A Proposal to the Kimberly-Clark Corporation for the Development and Perfection of Certain Patents for Health Hazards Mitigation with Potentially Mutual Financial Benefit

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Proposal for: **Date:** April 9, 2021

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APPENDICES

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I. ABOUT CAMERON MOSTAGHIM

My name is Cameron Mostaghim and I am a California native who also happens to be a shareholder of a nominal number of KC shares of stock. I am 47 years old and possess four degrees, all with honors, with majors and studies involving: Social Sciences, Apparel Design with an undeclared minor in manufacturing processes and management, and a Law Degree. My professional work history includes experience within retail trades, office and administrative experience, and I have held several legal jobs providing substantial litigation and appellate related work experience. My last job was as a claims analyst with an employer within the insurance industry where I made insurance coverage assessments, processed and resolved claims, and prepared written liability assessments and correspondence. At the moment, I am currently located in the Los Angeles area and can be reached by telephone or email with additional information available through my LinkedIn profile hyperlink below:

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II. KIMBERLY CLARK AS A PROSPECTIVE BUSINESS PARTNER

As you are certainly aware, Kimberly Clark (hereafter "KC") is a global products manufacturer specializing in disposable consumer goods, particularly those involving household consumables and personal health and hygiene products.

KC possess a variety of intellectual property patents pertaining to the products it manufactures and offers for sale through its distribution channels. For example, with respect to KC's well known household name brand Kleenex products, KC seemingly has approximately 74 separate and distinct intellectual property ("IP") registrations to its name and credit. As to KC's intellectual property rights, in some instances, those IP registrations pertain to predominantly methods or processes, for example U.S. Patent #6,709,550 titled *Method for Forming a Multi-Layered Paper Web*, **Appendix 1**, and in other instances those IP registrations pertain to predominantly utility patent matters, for example U.S. Patent #7,132,379 titled *Antimicrobial Absorbent Article, and Methods of Making and Using the Same*, **Appendix 2**.

Over the past few years, I have come up with several ideas for patents and business ventures, though some would require large capital investments to both secure the appropriate intellectual property rights and render the business ventures viable. As to this instant proposal, it was selected because of the relative simplicity of ideas and concepts to be patented as compared to the others. KC was specifically selected concerning this business opportunity and proposal because of KC's manufacturing position, both globally and within its respective market segment, its appreciation for and acquisition of substantial

IP rights for its products, and the symbiotic and potentially mutually beneficial nature that is likely to derive from this business proposal, assuming it materialize and be brought to fruition.

III. THE OBJECTIVE OF THE COOPERATIVE PROPOSAL WITH KIMBERLY CLARK

With no shortages of existing harmful viruses, bacteria, and pathogens within our world today, the main primary objectives of this proposal are to:

1) Assist, ideally and hopefully in a timely manner, in the intervention and prevention of health hazards attending surface contact exposures to the Covid-19 virus,
2) Assist with minimization and prevention of hazardous contact with other harmful viruses, bacteria, and pathogens, irrespective of the continued presence or prevalence of the Covid-19 virus,
3) Aid in fulfilling a product need and sanitary process through the would-be patents pertaining to their respective product and process,
4) Reduce exposure risks to non-users of the would-be product through their use of the same affected item(s) by users of the developed product and process,
5) Bring about a greater degree of sanitation and cleanliness with respect to the environments in which the would-be product and process is implemented for use, and
6) Recognize what is seemingly a permanent global policy shift in sanitation standards and health hazards mitigation practices by creating a product with potential for broad merchandising capability and significant profit potential within its specific market segment.

The finite objective of this proposal is to secure IP patent registrations and, once filed, cooperatively assess the best method for exploiting the ideas within those patents to best optimize potential profit revenues, whether such be further realized through Kimberly-Clark's internal product development and manufacturing channels, sale of the patents to appropriate third-party manufacturers and/or distributors, licensing of patent rights to interested manufacturers, or such other avenues as may be decided. These potential patents are further discussed below. Likewise, the below discussions concerning customer base, competing products, product differentiation, projected unit costs, and marketing and distribution are provided for background, insight, and to aid in assessing further product development. While the specifics of full product development and full exploitation and capitalization of secured IP patents are anticipated to be matters of additional discussion in collaboration with KC for best maximization and use, such is anticipated to occur at a later time after such patents are procured or, at a minimum, after patent applications are filed thereby preserving rights to any patents that might ultimately be granted and registered.

This proposal concerns definitively one, but possibly two patents. The first prospective patent would be a utility patent on a durable manufactured good with commercial applications, possibly suitable as an addition to the Kimberly-Clark Professional line of products. The product has already been conceptualized and the technical aspects of the product have been well thought out, though no endeavors have yet been made to formalize those matters or procure IP rights with respect to patents. For both design purposes and cost considerations, at this juncture, the product will likely be best suited for an injection mold manufacturing process with a hard durable plastic construction.

The second patent, working in tandem with but separate from the first patent, would involve a process and method by which the durable good referenced above would be utilized, ideally, in conjunction with one of KC's existing products to, if such patent be successfully granted, create a new method for enhancing or accomplishing a particular task. Although I am uncertain if the process and method idea and concept is patentable, my best current evaluation is that such a patent is possible, provided the patent application is prepared properly with adequate descriptions describing what and how the process works to achieve the desired objective.

IV. HOW THE PROPOSAL POTENTIALLY BENEFITS KIMBERLY-CLARK

Assuming KC is agreeable and desires to partner in this business proposal, if the patents are procured and exploited to their fullest potential, KC could benefit through increased marketing exposure with the utility patent product that is best suited for use with one of KC's already existing products. To that end, KC could potentially realize:

1) Intangible benefits of additional marketplace presence with any additional marketing of its products undertaken in conjunction with the durable goods that are the subject of the first proposed patent,
2) Increases in specific product revenues related to the KC product that is intended to be utilized in conjunction with the durable goods that are the subject of the first proposed patent, or, alternatively,
3) Product revenues related to the product that is the subject of the first proposed patent to the extent the product is brought to a manufacturing phase or, alternatively, revenues or royalties from the licensing of the patents to a third-party manufacturer to produce and market the products for distribution and sale if such avenue be pursued,
4) An increase in potential intellectual property rights consistent with KC's existing product lines and market segments,
5) A potential increase in market presence demonstrating products with a solutions-based problem-solving approach to issues falling within the product sphere and scope of KC's market segment and, finally,

6) KC potentially benefits through the creation of a business relationship that might form the basis of future business endeavors as I have numerous ideas for various products in other areas and have simply chosen this one as a starting point.

V. HOW THE PROPOSAL POTENTIALLY BENEFITS CAMERON MOSTAGHIM

As discussed below in the overview of the funding proposal, Cameron Mostaghim is a necessary resource in the development and implementation of this proposal. In that regard, assuming KC's desire and willingness to proceed with this business proposal, depending upon KC's preferred method of implementation as further discussed below, Mr. Mostaghim will benefit through:

1) Wages and compensation received during the duration of the project lifecycle and contractual term of employment,
2) A learned and acquired familiarity of IP procurement of patents in an actual and practical real-world situation,
3) An expansion of professional networking contacts,
4) Accomplishment of bringing a conceptualized idea into a pre-manufacturing and pre-production ready status (or production status if KC so desires and is agreeable), and
5) Novelty of potential IP patent ownership rights in joint collaborative partnership, ownership, or licensing with KC.

Of course, it goes without saying that the objective of any business proposal is successful capitalization with a realization of maximizing profits whether such occur through KC product development channels or externally contracted business partners.

VI. TARGET MARKET, MARKET COMPARISONS, AND RESEARCH

A. Product Objective

As mentioned, the product is intended to be a preventative health-related item sold for use in public commercial places with the purpose of minimizing potential health hazards by reducing exposure risks to harmful viruses, bacteria, and pathogens.

B. Potential Customers

The customer base is "open to the public" businesses engaged in direct client and consumer interface, private employers, and shared work space environments. To be clear, the durable good product is a location specific product to be used within the confines of businesses (large scale "open to the public" commercial buildings and private commercial buildings), but it is the businesses themselves that would be to product consumers purchasing the product to aid in health and illness prevention of the building's occupants.

C. Existing Products

There are currently three known products (referenced as Product A, Product B, and Product C) that *attempt* to implement the above objective with varying success.

Product A, which I have seen in existence and use, is not common. To date, I have only encountered Product A on two occasions ever. Product A, however, does not completely accomplish the objective for which it was created. This is based upon personal observations of people's use of that product improperly and, even when used properly, it

only minimizes potential harmful exposure risks rather than eliminating potentially hazardous contacts. To that end, the first known existing product falls short in implementing the objective and purpose for which it was created.

As to Product B, I have seen it more frequently that the two times Product A was encountered, but it is still uncommon. A liberal estimation of its prevalence – as based upon personal observations of frequency in which it was encountered within commercial building environments – is estimated to be about three percent, but less than 5 percent. As to efficacy, Product B is efficient in achieving the objective for which it was created, but it does contain certain limitations. It cannot be used by certain disabled persons and is therefore not functional for a population segment within that population group. Further, Product B, although efficient at achieving its desired objective, contains a unique hazard attending its use that, while minimal, does potentially expose commercial landowners, lessors, and property managers to liability in the event of an accident as the potential hazard is directly attributable to the manner in which Product B is used.

Product C, while known to exist by virtue of having seem a video clip concerning its use and demonstrated application, has never been personally observed as utilized in any commercial building environment. Although purely speculative, the absence of ever having seen Product C in use is believed to be attributable to a less than ideal product design and – due to its design limitations – is not usable or suitable for certain installations.

Notably, while Products A, B, and C attempt to achieve the same thing, Products A and B are most similar, but product C fills a gap and can be used in applications that Product A and B cannot. Conversely, while Product A and B are both efficient in achieving their

desired objective, they each have their own limitation that Product C attempts to fill. In that regard, while Product A and B are better at achieving the purpose for which they were created, neither appears to be suitable for universal use and application.

D. Product Differentiation

In contrast to Products A, B, and C, the would-be product that is the subject of this proposal can be utilized and is suitable for all applications for which Products A, B, and C have been utilized. Likewise, the would-be product that is the subject of this proposal is suitable for use by certain disabled population segments that Product B and Product C are not. Finally, the would-be product that is the subject of this proposal has no inherent or latent risk potential attending its use other than those that would exist independently without the use of the would-be product. In this regard, the would-be product that is the subject of this proposal has the broadest application of potential use for the purpose which it was created with the least amount of risk attending its use.

E. Best Cost Guestimates

The product is likely best made with hard durable plastic materials by way of an injection molding manufacturing process and would integrate one turn key cam locking mechanism, application of one illustration instructional adhesive sticker, and four mounting screws or heavy-duty adhesive mounts as an optional alternative to stationary permanent mounting. Without complete information, best preliminary estimates as to large scale production costs, place the per unit cost for foreign manufacturing at approximately

$3 per unit, exclusive of recurring charges for the KC products that are intended to be used with the product. The foregoing estimation presumes least expensive sourcing and manufacturing costs, without shipping or overhead expenditures, with domestic manufacturing costs anticipated to be somewhat higher.

F. Likely Marketing and Distribution Channels

Based upon the target consumer, and the KC product that is intended to be concurrently utilized with the would-be product, the anticipated and projected marketing and distribution channels are direct website advertising and demonstration (with possibility of sales, but not order fulfillment) possible distribution through KC channels to KC customers, and direct mail catalogs catering to commercial businesses as follows:

1) Direct marketing through an accessible website highlighting the use and benefits of the product (possibly allowing orders, though any orders would be fulfilled through specially created manufacturing and distribution channels),
2) Office supply catalogs,
3) Catalogs specific to certain industries, for example, restaurant supply catalogs and janitorial supply catalogs,
4) Office supply and janitorial supply companies,
5) Possibly specialty segment retailers such as Office Depot and Staples, and

6) Such other possible supply and distribution channels as may be utilized by KC in conjunction with its own product that is intended to be utilized with the would-be patented product.

VII. THE PROPOSAL FOR FUNDING

The three greatest expenses involved in procuring the potential IP rights referenced above are: 1) IP patent application preparation costs, registration filing fees, and related professional service fees, 2) project management costs related to the implementation of the above objectives while driving the process forward towards perfecting the potential patents, and 3) business expenses and costs to the extent any funding occurs by way of capital contribution to a separately formed business entity or subsidiary affiliate.

A. Pre-Production Expenses: Patent Procurement

Variables in patent application preparation costs and registration filing fees are, as I am sure you are likely aware, dependent upon whether a national patent is sought or whether a decision is made to elect an international patent application under the international Patent Cooperation Treaty (PCT application). Preliminary research seems to indicate that the patent application and, ultimately, the total patent costs bear a correlation to the complexity of the subject of the patent with PCT applications potentially running into the cost of $[redacted] range due to international patent office searches and related fees for foreign language translation services.

