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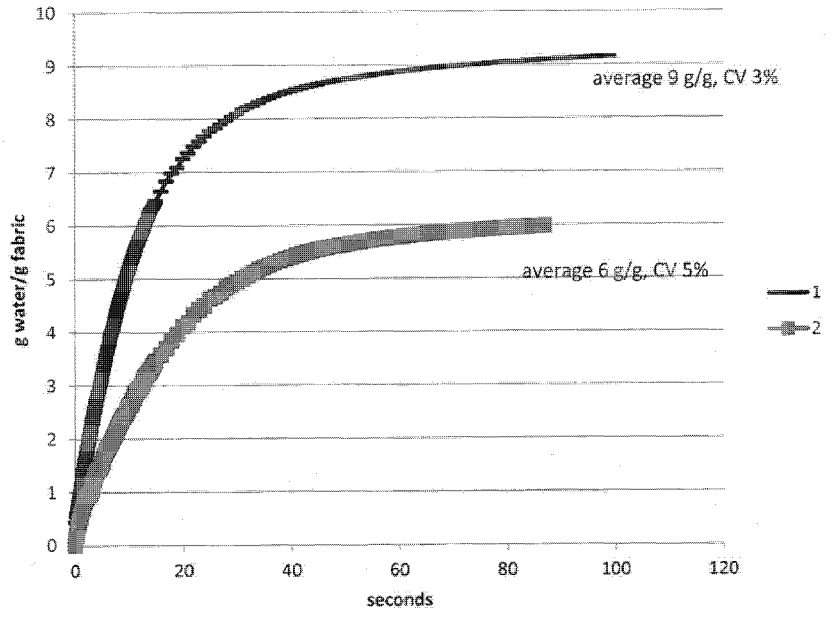
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(54) Title: A NONWOVEN WEB DESIGNED FOR USE IN A CLEANING AND DISINFECTING WIPE

Fig. 1:



(57) Abstract: This invention describes a nonwoven material for use in a cleaning and disinfecting wipe, containing at least a first cellulosic nonwoven web which (a) can be loaded with a cleaning and disinfecting solution, (b) has high wet strength and abrasion resistance, (c) is absorbent and able to dispense absorbed liquids uniformly, and (d) is compostable and based on renewable resources, characterized in that the cellulosic nonwoven web is made from essentially pure cellulose formed from essentially continuous filaments and multibonded by merged filaments, hydrogen bonding and physical intermingling of the filaments. Further described is the use of the inventive nonwoven material as a base sheet for the manufacture of a compostable cleaning and disinfecting wipe, such wipe being loaded with a cleaning and disinfecting solution. Further described is a compostable cleaning and disinfecting wipe, containing (a) a nonwoven material as a base sheet and (b) a cleaning and disinfecting solution.

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A nonwoven web designed for use in a cleaning and disinfecting wipe

This invention relates to a nonwoven material suitable to be used as the base sheet for a cleaning and disinfecting wipe, and, more particularly, to an essentially pure cellulose nonwoven web formed from essentially continuous filaments and multibonded by merged filaments, hydrogen bonding and physical intermingling of the filaments, providing the dimensional stability, hard surface cleaning ability, disinfectant and cleaning solution holding capacity and ability to release said solutions during use. This invention further relates to additional bonding of this web alone, or to other webs or materials through hydroentangling to enhance these key performance properties needed in a cleaning and disinfecting wipe.

The term "essentially pure cellulose" shall address the fact that cellulosic moulded bodies, e.g. made according to the lyocell process, always contain a small amount of polymers other than cellulose, namely hemicellulose. This does not influence in any way the suitability for the use according to this invention.

Prior Art

The use of nonwovens in cleaning and disinfecting wipes is well known. U.S. 4,448,704 discloses the use of paper, textile or nonwoven substrates for cleaning wipes. U.S. 4,666,621 describes the use of a chemically bonded nonwoven for use a cleaning wipe substrate. U.S. 4,659,609 describes the use of meltblown thermoplastic nonwovens for use in cleaning wipes. U.S. 7,517,556 teaches the use of a surface coated nonwoven substrate with a basis weight less than 300 grams/metre^2 for use as a cleaning wipes substrate. U.S.7,696,109 and U.S. 7,947,613 describe a low density nonwoven used in cleaning wipes, in order to more uniformly dispense cleaning chemicals to a surface. U.S. 7,091,140 and U.S. 7,455,200 describe a product ("Spinlace") which hydroentangles spunlaid thermoplastic nonwovens with absorbent cellulosic webs to form a high strength, high abrasion resistant cleaning wipe.

The nonwoven substrate for cleaning and disinfecting wipes has been the subject of much research and even today is not an optimal product. A cleaning and disinfecting wipe must both clean and disinfect; this requires a material with high wet strength as well as high abrasion resistance and must drape well to meet consumer expectations, must be able to hold sufficient cleaning and disinfecting solution, and must dispense this solution evenly over a sufficient area. Additionally, this substrate must be able to remove contaminants from the surface, and should not streak or leave a visible residue on the cleaned surface. Cost and sustainability are also important issues.

