[0025] Also the total basis weight of lotion on the tissue is equal or less than 9 g/sqm , less than 6 g/sqm , less than 4.5 g/sqm , 3.0 g/sqm and most preferably less than 2 g/sqm .

[0026] In some embodiments, a ratio R is considered:

$$R = \frac{\text{Lotion basis weight of the protruding deposits(g/sqm)}}{\text{lotion basis weight of the tissue(g/sqm)}}$$

[0027] The beneficial effects are observed when R is greater than 0.005. R can also be 0.01, 0.02, 0.05, 0.1, 0.2, or 0.3 in preferred embodiments.

[0028] It has been observed that the beneficial effects are obtain in some embodiments when the density of protruding deposits is at least 1, 3, 5 or 10 per sqcm of tissue.

[0029] In some embodiments, the lotion can be visualized by osmium tetroxide staining, described herein. In other embodiments, the lotion can be visualized by Infrared spectroscopy (IR spectroscopy), which method is referenced herein.

[0030] In such embodiments, the total basis weight of lotion on the tissue is generally at least 0.3 g/sqm , 0.6 g/sqm , 1.0 g/sqm , 1.5 g/sqm or 2.5 g/sqm . In some embodiments, it has been found that relatively large area of the tissue covered by deposits of relatively large height (or elevation) is preferred. This delivers a product with a higher lotion

transferability. This can be expressed by the ratio R_2 , wherein

$$R_2 = \frac{\frac{\text{Area of the protruding deposits measured at the threshold value of claim 1(mm}^2\text{)}}{\text{Area of the tissue(mm}^2\text{)}} * \text{Lotion weight of the tissue(g/sqm)}}{\text{Lotion weight of the tissue(g/sqm)}}$$

[0031] R_2 is at least 0.005, 0.001, at least 0.05 or at least 0.08.

[0032] In some embodiments, the invention is related to a multiply tissue product. When the multiply tissue product comprises 2 plies, it has been found that the invention works well when at least one of the external surfaces (outwardly orientated surfaces) has more lotion than its corresponding internal surface (inwardly orientated surfaces). This can be determined by scanning electron microscopy. When the multiply tissue product has at least 3 plies, it has been found that the lotion transferability is suitable when at least 60%, at least 70% at least 80% or at least 90% of the lotion is located one of the outer plies. Indeed, the lotion present on the inner ply(ies) contributes much less in the transfer of the lotion to the users skin.

Lotion

[0033] The present invention as described here particularly focuses on smoothening lotion. It should be noted that any type of additives or compound could be applied by the described process, as long as the physical characteristics (e.g. melting point, viscosity), and the application temperature are adjusted to obtain the desired distribution pattern of the applied additives or compounds at the surface of the paper tissue. These additives or compounds could include: hydration lotion, soap, moisturizers, sun-protection, make-up removal ingredients, anti-aging, disinfectants, or more generally additives/compounds in the cosmetic and therapeutic fields, detergents, soaps, waxes, cleaning additives and more generally compounds for the cleaning, maintenance, protection and treatment of objects, surfaces or mechanical parts.

[0034] Lotions are in most instances of heterogeneous composition. They may contain solids, crystalline gel structures, polymeric material below glass point, a multiplicity of phases (such as oily and water phase) and/or emulsified components. It may be difficult to determine precisely the melting temperature of the lotion, i.e. difficult to determine the, temperature of transition between the liquid form, the quasi-liquid form, the quasi-solid form and the solid form. The terms melting temperature, melting point, transition point and transition temperature are used interchangeably in this document and have the same meaning.

[0035] For the purpose of this invention it is considered that not only the melting temperature relates to the definition of the form or state of the lotion (liquid, solid, quasi-liquid, quasi-solid), but also its Theological properties. For the purpose of this invention, it is defined that liquid or quasi-liquid lotion are able to flow, move, and migrate, for example under the force encountered during the process of application. Solid or quasi-solid lotions are not able to flow freely and are somewhat immobilized at their location. For

example a lotion will be said liquid or quasi-liquid if it can be fed onto the rotating surfaces and expelled there from under the used process conditions. A lotion will be said solid or semi-solid if it does not significantly freely migrates from the surface into the inner structure of the tissue at room temperature, i.e. 23° C. until the product is usually used.