As most of KC's existing patents appear to be international patents, consistent with KC's position as a company of international presence with manufacturing capabilities of global reach, it is both advisable and believed that international PCT applications would be the preferred choice should KC desire to proceed with this proposal. With that said, the

two patents are, in my assessment, on the simpler side of complexity that will avoid exceptional costs associated with highly technical and sophisticated explanations and diagrams. Although securing the two patents by PCT application may be costly, any such expenses would presumably be well within any funding and expense allocations that KC is capable of making given the size of the company and its annual revenues. As there are two potential patents involved (one is in the nature of a utility patent and one in potentially in the nature of a process-type patent), both being not overly technical or complex, an initial budget projection of $[redacted] should be allocated with a total potential outlay commitment of $[redacted] if patent applications are developed and exploited to their fullest potential within major international markets.

B. Pre-Production Expenses: Project Management

The second expense component attends project management costs and fees pertaining to managerial oversight through patent procurement. As I have already conceptualized and designed the product in my mind and developed a product name, I am seemingly a necessary resource in the development of these patents and the patent project management lifecycle. Preliminary research seems to indicate that the entire patent process may be a lengthy duration with PCT applications seemingly taking three years on average. To that end, it seems that a minimum of two years, but likely three years, time would be needed for human resource expenditure budgeting and project management oversight costs. Considering the high compensation of executive salaries in general, and – to a lesser extent – compensation of directors' salaries and KC director salaries in particular, it would

seem that a two year contract with a $[redacted] per year wage/salary budget allocation would be a reasonable market wage for this project position and handling these matters based upon my education, prior work history, demonstrated aptitude as show with this proposal, significant time already expended in developing this proposal, the potential intellectual property patents to be developed and interest to be acquired by KC, the potential increased revenues to KC through the use of its products that are intended to be used with the would-be product to be developed, and prospect of potential revenues from the would-be product itself should a decision be made to progress to manufacturing and distribution beyond the primary proposed contractual objective of patent registration. Based upon the forgoing, a minimum initial budget commitment of $[redacted] would be needed for the two-year contract with the parties considering potential possible renewals, if mutually agreeable.

The pre-production project management costs would cover, exclusive of expenses, the following matters as more fully discussed within the project timeline at the end of this proposal:

1) Progression and advancement of the patent process by:
   a. selection of patent professionals to assist with applications,
   b. creation of a rough working model of the product to assist with the patent process, diagraming in particular, and reduction in patent application fees pertaining to technical drawings, and
   c. ongoing coordination with patent service professionals.
2) Ongoing project management with at least informal quarterly reporting updates on the progress and project status,

3) An attempt at a formal production cost analysis, which has already been informally started,

4) An attempt at identifying suitable sourcing and manufacturing suppliers to the extent product development is not to occur within KC product development and distribution channels,

5) Coordination and conferring with KC's designated contact to achieve the proposal objectives, and

6) Depending upon how far and by what means product development might occur, possible consulting concerning product development or manufacturing beyond the patent procurement phase if such is within the timeframe duration of the initially proposed two-year contract.

C. Contingent Expenses

As mentioned, to the extent that KC is agreeable and desires to proceed with this proposal, and to the extent that the proposal is funded with a capital infusion to a newly formed entity, there would be additional contingent expenses attending:

1) Business formation,

2) Business presence expenses (virtual office expenses at a minimum),

3) Website development costs, and

4) Professional Services fees (accounting and tax services).

The budgeting allocations for these expenses would largely depend upon the extent of operations during the patent procurement process. That is, whether patent procurement

was completed before any manufacturing were contemplated and initiated or whether marketing and manufacturing were to commence after patent applications were filed, but prior to the patents having issued. In any event, minimal space office rental for non-virtual brick and mortal office facilities and related services would seemingly cost approximately $[redacted] per year, though alternative and more efficient arrangements could likely avoid such contingent expenses.

VIII. KIMBERLY-CLARK'S CONSIDERATION IN EXCHANGE FOR FUNDING

As mentioned, there are two potential patents; one concerning a utility patent and the other concerning a process. There appears to be a variety of ways that capital financing and business structuring might occur, which – in part – depends upon whether KC would proceed with product development and manufacturing internally or not. In exchange for funding, and in recognition of and attempting to foster a cooperative partnership approach in implementing the proposal, with agreed financial contribution commitments, KC will acquire a undivided [redacted]% joint ownership interest in the patent rights or, alternatively, a [redacted]% ownership interest in net revenues derived from the patent rights.

IX. ALTERNATIVE IMPLEMENTATIONS OF THE PROPOSAL

There appears to be a few alternative methods towards implementation of the above proposal with the preferred method of implementation being dependent upon KC's input and considerations given to: 1) KC's board authority and autonomy and 2) implications of potential necessity or time considerations for acquiring board or shareholder approvals for the business proposal. The first proposal below is believed to be the most ideal, from the perspective of the proposal objectives, expense allocations, and time expediency though other proposals are also suggested as possible alternatives. To be clear, the current funding proposal and request is specific to funding Option [redacted] would require additional capital funding for additional related expenses.

A. Option One: A Project-Based Multi-Year Contractual Employment Arrangement with Employee Retained Rights to Intellectual Property (Equity Financing in IP Patents)

Under this approach, KC and Mr. Mostaghim would enter into a non-exclusive project-based two year multi-year contractual employment arrangement whereby Mr. Mostaghim would retain, at a minimum, [redacted]% majority ownership rights to any would be patents without regard to usual principles that ideas and inventions developed in the course of employment are "for hire" employer property.

The advantages to this approach include: contractual understandings of the parties' objectives and respective roles, an absence of any possible needed shareholder approvals for external investments, 100% expense allocations to KC as offsets to income for

development expenditures and costs regardless of overall success of the business proposal (as opposed to the other options that would result in only proportional expense allowances and deductions based upon only partial ownership interests from a newly formed business entity), a contractually guaranteed ownership interest in the outcome of the successful patent endeavors, and substantial input in the end results of profit maximization of the developed patents. To the extent multi-owner patent applications are not permitted, patent applications can be pursued by Mr. Mostaghim with advance contractual agreement to transfer an undivided [redacted]% ownership interest, or alternatively net profits, once the patents are secured. In this regard, Mr. Mostaghim would become a contract-based employee of KC and, independent of contractual wages, a pre-funded expense account would or could be made available to cover costs of engaging patent professionals and handling expense related matters. Finally, there is a minimization of expense and regulatory matters pertaining to separate entity creation as discussed in the alternative options below.

B. Option Two: Capital Funding with a [redacted]% Equity Interest Held by Kimberly-Clark or its Subsidiary (Equity Financing in a Developed Business Enterprise Owning the IP Patents)

As is common with most business enterprises, the usual business startup model employs the formation of a business entity, capital infusion, and commencement of business operations. Recognizing KC's current status as a publicly traded company, it is understood that – due to corporate governance and regulation – a traditional business startup model with capital infusion from KC may not be possible or preferred. However, to the extent that such a business model was possible or desired, considering the funding

requirements for PCT applications and duration of time attending the processing of such applications, an LLC would likely be the logical business structure.

Under this approach, KC and Mr. Mostaghim (only in a representative capacity for the would-be newly created entity and not in a personal capacity) would enter into capital financing arrangement whereby Mr. Mostaghim would form an LLC with KC or one of its subsidiaries that would hold a [redacted]% membership interest in exchange for the capital contribution.

The advantages to this approach are autonomy and independence of the newly created business with a unique and distinct market presence facilitating use of the already conceptualized business and product name.

The disadvantages to this approach include, possible shareholder approvals for external investments and related delays, impediments to cooperative input and oversight by KC over the project as a whole, an absence of income offsets with incurred expenses that would be available to KC regardless of the proposal's success (in the absence of an internal cross-member agreement for expense allocations), increased expenses and overhead of separate business formation and compliance costs, lack of facilitation of ongoing collaboration with a designated KC contact towards achieving the proposal objectives, potential complications or lack of structuring feasibility concerning KC's existing regulatory filings, and a need for a formal appointee or representative by KC in representing KC membership interests in the LLC.

C. Option Three: Strict Contractual Capital Funding without any Equity Interest (Debt Financing)

Under this approach, KC and Mr. Mostaghim (only in a representative capacity for the would-be newly created entity and not in a personal capacity) would enter into a contractual financing agreement without any concurrent ownership interest by KC in any separately created business startup. Although this option might solve structural complications involved in the second option, it would seemingly still require shareholder and board approval for the external investment aspects of the transaction creating potential time delays.

Ultimately, the first proposal is believed to be best and most beneficial to all parties. KC can receive the possible benefits of maximized development from the patents, retain oversight, expense the costs of development, obtain an ownership interest in exchange for the financing contribution while Mr. Mostaghim can receive input, guidance, and collaboration with KC's designated representative who has access to KC's resources and knowledge base within KC's business industry and market segment while also conferring with a KC designated representative on an as-needed basis. To the extent KC may have a proposal other than those options identified above, discussions concerning the viability and benefits of those alternatives may be discussed for consideration.

X. ESTIMATED PROJECTED TIMELINES

The project lifecycle and time estimates are not definitive until the specifics of the potential funding options, referenced above, are first selected. The below project lifecycle timeline, referenced in a quarterly lifecycle, contemplates the Option [redacted] funding arrangement.[1] To the extent a different funding option were selected, one of the first tasks to be accomplished would be a reformulation of the project lifecycle time estimates based upon the alternative funding option. As an example, the creation of a separate business as an ongoing concern involves additional tasks and additional time that is not present with the schedule created for Option [redacted] funding, which is part of the reason Option [redacted] is preferred.[2]

A. Phase I: *Months One to Three*

Phase I consists of three main tasks. First, implementation of a protocol for regular reporting on updates of the project's advancement and completion, even if by informal means, that will form the basis of intermittent regular reporting during the pendency of the project with any needed understandings concerning the funding

[1] Again, the timeline is an estimate that will invariably be subject to revision by external scheduling events (i.e., patent application preparation and processing times) and other events that are uncontrollable from the aspect of this project management proposal.

[2] [redacted] funding is likewise preferred on the basis that it has a definitive project-based conclusion and end date affording eventual pursuit of the multiple other business ideas that Mr. Mostaghim seeks to develop.

arrangement. The second main task involves patent attorney or patent agent vetting, interviewing, pricing, inquiry concerning duration for application preparation, establishing communications standards with patent professionals, eventual selection of patent professional, and engagement. The third task, though not definitive, but believed to be possible (even if in crude form), is the preparation or attempt at preparation of a 3D model of the product to facilitate ease of understanding by the engaged patent professionals, afford an object of reference for patent diagram art, and minimizes expenses related to patent application artistic drawing costs.

B. Phase II: *Months Four to Six*

Two main tasks will be undertaken. First, the patent applications will be prepared and filed. Although such is not certain at this time, it is reasonably anticipated that preparation of a patent application should not take longer than three months from the time the patent attorney or agent is provided with all necessary information to accomplish completion of the application, preparation of art, and outlining of patent claims. Protocols will be established for periodic brief reporting of status updates on the patent application process, completion, and estimated time to filing. Second, a preliminary assessment of costing and cost analysis for specific per unit production costs will be undertaken exploring utilization of domestic suppliers and manufacturers. Alternative foreign manufacturing cost analysis will

be done to the extent that such is possible taking into account language barriers and potential difficulties in locating suitable foreign suppliers.

C. Phase III: *Months Seven to Nine*

Phase III involves continued follow up on patent application status and information received from the PTO. Protocols will be implemented for the relay and submission of all filings and communications by and between the patent attorney or patent agent and the PTO examiner on a monthly basis for purposes of record keeping, documentation of the patent application process, and independent assessments of progress and completion of advancing the application to final registration status. Monthly document submission will continue until the sooner of the end of the project or the culmination of registration numbers issuing for the applicable patents.

To the extent costing analysis is not finalized that process will continue. Best estimates for cost analysis will be compiled and reported for assessments and viability of further product development, manufacturing feasibility, and preferred supplier contacts taking cost considerations and production output into account.

D. Phase IV: *Months Ten to Twelve*

Phase IV will involve continued patent progress monitoring. Once cost analysis is complete it will be submitted in writing to involved decision makers for review with any necessary meetings scheduled, assessments for further or additional information will be made, and review concerning retained control manufacturing, outsourced manufacturing, or potential patent licensing will be reviewed and ideally determined.

E. Phase V: *Months Thirteen to Fifteen*

Phase V will involve continued patent progress monitoring. Attempt to ascertain patent registration issue date should be made. To the extent decisions are made to continue into a manufacturing stage, discussions concerning additional funding will occur. Likewise, assuming manufacturing is contemplated, Phase V will involve solidification of a marketing strategy with compiling research on specific companies and avenues for merchandising, advertisings, and cataloging. An assessment of creating or obtaining a pre-production professional quality sample product will be assessed for possible marketing with a created website and demo video. Preferred suppliers will be alerted of any intent to commence manufacturing and any proposed contractual arrangements or commitments will be communicated.