Most of the previous technology has addressed one or more of these issues, but not all. U.S. 4,666,621 provides strength and absorbency, but abrasion resistance is minimal and the chemical binder leaves a visual residue on the cleaned surface. U.S. 4,659,609 provides strength and abrasion resistance, with no residue to cause streaks, but its thermoplastic composition minimizes liquid holding capacity and dispensing consistency. U.S. 7,517,556 adds an abrasive coating to an absorbent nonwoven, but this coating affects dispensing ability and drape, while negatively impacting cost. Finally, U.S. 7,091,140 and U.S. 7,455,200 describe the commercially preferred nonwoven technology used today for cleaning and disinfecting wipes: A composite structure of absorbent cellulosic material with a spunlaid thermoplastic nonwoven on the surface. The spunlaid provides abrasion resistance, cleaning ability, and strength, while the cellulosic web provides liquid holding capacity. There are no residual materials to leave streaks. But the spunlaid thermoplastic cannot hold liquids and must be added incrementally above the weight of cellulosic material required for this. This adds cost. The spunlaid thermoplastic nonwoven has an undesirable feel to the consumer, even wet. Spunlaid thermoplastics are based on petroleum or natural gas, non-renewable resources and are not biodegradable or compostable. A growing global concern about micro-plastic particles contaminating the environment further negatively impacts this product's sustainability.

The present invention relates to the use of specially designed nonwoven substrates produced using novel variants of the spunlaid nonwoven process, comprising 100% cellulose polymers. There are known methods and products using spunlaid cellulose webs. U.S. 6,358,461, U.S. 7,067,444, U.S. 8,012,565, U.S. 8,191,214, U.S. 8,263,506 and U.S. 8,318,318 all teach methods for producing and using spunlaid cellulose webs. But none of these teach either production methods for or products addressing the specific substrate requirements for cleaning and disinfecting wipes

Problem

Traditionally, cleaning and disinfecting wipes have consisted of a substrate (either paper, textile or nonwoven) and a cleaning solution (either pre-loaded or applied separately). These cleaning solutions are mainly aqueous solutions containing quaternary ammonium salts.

While the more traditional method of using a paper towel and a separately sprayed cleaning and disinfecting solution is still widely used, consumers and even institutions prefer the convenience, time (and cost) savings as well as the consistency of preloaded pre-moistened wipes.

Paper towels and sprayed cleaning and disinfecting solutions combine a substrate with poor wet strength, abrasion resistance and absorbency with a solution application which has neither consistency nor any method of applying the correct amount to a surface.

Preloaded pre-moistened cleaning and disinfecting wipes remove much of the uncertainty. The correct amount of solution is added to each wipe. The substrate has higher absorbency and wet strength than a paper towel.

The problem with current wipe technology is that there are several key values needed which require opposing properties. For example, more absorbent materials are typically lower strength; higher liquid holding capacity materials are usually inefficient at dispensing liquid solutions evenly; abrasion resistant materials are usually not absorbent; strong materials are usually stiff; strong

and abrasion resistant materials are usually expensive and not regarded as sustainable.

A wide variety of nonwovens are used as substrate for cleaning and disinfecting wipes, including airlaid, spunlace, carded, needlepunch and spunlaid. The best technology today and the most widely used substrate commercially by far is spunlace. Two separate variants are widely used; standard spunlace and spunbond/pulp (SP) spunlace.

Standard spunlace uses carded webs as precursors; these carded webs are formed, and then bonded using high pressure water jets (i.e. hydroentangled). For cleaning and disinfecting wipes, most products use two carded staple length fibres, one hydrophobic for dimensional stability and abrasion resistance, and one hydrophilic for absorbency. Standard spunlace is very widely available with consistent quality, and is widely used in cleaning and disinfecting wipes for this reason. This is a compromise product, with minimally acceptable wet strength, abrasion resistance, absorbency, liquid dispensing properties and is usually not biodegradable or compostable nor based 100% on renewable resources.

Spunbond/pulp (SP) spunlace is the product of choice and considered "state of the art" for cleaning and disinfecting wipe substrate, but is limited in availability and consistent quality is often lacking. This product combines a pre-manufactured spunlaid nonwoven with a pre-formed cellulose web (either airlaid or wetlaid), then bonds them together using high pressure water jets (hydroentangling). These products add spunlaid thermoplastic nonwoven to the surface to add abrasion resistance, but at the expense of absorbency capacity, drape and cost as well as sustainability. They use a cellulose web for absorbency, but at the expense of strength and abrasion resistance. This is another compromise product, but at an overall higher level in most important properties needed for a cleaning and disinfecting wipe.

There is a distinct need for a sustainable product at a reasonable cost with high wet strength, abrasion resistance, liquid dispensing capability,

absorbency capacity, no residual chemicals/streaks, and consumer pleasing drape.

