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(54) Title: A NONWOVEN WEB DESIGNED FOR USE IN AN INDUSTRIAL CLEANING WIPE

(57) Abstract: The object of this invention is a nonwoven material suitable for use in an industrial cleaning wipe, containing at least a first cellulosic nonwoven web which (a) has excellent cleanability, (b) has high wet strength and abrasion resistance, (c) is absorbent and able to dispense absorbed liquids uniformly, and (d) is biodegradable, compostable and based on renewable resources, wherein the cellulosic nonwoven web is made from essentially pure cellulose formed of essentially continuous filaments and multibonded by merged filaments, hydrogen bonding and physical intermingling of the filaments, the use of the inventive nonwoven material as a base sheet for the manufacture of a compostable industrial cleaning wipe. A further object of the invention is a compostable industrial cleaning wipe, that contains the inventive nonwoven material as a base sheet.



A nonwoven web designed for use in an industrial cleaning wipe

This invention relates to a nonwoven material suitable to be used as an industrial general purpose cleaning wipe, and, more particularly, to such a material containing at least an essentially pure cellulose nonwoven web formed of essentially continuous filaments and multibonded by merged filaments, hydrogen bonding and/or physical intermingling of filaments. This web provides the cleanability, dimensional stability, wet strength, abrasion resistance, solvent resistance and absorbency required by an industrial general purpose cleaning 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 industrial general purpose cleaning wipes is well known. U.S. 3,879,257 describes a cellulosic nonwoven described as double re-crepe, or DRC, bonded with a latex binder. Coform is a nonwoven combining meltblown polyolefin with wood pulp and is described in U.S. 4,818,464 and U.S. 4,100,324. U.S. 8,333,918 and U.S. 7,994,079 describe U.S. a 100% meltblown polyolefin nonwoven used for wipers. U.S. 7,194,788 describes a hydroentangled composite material containing both staple length fibers as well as meltblown polyolefin webs. JP 2014159662 describes a laminate of hydrophobic and hydrophilic nonwovens. WIPO WO2014094722 describes an airlaid pulp nonwoven used as a wiper.

There has been significant research in nonwovens for industrial cleaning wipes but the current technology is not yet optimal. Most of the current technology recognizes the need for absorbency of cellulosic material coupled with the abrasion resistance and strength of synthetic staple fibers or a meltblown nonwoven. Even for wipers which are supplied dry, most are used

with a cleaning solution that must be applied with the wiper, and then removed through absorption within the wiper. Otherwise, contaminated cleaning solution is merely moved around a surface, and then left on that same surface. Additionally, a biodegradable product produced in a sustainable
5 process is strongly desired.

Previous technology has addressed one or more of these issues, but not all. U.S. 3,879,257 describes a primarily wood pulp based wiper, but abrasion resistance and strength are only moderate and requires the use of a wet
10 strength adding polymeric latex binder, which also imparts non-biodegradability. U.S. 8,333,918 and U.S. 7,994,079 describe products based on meltblown polyolefins, which deliver excellent abrasion resistance, but little absorbency and liquid drying capability. These products are also not biodegradable. U.S. 4,818,464, U.S. 4,100,324, and U.S. 7,194,788
15 recognize the value of meltblown nonwovens for strength combined with cellulosic nonwovens for absorbency. However, meltblown polyolefin based nonwovens are not biodegradable; they also contribute very limited liquid absorbency.

20 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
25 methods for producing and using spunlaid cellulose webs. However, none of this prior art teaches production methods for, or products addressing the specific substrate requirements for industrial cleaning wipes.

Problem

30 Industrial cleaning wipes or wipers are typically based on paper, textiles or nonwovens. These substrates are used in combination with either an aqueous cleaning solution or solvent based cleaning fluid. Usually, the cleaning solution or fluid is applied to the surface, then the wipe is used to combine with the cleaning solution while applying cleaning force to the surface

and moving the cleaning fluid over the surface. A cleaning wipe or wiper must be able to clean a surface (cleanability); it should do so without abrading or deteriorating. Additionally no lint or wipe material should be left on a surface after cleaning. The wipe or wiper must not tear when wet and wiping a surface. Additionally, the wiper must be able to absorb and remove the spent or used cleaning solution. Finally, biodegradability of the wipe and a sustainable production process are desired.