[0036] The lotion may comprise a surface treating agent. Nonlimiting examples of suitable surface treating agents that may be included in the lotion can be selected from the group consisting of: polymers such as polyethylene and derivatives thereof, hydrocarbons, waxes, oils, silicones (polysiloxanes), quaternary ammonium compounds, fluorocarbons, substituted C₁₀-C₂₂ alkanes, substituted C₁₀-C₂₂ alkenes, in particular derivatives of fatty alcohols and fatty acids (such as fatty acid amides, fatty acid condensates and fatty alcohol condensates), polyols, derivatives of polyols (such as esters and ethers), sugar derivatives (such as ethers and esters), polyglycols (such as polyethyleneglycol) and mixtures thereof.

[0037] The lotion may comprise oils and/or emollients and/or waxes (any and all of which may be a transferable agent) and/or immobilizing agents. In one example, the lotion comprises from about 10% to about 90% of an oil and/or liquid emollient and from about 10% to about 50% of immobilizing agent and/or from about 0% to about 60% of petrolatum and optionally the balance of a vehicle.

[0038] The lotion may be heterogeneous. They may contain solids, gel structures, polymeric material, a multiplicity of phases (such as oily and water phase) and/or emulsified components. It may be difficult to determine precisely the melting temperature of the lotion, i.e. difficult to determine the temperature of transition between the liquid form, the quasi-liquid form, the quasi-solid form and the solid form. The terms melting temperature, melting point, transition point and transition temperature are used interchangeably in this document and have the same meaning.

[0039] The lotion may be semi-solid, of high viscosity so they do not substantially flow without activation during the life of the product or gel structures.

[0040] The lotion may be shear thinning and/or they may strongly change their viscosity around skin temperature to allow for transfer and easy spreading on a user's skin.

[0041] The lotion may be in the form of emulsions and/or dispersions.

[0042] In one example of a lotion, the lotion has a water content of less than about 20% and/or less than 10% and/or less than about 5% or less than about 0.5%.

[0043] In another example, the lotion may have a solids content of at least about 15% and/or at least about 25% and/or at least about 30% and/or at least about 40% to about 100% and/or to about 95% and/or to about 90% and/or to about 80%.

[0044] Nonlimiting examples of suitable oils and/or emollients include glycols (such as propylene glycol and/or glycerine), polyglycols (such as triethylene glycol), petrolatum, fatty acids, fatty alcohols, fatty alcohol ethoxylates, fatty alcohol esters and fatty alcohol ethers, fatty acid ethoxylates, fatty acid amides and fatty acid esters, hydrocarbon oils (such as mineral oil), squalane, fluorinated emollients, silicone oil (such as dimethicone) and mixtures thereof.

[0045] Immobilizing agents include agents that may prevent migration of the emollient into the paper tissue such that the emollient remain primarily on the surface of the paper tissue and/or sanitary tissue product and/or on the surface treating composition on a surface of the paper tissue and/or sanitary tissue product and facilitate transfer of the lotion to a user's skin. Immobilizing agents may function as viscosity increasing agents and/or gelling agents.

[0046] Nonlimiting examples of suitable immobilizing agents include waxes (such as ceresin wax, ozokerite, microcrystalline wax, petroleum waxes, fisher tropsh waxes, silicone waxes, paraffin waxes), fatty alcohols (such as cetyl and/or stearyl alcohol), fatty acids and their salts (such as metal salts of stearic acid), mono and polyhydroxy fatty acid esters, mono and polyhydroxy fatty acid amides, silica and silica derivatives, gelling agents, thickeners and mixtures thereof.

[0047] In one example, the lotion comprises at least one immobilizing agent and at least one emollient.

[0048] In one example, the lotion comprises a sucrose ester of a fatty acid.