Description

It is the object of the present invention to provide a nonwoven material for use in a cleaning and disinfecting wipe, containing at least a first cellulosic nonwoven web which (a) can be loaded with a cleaning and disinfecting solution, (b) has high wet strength and abrasion resistance, (c) is absorbent and able to dispense absorbed liquids uniformly, and (d) is compostable and based on renewable resources, wherein the cellulosic nonwoven web is made from essentially pure cellulose formed from essentially continuous filaments and multibonded by merged filaments, hydrogen bonding and physical intermingling of the filaments.

Such a nonwoven material to be used as a cleaning and disinfecting wipe substrate is designed to be a sustainable and cost effective nonwoven with high wet strength, abrasion resistance, absorbency, uniform liquid dispensing, consumer pleasing drape, and no residual chemicals/streaks. This nonwoven material will provide both high strength and high absorbency and liquid handling properties, and is a sustainable product.

The degree of merged filament bonding also results in a range of filament diameters and cross-sections being present. This characteristic enables additional cleanability versus nonwoven webs with a tight range of fiber and/or filament diameters.

Preferably the inventive nonwoven material is further bonded or treated by a hydroentanglement process. It surprisingly still has acceptable consumer acceptable drape and softness while it still can be loaded with a cleaning and disinfecting solution, has high wet strength and abrasion resistance, is absorbent and dispenses absorbed liquids uniformly, and is compostable and based on renewable resources.

The first cellulosic nonwoven web is preferably made according to a lyocell process.

Cellulosic fibres can be produced by various processes. In one embodiment a lyocell fibre is spun from cellulose dissolved in N-methyl morpholine N-oxide (NMMO) by a meltblown process, in principle known from e.g. EP 1093536 B1, EP 2013390 B1 and EP 2212456 B1. Where the term meltblown is used it will be understood that it refers to a process that is similar or analogous to the process used for the production of synthetic thermoplastic fibres (filaments are extruded under pressure through nozzles and stretched to required degree by high velocity/high temperature extension air flowing substantially parallel to the filament direction), even though the cellulose is dissolved in solution (i.e. not a molten thermoplastic) and the spinning & air temperatures are only moderately elevated. Therefore the term "solution blown" may be even more appropriate here instead of the term "meltblown" which has already become somewhat common for these kinds of technologies. For the purposes of the present invention both terms can be used synonymously. In another embodiment the web is formed by a spun bonding process, where filaments are stretched via lower temperature air. In general, spunbonded synthetic fibres are longer than meltblown synthetic fibres which usually come in discrete shorter lengths. Fibres formed by the solution blown lyocell process can be continuous or discontinuous depending on process conditions such as extension air velocity, air pressure, air temperature, viscosity of the solution, cellulose molecular weight and distribution and combinations thereof.

In one embodiment for making a nonwoven web the fibres are contacted with a non-solvent such as water (or water/NMMO mixture) by spraying, after extrusion but before web formation. The fibres are subsequently taken up on a moving foraminous support to form a nonwoven web, washed and dried.

Freshly-extruded lyocell solution ('solvent spun', which will contain only, for example, 5-15% cellulose) behaves in a similar way to 'sticky' and deformable thermoplastic filaments. Causing the freshly-spun filaments to contact each other while still swollen with solvent and with a 'sticky' surface under even low pressure will cause merged filament bonding, where molecules from one

filament mix irreversibly with molecules from a different filament. Once the solvent is removed and coagulation of filaments completed, this type of bonding is impossible.

It is another object of the present invention to provide a process for the manufacture of a nonwoven material consisting of essentially continuous cellulosic filaments by:

a. Preparation of a cellulose-containing spinning solution

b. Extrusion of the spinning solution through at least one spinneret containing closely-spaced meltblown jet nozzles

c. Attenuation of the extruded spinning solution using high velocity air streams,

d. Forming of the web onto a moving surface [e.g. a perforated belt or drum],

e. Washing of the formed web

f. Drying of the washed web

wherein in step c. and/or d. coagulation liquor, i.e. a liquid which is able to cause coagulation of the dissolved cellulose; in a lyocell process this preferably is water or a diluted solution of NMMO in water, is applied to control the merged filament bonding. The amount of merged filament bonding is directly dependent on the stage of coagulation of the filaments when the filaments come into contact. The earlier in the coagulation process that the filaments come into contact, the greater the degree of filament merging that is possible. Both placement of the coagulation liquor application and the speed at which the application liquor is applied can either increase, or decrease, the rate of coagulation. Which results in control of the degree (or amount) of merged filament bonding that occurs in the material.

Preferably the merged filament bonding is further controlled by filament spinning nozzle design and arrangement and the configuration and temperature of filament extension air. The degree of molecular alignment that is present as the solution exits the spinning nozzle has an impact on the coagulation rate. The more aligned the molecules are, the faster the coagulation rate, and conversely, the less aligned the molecules are, the slower the coagulation rate. The spinning nozzle design and arrangement,

along with the molecular weight of the cellulosic raw material used will determine the starting coagulation rate at the exit of the spinning nozzle. Additionally, the rate of cooling (temperature decrease) of the solution upon spinning nozzle exit will impact the coagulation rate as well. The slower the cooling rate, the slower the coagulation rate, and conversely, the faster the cooling rate, the faster the coagulation rate. Therefore, configuration of the filament extension air can directing impact the cooling rate and therefore, impact the coagulation rate, which impacts the achievable amount of merged filament bonding that is possible.