The problem with current industrial cleaning wipe technology is that none addresses all of the needs. Several nonwoven types are used for industrial cleaning wipes. Meltblown polyolefin nonwoven based wipes address strength and abrasion resistance needs, but are not absorbent or biodegradable. Cellulosic fiber nonwoven based wipes, like wetlaid double recrepe or airlaid nonwovens, address absorbency and biodegradability needs, but fall short in strength and abrasion resistance. Composites (like coform or hydroentangled spunbond pulp) and laminates combining meltblown and cellulosic nonwovens are good compromises, providing average strength, abrasion resistance, and absorbency, with partial biodegradability. Still, an optimal solution is still not available.

There is a distinct need for a biodegradable, sustainably produced strong, abrasion resistant and absorbent nonwoven substrate with excellent cleanability for use in industrial cleaning wipes.

Description

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

The nonwoven material according to the invention is used in an industrial cleaning wipe that is designed to be a biodegradable, compostable and sustainable nonwoven with excellent cleanability, high strength, high abrasion resistance, high absorbency, and 100% biodegradability. The nonwoven web which is a 100% essentially continuous filament cellulose nonwoven will provide both high strength/abrasion resistance and high absorbency, and as a sustainable product, produced using an environmentally sound process.

Compared to nonwoven substrates based on meltblown polyolefins, the present invention is more absorbent and biodegradable and sustainably produced.

Compared to nonwoven substrates based on cellulosic fibers, the present invention has superior strength and abrasion resistance, with comparable absorbency, biodegradability and sustainability.

Compared to composites, including those of hydroentangled combinations of meltblown polyolefins with cellulose materials, the present invention has equivalent strength, superior cleanability, liquid take up rate, and overall absorbency.

The degree of merged filament bonding also results in a wider 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 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.

5 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
 - 10 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
- 15 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
- 20 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
- 25 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

30 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 directly 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
5 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
10 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
15 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
20 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 will not have the same degree of flexibility as a single filament and this will limit the total area over which the filament will
25 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
30 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
5 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
10 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.

15 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
20 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
25 additional compaction steps can be used after filament laydown to further increase the actual amount of merged filament bonding 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.

30 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.

5 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
10 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
15 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,
20 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
25 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
30 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 formed of essentially continuous filaments, pulp fiber or staple fiber, which 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 formed of essentially continuous filaments, pulp fiber or staple fiber, which 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 cleanability 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 continuous filaments, made according to a lyocell process, or one layer consist of continuous filaments, made according to a lyocell process, and the second layer consist of pulp fiber.

5

In particularly preferred embodiments of a three-layer material according to the invention either all three layers consist of 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.

10

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 industrial cleaning wipe. The resulting wipe is both water and oil absorbent, has acceptable consumer acceptable drape and softness and is compostable and based on renewable resources.

15

Still another object of the present invention is to provide a compostable industrial cleaning wipe, containing the inventive nonwoven material according as a base sheet.

In a preferred embodiment of the invention, the nonwoven material of the compostable industrial cleaning wipe is further process by hydroentanglement. 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.

20

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.

25

Examples

All samples discussed were conditioned at 23°C ($\pm 2^\circ\text{C}$) and 50% ($\pm 5\%$) relative humidity for 24 hours.

30

Example 1

A 50-gsm wipe product of the present invention was compared to the
5 cleanability performance, strength and stiffness of a commercially available
industrial wipe of same basis weight being comprised of spunbond
polypropylene, wetlaid pulp and being hydroentangled.

Both samples were tested for cleanability, tensile properties and stiffness. The
10 cleanability test was performed using the below equipment:

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
15 Software: SMATECH Sondermaschinen & Automatisierungstechnik

Tensile properties were measured according to standard method DIN EN 29
073 part 3/ISO 9073-3, although a clamping length of 8cm rather than 20cm
was used. Stiffness was measured using a 'Handle-o-meter', according to
20 standard method WSP 90.3, with ¼-inch slot width, stainless steel surface,
1000 g beam. The sample size tested was 10 x 10 cm.

