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(19) (CA) **APPLICATION FOR CANADIAN PATENT** (12)

(54) Tissue Products Made from Low-Coarseness Fibers

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ABSTRACT

5 Tissue products made with fibers having a low Coarseness Index
have improved softness relative to tissue products made with
conventional papermaking fibers.

TISSUE PRODUCTS MADE FROM LOW-COARSENESS FIBERS

5 In the manufacture of tissue products, such as facial tissue
and bath tissue, continual attention has been given to ways to
improve softness of the product as perceived by the consumer. For
example, it has long been known that the use of fibers from certain
species of hardwoods, such as eucalyptus, improves the perceived
10 softness of tissue products and such fibers have been incorporated
into commercially available products for years. Other efforts to
improve softness have focused on the creping step and the attendant
adhesion of the uncreped web to the creping cylinder. Layering has
also received considerable attention, particularly by placing the
15 eucalyptus fibers in the outer layers to maximize the tactile
response. All of these approaches have their place in improving the
perceived softness of tissue products, but there are other factors to
consider which, until now, have not been fully appreciated.

It has now been discovered that a key to achieving softness in tissue products lies in the Coarseness Index of the species of fibers used to form the sheet or, viewed another way, the Coarseness Index of the fibers of the furnish used to form the sheet when a mixture of fiber species is used. The Coarseness Index of conventional softwood fibers ranges from about 11 to about 20. The Coarseness Index of conventional hardwood fibers also varies considerably, eucalyptus being about 8 and northern hardwood kraft fibers being about 12. However, by substituting lower-coarseness fibers for one or more fiber species of a conventional tissue making furnish, the softness of the resulting product can be improved compared to the same product made the same way but without the lower coarseness fibers.

For purposes herein, improvements in tissue softness can be expressed in terms of a panel softness number, the Tensile/Modulus Ratio, which will hereinafter be described, or Profile Index, which will also be hereinafter described. The Tensile/Modulus Ratio and

the Profile Index are advantageous for assessing softness improvements in that they are objective measurements as compared to a panel softness evaluation, which is subjective. It must be kept in mind, however, that perceived softness is comprised of many different factors, not all of which are accounted for by any single objective test. Nevertheless it has been found that the two major influences on perceived softness are stiffness and surface depth. The Tensile/Modulus Ratio is a measurement of the stiffness of the tissue and the Profile Index is a measure of the surface depth. Therefore both of these objective measurements can be used in the appropriate circumstances to be indicative of softness improvements.

Furthermore, the softness improvements imparted by this invention can be achieved without any loss of strength (after correction to constant tensile strength either mathematically or by manipulation of furnish or processing). In all aspects of this invention, the tissue product can have a geometric mean tensile strength of about 500 grams or greater and an increased Tensile/Modulus Ratio or an increased Profile Index compared to the same tissue product without any of the low-coarseness fiber species described. In addition, the absorbent capacity of the tissue products made with certain lower-coarseness fibers, such as milkweed seed floss fibers, can surprisingly be increased compared to the same tissue product made without the lower coarseness fibers.

Hence, in one aspect the invention resides in a tissue product comprising from about 5 to about 50 dry weight percent fibers of a nonwoody species having an average Coarseness Index of 9.0 or less, preferably 8.0 or less, and most preferably 7.0 or less.

In another aspect, the invention resides in a tissue product formed from a fiber furnish having a Furnish Coarseness Index of 7.5 or less, preferably 7.0 or less.

In another aspect, the invention resides in a tissue product comprising first and second fiber species, wherein the first fiber species has an average fiber length greater than 1 millimeter (long fiber) and a second fiber species has an average fiber length less than 1 millimeter (short fiber), and wherein the first fiber species

has a Coarseness Index of 10 or less, preferably 9 or less, and most preferably 8 or less.