In a preferred embodiment of the process according to the invention at least two spinnerets (also known as jets), preferably between two and ten, and further preferred between 2 and 6, each one arranged to form a layer of nonwoven web, are used to obtain a multilayer nonwoven material. By applying different process conditions at the individual spinnerets it is even possible to obtain a multilayer nonwoven material wherein the individual layers have different properties. This may be useful to optimize the nonwoven material according to the invention for different applications. In one embodiment this could provide a gradient of filament diameters from one side of the material to the other side by having each individual web having a standard filament diameter that is less than the web on top, it is possible to create a material suitable for use as an air filter media that will provide a gradient of pore size (particle size capture). This will provide an efficient filtration process and result in a lower pressure drop across the filter media compared to a single web with similar characteristics at the same basis weight and pore size distribution.

Preferably the filaments are spun using a solution of cellulose in an aqueous amine oxide and the coagulation liquor is water, preferably with a content of amine oxide not being able to dissolve cellulose, also referred to as a lyocell process; the manufacture of such a solution is in principle known, e.g. from U.S. 6,358,461, U.S. 7,067,444, U.S. 8,012,565, U.S. 8,191,214, U.S. 8,263,506 and U.S. 8,318,318; preferably the amine oxide is NMMO.

The present invention describes a cellulosic nonwoven web produced via a meltblown or spunbond-type process. The filaments produced are subjected to touching and/or compaction and/or intermingling at various points in the process, particularly before and during initial web formation. Contact between filaments where a high proportion of solvent is still present and the filaments are still swollen with said solvent causes merged filament bonding to occur. The amount of solvent present as well as temperature and contact pressure (for example resulting from extension air) controls the amount of this bonding.

In particular the amount of filament intermingling and hydrogen bonding can be limited by the degree of merged filament bonding. This is the result of a decrease in filament surface area and a decrease in the degree of flexibility of the filaments. For instance, as the degree of merged filament bonding increase, the amount of overall surface area is decreased, and the ability of cellulose to form hydrogen bonds is directly dependent on the amount of hydroxyl groups present on the cellulosic surface. Additionally, filament intermingling happens as the filaments contact the forming belt. The filaments are traveling at a faster rate of speed than the forming belt. Therefore, as the filament contacts the belt, it will buckle and sway side to side, and back and forth, just above the forming belt. During this buckling and swaying, the filaments will intermingle with neighboring filaments. If the filaments touch and merge prior to the forming belt, this limits the number of neighboring filaments by which it can intermingle with. Additionally, filaments that merge prior to contacting the forming belt with not have the same degree of flexibility as a single filament and this will limit the total area over which the filament will buckle and sway.

Surprisingly, it has been found that high levels of control of filament merging can be achieved by modifying key process variables. In addition, physical intermingling of at least partially coagulated cellulose filaments can occur after initial contact with non-solvent, particularly at initial filament laydown to form the web. It arises from the potential of the essentially continuous filaments to move laterally during initial filament formation and initial laydown. Degree of physical intermingling is influenced by process conditions such as residual

extension air velocity at the foraminous support (forming belt). It is completely different from the intermingling used in production of webs derived from cellulose staple fibers. For staple fibers, an additional process step such as calendaring is applied after the web has been formed. Filaments which still contain some residual solvent are weak, tender and prone to damage. Therefore, in combination with controlling degree and type of bonding at this stage, it is essential that process conditions are not of a type which could cause filament and web damage. Initial drying of the washed but never-dried nonwoven, together with optionally compacting, will cause additional hydrogen bonding between filaments to develop. Modifying temperature, compacting pressure or moisture levels can control the degree of this hydrogen bonding. Such treatment has no effect on intermingling or the merged filament bonding.

In a preferred embodiment of the invention the nonwoven material is dried prior to subsequent bonding/treatment.

In a preferred embodiment of the invention the percentage of each type of bonding is controlled using a process with up to two compaction steps, where one of these compaction steps is done after step d. of the inventive process where the spun filaments are still swollen with a solvent, and one of these compaction steps is done before or in step e. of the inventive process where all or most of the solvent has been removed and the web has been wet with water. As previously discussed, control of the coagulation of the spun solution is a factor in controlling the degree of merged filament bonding. This preferred embodiment concerns decreasing the coagulation rate to a state where additional compaction steps can be used after filament laydown to further increase the actual amount of merged filament boding that is achievable. It might be helpful to view the maximum achievable filament bonding as the state where we have merged all filaments into an essentially film-like structure.