[0049] The lotion may be comprise a transferable agent and thus be considered a transferable lotion. A transferable lotion comprises at least one transferable agent that is capable of being transferred to an opposing surface such as a user's skin upon use. In one example, at least 0.1% of the transferable lotion present on the user contacting surface transfers to the user's skin during use. The amount of transferable composition that transfers to a user's skin during use can be determined by known methods such as by tape stripping the skin 3 times, after use of the paper tissue and/or sanitary tissue product by the user, with Tegaderm Tapes, available from 3M, and analyzing the tapes for the transferable composition or a component within the transferable composition assuming all components of the transferable composition transfer equally.

[0050] Other optional components that may be included in the lotion include vehicles, perfumes, especially long lasting and/or enduring perfumes, antibacterial actives, antiviral actives, disinfectants, pharmaceutical actives, film formers, deodorants, opacifiers, astringents, solvents, cooling sensate agents, and the like. Particular examples of lotion components include camphor, thymol, menthol, chamomile extracts, aloe vera, calendula officinalis, alpha bisabolol, Vitamin E, Vitamin E acetate.

[0051] In one example, the lotion is present on the surface of the paper tissue and/or sanitary tissue product and/or on the surface treating composition present on the surface of the paper tissue and/or sanitary tissue product at a level of at least about 0.5 g/m² and/or at least about 1.0 g/m² and/or at least about 1.5 g/m² per user contacting surface. In another example, the lotion is present on the surface of the paper tissue and/or sanitary tissue product and/or on the surface treating composition present on the surface of the paper tissue and/or sanitary tissue product at a level of from about 0.5 g/m² and/or from about 1.0 g/m² and/or from about 1.5 g/m² to about 10 g/m² and/or to about 8 g/m² and/or to about 6 g/m² per user contacting surface.

[0052] As used herein a "vehicle" is a material that can be used to dilute and/or emulsify agents forming the surface treating composition and/or lotion to form a dispersion/emulsion. A vehicle may be present in the surface treating composition and/or lotion, especially during application of the surface treating composition and/or to the paper tissue.

A vehicle may dissolve a component (true solution or micellar solution) or a component may be dispersed throughout the vehicle (dispersion or emulsion). The vehicle of a suspension or emulsion is typically the continuous phase thereof. That is, other components of the dispersion or emulsion are dispersed on a molecular level or as discrete particles throughout the vehicle.

[0053] Suitable materials for use as the vehicle of the present invention include hydroxyl functional liquids, including but not limited to water. In one example, the lotion comprises less than about 20% and/or less than about 10% and/or less than about 5% and/or less than about 0.5% w/w of a vehicle, such as water. In one example, the surface treating composition comprises greater than about 50% and/or greater than about 70% and/or greater than about 85% and/or greater than about 95% and/or greater than about 98% w/w of a vehicle, such as water.

[0054] It has been found that a suitable lotion of the present invention has a water content of less than 20%, less than 10%, less than 5% or less than 0.5%.

EXAMPLE 1 of Lotion Formulation

[0055] It has been found that the present invention is of particular efficacy when the lotion has the following composition (in weight/weight percent):

Stearyl Alcohol CO1897*	30%
SEFOSE 1618S**	50%
Mineral oil (Carnation)***	20%

*Available from Procter&Gamble Chemicals, Cincinnati, USA

**Sucrose esters of fatty alcohols, available from Procter&Gamble Chemicals, Cincinnati, USA

***Available from Crompton Corporation

EXAMPLE 2 of Lotion Formulation

[0056] It has been found that the present invention is of particular efficacy when the lotion has the following composition (in weight/weight percent):

Stearyl Alcohol CO1897*	40%
Petrolatum (Snowwhite V28EP)**	30%
Mineral oil (Carnation)**	30%

*Available from Procter&Gamble Chemicals, Cincinnati, USA

**Available from Crompton Corporation

EXAMPLE 3 of Lotion Formulation

[0057] It has been found that the present invention is of particular efficacy when the lotion has the following composition (in weight/weight percent):

Stearyl Alcohol CO1897*	20%
SEFOSE 1618S**	80%

*Available from Procter&Gamble Chemicals, Cincinnati, USA

**Sucrose esters of fatty alcohols, available from Procter&Gamble Chemicals, Cincinnati, USA

[0058] All three formulations have been applied to the tissue described in paper tissue example 1 at add on levels between 1.5 g/sqm and 6 g/sqm on each side.