It was seen that both samples were on the same level of tensile strength in
MD and in CD even though the product of the invention is fully cellulosic. The
25 sample of invention shows double the amount of overall stiffness compared to
the competitive product leading to a dimensionally stable and robust product.

For the cleanability both samples were wetted with water 3 fold (equilibrium
time 2 h). Then the samples were used in MD for a wiping test picking up
30 Nutella from a plastic foil (spread 8x8cm, with a layer thickness of 0.5mm).
The wiping equipment (detail above) simulates a real wiping movement with
wiping pressure (550 g).

Within a 3-fold determination, the fabric of the invention reached on average a 35 % higher cleanability rate than the said competitive product, with result CV % below 5%.

5

Example 2

The 50-gsm wipe product of invention of example 1 was further analyzed for water uptake speed and level and water absorbency capacity versus the competitive product of example 1.

10

The water absorbency capacity was tested according to DIN 53923 (conditioning climate of samples: 23°C ($\pm 2^\circ\text{C}$) and 50% ($\pm 5\%$) relative humidity). The sample of invention showed a 3 % higher water absorbency capacity than the competitive product.

15

Water uptake speed and level were 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) was 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 taken up amount of water is below 0.005g/20sec

20

In Fig. 1, it can be seen that the sample of the invention has a much faster average liquid uptake and levels off at a higher average end value than the sample being spunbond polypropylene, wetlaid pulp and hydroentangled.

25

Fig. 1 shows the water uptake speed average of 5 measurements of sample 1 (sample of invention) versus sample 2 (spunbond polypropylene, wetlaid pulp and hydroentangled).

30

Example 2 shows that the product of invention is superior to the tested competitive product in liquid uptake speed and amount and in holding the absorbed water.