The present invention describes a process and product where merged filament bonding, physical intermingling and hydrogen bonding can be controlled independently. However, the degree of merged filament bonding

can limit the degree of physical intermingling and hydrogen bonding that can occur. In addition, for the production of multi-layer web products, process conditions can be adjusted to optimise these bonding mechanisms between layers. This can include modifying ease of delamination of layers, if required.

In addition to merged filament, intermingling and hydrogen bonding being independently set as described above, additional bonding/treatment steps may optionally be added. These bonding/treatment steps may occur while the web is still wet with water, or dried (either fully or partially). These bonding/treatment steps may add additional bonding and/or other web property modification. These other bonding/treatment steps include hydroentangling or spunlacing, needling or needlepunching, adhesive or chemically bonding. As will be familiar to those skilled in the art, various post-treatments to the web may also be applied to achieve specific product performance. By contrast, when post-treatments are not required, it is possible to apply finishes and other chemical treatments directly to the web of this invention during production which will not then be removed, as occurs with, for example, a post-treatment hydroentanglement step.

Varying the degree of merged filament bonding provides unique property characteristics for nonwoven cellulose webs with regards to softness, stiffness, dimensional stability and various other properties. Properties may also be modified by altering the degree of physical intermingling before and during initial web formation. It is also possible to influence hydrogen bonding, but the desired effect of this on web properties is minor. Additionally, properties can be adjusted further by including an additional bonding/treatment step such as hydroentangling, needlepunching, adhesive bonding and/or chemical bonding. Each type of bonding/treatment provides benefits to the nonwoven web. For example, hydroentangling can add some strength and soften the web as well as potentially modifying bulk density; needling is typically employed for higher basis weights and used to provide additional strength; adhesive and chemical bonding can add both strength and surface treatments, like abrasive material, tackifiers, or even surface lubricants.

The present invention allows independent control of the key web bonding features: merged filaments, intermingling at web formation, hydrogen bonding and optional additional downstream processing. Manipulation of merged filament bonding can be varied to predominantly dictate the properties of the nonwoven web.

In a further preferred embodiment of the invention the nonwoven material contains a second layer, consisting of a cellulosic nonwoven web, which is essentially formed of essentially continuous filaments, pulp fiber or staple fiber, is formed on top of the first cellulosic nonwoven web, and subsequently both layers are hydroentangled together. One useful advantage of two layers is that one layer can be higher density, and have a more abrasive surface and clean a surface better ("scrubby layer") while the other is lower density, and more absorbent ("absorbent layer"). Another useful advantage of a dual-layer structure is that one layer can be designed to provide the tensile strength, while another layer can be designed to provide the absorbency, cleanability, or other desired attribute.

In a further preferred embodiment of the invention the nonwoven material contains a third layer, consisting of a cellulosic nonwoven, which is essentially formed of essentially continuous filaments, pulp fiber or staple fiber, is formed on top, and subsequently all three layers are hydroentangled together Here, another useful advantage is to have one outer layer as high density for cleaning a surface ("scrubby layers"), another outer layer to have a high surface area for excellent active ingredient distribution with the center layer designed to have a high absorbent capacity.

In especially preferred embodiments of the invention one or more of the cellulosic nonwoven layers within the nonwoven material, if formed of essentially continuous filaments, are made according to a lyocell process. As known to an expert in the art, the lyocell process allows for use of a sustainable raw material (pulp) and provides a final filament with high purity (very low residual chemicals).

In particularly preferred embodiments of a two-layer material according to the invention either both layers consist of essentially continuous filaments, made according to a lyocell process, or one layer consist of essentially continuous filaments, made according to a lyocell process, and the second layer consist of pulp fiber.

In particularly preferred embodiments of a three-layer material according to the invention either all three layers consist of essentially continuous filaments, made according to a lyocell process, or the two outer layers consist of continuous filaments, made according to a lyocell process, and the middle layer consist of pulp fiber.

In a further preferred embodiment of the invention the nonwoven material contains a surface treatment chemical to improve the release of a preloaded cleaning lotion. This surface treatment chemical can be applied to any of the cellulosic web layers. It can be applied either to a layer before combining it with the other layer or layers or it can be applied to the material once all cellulosic web layers are combined. These surface treatments would consist of any chemistry that is designed to alter the polarity, or the ionic charge of the cellulosic filament and/or fiber surface and also designed to be compatible with the disinfecting and cleaning lotion. In particular suitable are the following substances: Chitosan, polyamide-epichlorhydrine resin, polyamide resin, melamine resin, polyaluminium chloride, polyaluminium chlorohydrate, polyaluminium sulfate, polyamine including a backbone comprising a cationic amine group. All disinfecting wipes contain both active and inert ingredients in their lotions. The active ingredients are the disinfecting chemicals. The most commonly used active ingredient chemicals today are quaternary ammonium compounds, alcohols, sodium hypochlorite and hydrogen peroxide. These are used either alone or in combination. An example for a commercially used composition is 0.184% n-alkyl (C_{14}, 60% C_{16}, 30% C_{12}, 5% C_{18}, 5%) dimethyl benzyl ammonium chloride plus 0.184% n-alkyl (C_{14}, 32% C_{12}, 68%) dimethyl ethyl benzyl ammonium chloride as its active disinfectant. Another example for a commercially used composition is 0.26% n-alkyl (C_{14}, 50% C_{16}, 10% C_{12}, 40%) dimethyl benzyl ammonium chloride as its active