[0059] Process conditions and equipment are described in US patent application titled "Paper tissue with high lotion transferability" by J. Kleinwaeschter, D. Butz, C. Marcott and G. Di Girolamo.

Data

[0060]

	Formulation 1	Formulation 2	Formulation 3
Lotion basis weight of the tissue	2.1 g/sqm	3 g/sqm	2.1 g/sqm
Density of deposits (sqcm)	10	2.7	3.7
Ratio R	0.27	0.04	0.06
Mean deposit volume (mm ³ /1000)	6.8	4.6	6.4
Ratio R ₂ (smq/g)	0.0084	0.0013	0.0022

Paper Tissue Example 1

[0061] The tissue paper used in the following examples is a conventional wet pressed, homogeneous, dry creped tissue paper with a basis weight of about 15.4 g/sqm. The paper web has a composition of about 40% Northern Softwood Kraft and 60% Eucalyptus. Following the papermaking, four sheets of paper are combined together in an off line combining operation. The pre-combined 4-ply parent roll is subsequently converted into a 4-ply tissue product. The 4-ply parent roll is unwound and subjected to calendering between two smooth steel calender rolls followed by high pressure embossing to achieve ply bonding. The majority of the tissue paper remains unaffected by the high pressure embossing. Finally the tissue was cut in machine direction, followed by cutting in cross direction into sheets of approximately 21 cm×21 cm, folded, stacked into stacks of 9 sheets and packed into individual pocket packs. The 4-ply paper tissue product obtained by the above described process had a basis weight of approximately 60 g/sqm (not including any lotion applied), a thickness of 0.27 mm, a bulk of 4.5 cm³/g, a machine direction strength of 1280 g/in, a cross direction strength of 610 g/in, and a wet burst of about 200 g. It contained a wet strength agent and a dry strength agent.

Paper Tissue Example 2

[0062] The tissue paper used in the following examples is a conventional wet pressed, layered, dry creped tissue paper with a basis weight of about 14.6 g/sqm. The outer layer contains about 100% Eucalyptus fiber whereas the inner layer is composed of a furnish mix of about 85% Northern Softwood Kraft, 10% CTMP and about 5% Eucalyptus fiber. Both layers are of about equal basis weight (symmetrical layer split). Following the papermaking, four sheets of paper are combined together in an off line combining operation. The pre-combined 4-ply parent roll is subsequently converted into a 4-ply tissue product. The 4-ply parent roll is unwound and subjected to calendering between two smooth steel calender rolls followed by high pressure embossing to achieve ply bonding. The majority of the tissue paper remains unaffected by the high pressure embossing. Finally the tissue was cut in machine direction, followed by cutting in cross direction into sheets of approximately 21 cm×21 cm, folded, stacked into stacks of 9 sheets and packed into

individual pocket packs. The 4-ply paper tissue product obtained by the above described process has a basis weight of approximately 60 g/sqm (not including any lotion applied), a thickness of 0.27 mm, a bulk of 4.5 cm³/g, a machine direction strength of 1180 g/in, a cross direction strength of 560 g/in, and a wet burst of about 200 g. It contains a wet strength agent and a dry strength agent.

Methods

[0063] Bulk of the tissue paper: The bulk of the tissue is defined as the reciprocal value of the density (in g/cm³). See column 13, lines 61-67 of U.S. Pat. No. 5,059,282 (Ampulski et al), issued Oct. 22, 1991 which describes how the density of tissue paper is measured. The paper is equilibrated at 23 degrees Celsius and 50% (=/-2%) relative humidity for at least 2 hours prior to measurement.