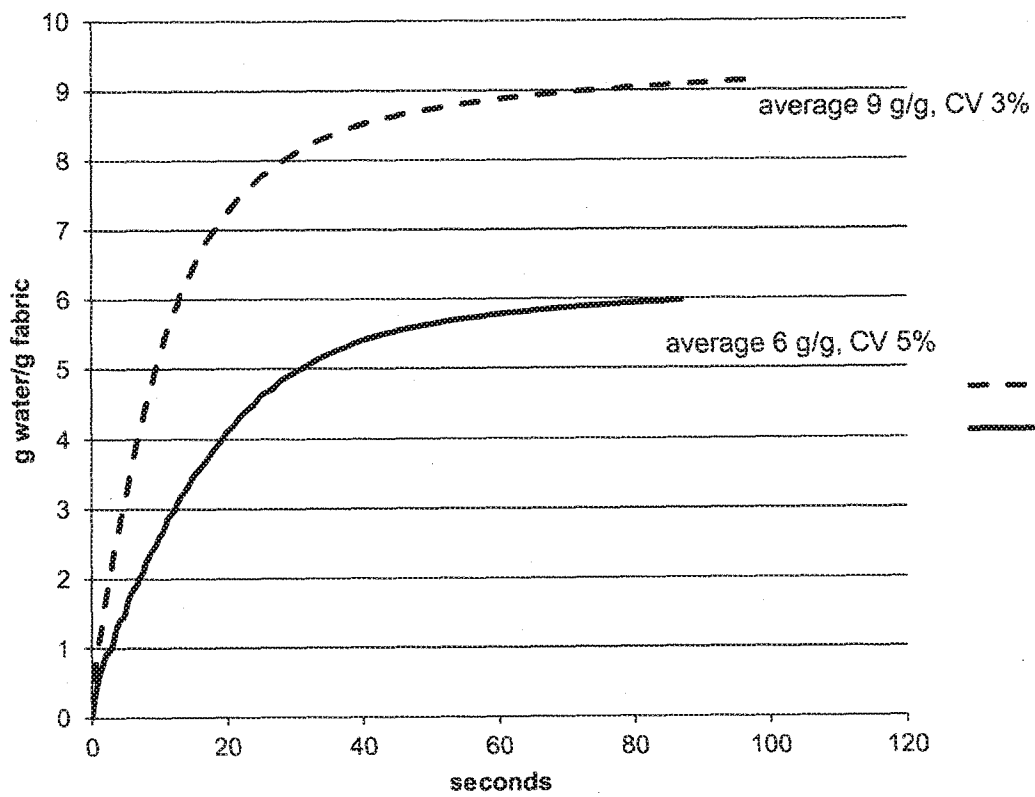
35

Claims

1. A nonwoven material suitable for use in an industrial cleaning wipe, containing at least a first cellulosic nonwoven web, characterized in that the cellulosic nonwoven web is made from essentially pure cellulose
5 formed of 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, needlepunch or chemical bonding process to modify the physical properties.
- 10 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 essentially formed of essentially continuous filaments, pulp fiber or staple fiber, is formed on top of the first cellulosic nonwoven web,
15 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
20 essentially continuous filaments, pulp fiber or staple fiber, and subsequently all layers are 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
25 subsequently all layers are hydroentangled together.
8. The nonwoven material of Claim 4 or 6, 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.
- 30 9. Use of the nonwoven material of claim 1 as a base sheet for the manufacture of a compostable industrial cleaning wipe.
10. A compostable industrial cleaning wipe, containing a nonwoven material according to claim 1 as a base sheet.

11. The compostable industrial cleaning wipe of Claim 10 wherein the nonwoven material is further bonded or treated by a hydroentanglement process.

Fig. 1



INTERNATIONAL SEARCH REPORT

International application No
PCT/AT2017/000023

A. CLASSIFICATION OF SUBJECT MATTER INV. D04H1/4258 A45D44/00 A61Q19/00 A61K8/02 D04H3/013 D04H3/11 D01D5/098 B32B5/26 D04H1/4374 D04H1/492 D01F2/00																				
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 A45D A61Q A61K D01D B32B D01F																				
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 <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>US 2005/056956 A1 (ZHAO RONGGUO [US] ET AL) 17 March 2005 (2005-03-17)</td> <td>1-3,8,10,11</td> </tr> <tr> <td>Y</td> <td>paragraph [0012] - paragraph [0016] paragraph [0027] - paragraph [0028]; claims 1, 12; figures 3-6; example 1</td> <td>4-7,9</td> </tr> <tr> <td>X</td> <td>WO 98/26122 A1 (COURTAULDS FIBRES HOLDINGS LTD [GB]; LAW STEPHEN JOHN [GB]; STREET HEA) 18 June 1998 (1998-06-18)</td> <td>1-4,8,10</td> </tr> <tr> <td>Y</td> <td>page 3, line 6 - line 11 page 7, line 13 - page 8, line 29; figure 1; table 3</td> <td>5-7,9,11</td> </tr> <tr> <td></td> <td>----- -/--</td> <td></td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	US 2005/056956 A1 (ZHAO RONGGUO [US] ET AL) 17 March 2005 (2005-03-17)	1-3,8,10,11	Y	paragraph [0012] - paragraph [0016] paragraph [0027] - paragraph [0028]; claims 1, 12; figures 3-6; example 1	4-7,9	X	WO 98/26122 A1 (COURTAULDS FIBRES HOLDINGS LTD [GB]; LAW STEPHEN JOHN [GB]; STREET HEA) 18 June 1998 (1998-06-18)	1-4,8,10	Y	page 3, line 6 - line 11 page 7, line 13 - page 8, line 29; figure 1; table 3	5-7,9,11		----- -/--	
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X	US 2005/056956 A1 (ZHAO RONGGUO [US] ET AL) 17 March 2005 (2005-03-17)	1-3,8,10,11																		
Y	paragraph [0012] - paragraph [0016] paragraph [0027] - paragraph [0028]; claims 1, 12; figures 3-6; example 1	4-7,9																		
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Y	page 3, line 6 - line 11 page 7, line 13 - page 8, line 29; figure 1; table 3	5-7,9,11																		
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☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.																				
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Date of the actual completion of the international search		Date of mailing of the international search report																		
10 October 2017		19/10/2017																		
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INTERNATIONAL SEARCH REPORT