F. Phase VI: *Months Sixteen to Eighteen*

Phase VI will involve continued patent progress monitoring. Attempts to implement a marketing plan should be taken by contacting the identified advertisers, suppliers, catalogs, etc., to establish business contacts in anticipation of product placement or availability notices or ads. Assessments should be made concerning inventory stock piles with concerns of product storage or whether manufacturing will be made to order. Manufacturing lead times and shipping times are to be assessed if not already known. Manufacturing commences to extent stock piled products are contemplated. If pre-production demo model was procured or created, product notices and ads are placed with identified marketing channels utilizing pre-production demo model and ad creation as may be needed.

G. Phase VII: *Months Nineteen to Twenty-One*

Phase VII will involve continued patent progress monitoring. Patent registration should be complete or nearing completion. Assessments concerning effectiveness of marketing avenues and cost / benefit analysis should be undertaken if costs were incurred in formulating and creating avenues for marketing. In addition to cost assessments, evaluation of marketing channel effectiveness should be assessed (i.e., did the targeted marketing channels generate leads or orders). Reassessments and modifications to marketing channels, if needed and possible,

should be undertaken. Order fulfillment evaluations should be made for any orders received and processed (wait time, processing time, time to delivery and completion) and appropriate checks should be taken that commercial partners have paid on any accounts receivable.

H. Phase VIII: *Months Twenty-Two to Twenty-Four*

Phase VIII will involve continued patent progress monitoring. Patent registration should ideally be completed. Review and reassess existing business model and segment as a whole, assess problematic issues or areas in manufacture, order processing, or fulfillment with particular attention to cause of problem. Implementation of corrections to processes regarding cause(s) of problem(s) should occur.

XI. CONCLUSION

Assuming Kimberly-Clark has an interest in exploring potential additional income revenue possibilities, as presumably they would as such is within the best interest for long term corporate operations and shareholders alike, with minimum expenditures allocated towards the development of the ideas and proposals herein advanced as compared to KC's available revenues and operating budget, KC has the opportunity of acquiring an interest in certain developed intellectual property patents that, with optimization, have the potential of bringing KC and its shareholders additional revenues with a comparatively relative minimal expense.

While the specifics of the above proposal can be worked out through further collaboration, I look forward to the prospect of further communications where the opportunities within this proposal can be further explored to the advantage of all involved parties. Thank you for the taking time to consider this proposal and I look forward to hearing from you in the near future.

APPENDIX 1

US006709550B2

(12) **United States Patent**
Holz et al.

(10) **Patent No.: US 6,709,550 B2**
(45) **Date of Patent: Mar. 23, 2004**

(54) **METHOD FOR FORMING A MULTI-LAYERED PAPER WEB**

(75) Inventors: **Jeffrey D. Holz**, Sherwood, WI (US); **Thomas G. Neal, Jr.**, Appleton, WI (US); **Robert E. Donnelly**, Cumbria (GB); **Michelle Nault**, Battle Creek, MI (US); **Devany H. Martin**, Neenah, WI (US)

(73) Assignee: **Kimberly-Clark Worldwide, Inc.**, Neenah, WI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 7 days.

(21) Appl. No.: **10/225,667**

(22) Filed: **Aug. 22, 2002**

(65) **Prior Publication Data**

US 2002/0195215 A1 Dec. 26, 2002

Related U.S. Application Data

(62) Division of application No. 09/707,535, filed on Nov. 7, 2000, now Pat. No. 6,464,830.

(51) **Int. Cl.**[7] **D21H 27/30**; B32B 29/00

(52) **U.S. Cl.** **162/130**; 162/129; 162/147; 162/189; 162/191; 428/535

(58) **Field of Search** 162/109–117, 123–133, 162/147, 149, 189, 191, 231, 298–301, 336, 343; 428/535, 537.5, 326, 342, 152–154, 511

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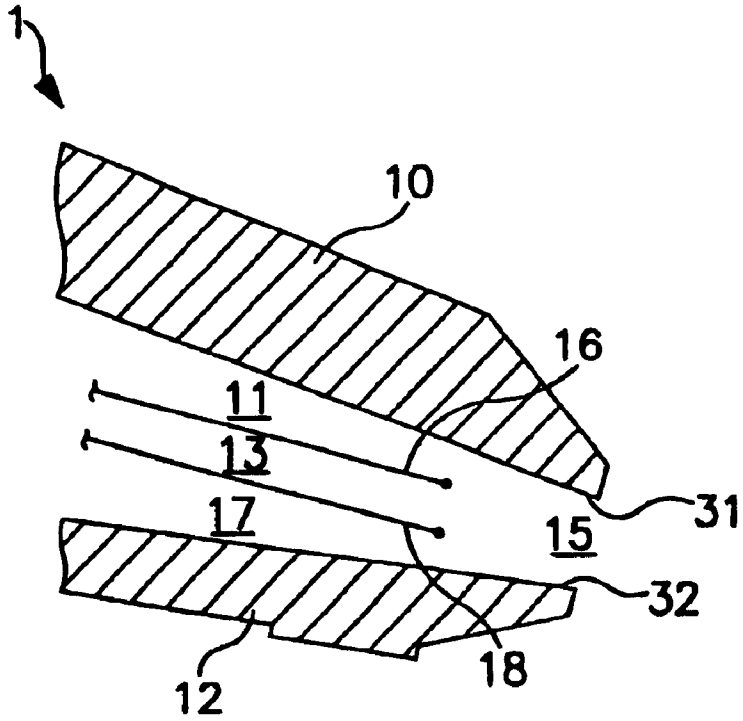
(57) **ABSTRACT**

A multi-layered paper web that has increased strength for minimizing slough and lint is provided. In one embodiment, the paper web contains an outer layer formed from unrefined hardwood fibers and an inner layer formed from refined hardwood, softwood, and machine broke fibers. During formation within a headbox, the outer and inner fibrous layers are allowed to partially blend. By partially blending the layers, the fibers within each layer can form bonds in the −z direction to provide sufficient strength to minimize lint and slough.

17 Claims, 1 Drawing Sheet



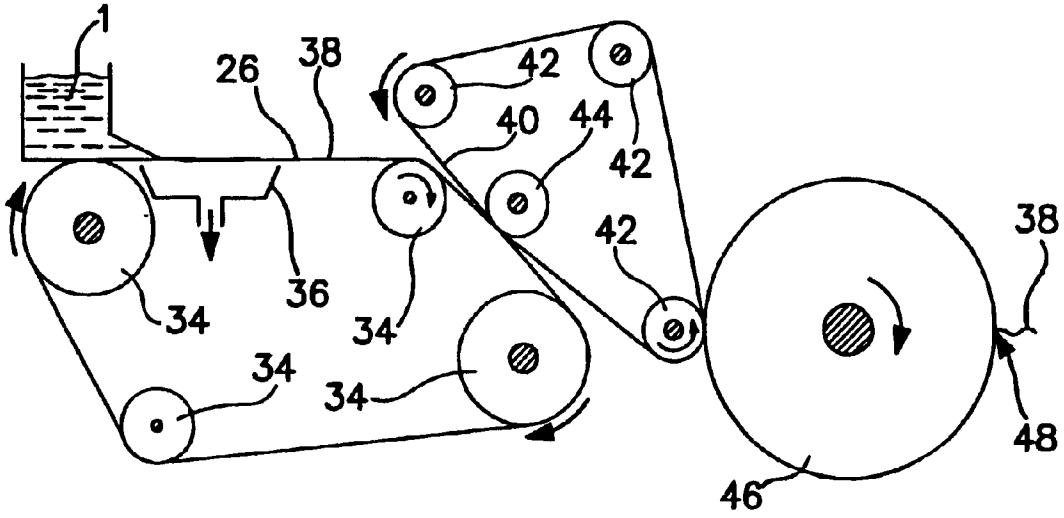

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FIG. 1

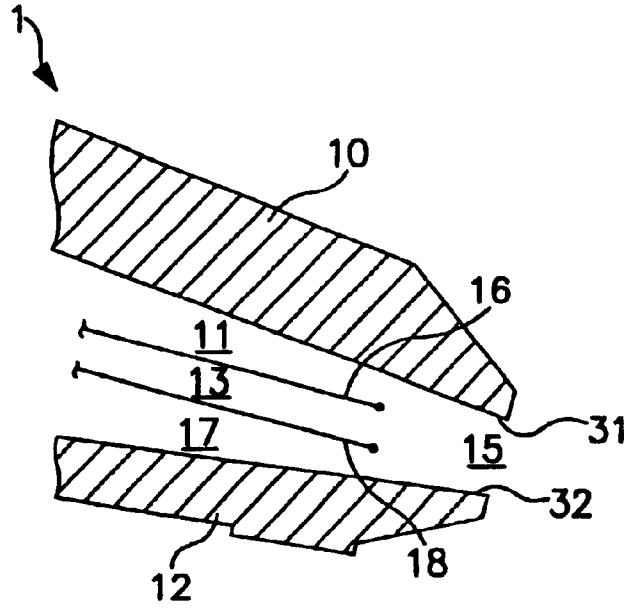
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FIG. 2

METHOD FOR FORMING A MULTI-LAYERED PAPER WEB

RELATED APPLICATIONS

The present application is a divisional of U.S. application Ser. No. 09/707,535, which was filed on Nov. 7, 2000 now U.S. Pat. No. 6,464,830.

BACKGROUND OF THE INVENTION

Tissue products such as paper towels, facial tissue, bath tissue, and other similar products have been formed in a variety of ways. A tissue product often has more than one layer to impart certain properties to the product For example, the products may be formed from a multi-layered paper web having an outer layer that gives the web a relatively soft feel. A variety of techniques have traditionally been used to form such multi-layered paper webs.

For example, some multi-layered webs have been formed by fully blending short fibers and long fibers to form an outer layer of the web. Moreover, other tissue products, such as described in U.S. Pat. No. 4,300,981 to Carstens, have been formed by utilizing primarily short fibers to form the outer layer so that the purity of the resulting short fiber outer layer can be substantially maintained. However, in some instances, minimal mixing has occurred within the layers such that 5% or less of the fibers within one layer comes from the fibers of an adjacent layer.

However, one problem associated with such conventional methods for forming multi-layered webs is that the webs do not have sufficient softness and/or strength. In particular, many of the conventional webs are soft, but lack sufficient strength in the −z direction. As a result, some fibers within the outer layer can break away from the web, thereby causing lint and slough.

As such, a need currently exists for an improved method of forming a paper web that is soft, but also possesses sufficient strength in the −z direction.

SUMMARY OF THE INVENTION

The present invention is generally directed to a method of forming a multi-layered paper web. In particular, the method of the present invention includes partially blending a first fibrous layer containing hardwood fibers with a second fibrous layer containing hardwood fibers and softwood fibers. Other fiber furnishes may also be utilized if desired.

In some embodiments, some of the fibers may be refined prior to forming the paper web. Refining can generally impart at least some strength to the web without substantially deteriorating bulk and/or stiffening the web. For example, one type of refining technique known as fibrillation can be utilized. When the fibers are refined, the extent of refinement can generally vary.

To form a paper web, in one embodiment, the fibers are supplied to a headbox that distributes the fibers to a papermaking machine. In one embodiment, to separate the fibers into layers, a headbox is provided that can include one or more dividers. For example, in one embodiment, a three-layered headbox is utilized that includes dividers that do not completely extend to the slice opening. In some instances, the dividers can be positioned so that the tips of the dividers are at least about 0.25 inches from the end of the slice opening, particularly from about 0.5 inches to about 10 inches, and more particularly between about 0.5 inches to about 7 inches.

In one embodiment, one layer within the headbox includes hardwood fibers and an adjacent layer within the

headbox includes a hardwood fibers and softwood fibers. Other headbox layers and/or fibrous materials may also be utilized. For example, in one embodiment, a three-layered headbox can include an outer layer containing hardwood fibers, an inner layer containing hardwood fibers and softwood fibers, and another outer layer containing softwood fibers and hardwood fibers.

In some embodiments, it may be desired that the fibrous layers be provided in approximately equal weights to aid in processing. For example, in some embodiments, a two-layered headbox has two fibrous layers that each are about 40% to about 60% of the weight of all the fibrous layers, particularly between about 45% to about 55%, and more particularly about 50%. Moreover, in other embodiments, a first fibrous layer containing hardwood fibers can be between about 30% to about 50% of the weight of all the fibrous layers, particularly between about 35% to about 45%, and more particularly about 40%. In addition, a second and third fibrous layer containing hardwood fibers and softwood fibers can each be about 20% to about 40% of the weight of all the fibrous layers, particularly between about 25% to about 35%, and more particularly about 30%.

In accordance with the present invention, the fibers from a first fibrous layer containing hardwood fibers can be partially blended with the fibers from a second fibrous layer containing softwood fibers and hardwood fibers. For example, in one embodiment, the fibrous layers are partially blended within a headbox. Once partially blended, the resulting web is formed with an outer layer having from about 5% to about 20% by weight of softwood fibers, particularly from about 5% to about 15%, and more particularly 10% to about 15% by weight of softwood fibers, which originate from the second fibrous layer.