5 In another aspect, the invention resides in a tissue product comprising first and second fiber species, wherein the first fiber species has an average fiber length greater than 1 millimeter and the second fiber species has an average fiber length less than 1 millimeter, and wherein the second fiber species has a Coarseness Index of 7 or less.

10 In another aspect, the invention resides in a tissue product comprising fibers of at least two different fiber species, wherein a first fiber species has an average fiber length greater than 1 millimeter and a second fiber species has an average fiber length less than 1 millimeter, wherein the first fiber species has a Coarseness Index of 10 or less and the second fiber species has a
15 Coarseness Index of 7 or less.

In another aspect, the invention resides in a tissue product comprising a fibrous sheet having first and second layers, said first layer being the outer surface of the tissue product, said first layer comprising at least about 5 dry weight percent fibers of a nonwoody species having an average Coarseness Index of about 7.5 or less, preferably about 7.0 or less. When forming layered tissue sheets, it is advantageous to incorporate the softness properties of the low-coarseness fibers in the outer layers of the tissue product. The low-coarseness fibers in the outer (first) layer can have an average
25 fiber length of about 1.5 millimeters or greater. Especially suitable fibers for this purpose are milkweed seed floss fibers, which provide significant improvements in surface depth. Other low-coarseness fibers, including low-coarseness fibers having an average fiber length of about 1.5 millimeter or greater, can be used in any
30 layer, including the inner layers, to improve (lessen) the stiffness of the sheet. The net result is improved softness at constant tensile strength by two different mechanisms (surface depth and stiffness). The low-coarseness fibers in the outer layer can have a fiber length of about 1.5 millimeter or greater.

35 Those skilled in the art of making tissue will appreciate that there are many other factors which influence tissue softness besides

the Coarseness Index, including fiber length, fiber bonding, fiber collapse, fiber chemistry, creping, etc. However, Coarseness Index has been discovered to be a dominant factor among fiber characteristics. In all aspects of this invention, it is preferable that the fibers have a numerical average fiber length of less than 6 millimeters, most preferably less than 4 millimeters, as it has been found that longer fibers cause unacceptably poor formation using conventional forming apparatus.

For purposes herein, "tissue product" means a product having one or more fibrous sheets, preferably creped, each sheet having a dry basis weight of from about 5 to about 40 pounds per 2880 square feet, preferably from about 5 to about 25 pounds per 2880 square feet, and most preferably from about 5 to about 10 pounds per 2880 square feet. Bulk densities for tissue products are typically less than about 0.2 grams per cubic centimeter and often are less than about 0.15 grams per cubic centimeter. The fibrous sheets can be layered or not layered (blended). For layered sheets, it is preferable to provide an outer layer, which is the outwardly facing surface of the tissue product, with a long low-coarseness fiber such as milkweed seed floss fibers to impart a softness resulting from significant surface depth, and provide an inner layer with fibers which can provide strength, such as softwood fibers, or other low-coarseness fibers which provide improved tensile/modulus ratios, such as abaca fibers, pineapple fibers, and synthetic fibers. Products such as facial tissue, bath tissue, paper towels, and dinner napkins are specific examples of tissue products within the meaning of this invention, including single-ply, two-ply, three-ply or other multiple-ply forms.

The Coarseness Index for any given species of fiber or any fiber furnish is the weight per unit length of fiber (e.g. milligrams per 100 meters) and is defined as follows:

$$\text{Coarseness Index} = \frac{100}{(F/G)(L)}$$

wherein (F/G) = millions of fibers per gram of fiber; and

(L) = the numerical average length of the fibers in millimeters.