[0064] Average lotion add-on level by solvent extraction (basis weight of lotion on the tissue): A representative sample of about 2g of the lotion treated tissue is extracted by Accelerated Solvent Extraction (ASE) using a model ASE 200, available from Dionex Corp., USA. The following conditions are used: 11 ml extraction cell, solvent mixture: 50 % Acetone/n-Hexane; temperature: 100° C. (heat and static 5 minutes); pressure: 1000 PSI; two cycles with 100% flush. The solvent is evaporated and the residue is determined gravimetrically. The lotion add on is then calculated as

$$\text{Average lotion} = \frac{\text{Weight of the extract in [r]} \times \text{Basis weight of the sample in [g/sqm]} \text{ add on in g/sqm}}{\text{Weight of the sample before extraction in [g]}}$$

[0065] Osmium Staining: A square sample of tissue of about 4 cm×4 cm is cut from a flat, unembossed and unfolded area of the tissue product to be analyzed (a smaller area can be used if needed). All tissue samples are placed in open containers equidistant from an open container of 10 ml of a 4% OSO₄ solution (in water) under a glass staining dome in a hood. The vapor staining is done typically for 24 hours. The duration of staining is not very critical and can be longer or shorter depending on the affinity of the lotion for osmium and the desired level of "blackness". Staining is stopped when the best possible contrast in the sample between lotion spots and substrate is reached. Because paper fibers will slowly pick up the osmium stain and darken, there is point in the staining process where the lotion will no longer react but the paper fibers will continue to do so, reducing the contrast between lotion and fibers.

[0066] Sample Preparation for Surface Analysis: The sample tissue is placed on a 2 inch×3 inch (about 5 cm×7.6 cm) glass slide with the surface that is to be analyzed, facing up. The edges of the ply were carefully taped to the slide to produce a flat sheet.

[0067] Surface Analysis: The mounted samples described above were analyzed by a GFM Primos optical 3D measuring system (Teltow, Germany) which is based on the digital stripe projection technique. The system has a field of view of 2.7×2.1 cm and a detector containing 1300×1000 pixels. The operating software was Primos version 4.074. If possible the full field view should be used, only if the sample does not contain a large enough flat, unfolded and unembossed area should a smaller field of view be used for analysis. The system produces a grayscale camera image (GS image) for each sample analyzed as well as a 3D surface

height image (3D image) calibrated in microns. The GS image was exported from the Primos software as a BMP image for further processing. The 3D image was processed using the Primos software Align function which removes tilt and exported as a Fringe File Version 1 format (FD3).

[0068] Surface Data Image Analysis: Both the GS image (BMP) and the 3D image (FD3) were imported into MatLab (MathWorks, Natick, Mass., USA) for all further image processing. Functions from the MatLab Image Processing Toolbox v4.2 add-on were used in the processing of the data. The 3D image was smoothed with an averaging convolution filter of kernel size 151 and the resulting image subtracted from the original 3D image. This corrected the image for any wrinkles or curvature in the sample arising from the mounting procedure. The resulting image was then smoothed slightly with a median filter of kernel size 5 to remove any high frequency noise from the measurement. These operations produced an image with the mean plane of the surface at zero height (m3D). The image was then thresholded to eliminate any data that fell below 25 microns above the mean plane (mt3D).

[0069] Correlation of the data with lotioned areas:

[0070] (a) Osmium Staining

[0071] The GS image of the osmium stained sample was smoothed with an averaging convolution filter of kernel size 151 and the resulting image subtracted from the original GS image. This corrected the image for uneven illumination characteristic of the Primos system. The resulting image was then smoothed slightly with a median filter of kernel size 5 to remove any high frequency noise from the measurement. This image was then scaled from (min, max) to (0,1) and a thresholding operation applied so that values below 0.30 were set to a binary 1 and values above or equal to 0.30 were set to zero. This binary mask (BM) shows 1's where there is darkly stained lotion and zeros everywhere else.

[0072] (b) Scanning Infrared Spectroscopy

[0073] If the staining method is not appropriate to identify lotioned areas, other methods to identify lotioned areas can be used, preferably infrared scanning spectroscopy. This may be appropriate in case staining does not allow to separate the areas with a high amount of lotion (these are the areas that may protrude from the surface) from the rest of the surface area, e.g. if the lotion material does not stain or does not stain enough for differentiating it from the background, or, e.g. if the substrate itself stains. An appropriate method to identify lotioned areas by IR scanning spectroscopy is described in US patent application titled "Paper tissue with high lotion transferability" by J. Kleinwaeschter, D. Butz, C. Marcott and G. Di Girolamo. In this method it is described how to measure the local lotion basis weight in an area of 25 μm×25 μm of a sample with an area of 0.5 cm×0.5 cm or larger.