By partially blending the fibers of one layer with the fibers of another layer, the resulting multi-layered paper web can have improved strength and yet remain soft. For example, partial blending can promote bonding of the fibers in the −z direction, thereby inhibiting the production of lint and slough, which typically results from weak −z directional bonds.

Other features and aspects of the present invention are discussed in greater detail below.

BRIEF DESCRIPTION OF THE DRAWINGS

A full and enabling disclosure of the present invention, including the best mode thereof to one of ordinary skill in the art, is set forth more particularly in the remainder of the specification, including reference to the accompanying figures in which:

FIG. **1** is a schematic diagram of one embodiment of a papermaking machine used to form a multi-layered paper web; and

FIG. **2** is a cross-sectional view of one embodiment of a headbox that can be used to form a multi-layered paper web.

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

DETAILED DESCRIPTION OF REPRESENTATIVE EMBODIMENTS

Reference now will be made in detail to various embodiments of the invention, one or more examples of which are set forth below. Each example is provided by way of explanation of the invention, not limitation of the invention. In fact, it will be apparent to those skilled in the art that

various modifications and variations can be made in the present invention without departing from the scope or spirit of the invention. For instance, features illustrated or described as part of one embodiment, can be used on another embodiment to yield a still further embodiment. Thus, it is intended that the present invention covers such modifications and variations as come within the scope of the appended claims and their equivalents.

In general, the present invention is directed to a method of forming a multi-layered paper web that can have good softness and strength characteristics. For example, in one embodiment, the present invention is directed to a method that includes the steps of partially blending one fibrous layer with another fibrous layer within a headbox to promote fiber bonding in the −z direction.

Multi-layered paper webs formed in accordance with the present invention can generally be formed from any of a variety of materials. In particular, a variety of natural and/or synthetic fibers can be used. For example, some suitable natural fibers can include, but are not limited to, nonwoody fibers, such as abaca, sabai grass, milkweed floss fibers, pineapple leaf fibers; softwood pulp fibers, such as northern and southern softwood kraft fibers. Other illustrative examples of suitable softwood pulps include southern pines, red cedar, hemlock, black spruce, and mixtures thereof. Exemplary commercially available softwood pulp fibers suitable for the present invention include those available from Kimberly-Clark Corporation under the trade designations "Longlac-19". Northern softwood kraft fibers, such as the fibers described above, generally have a fiber length of about 1.8 mm to about 2.5 mm. Softwood fibers can, in some embodiments, further enhance the strength of the web.

In addition, hardwood pulp fibers, such as eucalyptus, maple, birch, or aspen, can be utilized. Eucalyptus fibers, for instance, which are typically from about 0.8 to 1.2 mm in length, provide uniform formation and greatly increase the softness of the web. Moreover, machine broke fibers (i.e., internally recycled fibers) may also be used. Furnishes including other types of recycled fibers, such as from newsprint, reclaimed paperboard, and office waste, may also be used. Further, some synthetic fibers, such as rayon fibers, ethylene vinyl alcohol copolymer fibers, and polyolefin fibers, can be used in some instances.

To form a multi-layered, wet-laid paper web, one or more fiber furnishes are first typically provided. For instance, in one embodiment, at least two fiber furnishes can be utilized. Although other fibers may be utilized, the first fiber furnish typically contains hardwood fibers, such as eucalyptus fibers. Moreover, the second fiber furnish can contain hardwood fibers, softwood fibers (e.g., northern or southern softwood kraft fibers), machine broke (i.e., internally recycled fibers), combinations thereof, and the like. In one embodiment, for example, the second fiber furnish contains softwood and hardwood fibers.

If desired, more than two fiber furnishes may also be utilized. For example, in one embodiment, a third fiber furnish containing machine broke fibers is utilized. The above fiber furnishes can then be fed at to pulpers that disperse the fibers into individual fibers. The pulpers can run continuously or in a batch format to supply fibers to the papermaking machine.

Once a batch of fibers has been dispersed, the furnish can then, in some embodiments, be pumped to a dump chest and diluted to about a 3–4% consistency. For example, in one embodiment, the first fiber furnish containing hardwood fibers is transferred to a dump chest. Thereafter, the first fiber furnish is transferred directly to a clean stock chest, where it is diluted to a consistency of about 2–3%. If desired, the clean stock chest can be maintained at a relatively constant level to allow the continuous addition of a treatment, such as a softening agent, to enhance the properties of the finished product.

In other embodiments, one or more of the fiber furnishes may be refined prior to being utilized in the paper web. For example, in one embodiment, the second fiber furnish containing hardwood and softwood fibers is transferred to a blend chest, where a third fiber furnish containing broke fibers can be mixed therewith. The proportion of broke is typically dictated by performance specifications and current broke storage levels. Once fully blended, in one embodiment, the softwood fibers, hardwood fibers, and broke fibers, are then transferred to a refiner.

Refining can generally impart at least some web strength without substantially deteriorating bulk and/or stiffening the web. For example, one type of refining technique known as fibrillation can be utilized. Fibrillation generally refers to the random splitting of fibers into minute fibrous elements or fibrils. Fibrillation can be accomplished through mechanical agitation, such as described in U.S. Pat. No. 4,608,292 to Lassen or U.S. Pat. No. 4,701,237 to Lassen, which are incorporated herein in their entirety by reference thereto, as well as through other methods, such as by contacting the fibers with a fibrillation-inducing medium. For instance, U.S. Pat. No. 5,759,926 to Pike et al., U.S. Pat. No. 5,895,710 to Sasse et al., and U.S. Pat. No. 5,935,883 to Pike, which are incorporated herein in their entirety by reference thereto, describe a variety of fibrillation-inducing mediums that can be used in the present invention, such as hot water, steam, air/steam mixtures, etc.

When the fibers are refined, as described above, the extent of refinement can generally vary. In fact, any amount of refinement can provide at least some increase in strength. In some embodiments, for example, the fibers are refined to an extent such that the resulting fibers have a Canadian Standard Freeness ("CSF") (TAPPI T227m-58) between about 400 CSF to about 800 CSF, and more particularly, between about 500 CSF to about 700 CSF. Canadian Standard Freeness is generally a measurement of the drainage properties of fibers as a result of refinement. For example, 800 CSF represents a relatively low amount of pulp refinement, while 400 CSF represents a relatively high amount of pulp refinement.

Thereafter, the fiber furnishes can then be pumped from the refiner or chest to a low density cleaner that can decrease the consistency to about 0.6%. If desired, various dry and/or wet strength agents can also be added to improve the sheet integrity. The furnishes can further be diluted, if desired, to about 0.1% consistency at the fan pump prior to entering the headbox.

To form a paper web, the furnishes are then supplied to a headbox for distribution to a papermaking machine. In general, any headbox capable of forming a multi-layered web in accordance with the present invention can be utilized.

One particular embodiment of a headbox for forming a multi-layered web in accordance with the present invention is illustrated in FIG. **2**. For instance, a headbox **1** is provided for issuing a free jet (not shown) of fibers. The angle of impingement of the free jet and its point of impact can vary for different processes and forming geometries. The fibers are deposited onto a forming wire while water is removed, such as through combinations of gravity, centrifugal force, or vacuum suction.

Referring to FIG. **2**, the headbox **1** is depicted in more detail. In particular, as shown, the headbox **1** is three-layered and includes an upper head box wall **10** that ends at an upper headbox lip **31** and a lower head box wall **12** that ends at a lower headbox lip **32**. The space between the upper headbox lip **31** and the lower headbox lip **32** is sometimes referred to as a slice opening **15**. As shown, the headbox **1** is divided into layers **11**, **13**, and **17** by a first divider **16** and a second divider **18**. However, although the embodiment depicted and described herein contains two dividers, it should be understood that any number of dividers can be utilized in the present invention to form a multi-layered paper web. For instance, one divider can be used to form a two-layered web of the present invention.

In general, the dividers **16** and **18** used in the headbox **1** can be made from any of a variety of materials and can be located in a variety of positions. For example, the dividers can be made of rigid and/or flexible materials, such as described in U.S. Pat. No. 5,129,988 to Farrington. Jr., which is incorporated herein in its entirety by reference thereto. Moreover, the dividers may be positioned at any desired angle so that the fibrous layers converge or diverge as they flow through the headbox. Further, the dividers can also be formed so that the tips of the dividers do not completely extend to the end of the slice opening **15**. For example, in some embodiments, the dividers are positioned so that the tips of the dividers are at least about 0.25 inches from the end of the slice opening **15**, particularly from about 0.5 to about 10 inches, and particularly from about 0.5 to about 7 inches.

In general, the fibrous layers formed within the headbox **1** can contain a variety of fibers, such as described above. For instance, in one embodiment, an unrefined layer of hardwood fibers can be formed within the outer layer **11** of the headbox **1**. In addition, a refined layer of softwood fibers and hardwood fibers, such as described above, can be formed within the inner layer **13** of the headbox **1**. In some embodiments, another refined layer can also be formed within the outer layer **17** of the headbox **1**. However, it should be understood that the layers described above are but one embodiment of the present invention, and that the fibrous layers formed within the outer layers **11** and **17** and the inner layer **13** of the headbox **1** may also be made from a variety of other fibrous materials. For example, in one embodiment, the fibrous layer formed within the inner layer **13** and the outer layer **17** of the headbox **1** may contain softwood, hardwood, and broke fibers.

In general, the fibrous layers formed within the headbox **1** can be provided in any desired proportion. In some embodiments, it is desired that the fibrous layers be provided in approximately equal weights to aid in processing. For example, when using two fibrous layers, the weight of each fibrous layer can be between about 40% to about 60% of the weight of all the fibrous layers, particularly between about 45% to about 55%, and more particularly about 50%. Moreover, when containing three layers, such as shown in FIG. **2**, the fibrous layer formed within the outer layer **11** of the headbox **1** can be between about 30% to about 50% of the weight of all the fibrous layers, particularly between about 35% to about 45%, and more particularly, about 40%. In addition, the fibrous layers formed within the inner layer **13** and outer layer **17** of the headbox **1** can each be about 20% to about 40% of the weight of all the fibrous layers, particularly between about 25% to about 35%, and more particularly, about 30%.

In accordance with the present invention, the fibers from the fibrous layer formed within the outer layer **11** of the headbox **1** can be "partially blended" with the fibers from the fibrous layer formed within the inner layer **13** of the headbox **1**. For instance, in one embodiment, the fibers can be "partially blended" at the slice opening **15** of the headbox **1** due to the length of the dividers **16** and **18**. As used herein, the phrase "partially blending" or "partially blended" generally refers to the controlled intermixing of two or more fibrous layers. For example, in one embodiment, the fibrous layer formed within the outer layer **11** contains hardwood fibers and the fibrous layer formed within the inner layer **13** contains both softwood and hardwood fibers. Once partially blended within the headbox **1**, however, the resulting web is formed with an outer layer having from about 5% to about 20% by weight of softwood fibers, particularly from about 5% to about 15%, and more particularly from about 10% to about 15% by weight of softwood fibers, which originate from the fibrous layer formed within the inner layer **13**. However, it should be understood that such partial blending need not occur within the headbox **1**. For example, the fibrous layers can be partially blended at other stages in the papermaking process as well.

By partially blending the fibers of one fibrous layer with the fibers of another fibrous layer, a multi-layered paper web can be formed that has improved strength and softness. For example, partial blending allows a portion of the softwood fibers contained within the fibrous layer formed within the inner layer **13** of the headbox **1** to migrate to the fibrous layer formed within the outer layer **11** of the headbox **1**. Thus, in addition to hardwood fibers, the fibrous layer formed within the outer layer **11** also contains a small portion of softwood fibers, which provides some strength in the x-y plane to the fibrous layer formed within the outer layer **11** without having a substantial affect on the softness provided by the hardwood fibers. Moreover, as a result of partial blending, it is believed that the softwood fibers of the fibrous layer formed within the outer layer **11** maintain a relatively large amount of hydrogen bonding with softwood and other fibers remaining in the fibrous layer formed within the inner layer **13**. Such hydrogen bonding promotes strength in the –z direction of the web, thereby inhibiting the production of lint and slough, which typically results from weak –z directional bonds.

After the free jet of fibers is deposited by the headbox **1**, any suitable technique or process can be used to produce a paper or tissue web. For example, the papermaking process can utilize wet-laying, creping, embossing, wet-pressing, through-drying, through-dry creping, uncreped through-drying, double creping, winding, finishing, as well as other steps in forming the multi-layered paper web. For example, techniques, such as disclosed in U.S. Pat. No. 4,300,981 to Carstens; U.S. Pat. No. 5,048,589 to Cook, et al.; U.S. Pat. No. 5,399,412 to Sudall, et al., U.S. Pat. No. 5,494,554 to Edwards, et al., and U.S. Pat. No. 5,785,813 to Smith, at al., which are incorporated herein in their entirety by reference thereto, can be utilized.