For purposes herein, the "Furnish Coarseness Index" is the Coarseness Index of the furnish used to produce a particular tissue product in accordance with the foregoing formula. It is useful when two or more fiber species are used to make up the furnish. It should be noted that the proper value for the Furnish Coarseness Index is not simply the weighted averages of the Coarseness Indices of the individual fiber species of the furnish. Instead, the Furnish Coarseness Index is calculated in accordance with the following formula:

$$\frac{\text{weight \% component \#1}}{\text{Coarseness Index of component \#1}} + \frac{100}{\text{weight \% component \#2}} + \dots + \frac{\text{weight \% component \#n}}{\text{Coarseness Index of component \#n}}$$

For example, if two fiber species are blended in equal weight percent amounts (50 weight percent) with one fiber species having a Coarseness Index of 11.2 and the other fiber species having a Coarseness Index of 7.8, the Furnish Coarseness Index of the blend is calculated to be 9.2 as follows:

$$\frac{50}{11.2} + \frac{50}{7.8} = 9.2$$

Measuring the Coarseness Index for a given fiber species can yield different values depending upon the measurement method. The traditional method (direct weighing) involves microscopic selection and measuring the length of the selected fibers followed by weighing the known fiber or fibers using a quartz torsion ultramicrobalance. This method is tedious and is generally biased toward measuring the coarseness of true fibers as opposed to other non-fibrous elements and debris which are commonly present in many natural fiber samples. In such cases, the Coarseness value is not realistically representative of the actual material being used to manufacture the tissue product.

Unless otherwise indicated, the Coarseness Index values reported herein were obtained by using a Kajaani Model FS-100 fiber analyzer commercially available from Kajaani Inc. Automation,

Atlanta, Georgia. For a given sample, the FS-100 measures the number of fibers and other elements present and their average length. With these measurements, and knowing the weight of the sample (0.001 grams air dry), the Coarseness Index can be readily calculated. A more
5 advanced instrument, the model FS-200, automatically calculates the Coarseness Index, eliminating the need for manual calculation. Either of these two instruments or their equivalents can be used for measuring the Coarseness Index for purposes herein, although the Coarseness Index values from each may be slightly different in some
10 instances. These instruments do not discriminate between fibers and other particles in the sample. All particles are counted and measured. Limited experience to date has shown Coarseness Index values obtained using the Kajaani instruments to be about 35 percent lower than those values obtained by using the traditional direct
15 weighing method. For example, the Coarseness Index of abaca leaf fibers was found to be 8.5 via the Kajaani FS-100 versus a value of 11.2 by direct weighing. Similarly, the Coarseness Index for a rayon synthetic fiber was measured to be 11.5 via the Kajaani FS-100 versus
20 16 by direct weighing.

When using the FS-100, sample preparation was conducted by initially calculating and weighing out a sample to yield approximately 10 oven-dried grams of the material being tested. The sample was diluted to a consistency of 1.67 percent and dispersed at the slowest speed of an Osterizer household blender for 30 seconds.
25 The blended slurry was poured into a plastic container, rinsing the blender well, and diluted to 8000 milliliters using distilled water. The consistency of the diluted slurry was calculated and the amount of the slurry required to give 1.00 grams of oven-dried fiber was determined. This amount of sample was poured into a one liter
30 graduate. To this was added distilled water to bring the total volume to 1000 milliliters (consistency equalled 0.001 grams per cubic centimeter). This sample was then poured into a two-liter beaker. Using a magnetic stirring bar, the diluted slurry was gently agitated while withdrawing a 25 milliliter sample with a pipette.
35 The 25 milliliter sample was transferred to a 250 milliliter graduate, the pipette was rinsed, and the sample further diluted to

250 milliliters with distilled water. The distilled sample was then placed in a 600 milliliter beaker. Again using a magnetic stirring bar, the slurry was gently agitated while withdrawing a 10 milliliter sample with a pipette. The 10 milliliter sample was transferred to a
5 100 milliliter beaker and the pipette contents were rinsed into the beaker with distilled water. This was the sample introduced into the FS-100. It contained 0.001 grams of fiber. When making the measurement, it is essential to count every fiber or other
10 particulates in the sample. Hence the beaker containing the sample was rinsed into the capillary funnel of the FS-100 three times. For each sample, three specimens were tested and their average values were used in the Coarseness Index calculations.