[0074] Preferably a sample of at least 1 cm×1 cm is used. The file containing the local lotion basis weight can be exported as a 8 bit grayscale bitmap file and transformed into the desired binary mask BM, using an image analysis program, e.g. AnalySIS (available from Soft Imaging GmbH, Germany) as described in the US patent application cited above, by setting all pixels with a local lotion basis weight of 10 g/sqm to "1" in the binary mask BM and all

other points to "0". Appropriate fiducial marks within the image can be used to register the binary mask with the 3D height image.

[0075] To eliminate any data points that were not identified as lotion (dark area) in the binary mask (BM), the resulting 3D image in the paragraph above (mt3D) was multiplied pixel by pixel with the binary mask (BM). Areas of the resulting image not indicated as lotion in BM became zero. Area regions less than 0.10 mm² (225 pixels) were removed from the final image. A border of one half the largest kernel size used (151/2=75) was removed from all sides of the image to eliminate invalid data resulting from the convolution operations, producing the final composite image (FC).

[0076] Data points in FC that were not zero, were projected onto the mean plane (in image FC the mean plane is at zero) and the area calculated by summing the calibrated pixels. The volume above the mean plane was also determined by summing the projected area pixels times each pixels actual height above the mean plane. The separate area and volume regions were recorded for each sample and the total, mean, and standard deviation for the areas and volumes calculated. The measurement field of view was used to further calculate the lotion coverage area fraction and lotion volume per area of sample.

[0077] The lotion basis weight of the protruding deposits (in g/sqm) is obtained from the mean volume of the deposits per area multiplied by the density of the lotion.

[0078] The ratio R is then calculated by dividing the lotion basis weight of the deposits (in g/sqm) by the lotion basis weight of the tissue (in g/sqm).

[0079] All documents cited herein are, in their relevant part, incorporated herein by reference; the citation of any document is not to be construed as an admission that it takes away patentability of the present invention.

[0080] 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.

What is claimed is:

1. A paper tissue having first and second opposed surfaces, comprising a lotion on at least one surface of said paper tissue, said lotion being present in substantially discrete protruding deposits onto said first surface, wherein said paper tissue has a bulk of equal or less than 5.2 cm³/g of tissue wherein said protruding deposits have an average height of at least 30 μm.

2. A paper tissue of claim 1 wherein said deposits have an average height of at least 35 μm.

3. A paper tissue of claim 2 wherein said deposits have an average height of at least 38 μm.

4. A paper tissue of claim 1 wherein a ratio R is defined by

$$R = \frac{\text{Lotion basis weight of the protruding deposits(g/sqm)}}{\text{lotion basis weight of the tissue(g/sqm)}}$$

and said ratio R is larger than 0.005.

5. A paper tissue of claim 4 wherein said ratio R is larger than 0.01.

6. A paper tissue of claim 1 wherein said paper tissue comprised at least 2 protruding deposits per square cm of tissue.

7. A paper tissue of claim 1 wherein said lotion is detected by osmium tetroxide staining.

8. A paper tissue of claim 1 wherein said lotion is detected by scanning IR spectroscopy.

9. A paper tissue of claim 1 wherein said lotion comprises at least 30% SEFOSE 1618 S® and preferably at least 10% stearyl alcohol.

10. A paper tissue of claim 1 wherein the lotion basis weight on said tissue is equal or less than 9 g/sqm.

11. A paper tissue of claim 1 wherein the ratio R₂ is defined as

$$R_2 = \frac{\frac{\text{Area of the protruding deposits measured at the threshold value of claim 1(mm}^2\text{)}}{\text{Area of the tissue(mm}^2\text{)}} * \text{Lotion weight of the tissue(g/sqm)}}{\text{Lotion weight of the tissue(g/sqm)}}$$

and R₂ is at least 0.0005.

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