disinfectant. Inert ingredients include buffers, pH adjusters, fragrances, emollients, surfactants, and water. These active ingredients can have a polarity, or ionic charge, that can be attracted to the cellulosic filament and/or fiber surface. The chemical treatment would be designed to alter the cellulosic filament and/or fiber surface such that the polarity and/or ionic charge are 0, or that they are opposite to that of the active ingredients. This will maximize the ability of the nonwoven material to release the active ingredient to the surface that is being cleaned and disinfected. It is known to one experienced in the art, that while the disinfectant or antimicrobial can kill the microbes responsible for compostability in very localized areas, they are rapidly deactivated in excess soil or moisture, and then will decompose normally, which still allows the nonwoven material to be biodegradable and compostable.

It is another object of the present invention to use the nonwoven material as described above as a base sheet for the manufacture of a compostable cleaning and disinfecting wipe, such wipe being loaded with a cleaning and disinfecting solution. Suitable solutions are in principle well known to the expert. That wipe can be packaged wet and ready for use. This provides a convenience product to the end consumers for quick cleaning and disinfecting of surfaces. Further that wipe has high wet strength and abrasion resistance, is absorbent and dispenses absorbed liquids uniformly and is based on renewable resources.

Still another object of the present invention is to provide a compostable cleaning and disinfecting wipe, containing (a) a nonwoven material according to the above description as a base sheet and (b) a low moisture content cleaning and disinfecting solution. Suitable solutions are in principle well known to the expert. That wipe can be packaged dry and water activated just prior to use. This gives remarkable economic and handling advantages to the retailers as well as to the end consumers. Further that wipe has high wet strength and abrasion resistance, is absorbent and dispenses absorbed liquids uniformly and is based on renewable resources.

In a preferred embodiment of the invention the nonwoven material of the compostable cleaning and disinfecting wipe is further bonded or treated by a hydroentanglement process. Undergoing this additional process enables a greater range of wipe functionality design. Such attributes as thickness, drape, softness, strength and aesthetic appearance can be tailored to meet specific wipe requirements.

The invention will now be illustrated by examples. These examples are not limiting the scope of the invention in any way. The invention includes also any other embodiments which are based on the same inventive concept.

Examples

All samples discussed below were conditioned at 23°C (±2°C) and 50% (±5%) relative humidity for 24 hours.

Example 1:

A 50 gram/square meter, one-layer nonwoven material composed of 100% essentially continuous filament cellulose being bonded by merged filaments, filament intermingling and hydrogen bonding, further subjected to a hydroentanglement step, made according to the process described in EP 2 013 390 B1, is preloaded with a cleaning and disinfecting solution. This essentially continuous filament cellulose nonwoven has the absorbency of conventional cellulose based nonwovens with the strength of a spunlaid nonwoven. It also comprises a broad range of filament diameter distribution and cross sections.

To show the potential of the newly developed product an in-house cleanability test was performed. For this the 50 gsm basis weight cellulosic sample of the invention was compared with a commercial disinfecting web of same basis weight being comprised of hydroentangled spunbond polypropylene and wetlaid pulp.

Both samples were conditioned at 23°C (±2°C) and 50% (±5%) relative humidity and wetted with water 3-fold (equilibrium time 2 h). Then they were

used in MD for a wiping test picking up Nutella from a plastic foil (spread 8x8cm, layer thickness 0.5mm). The wiping equipment simulates a real wiping movement with 550 g wiping pressure. Tests were repeated three times to obtain a representative average.

The results showed that the product of the invention achieved 35 % higher cleanability rate than the commercial product, with result CV below 5%

Equipment detail:
Cleanability tester for wipes, „Wischtester Fasertücher 2013“, Type S03003-001, Mach.-Nr.: 001, Art.Nr.: 84311, Year built: 12/2013
from SOMA Sondermaschinen u. Werkzeugbau GmbH
Software: SMATECH Sondermaschinen & Automatisierungstechnik

Example 2:
The 50 gsm nonwoven material of the invention described in example 1 was further analyzed for water uptake and water delivery versus the commercial product of example 1.

Water uptake was measured using an ATS (Absorbency Testing System ATS-600, of Sherwood Instruments, Inc., Lynnfield, USA). With that the test sample (sample size round, diameter 5 cm, conditioned at 23°C (±2°C) and 50% (±5%) relative humidity) is supplied with water from the bottom and water taken up by the sample without having any hydrostatic pressure is evaluated. The measurement for each sample is stopped when the amount of water taken up is below 0.005g/20sec.