Referring to FIG. **1**, for example, one embodiment of a paper making machine is illustrated which is capable of receiving the stratified fibrous furnishes from the headbox **1** and forming a wet-laid paper web. As shown, in this embodiment, a forming fabric **26** is supported and driven by a plurality of guide rolls **34**. A vacuum box **36** is disposed beneath forming fabric **26** and is adapted to remove water from the fibrous layers to assist in forming a wet-laid web.

From the forming fabric **26**, a formed web **38** is transferred to a second fabric **40**, which may be either a wire or a felt. The fabric **40** is supported for movement around a continuous path by a plurality of guide rolls **42**. Also

included is a pick up roll **44** designed to facilitate transfer of web **38** from fabric **26** to fabric **40**.

From the fabric **40**, a web **38**, in this embodiment, is transferred to the surface of a rotatable heated dryer drum **46**, such as a Yankee dryer. The web **38** is lightly pressed into engagement with the surface of dryer drum **46** to which it adheres, due to its moisture content and its preference for the smoother of the two surfaces. In some cases, however, a creping adhesive, such as an ethylene vinyl acetate, can be applied over the web surface or drum surface for facilitating attachment of the web to the drum.

As the web **38** is carried through a portion of the rotational path of the dryer surface, heat is imparted to the web causing most of the moisture contained within the web to be evaporated. The web **38** is then removed from dryer drum **46** by a creping blade **48**. Although optional, creping the web **38** as it is formed further reduces internal bonding of the fibers within an outer layer of a web, thereby increasing softness. However, because of the additional –z directional bonds formed as described above, the outer layer of the web can retain sufficient strength after creping to minimize lint and slough.

If desired, the paper web **38** can then, in some embodiments, be pulled through a curing or drying station (not shown). The drying station can include any form of a heating unit, such as an oven energized by infrared heat, microwave energy, hot air or the like. The drying station may be, in some instances, be used to dry the web and/or cure the bonding agents. Once drawn through the drying station, the web **38** can be wound into a roll of material or fed directly to further processing stations.

A variety of other chemical treatments can also be applied to the paper web in any manner during any stage of the papermaking process. Examples of some suitable treatments include, but are not limited to, wet strength agents, dry strength agents, softening agents, refining agents, antioxidants, antimicrobial agents, colorants, emollients, external analgesics, humectants, moisturizing agents, etc. Moreover, such chemical treatments can be applied at any stage during the papermaking process, such as described in U.S. Pat. No. 5,785,813 to Smith, et al.

A multi-layered paper web made in accordance with the present invention can generally have a variety of beneficial properties. For instance, the web can be soft, yet also possess sufficient strength for reducing lint and slough. For example, in one embodiment, the web has an outer layer of hardwood fibers partially blended with a layer of hardwood and softwood fibers. This partial blending can promote bonding and strength in the –z direction between the outer fibrous layer and an inner fibrous layer. Typically, such enhanced –z directional strength is also not substantially deteriorated after creping.

Furthermore, by providing a web with layers of relatively balanced weight, the uniformity of the cross-deckle profile of the web can also be improved. As used herein, the phrase "cross-deckle profile" generally refers to the weight and strength of a paper web in the cross-direction at various points along a selected cross-section of the web. A web with a relatively uniform cross-deckle profile can allow the tissue product to be processed more easily, which further allows the useful properties of the tissue product to be better balanced.

The multi-layered paper webs formed according to the present invention can be incorporated into a variety of tissue products. For example, in one embodiment of the present invention, a single-ply tissue product can be formed from a multi-layered paper web made according to the present invention. In another embodiment, a tissue product can be formed to have three plies wherein at least one of the plies is a multi-layered paper web formed according to the present invention. In some embodiments, the basis weight of the tissue products can range from about 5 grams per square meter to about 100 grams per square meter, and particularly between about 10 grams per square meter to about 60 grams per square meter.

While the invention has been described in detail with respect to the specific embodiments thereof, it will be appreciated that those skilled in the art, upon attaining an understanding of the foregoing, may readily conceive of alterations to, variations of, and equivalents to these embodiments. Accordingly, the scope of the present invention should be assessed as that of the appended claims and any equivalents thereto.

What is claimed is:

1. A multi-layered, wet-laid paper web comprising:

a first layer of a first fibrous material that contains hardwood fibers partially blended with between about 5% to about 20% softwood fibers; and

a second layer of a second fibrous material that contains hardwood fibers and softwood fibers, wherein said softwood fibers within said first layer originated from the same fibrous furnish as the softwood fibers within said second layer.

2. A multi-layered, wet-laid paper web as defined in claim **1**, wherein said softwood fibers are refined.

3. A multi-layered, wet-laid paper web as defined in claim **1**, wherein said second fibrous material contains machine broke fibers.

4. A multi-layered, wet-laid paper web as defined in claim **1**, wherein said hardwood fibers contains eucalyptus fibers.

5. A multi-layered, wet-laid paper web as defined in claim **1**, wherein said first layer comprises between about 40% to about 60% of the combined weight of said first and second layers and said second layer comprises between about 40% to about 60% of the combined weight of said first and second layers.

6. A multi-layered, wet-laid paper web as defined in claim **5**, wherein said first layer comprises between about 45% to about 55% of the combined weight of said first and second layers and said second layer comprises between about 45% to about 55% of the combined weight of said first and second layers.

7. A multi-layered, wet-laid paper web as defined in claim **1**, further comprising a third layer of a third fibrous material, said third fibrous material containing hardwood fibers and softwood fibers.

8. A multi-layered, wet-laid paper web as defined in claim **7**, wherein said first layer comprises between about 30% to about 50% of the combined weight of said first, and second, and third layers, said second layer comprises between about 20% to about 40% of the combined weight of said first, and second, and third layers, and said third layer comprises between about 20% to about 40% of the combined weight of said first, second, and third layers.

9. A multi-layered, wet-laid paper web as defined in claim **7**, wherein said first layer comprises between about 35% to about 45% of the combined weight of said first, second, and third layers, said second layer comprises between about 25% to about 35% of the combined weight of said first, second, and third layers, and said third layers comprises between about 25% to about 35% of the combined weight of said first, second, and third layers.

10. A multi-layered, wet-laid paper web as defined in claim **1**, wherein said first layer contains between about 5%

to about 15% by weight softwood fibers originating from the same fibrous furnish as the softwood fibers within said second layer.

11. A multi-layered, wet-laid paper web as defined in claim **1**, wherein said first layer contains about 10% to about 15% by weight softwood fibers originating from the same fibrous furnish as the softwood fibers within said second layer.

12. A multi-layered, wet-laid paper web comprising:

a first layer of a first fibrous material that contains hardwood fibers partially blended with between about 10% to about 15% softwood fibers; and

a second layer of a second fibrous material that contains hardwood fibers and softwood fibers, wherein said softwood fibers within said first layer originated from the same fibrous furnish as the softwood fibers within said second layer, wherein said first layer comprises between about 40% to about 60% of the combined weight of said first and second and third layers and said second layer comprises between about 40% to about 60% of the combined weight of said first and second layers.

13. A multi-layered, wet-laid paper web as defined in claim **12**, wherein said softwood fibers are refined.

14. A multi-layered, wet-laid paper web as defined in claim **12**, wherein said first layer comprises between about 45% to about 55% of the combined weight of said first and second layers and said second layers comprises between about 45% to about 55% of the combined weight of said first and second layers.

15. A multi-layered, wet-laid paper web comprising:

a first layer of a first fibrous material that contains hardwood fibers partially blended with between about 10% to about 15% softwood fibers;

a second layer of a second fibrous material that contains hardwood fibers and softwood fibers, wherein said softwood fibers within said first layer originated from the same fibrous furnish as the softwood fibers within said second layer; and

a third layer of a third fibrous material, said third fibrous material containing hardwood fibers and softwood fibers, wherein said first layer comprises between about 30% to about 50% of the combined weight of said first, second, and third layers, said second layer comprises between about 20% to about 40% of the combined weight of said first, second, and third layers, and said third layer comprises between about 20% to about 40% of the combined weight of said first, second, and third layers.

16. A multi-layered, wet-laid paper web as defined in claim **15**, wherein said softwood fibers are refined.

17. A multi-layered, wet-laid paper web as defined in claim **15**, wherein said first layer comprises between about 35% to about 45% of the combined weight of said first, second, and third layers, said second layer comprises between about 25% to about 35% of the combined weight of said first, second, and third layers, and said third layer comprises between about 25% to about 35% of the combined weight of said first, second, and third layers.

* * * * *

APPENDIX 2

US007132379B2

(12) **United States Patent**
Shanklin

(10) **Patent No.: US 7,132,379 B2**
(45) **Date of Patent: *Nov. 7, 2006**

(54) **ANTIMICROBIAL ABSORBENT ARTICLE, AND METHODS OF MAKING AND USING THE SAME**

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(73) Assignee: **Kimberly-Clark Worldwide, Inc.**, Neenah, WI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 43 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **09/753,134**

(22) Filed: **Dec. 29, 2000**

(65) **Prior Publication Data**

US 2001/0037100 A1 Nov. 1, 2001

Related U.S. Application Data

(60) Provisional application No. 60/174,088, filed on Dec. 30, 1999.

(51) **Int. Cl.**

B32B 27/04	(2006.01)
B32B 27/12	(2006.01)
A61K 9/70	(2006.01)
A61L 15/16	(2006.01)
A61F 13/15	(2006.01)

(52) **U.S. Cl.** **442/123**; 424/443; 424/447; 604/358; 442/97; 442/99; 442/102

(58) **Field of Classification Search** 424/443, 424/446, 447; 428/532, 537.1, 537.5; 442/123, 442/97, 99, 102; 604/358
See application file for complete search history.

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Assistant Examiner—Lynda M. Salvatore
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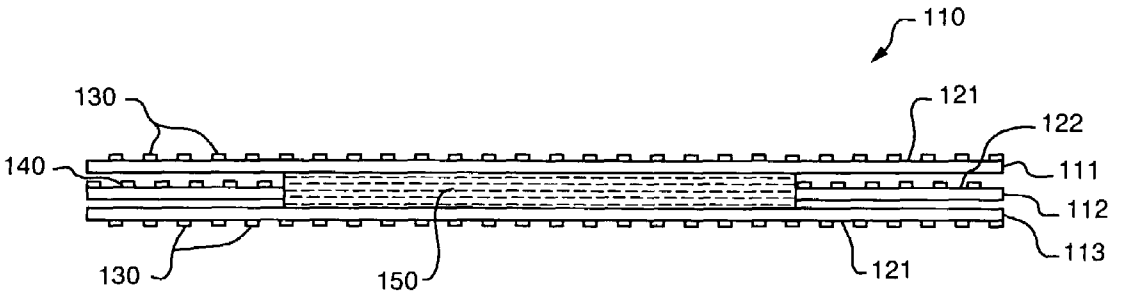
(57) **ABSTRACT**

A non-irritating multi-ply absorbent article made by treating an inner surface with one or more antimicrobial agents and treating the one or more outer surfaces with one or more siloxane compositions, and methods of making and using the same. The antimicrobial agent will remain confined to the inner portion of the absorbent article, thereby preventing irritation to the user, and the siloxane treated ply(s) will provide a pleasing, soothing, non-irritating tactile quality. In one embodiment, the siloxane composition comprises an amine-modified polysiloxane, in which case the product will also entrap any absorbed fluid, holding it in contact with the antimicrobial agent, and preventing it from wetting through the product and contacting the user.