It will be appreciated that not all fibers are wettable and hence some modification to the standard procedure may be necessary to
15 measure the Coarseness Index of such fibers. For example, it may be necessary to treat the surface of the fibers with a surfactant in order to render them sufficiently wettable to be slurried with water. Alternatively, some fibers such as polyesters can be measured by using denatured alcohol instead of water as the vehicle for preparing
20 the sample. In addition, more dilute samples may be necessary. Those familiar with the operation of the Kajaani FS-100 will appreciate the need for departing from the standard procedure from time to time depending upon the nature of the particular fiber being measured.

25 To fully understand the meaning of the Coarseness Index, it is important to distinguish coarseness from slenderness, which is a different parameter. Fiber slenderness is the ratio of fiber length to fiber diameter. This concept does not take into account the density of the fiber material or the thickness of the fiber wall for
30 hollow fibers. Hence two fibers of the same length and outside diameter, but differing in wall thickness, will have the same slenderness but different coarsenesses. At the same time, a very long fiber having a thick diameter may have a high slenderness but may also have a high coarseness. The difference between coarseness
35 and slenderness can be significant and can be the difference between a soft sheet and a stiff sheet. It is also important to note that

coarseness is not directly a function of fiber length. A fiber having a given Coarseness Index will still have the same Coarseness Index after being shortened because the fibers per gram of fiber will be increased in the same proportion as the length reduction, thereby netting no change. This of course is not the case with slenderness, in which case the slenderness of the fiber is reduced in proportion to the length reduction.

Fiber species having an average Coarseness Index below 9.0 and useful for purposes of this invention include natural fibers, synthetic fibers and combinations thereof. As used herein, "species" is a term to be broadly interpreted to designate a source of fiber which is different from other fiber sources. It can be a plant species, a particular part of a plant species, such as the leaves, or a chemical species. A nonwoody fiber species is any fiber species, including synthetics, that is not a woody plant species. To distinguish woody from nonwoody plants, there are four criteria: (1) Woody plants must be vascular plants; i.e., they must possess specialized conducting tissues consisting of xylem (wood) and phloem (inner bark). The xylem is lignified and is the wood of the mature plant. Plants devoid of vascular tissue cannot produce wood. (2) Woody plants must be perennial plants; i.e., they must live for a number of years. (3) Woody plants must possess a stem that persists from year to year. Many perennials fail to be classed as woody plants because their stems die back to the ground each autumn, the roots persisting through the winter and producing a new stem the following spring. Some plants possess persistent creeping stems and hence fall into the category of woody plants, even though they appear to be herbaceous. (4) Typical woody plants, which include all the commercially important timber trees, exhibit secondary thickening; i.e., they have a means of thickening their stems by subsequent growth in diameter, not traceable to terminal growing points. This is achieved through the activities of a growing layer, called cambium, which is situated just outside the last-formed layer of wood and beneath the inner bark (phloem); new wood and new phloem are thus produced yearly and are developed between the previously formed wood and bark.

Preferred natural fibers within the scope of this invention (average fiber lengths in millimeters in parenthesis) include, without limitation, seed hair fibers from milkweed and related species, abaca leaf fiber (2.87)(also known as Manila hemp),
5 pineapple leaf fibers (0.82), sabai grass (0.57), esparto grass (0.55), rice straw (0.40), banana leaf fiber (1.25), and bast (bark) fibers from paper mulberry (0.42). Suitable synthetic fibers include rayons, acrylics, polyesters, acetates, and polyolefins of suitable coarseness. It is within the scope of this invention to provide
10 tissue products that comprise mixtures of one or more low-Coarseness Index fibers, such as combining milkweed seed floss fibers with abaca fibers to achieve high surface depth (Profile Index) and improved stiffness (Tensile/Modulus Ratio).