Fig. 1 shows the water uptake speed, average of 5 measurements. Sample 1 is cellulosic, nonwoven material of the invention; sample 2 is the commercial sample (spunbond polypropylene, wetlaid pulp and hydroentangled) for comparison. In Fig. 1 it can be seen that the fabric of the invention has a much faster average liquid uptake and levels off at a higher average end value than the commercial sample.

The same nonwoven web samples were tested using the cleanability device explained in example 1 to assess their water delivery to a plastic foil during wiping movement, giving an indication about delivery of water based disinfecting lotions to surface. For this purpose the same settings as in example 1 were used and wiping was performed with a wet wipe (3 fold loaded with water, equilibrium time 2 hours), over a clean plastic foil and the transferred water to foil was evaluated gravimetrically. The test was carried out three times per sample. The sample fabric of the invention delivered the same amount of water to the plastic foil as the commercial spunbond polypropylene, wetlaid pulp and hydroentangled sample.

The test demonstrates that on one hand the fabric of the invention shows superior liquid uptake properties, giving fast converting speeds, and on the other hand it retains the ability to deliver liquid to surfaces which is important for the disinfecting process.

Example 3

In this example, a 65 gram/square meter nonwoven material of the invention, also manufactured in accordance with EP 2 013 390 B1, is hydroentangled and preloaded with a cleaning and disinfecting solution. The fabric of the invention has added drape and softness without sacrificing strength or absorbency properties.

Example 4

In this example, a composite nonwoven material consisting of the nonwoven web of the invention, also manufactured in accordance with EP 2 013 390 B1 plus a pulp web are hydroentangled. This provides lower cost without sacrificing strength or absorbency properties of the nonwoven material.

Example 5

In this example, a 65 gram/square meter nonwoven material of the invention with or without hydroentangling is coated with a surface treatment chemical (also called a “release agent”) designed to release the active cleaning and

disinfecting chemicals from the wipe's lotion, providing consistent active ingredient delivery. Surprisingly this was achieved without sacrificing absorbency properties, strength, drape or softness.