28 Claims, 2 Drawing Sheets



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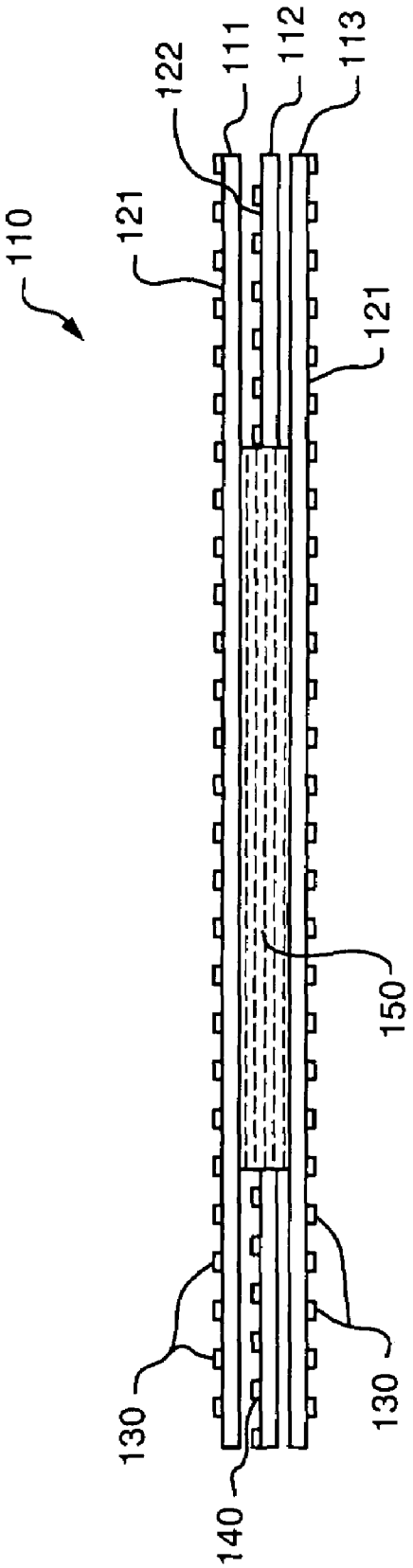


FIG. 1

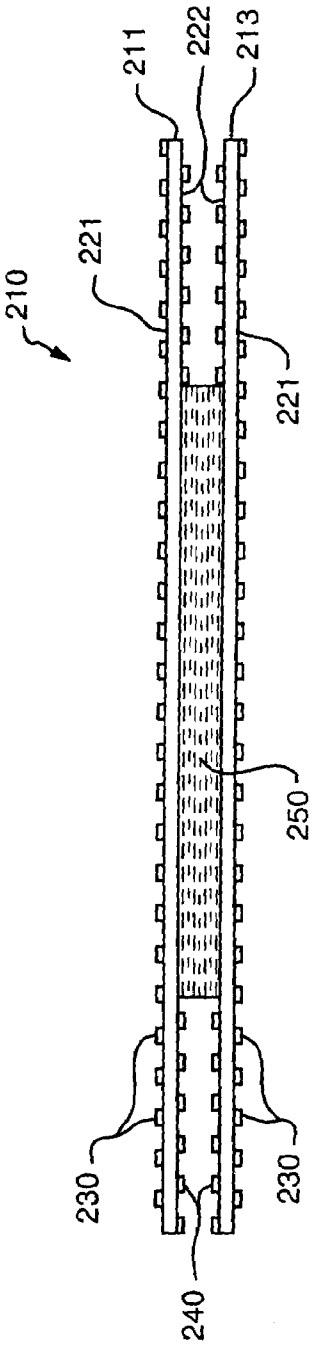

210
211
222
213
221
221
250
230
230
240

FIG. 2

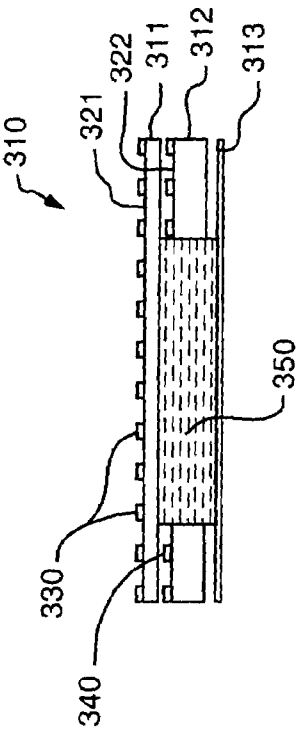

310
321
322
311
312
313
350
330
340

FIG. 3

ANTIMICROBIAL ABSORBENT ARTICLE, AND METHODS OF MAKING AND USING THE SAME

RELATED APPLICATIONS

This application is a continuation of U.S. application Ser. No. 60/174,088 entitled "Antimicrobial Absorbent Article, and Methods of Making and Using the Same," filed Dec. 30, 1999, the entire disclosure of which is incorporated herein by reference.

FIELD OF THE INVENTION

The present invention generally relates to an absorbent article such as a facial tissue which comprises several plies or plies of material. More particularly, the present invention relates to a multi-ply absorbent article and methods of making and using the same wherein one or more inner surfaces of one or more plies is treated with an antimicrobial agent, and one or more outer surfaces of one or more plies is treated with a siloxane composition.

BACKGROUND

Antimicrobial articles treated with virucides and germicides are known in the art. U.S. Pat. Nos. 4,828,912 and 4,897,304, both issued to Hossain et al., pertain to the use of a carboxylic acid/surfactant virucidal composition in absorbent products. U.S. Pat. Nos. 4,764,418 and 4,824,689, both issued to Kuenn et al., pertain to the addition of water-soluble humectants to carboxylic acid/surfactant virucides for use in tissue products to reduce irritation potential. U.S. Pat. No. 4,738,847 issued to Rothe et al., pertains to adding a carboxylic acid/surfactant virucide to the center ply of a three ply tissue to prevent transfer of the virucidal composition to the user, and thereby reduce irritation potential.

Products such as those disclosed in the Hossain et al. and Kuenn et al. patents can be highly irritating because the virucidal carboxylic acids come in contact with the skin when the tissue is used. There is also no mechanism for preventing the body secretion or fluid from soaking through the tissue and contacting the user.

Products such as those of Rothe et al. have less potential for irritation because the virucidal composition is confined in the inner ply. However, these tissues tend to be harsh rather than soft because the water added with the virucidal composition degrades the tactile properties of the tissue. There is also no mechanism for preventing the body secretion or fluid from soaking through the tissue and contacting the user.

Irritation caused by virucidal or germicidal treatments to absorbent articles is a persistent problem. There have been attempts to ameliorate this problem by mixing the virucidal or germicidal treatment with lotions or emollients. U.S. Pat. No. 5,720,966 issued to Ostendorf, pertains to a "medicated" lotion absorbent article. The "medication" may be a virucide or disinfectant. U.S. Pat. No. 5,830,487 issued to Klofta et al. pertains to a tissue with a virucidal lotion. The lotion comprises a carboxylic acid/nonionic surfactant virucidal composition. In both the Ostendorf and Klofta, et al. patents, the intent is for the lotion to reside predominantly on the surface of the absorbent article and transfer to the user.

Products such as those disclosed in the Ostendorf and Klofta et al. patents also have a high potential for irritation because the virucidal or germicidal composition is on the surface of the tissue and is intentionally transferred to the user, so the user remains in prolonged contact with the irritant. There is also no mechanism for preventing the body secretion or fluid from soaking through the tissue and contacting the user.

Siloxane treated tissues are also known in the art. U.S. Pat. No. 5,227,242 issued to Walter et al., and U.S. Pat. No. 5,059,282 issued to Ampulski et al., each pertain to a tissue treated with a siloxane composition resulting in a tissue that is soft, absorbent, and leaves a low amount of residue.

Prior art products such as those of Walter et al. and Ampulski et al. are very soft. However, they do nothing to kill or inactivate any microorganisms that may be present, so the discarded products remain a breeding ground and reservoir of potentially harmful microorganisms that may contribute to the spread of disease.

SUMMARY

The present invention provides an absorbent article that is soft, non-irritating, and capable of killing microorganisms. More specifically, the present invention provides a multi-ply absorbent article having an outer ply treated with a siloxane composition and an inner surface treated with an antimicrobial agent.

In one aspect of the invention, the absorbent article includes a plurality of plies, at least one of the plies defining an outer ply; at least one of the plies having a surface defining an inner surface; one or more siloxane compositions applied to the at least one outer ply; and an antimicrobial effective amount of one or more antimicrobial agents applied to the at least one inner surface.

In a further aspect of the invention, a method is provided for making the multi-ply absorbent article. In yet another aspect of the invention, a method is provided for using the multi-ply absorbent article to inhibit the spread of illness.

Other aspects of the invention will be apparent in view of the following description of the preferred embodiments and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram of an absorbent article having three plies, including two outer plies, according to one embodiment of the invention.

FIG. **2** is a diagram of an absorbent article having two plies according to a second embodiment of the invention.

FIG. **3** is a diagram of an absorbent article having three plies, including an outer ply, an absorbent inner ply, and a liquid-impermeable-ply, according to a third embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the accompanying drawings and initially to FIG. **1**, a multi-ply absorbent product is shown generally at **110**. The term "plies" refers to discrete product elements arranged in juxtaposition to each other. The term may refer to a plurality of web-like components such as in a multi-ply facial tissue; or it may refer to a collection of functional components arranged into a functional product, such as the liner, wrap sheet, absorbent, outer cover, etc., of diapers or other personal care products. The term "layer" refers to a plurality of strata of different fibers, chemical treatments, etc., within a ply.

In the embodiment shown in FIG. **1**, the multi-ply absorbent article **110** has a first outer ply **111**, an inner ply **112**, and

a second outer ply **113**. The first outer ply **111** and the second outer ply **113** each have an outwardly facing surface defining outer surfaces **121**. At least one surface of the inner ply **112** defines an inner surface **122**. In the embodiment shown, only one of the surfaces of the inner ply **112** defines an inner surface **122**; however, those skilled in the art will appreciate that in other embodiments both surfaces of the inner ply **112** may define an inner surface.

The plies of the absorbent article may be made from a cellulosic web, and formed as a three-ply facial tissue, bath tissue, paper towel, and the like. Alternately, the plies may be suitable nonwoven substrates and formed into articles such as industrial wipes, wet wipe materials such as wet-creped hand towels and spunbonded and meltblown polymeric webs commonly used in production of disposable hospital items such as surgical drapes, gowns, bedsheets, pillowcases, and the like. Other examples of nonwovens include composites of natural and/or synthetic fibers, formed by turbulent admixing, in nonwoven form. Textile materials of all types, including laminates of different materials, may be used as suitable substrates. For example, hygienic face masks used by persons suffering from respiratory illnesses provide an excellent means for utilizing the present invention. Other essentially inert carriers i.e., those which are essentially non-toxic and non-irritating to human or animal tissue under the conditions of normal use, will be apparent to those skilled in the art.

The inner surface(s) **122** of inner ply **112** is treated with an antimicrobial effective amount of an antimicrobial agent **140**. The term "antimicrobial effective amount" as used herein means an amount of an antimicrobial agent is effective to reduce the rate at which targeted microbes reproduce or to reduce the population of the microbes.

The antimicrobial agent serves to kill or inactivate any microorganisms, such as viruses, bacteria, or fungi, that are absorbed into the tissue with body secretions or fluids, thereby inhibiting the spread of disease, such as a viral infection. In a preferred method of use of the multi-ply absorbent article to inhibit the spread of illness, the multi-ply absorbent article is a facial tissue. A user contacts the absorbent article with a bodily discharge, such as a nasal discharge, and entraps the bodily discharge against the anti-microbial agent. The antimicrobial agent is confined to the inner surfaces of the multi-ply absorbent article ply(s), thus preventing its transfer to the skin and resultant irritation.

At least one of the outer surfaces **121** of the outer plies **111** and **113** is treated with a siloxane composition **130**, which gives the outer plies a softer feel. In a preferred embodiment, the siloxane compound **130** is an amine-modified polysiloxane. The amine-modified polysiloxanes of the siloxane composition **130** preferentially reside on the outer surface of the substrate to which they are applied, either as a result of hydrogen bonding, charge attraction, or other chemical interaction, thereby providing a softness benefit on the surface and providing a degree of water or fluid repellency. However, when a fluid does penetrate the outer surface, the fluid is readily absorbed by the central inner ply **112** and the polysiloxane on the opposite outer surface **113** delays further penetration of the liquid to the outside of the tissue, thus trapping the fluid **150** in the center of the product in contact with the antimicrobial agent. This "one-way-valve" effect protects the user from product wet-through during normal use, and entraps the fluid in contact with the antimicrobial agent.

The particulars of both the antimicrobial agent and the siloxane composition will be discussed in detail below.

FIG. **2** illustrates a second embodiment of the invention. The absorbent article 210 of this embodiment has two outer plies **211**, **213**. At least one of the outward surfaces **221** of the outer plies **211**, **213** are treated with a siloxane compound **230**. In this embodiment, there is no inner ply. The inner surface(s) **222** are defined by the inward surfaces of the outer plies **211**, **213**. At least one of the inner surface(s) **222** is treated with an antimicrobial agent **240**. As in the first embodiment, when the siloxane compound is an amine-modified polysiloxane, entrapped fluid **250** in the center of the article is placed in contact with the antimicrobial agent, thus killing microorganisms within the fluid **250** and preventing further exposure to the user.

FIG. **3** illustrates a third embodiment of the invention. The absorbent article **310** includes an outer ply **311**, an inner absorbent ply **312**, and a fluid or liquid impermeable base ply **313**. This embodiment is especially useful for products such as diapers, incontinence pads, and sanitary napkins, and the plies are made from materials generally known in the art for those products.

The outer ply **311** is generally made from material(s) that are hydrophilic, compressible, conformable and non-irritating to the wearer's skin. Acceptable materials are well known in the art and include, for example, various natural or synthetic fibers, wood pulp fibers, regenerated cellulose or cotton fibers, or a blend of pulp and other fibers, meltblown polymer, such as polyester, and polypropylene.

The inner absorbent ply **312** may also be comprised of other well-known materials used in absorbent articles, including multiple plies of cellulose wadding, rayon fibers, cellulose sponge, hydrophilic synthetic sponge, such as polyurethane, and the like.

Preferred materials for base ply **313** include polyolefin films such as polyethylene and polypropylene; copolymers of polyolefins including, but not limited to, ethylene vinyl acrylate and ethylene acrylic; microporous fabrics and microporous or micro-apertured films such as Goretex® sold by the W. T. Gore Company of Flagstaff and Phoenix, Ariz.; "sized" papers, tissue or paper treated with amino-functional siloxanes.