The amount of low-coarseness fibers (fibers having an average
15 Coarseness Index of about 9.0 or less) which can be utilized to make a tissue product can be any amount depending upon the fiber cost and the formation characteristics of the resulting furnish. In many instances, the amount can be about 5 dry weight percent or more, more specifically from about 5 to about 50 dry weight percent, more
20 specifically from about 5 to about 30 dry weight percent, and still more specifically from about 5 to about 15 dry weight percent. The amount of low coarseness fibers can be concentrated in the outer layers of the tissue product by forming the tissue with a layered headbox, in which up to 100 dry weight percent of the outer layer can
25 be made up of the low coarseness fibers, even though the percentage amount is significantly less in terms of the entire tissue product weight.

Brief Description of the Drawing

30 Figures 1A, 1B, 1C, 1D, 2, 3, and 4 all pertain to the determination of the Profile Index and are described below in connection with the description of the Profile Index.

Detailed Description of the Invention

35 Before describing specific examples of the products of this invention, it is appropriate to first briefly describe the means by

which softness values have been determined for illustrating the benefits of the products of this invention. It is emphasized that the softness values reported herein are only intended for comparing softness relative to other samples within a particular experiment and
5 are not to be interpreted as absolute values. Those skilled in the art will appreciate that there are other methods of assessing relative softness values, including objective testing of certain properties such as the ratio of the tensile strength to the specific modulus or the surface depth of the tissue or, ultimately, consumer
10 testing. In some of the Tables set forth herein, the ratio of tensile strength to the specific modulus (Tensile/Modulus Ratio) has been used as an indication of softness where sensory panel softness was lacking. Although the Tensile/Modulus Ratio is a reliable indicator for softness in most instances, it does not hold in the
15 case of milkweed seed floss fibers because the addition of milkweed fibers significantly increases the caliper of the tissue, thereby increasing the stiffness (specific modulus). The substantial and surprising impact of milkweed seed floss fibers on softness is instead attributable to the large increase in the surface depth of
20 the tissue as measured by the Profile Index hereinafter defined.

For purposes herein, product softness was determined by a trained sensory panel. Each panelist had been trained to feel and compare each test sample against multiple standards for each one of three characteristics: stiffness, surface depth, and abrasiveness.
25 The test sample received a numerical rating for each of the three characteristics, and the numerical ratings were factored into a formula which yielded a softness number for the test sample. Softness numbers generally run from 1 to about 12, although higher and lower (including negative values) are possible. The higher
30 values reflect greater softness and lower values correspondingly reflect lower softness. (The 95 percent confidence interval is about ± 0.5 softness points.) Directional changes in the softness numbers generated by the sensory panel correlate with consumer preferences in actual consumer testing, i.e. a tissue having a sensory panel
35 softness value of 8 would be preferred for softness by actual

consumers when compared to another sample having a sensory panel softness of 6.

Tensile strengths and specific modulus were measured using an Instron Model 1130, including a recorder and Microcon II along with Modulus and Yield Option and stackable speed reducer, available from Instron Corporation, Canton, Massachusetts, or a Sintech 2, available from MTS Sintech, Eden Prairie, Minnesota, with an IBM PC. Tensile strengths are expressed in grams. Specific modulus values (also referred to herein as "modulus") are expressed as kilograms and are calculated according to the following formula:

$$\text{Specific Modulus} = \frac{\text{Elastic Modulus} \times \text{TMI Bulk Thickness} \times 150.04}{\text{Basis Weight}}$$

wherein Specific Modulus is expressed as kilograms;
Elastic Modulus is expressed as kilograms per square centimeter;
TMI Bulk Thickness is expressed as inches; and
Basis Weight is expressed as pounds per 2880 square feet.

For tissue sheets, elastic modulus values, expressed as kilograms per square centimeter, were calculated from slope readings taken between 50 and 100 grams and between 100 and 200 grams on the stress/strain curve, with the higher of the two values being reported. For handsheets, the two readings were taken between 100 and 200 grams and between 400 and 500 grams because of the higher tensile strengths.