International application No

PCT/AT2017/000023

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 6 235 392 B1 (LUO MENGKUI [US] ET AL) 22 May 2001 (2001-05-22) column 5, line 48 - line 53 column 6, line 33 - line 57 column 9, line 30 - line 65; figures 13, 14 -----	1-11
X	HAYHURST M J: "SPUNBOND CELLULOSE", CHEMICAL FIBERS INTERNATIONAL,, vol. 56, no. 6, 1 June 2006 (2006-06-01), pages 386, 388-390, 393, XP001503726, ISSN: 0340-3343 -----	1-3,10
Y	the whole document -----	4-9,11
X	WO 2007/124521 A1 (CHEMIEFASER LENZING AG [AT]; WHITE PAT [GB]; HARMS HAI0 [AT]; HAYHURST) 8 November 2007 (2007-11-08) page 1, paragraph 6 page 2, paragraph 4 - page 3, paragraph 1 page 5, paragraph 2 - page 6, paragraph 6 page 8, paragraph 4 - paragraph 5; claims 1,7-15, 21, 22 -----	1-11
X	WO 2009/059342 A1 (CHEMIEFASER LENZING AG [AT]; WHITE PAT [GB]; HARMS HAI0 [AT]; HAYHURST) 14 May 2009 (2009-05-14) -----	1-11
Y	page 2, paragraph 2 - paragraph 3 page 4, paragraph 3 - page 5, paragraph 1 page 7, paragraph 5 page 10, paragraph 2 - paragraph 3; example 1 page 8, paragraph 2 -----	4-9,11
X	WO 2007/124522 A1 (CHEMIEFASER LENZING AG [AT]; STEINDL THOMAS [AT]; EINZMANN MIRKO [AT];) 8 November 2007 (2007-11-08) -----	1-11
Y	page 4, paragraph 1 - page 5, paragraph 3; claims 1, 23-32 -----	4-9,11

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/AT2017/000023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2005056956	A1	17-03-2005	NONE
WO 9826122	A1	18-06-1998	AT 234379 T 15-03-2003 AU 7847998 A 03-07-1998 CN 1240006 A 29-12-1999 DE 69719796 D1 17-04-2003 DE 69719796 T2 18-03-2004 EP 0944753 A1 29-09-1999 ES 2194227 T3 16-11-2003 US 6358461 B1 19-03-2002 WO 9826122 A1 18-06-1998
US 6235392	B1	22-05-2001	US 6235392 B1 22-05-2001 US 6511930 B1 28-01-2003 US 6596033 B1 22-07-2003 US 2002148050 A1 17-10-2002
WO 2007124521	A1	08-11-2007	AT 503625 A1 15-11-2007 CN 101432476 A 13-05-2009 CN 103173938 A 26-06-2013 EP 2013390 A1 14-01-2009 EP 2957667 A1 23-12-2015 ES 2553182 T3 04-12-2015 JP 5097771 B2 12-12-2012 JP 2009535521 A 01-10-2009 KR 20080111521 A 23-12-2008 US 2009186189 A1 23-07-2009 WO 2007124521 A1 08-11-2007
WO 2009059342	A1	14-05-2009	AT 505621 A4 15-03-2009 CN 101896656 A 24-11-2010 EP 2212456 A1 04-08-2010 ES 2550279 T3 05-11-2015 JP 5425088 B2 26-02-2014 JP 2011503368 A 27-01-2011 KR 20100080606 A 09-07-2010 US 2011124258 A1 26-05-2011 WO 2009059342 A1 14-05-2009
WO 2007124522	A1	08-11-2007	EP 2013385 A1 14-01-2009 US 2009312731 A1 17-12-2009 WO 2007124522 A1 08-11-2007