The outward surface **321** of outer ply **311** is treated with a siloxane compound **330**. At least one surface of the inner absorbent ply **312** defines an inner surface **322** and is treated with the antimicrobial agent **340**.

As with the other embodiments, the outer ply **311**, when treated with an amine-modified polysiloxane, acts as a "one-way valve," entrapping fluid **350**. The microorganisms in the entrapped fluid **350** are killed by the antimicrobial agent **340**, thereby limiting the exposure of the product user to the microorganisms.

Antimicrobial Agent

The antimicrobial agent may comprise any of the virucides, bacteriocides, germicides, fungicides, and disinfectants known in the art. Selection of any particular agent will be dependent on its efficacy versus relevant microorganisms, human safety and toxicological profile, and environmental safety and toxicological profile.

Preferred antimicrobial agents are virucidal compositions. Especially preferred virucidal compositions include, without limitation, the carboxylic acid or the carboxylic acid/surfactant compositions disclosed in U.S. Pat. No. 4,897,304, issued to Hossain et al.; U.S. Pat. No. 4,764,418, issued to Kuenn et al.; and U.S. Pat. No. 4,738,847, issued to Rothe et al., all of which are incorporated herein by reference.

As used herein, an anti-viral carboxylic acid is a material that is capable of killing such viruses as rhinovirus and

influenza. Carboxylic acids useful as virucides in the present invention include, without limitation, the compounds having the structure:

R—COOH

wherein R is a radical selected from the group consisting of C_1–C_6 alkyl, substituted C_1–C_6 alkyl, carboxy C_1–C_6 alkyl, carboxyhydroxy C_1–C_6 alkyl, carboxy halo C_1–C_6 alkyl, carboxy dihydroxy C_1–C_6 alkyl, dicarboxyhydroxy C_1–C_6 alkyl, C_1–C_6 alkenyl, carboxy C_1–C_6 alkenyl, dicarboxy C_1–C_6 alkenyl, phenyl, and substituted phenyl radicals. The hydrogen atoms of any of the above compounds may be substituted by one or more functional groups such as halogen atoms, hydroxyl groups, amino groups, thiol groups, nitro groups, and cyano groups, etc.

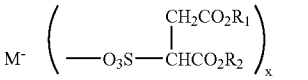
Especially preferred acids include citric acid, malic acid, maelic acid, tartaric acid, salicylic acid, glycolic acid, adipic acid, glutaric acid, succinic acid, benzoic, and mixtures thereof

The carboxylic acids can be present in the tissue product in any amount which is virucidally effective. The term "virucidally effective amount" means an amount sufficient to cause a 2 log drop in rhinovirus type 16 within 20 minutes in accordance with the Virucidal Assay Test described in the above said U.S. Pat. No. 4,897,304 and Canadian Pat. No. 1,188,225, although those skilled in the art of virology will recognize other suitable test procedures for this purpose. The addition rate on the virucidal composition to the tissue surface is preferred to be about 0.5 to 5.0 mg/in^2.

The carboxylic acids may be combined with a surfactant. Carboxylic acid/surfactant virucides are effective at add-on rates as low as 0.5 mg/in^2. The surfactant may be cationic, anionic, or nonionic. Preferred nonionic surfactants include the polyoxyethylenated alkylphenols such as TRITON X-100® manufactured by Union Carbide of Danbury, Conn., and the polyoxyethylenated sorbitol esters such as TWEEN 40®, manufactured by Uniquema of Wilmington, Del. Preferred cationic surfactants include cetylpyridinium chloride ($C_5H_5N^+(CH_2)_{15}\ CH_3Cl^-$), dimethylbenzethonium quaternary ammonium chloride ($Me_3CCH_2C(Me)_2C_6H_3(Me)$—$OCH_2CH_2OCH_2CH_2{}^+N(Me)_2H_2C_6H_5Cl^-$. The preferred anionic surfactants may be represented by the structures:

$$(ROSO_3)_xM^{+or\ (RSO}{}_3)_xM^+$$

wherein, M^+ is a mono, di or trivalent metal cation or an ammonium or substituted ammonium ion; x is an integer; and R is an alkyl group; or



wherein, M^+ and x are defined as above and R_1 and R_2 may be the same or different and may be represented by straight or branched chain aliphatic groups.

Preferred anionic surfactants include secondary alkane sulfonates and sarcosinate surfactants. Especially preferred anionic surfactants include sodium dodecyl sulfate ($CH_3(CH_2)_{10}$—$CH_2\ OSO_3$—Na), and the 1,4-bis (2-ethylhexyl) ester, sodium salt of sulfosuccinic acid, as manufactured by Cytec Industries of West Paterson, N.J., under the tradename of AEROSOL OT. The above surfactants are presented in an illustrative rather than a limiting sense.

Other additives may also be added to the anti-viral carboxylic acid. In a preferred embodiment, the antimicrobial agent includes a water-soluble humectant. For purposes herein, the term "humectant" means a hygroscopic compound or material which has an affinity for water and acts to stabilize the moisture content of a cellulosic web in the presence of fluctuating humidity. The term "water-soluble" means having a Hydrophile-Lipophile Balance (HLB) number of 7 or greater. The HLB index is well known in the chemical arts and is a scale which measures the balance between the hydrophilic and lipophilic solution tendencies of a compound. The HLB scale ranges from 1 to approximately 50, with the lower numbers representing highly lipophilic tendencies and the higher numbers representing highly hydrophilic tendencies. The presence of a water-soluble humectant can inhibit age-induced reduction in softness in webs containing carboxylic acids, particularly under conditions of low humidity (less than 35% relative humidity).

The water-soluble humectant can be any such material or compound which can be applied to the tissue web in a uniform manner, as by spraying, coating, dipping or printing, etc., and which possesses hygroscopic or humectant properties and which will not interfere with the virucidal effectiveness of the tissue product to the extent that the tissue product is no longer virucidally effective. It must be pointed out that many lotion-type tissue additives, which have HLB numbers less than 7 and hence are not water-soluble, interfere with virucidal activity. Examples of suitable water-soluble humectants include: polyglycols (as hereinafter defined), propylene glycol, sorbitol, lactic acid, sodium lactate, glycerol, and ethoxylated castor oil.

Polyglycols, which for purposes herein include esters or ethers of polyglycols, having a weight average molecular weight of from about 75 to about 90,000 are suitable for purposes of this invention. This molecular weight range represents physical states ranging from a low viscosity liquid to a soft wax to a fairly hard solid. The higher molecular weight polyglycols naturally have to be melted in order to be applied to a tissue web. Examples of suitable polyglycols include polyethylene glycol, polypropylene glycol, polyoxypropylene adducts of glycerol, methoxypolyethylene glycol, polyethylene glycol ethers of sorbitol, polyethylene glycol ethers of glycerol, polyethylene glycol ethers of stearic acid, polyethylene glycol ethers of lauryl alcohol, citric acid fatty esters, malic acid fatty esters, polyethylene glycol ethers of oleyl alcohol, and ethoxylated stearate esters of sorbitol. Polyethylene glycol is a preferred polyglycol because it can be applied to the tissue in amounts which are effective in improving softness without leaving a noticeable residue on the consumer's hands. Polypropylene glycol is also effective, but tends to leave more of a residue at equivalent amounts and is more hydrophobic than polyethylene glycol.

The amount of water-soluble humectant in a single ply or web of a tissue product of this invention can be about 0.05 to weight percent or greater. The weight percentage amount can vary greatly, depending upon the desired tactile properties, the amount of carboxylic acid present that needs to be counteracted, the properties of the water-soluble humectant itself, etc. Preferably, the amount of polyglycol in a single ply of the absorbent article can be from about 2 to about 6 weight percent.

The antimicrobial agent may comprise agents other than carboxylic acids. For example, in one embodiment, the antimicrobial agent comprises at least one quaternary ammonium compound. Preferred quaternary ammonium

compounds include cetylpyridinium chloride, methylbenzethonium chloride, benzethonium chloride, benzalkonium chloride, n-alkyl dimethyl benzyl ammonium chlorides, and n-alkyl dimethylethylbenzyl ammonium chlorides. Especially preferred quaternary ammonium compounds include cetylpyridinium chloride, methylbenzethonium chloride, benzethonium chloride, benzalkonium chloride. In another preferred embodiment, the antimicrobial agent comprises triclosan. Those skilled in the art will appreciate that a wide range of antimicrobial agents can be useful in the present invention, and the selection of a particular antimicrobial agent will depend upon the characteristics of a particular fluid that the particular absorbent article is designed to entrap.

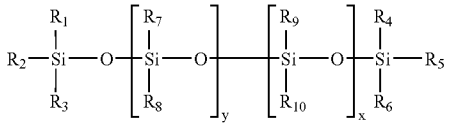
Siloxane Composition

The siloxane composition serves to soften the tissue and contributes to a pleasing, smooth, soothing, non-irritating tactile quality. Particular siloxane compositions can be tailored to enhance the absorbency characteristics of the absorbent article, such as by inhibiting wet-through or by entrapping the secretions or fluids within the inner regions of the absorbent article.

Suitable siloxane compositions include, but are not limited to, polydimethyl siloxanes, silicone glycols, epoxyfunctional silicones, carboxyfunctional silicones, hydroxyfunctional silicones, other organofunctional silicones, amine functional silicones, cationic silicones, silicone betaines, silicone amidoamine esters, silicone amidoamine phosphates, and mixtures thereof

Especially preferred siloxanes are amine-modified polysiloxanes, such as those disclosed in commonly assigned copending U.S. application Ser. No. 09/012,588, "Soft Absorbent Tissue Products Having Delayed Moisture Penetration," filed Jan. 23, 1998, and incorporated herein by reference.

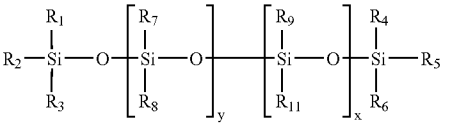
Amine-modified polysiloxane materials which are suitable for purposes of this invention have the following general formula:



wherein x and y are integers>0. The mole ratio of x to (x+y) can be from 0.005 percent to about 25 percent. The R_1–R_9 moieties are selected from C_1 to C_6 alkyl substituents. Additionally, R_2 and R_5 are selected from hydroxyl or C_1 to C_6 alkyl alcohol substituents. Preferred R_1–R_9 moieties include C_1–C_4.

The R_{10} moiety includes at least one amine-related functional group or groups such as amine, imine, and/or amide. For example, the amine-modified polysiloxane can be a polysiloxane where the R_{10} moiety contains one amine group per substituent or two or more amine groups per substituent, separated by a linear or branched alkyl chain.

Modified polysiloxane materials which are suitable for blending or mixing with the amine-modified polysiloxane(s) for purposes of balancing the hydrophobicity in accordance with this invention have the following general formula:



wherein x and y are integers>0. The mole ratio of x to (x+y) can be from 0.005 percent to about 25 percent. The R_1–R_9 moieties are selected from C_1 to C_6 alkyl substituents. Additionally, R_2 and R_5 are selected from hydroxyl or C_1 to C_6 alkyl alcohol substituents.

Preferred R_1–R_9 moieties include C_1–C_4. The R_{11} moiety includes at least one organic functional groups such as ethers, polyethers, esters, amines, imines, amides, or other functional groups, including the alkyl and alkenyl analogues of such functional groups.

As an example, the R_{11} moiety can be a polyether functional group of the generic form —R_{12}—(R_{13}—0)$_a$—(R_{14}—0)$_b$—R_{15}; wherein R_{12}, R_{13} and R_{14} are alkyl chains of C_1 to C_3, R_{15} can be hydrogen or a C_1–C_4 alkyl group, and "a" and "b" can be integers of from 1–100, more specifically from 10–30.

The viscosity range of the amine-modified polysiloxane, which is indicative of the molecular weight, can be from about 25 centipoise to about 2,000,000 centipoise or higher, more specifically from about 100 to about 1,000,000 centipoise.

In order to further optimize and balance the softness, hand protection and absorbency benefits of the modified polysiloxane treatment, blends of two or more modified polysiloxane materials can be applied to the surface of the tissue. In one particular example, a blend of a hydrophobic amino-modified polysiloxane and a hydrophilic polyether-modified polysiloxane can be used. The ratio of the amino-modified polysiloxane to the polyether-modified polysiloxane can be from 100 percent to about 10 percent, and more specifically from 100 percent to about 50 percent.

Those familiar with the polymer art will appreciate that the molecular weight (viscosity), the degree of substitution, the selected species for the various R groups and their chain lengths, the mole ratio of the "x" and "y" components of a single modified polysiloxane species, and blending two or more modified polysiloxane species can be varied to affect the hydrophobicity of the modified polysiloxane to be applied to the surface of the absorbent article.

The preferred addition rate of the siloxane composition is about 1%–2% siloxane solids per outer ply. An especially preferred add-on rate is about 1.5% siolxane solids per outer ply.