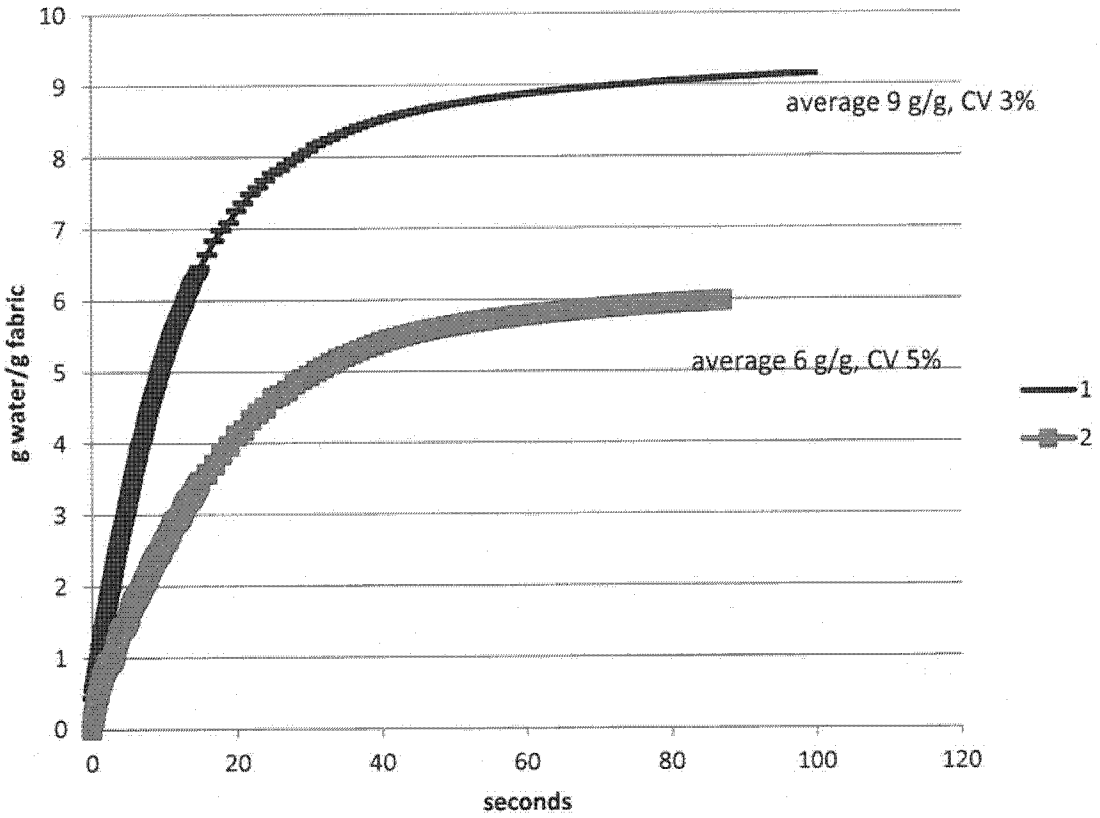
5

Claims

1. A nonwoven material for use in a cleaning and disinfecting wipe, containing at least a first cellulosic nonwoven web, characterized in that the cellulosic nonwoven web is made from essentially pure cellulose formed from essentially continuous filaments and multibonded by merged filaments, hydrogen bonding and physical intermingling of the filaments.
2. The nonwoven material of Claim 1 that is further bonded or treated by a hydroentanglement process.
3. The nonwoven material of Claim 1 where the first cellulosic nonwoven web is made according to a lyocell process.
4. The nonwoven material of Claim 1, where a second cellulosic nonwoven web, which is formed of essentially continuous filaments, pulp fiber or staple fiber, is formed on top of the first cellulosic nonwoven web and subsequently both layers are hydroentangled together.
5. A nonwoven material according to claim 1, wherein the number of layers is at least two, preferably between two and ten, with a further preferred range from 2 to 6.
6. The nonwoven material of Claim 5, where the layers are formed of essentially continuous filaments, pulp fiber or staple fiber, and subsequently all layers are bonded together bonded together using merged filament bonding, hydrogen bonding and filament intermingling.
7. The nonwoven material of Claim 5, where the layers are formed of essentially continuous filaments, pulp fiber or staple fiber, and subsequently all layers are hydroentangled together.
8. The nonwoven material of Claim 4 or 5, where one or more of the cellulosic nonwoven layers within the nonwoven material, if formed of essentially continuous filaments, are made according to a lyocell process.
9. The nonwoven material of any of claims 1 to 8, containing a surface treatment chemical to improve the release of a preloaded cleaning lotion.
10. Use of the nonwoven material of claim 1 as a base sheet for the manufacture of a compostable cleaning and disinfecting wipe, such wipe being loaded with a cleaning and disinfecting solution.

11. A compostable cleaning and disinfecting wipe, containing (a) a nonwoven material according to claim 1 as a base sheet and (b) cleaning and disinfecting solution.

Fig. 1:


10
9
8
7
6
5
4
3
2
1
0
g water/g fabric
0
20
40
60
80
100
120
seconds
average 9 g/g, CV 3%
average 6 g/g, CV 5%
1
2

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION**	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
PL0598-WO		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/AT2017/000021	3 April 2017 (03-04-2017)	
Applicant		
LENZING AG		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 4 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**
   a. With regard to the **language,** the international search was carried out on the basis of:
      [X] the international application in the language in which it was filed
      [ ] a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))
   b. [ ] This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).
   c. [ ] With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. [ ] **Certain claims were found unsearchable** (See Box No. II)

3. [ ] **Unity of invention is lacking** (see Box No III)

4. With regard to the **title,**
   [X] the text is approved as submitted by the applicant
   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**
   [X] the text is approved as submitted by the applicant
   [ ] the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the **drawings,**
   a. the figure of the **drawings** to be published with the abstract is Figure No. 1
      [ ] as suggested by the applicant
      [X] as selected by this Authority, because the applicant failed to suggest a figure
      [ ] as selected by this Authority, because this figure better characterizes the invention
   b. [ ] none of the figures is to be published with the abstract

INTERNATIONAL SEARCH REPORT

International application No
PCT/AT2017/000021

A. CLASSIFICATION OF SUBJECT MATTER
INV. D04H1/4258 A47L13/17 B08B1/00 B32B5/02 B32B5/26
D04H1/4374 D04H1/485 D04H1/56 D04H3/013 D04H3/11
C11D17/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D04H A47L B08B B32B C11D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2007/124521 A1 (CHEMIEFASER LENZING AG [AT]; WHITE PAT [GB]; HARMS HAIO [AT]; HAYHURST) 8 November 2007 (2007-11-08)	1-8,10, 11
Y	claims 1,14, 19-22 page 2, line 5 - page 3, line 6 page 5, line 4 - line 17 page 6, line 1 - line 12	9
X	WO 2009/105490 A1 (SELLARS ABSORBENT MATERIALS INC [US]; SELLARS WILLIAM R [US]) 27 August 2009 (2009-08-27)	1-8
Y	paragraphs [0024] - [0026]; claim 10; figures 1, 3	9
X	US 2010/167029 A1 (LUO MENGKUI [US]) 1 July 2010 (2010-07-01)	1-5,7,8
Y	paragraphs [0021] - [0022] paragraphs [0036] - [0038]	9

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 October 2017	20/10/2017

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Beckert, Audrey

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/AT2017/000021

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2009/324926 A1 (LUO MENGKUI [US]) 31 December 2009 (2009-12-31)	1-5,7,8
Y	paragraph [0021] paragraphs [0018] - [0019], [0033] paragraph [0012] -----	9
Y	WO 2004/001128 A1 (AHLSTROM WINDSOR LOCKS LLC [US]; ANNIS VAUGHAN RICHARD [US]; CLINE MEL) 31 December 2003 (2003-12-31) the whole document -----	9

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/AT2017/000021

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		EP 1540079 A1	15-06-2005
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