Production

In another aspect of the invention, a method of making a multi-ply absorbent article is provided. To produce the envisioned multi-ply absorbent article, it is necessary to treat an inner surface with the antimicrobial agent, ply the product together, and then crimp or seal the plies together before treating the outer plies or ply with the siloxane composition. This is necessary because the sheet will become difficult to crimp or seal after the siloxane composition has been applied.

The antimicrobial agent may be applied to the center ply(s) by any of the means known in the art. Suitable means include spraying, foam application, electrostatic application,

flexographic printing, and gravure printing. An especially preferred application method is smooth-roll coating. Other especially preferred methods include the gravure printing methods as disclosed in commonly assigned copending U.S. application Ser. No. 60/174,087, entitled "Germicidal Tissue Product Using Rotogravure Rolls," filed Dec. 30, 1999; in U.S. Pat. No. 4,950,545 issued to Walter et al.; or in commonly assigned co-pending U.S. Ser. No. 09/012,588, "Soft Absorbent Tissue Products Having Delayed Moisture Penetration," filed Jan. 23, 1998, all of which are incorporated herein by reference.

Likewise, the siloxane composition may be applied to the outer plies by any of the means known in the art. Suitable means include spraying, foam application, electrostatic application, and flexographic printing. Especially preferred application methods are gravure or rotogravure printing. Gravure printing is preferred because of the control it offers with respect to the amounts added to the article surface. The amount of modified polysiloxane(s) applied to the surface of the absorbent article will depend on the particular modified polysiloxane. However, suitable add-on amounts are from about 0.1 to about 5 weight percent based on the dry weight of the tissue product, more specifically from about 0.5 to about 3 weight percent, and still more specifically from about 0.7 to about 2 weight percent. It is preferable to first emulsify the modified polysiloxane(s) in water using the appropriate surfactant before applying the emulsion to the surface of the absorbent article. While the modified polysiloxane(s) preferentially resides on the surface of the absorbent article to which it is applied, polysiloxanes inherently migrate such that even the center ply of a three-ply tissue product may contain some of the silicone material. However, such amounts are much less than the amount on the outer surface of the absorbent article so that the center ply remains substantially hydrophilic and can wick and absorb liquid.

The invention will be further illustrated with reference to the following specific example. It is understood that the example is given by way of illustration and is not meant to limit the disclosure or the claims that follow.

EXAMPLE

A virucidal tissue product was formed from three plies. An inner ply was treated with 1.5 mg/in^2 of a virucidal formulation comprising a 2:1 ratio of citric to malic acid. Two outer plies were treated on their outfacing surfaces with about 1.5% by weight of an amine-modified polysiloxane. The inner ply was then sandwiched between the outer plies. A control tissue product was also formed from three plies. All the plies in the control tissue product were untreated.

A 1.8×1.1 inch rectangular portion each of the virucide treated tissue and the untreated tissue were inoculated with rhinovirus 2, ATCC VR-482 test virus. After 15 seconds of virus exposure, the virucide on the treated tissue was rapidly neutralized and the amount of surviving test virus was determined in each tissue. The virucide/amine-modified polysiloxane tissue exhibited a 3.6 log reduction in viable test virus compared to the untreated control tissue.

It should be readily understood by those persons skilled in the art that the present invention is susceptible of a broad utility and application. Many embodiments and adaptations of the present invention other than those herein described, as well as many variations, modifications and equivalent arrangements will be apparent from or reasonably suggested by the present invention and the foregoing description thereof, without departing from the substance or scope of the present invention.

Accordingly, while the present invention has been described herein in detail in relation to several embodiments, it is to be understood that this disclosure is only illustrative and exemplary of the present invention and is made merely for purposes of providing a full and enabling disclosure of the invention. The foregoing disclosure is not intended or to be construed to limit the present invention or otherwise to exclude any such other embodiments, adaptations, variations, modifications and equivalent arrangements, the present invention being limited only by the claims appended hereto and the equivalents thereof.

The invention claimed is:

1. A non-irritating, anti-microbial, multi-ply absorbent article comprising:

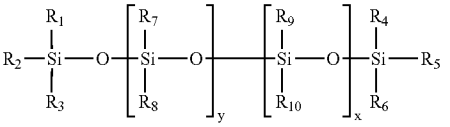
a plurality of plies, at least one of said plies defining an outer ply;

at least one of said plies having a surface defining an inner surface;

at least one siloxane composition applied to at least a portion of said at least one outer ply; and

an antimicrobially effective amount of at least one antimicrobial agent applied to said at least one inner surface;

wherein said at least one siloxane composition comprises at least one amine-modified polysiloxane selected from the group consisting of compounds having the formula:



wherein x and y are integers >0;

the mole ratio of x to (x+y) is from 0.005 percent to about 25 percent;

R_1, R_3, R_4, and R_6–R_9 are C_1 to C_6 alkyl substituents;

R_2 and R_5 are C_1 to C_6 alkyl, alkyl alcohol, or hydroxyl substituents; and

R_{10} is a moiety including at least one functional group selected from the group consisting of amines, imines, and amides.

2. The multi-ply absorbent article of claim **1**, wherein said plurality of plies comprises three plies.

3. The multi-ply absorbent article of claim **2**, wherein said three plies define two outer plies and an inner ply, respectively, and wherein a surface on said inner ply defines said inner surface.

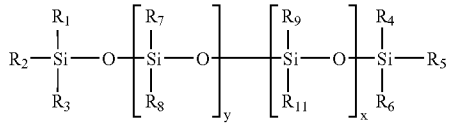
4. The multi-ply absorbent article of claim **2**, wherein said three plies define an outer ply, an inner ply, and a liquid-impermeable base ply, respectively, and wherein a surface on said inner ply defines said inner surface.

5. The multi-ply absorbent article of claim **1**, wherein said plurality of plies comprises at least two plies.

6. The multi-ply absorbent article of claim **5**, wherein each of said plies defines an outer ply, said plies each having two surfaces, and one of said surfaces on at least one of said plies defining said inner surface.

7. The multi-ply absorbent article of claim **1**, wherein R_{10} comprises at least one amine group.

8. The multi-ply absorbent article of claim **7**, wherein the amine-modified polysiloxane is blended with at least one other modified polysiloxane of the formula:



wherein x and y are integers >0;

the mole ratio of x to (x+y) is from 0.005 percent to about 25 percent;

R_1, R_3, R_4, and R_6–R_9 are C_1 to C_6 alkyl substituents;

R_2 and R_5 are C_1 to C_6 alkyl, alkyl alcohol, or hydroxyl substituents; and

R_{11} comprises at least one functional group selected from the group consisting of ethers, polyethers, esters, amines, imines, amides, and the alkyl and alkenyl analogues of such functional groups.

9. The multi-ply absorbent article of claim **8**, wherein R_{11} is of the general formula:

$$—R_{12}—(R_{13}—O)_a—(R_{14}—O)_b—R_{15};$$

wherein R_{12}, R_{13} and R_{14} are alkyl chains of C_1 to C_3, R_{15} is hydrogen or a C_1–C_4 alkyl group, and "a" and "b" are integers from 1–100.

10. The multi-ply absorbent article of claim **1**, wherein said at least one antimicrobial agent comprises at least one virucide.

11. The multi-ply absorbent article of claim **10**, wherein said at least one virucide comprises a carboxylic acid having the structure of R—COOH, wherein R is a radical selected from the group consisting of C_1–C_6 alkyl, carboxy C_1–C_6 alkyl, carboxyhydroxy C_1–C_6 alkyl, carboxy halo C_1–C_6 alkyl, carboxy dihydroxy C_1–C_6 alkyl, dicarboxyhydroxy C_1–C_6 alkyl, C_1–C_6 alkenyl, carboxy C_1–C_6 alkenyl, dicarboxy C_1–C_6 alkenyl, phenyl, and substituted phenyl radicals.

12. The multi-ply absorbent article of claim **1** formed as a facial tissue.

13. The multi-ply absorbent article of claim **1** formed as a bath tissue.

14. The multi-ply absorbent article of claim **1** formed as a paper towel.

15. The multi-ply absorbent article of claim **1** formed as a diaper.

16. The multi-ply absorbent article of claim **1** formed as a sanitary napkin.

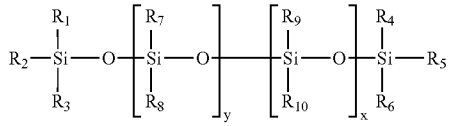
17. An absorbent article comprising:

a first outer ply, an inner ply, and a second outer ply;

at least one siloxane composition applied to an outward surface of said first and second outer plies; and

an antimicrobially effective amount of at least one antimicrobial agent applied to said inner ply;

wherein said at least one siloxane composition comprises at least one amine-modified polysiloxane selected from the group consisting of compounds having the formula:



wherein x and y are integers >0;

the mole ratio of x to (x+y) is from 0.005 percent to about 25 percent;

R_1, R_3, R_4, and R_6–R_9 are C_1 to C_6 alkyl substituents;

R_2 and R_5 are C_1 to C_6 alkyl, alkyl alcohol, or hydroxyl substituents; and

R_{10} is a moiety including at least one functional group selected from the group consisting of amines, imines, and amides.

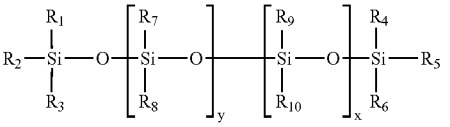
18. The absorbent article of claim **17**, wherein said at least one antimicrobial agent comprises at least one carboxylic acid.

19. A non-irritating, anti-microbial, multi-ply absorbent article comprising:

a plurality of plies, at least one of said plies defining an outer ply;

at least one of said plies having a surface defining an inner surface;

at least one siloxane composition applied to at least a portion of said at least one outer ply, wherein the at least one siloxane composition comprises at least one amine-modified polysiloxane selected from the group consisting of compounds having the formula:



wherein x and y are integers >0;

the mole ratio of x to (x+y) is from 0.005 percent to about 25 percent:

R1, R3, R4, and R6–R9 are C1 to C6 alkyl substituents;

R2 and R5 are C1 to C6 alkyl, alkyl alcohol, or hydroxyl substituents; and

R10 comprises at least one amine group; and

an antimicrobially effective amount of at least one antimicrobial agent applied to said at least one inner surface;

wherein the multi-ply absorbent article is formed as a facial tissue, a bath tissue, or a paper towel.

20. The multi-ply absorbent article of claim **19**, wherein the multi-ply absorbent article is formed as a facial tissue.

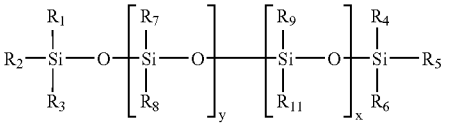
21. The multi-ply absorbent article of claim **19**, wherein the multi-ply absorbent article is formed as a bath tissue.

22. The multi-ply absorbent article of claim **19**, wherein the multi-ply absorbent article is formed as a paper-towel.

23. The multi-ply absorbent article of claim **19**, wherein said plurality of plies comprises three plies, wherein said three plies define two outer plies and an inner ply, respectively, and a surface on said inner ply defines said inner surface.

24. The multi-ply absorbent article of claim **19**, wherein said plurality of plies comprises two plies, wherein each of said plies defines an outer ply, said plies each having two surfaces, and one said surfaces on at least one of said plies defining said inner surface.

25. The multi-ply absorbent article of claim **19**, wherein said amine-modified polysiloxane is blended with at least one other modified polysiloxane of the formula:



wherein x and y are integers >0;

the mole ratio of x to (x+y) is from 0.005 percent to about 25 percent;

R_1, R_3, R_4, and R_6–R_9 are C_1 to C_6 alkyl substituents;

R_2 and R_5 are C_1 to C_6 alkyl, alkyl alcohol, or hydroxyl substituents; and

R_{11} comprises at least one functional group selected from the group consisting of ethers, polyethers, esters, amines, imines, amides, and the alkyl and alkenyl analogues of such functional groups.

26. The multi-ply absorbent article of claim **25**, wherein R_{11} is of the general formula:

$$—R_{12}—(R_{13}—O)_a—(R_{14}—O)_b—R_{15};$$

wherein R_{12}, R_{13} and R_{14} are alkyl chains of C_1 to C_3, R_{15} is hydrogen or a C_1–C_4 alkyl group, and "a" and "b" are integers from 1–100.

27. The multi-ply absorbent article of claim **19**, wherein at least one antimicrobial agent comprises at least one virucide.

28. The multi-ply absorbent article of claim **27**, wherein said at least one virucide comprises a carboxylic acid having the structure of R—COOH, wherein R is a radical selected from the group consisting of C_1–C_6 alkyl, carboxy C_1–C_6 alkyl, carboxyhydroxy C_1–C_6 alkyl, carboxy halo C_1–C_6 alkyl, carboxy dihydroxy C_1–C_6 alkyl, dicarboxyhydroxy C_1–C_6 alkyl, C_1–C_6 alkenyl, carboxy C_1–C_6 alkenyl, dicarboxy C_1–C_6 alkenyl, phenyl, and substituted phenyl radicals.

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