Absorbency (absorbent capacity) of tissues for purposes herein is determined by measuring the amount of water absorbed by the tissue after being placed flat on the surface of a water bath at 30°C. and allowed to fully wet out over its entire surface. More specifically, the absorbency can be determined by first weighing a tissue specimen to be evaluated. This is recorded as W_1 . A wire basket constructed of standard grade reinforced stainless steel wire cloth, used to contain the sample during testing, is lowered into the water bath to fully wet the basket. The basket is approximately 5.5 inches x 5.5 inches x 1.5 inches (140 mm. x 140 mm. x 38 mm.) and has a wire diameter of 0.0055 inch, an 80 x 80 mesh, and a 31.4 percent open area. The basket is removed from the bath and allowed to drain for

exactly 30 seconds. The wet basket is placed on a pan scale and weighed to determine the combined weight of the basket and the amount of water adhered to the basket during the procedure. This weight is recorded as W_2 . The wire basket is then placed into the water bath again and the tissue test specimen is placed onto the surface of the water bath above the wire basket. The tissue is allowed to wet out over its entire surface. The basket containing the tissue sample is removed from the water bath and allowed to drain for exactly 30 seconds. The drained basket containing the sample is placed onto a pan scale and weighed. This weight is recorded as W_3 . The absorbency, expressed as grams of water per gram of tissue, is determined by the following formula:

$$(W_3 - W_2 - W_1)/W_1$$

The Profile Index is a measure of the degree of surface irregularity present in the form of protruding fibers and fiber structures. As such it is indicative of the surface depth or cushioniness of the tissue and hence the softness. More specifically, the Profile Index is an index that quantifies the imaged silhouette of fibrous material protruding from the x-y plane of a tissue sample.

The Profile Index is measured using a digital image analyzer. The use of the Model Q-10 image analyzer, previously sold by Olympus Corporation, Lake Success, New York, in conjunction with Cambridge Instrument Corporation, Cambridge, England, is described herein, although other image analyzers can also be adapted to measure the Profile Index. The Q-10 digitizes a video image into a 512 (horizontal) by 480 (vertical) pixel display. The Q-10 has a 6 bit analog/digital converter which permits the brightness of each pixel to be resolved into 64 discrete shades of gray. Input to the Q-10 is a Dage Series 65 monochrome video camera utilizing an RS-170 output. This camera uses a vidicon sensing tube and is operated with automatic gain, pedestal and target voltage adjustments. The camera has a resolution of greater than 250 line pairs. The Q-10 is also equipped with an optional shading corrector.

The video camera is mounted on an Olympus BHS microscope with a stereo viewing port. The measurement is made with a 4X objective

and a 3.3X intermediate lens such that the field size is approximately 2.6 millimeters wide and 2.4 millimeters high when the signal is digitized by the Q-10 into 512 X 480 pixels.

When measuring the Profile Index, samples are illuminated in a transmission mode with a semi-diffused light source obtained by placing a diffuser directly on the microscope illumination collimator lens. For ease of use, a clear glass stage is used to set prepared samples. The Olympus microscope uses an electronic stage controlled by a joystick. The auto-stage is not essential to the measurement, but it does allow more rapid specimen positioning and testing.

Referring to Figures 1A - 1D, 2, 3 and 4, the sample preparation procedure for measuring the Profile Index will be described. In order to measure the Profile Index of a tissue, a sample 60 is cut to a dimension of one inch (machine direction) by three inches (cross-machine direction) and adhered to the side of a 0.1 mm thick, 22 x 40 mm glass coverslip 61 (No. 1, Corning Glass Works) using a strip of tape 62 as shown in Figure 1A. The sample is then draped over the long edge of the glass slide such that the machine direction of the sample is perpendicular to the edge of the glass slide. The other end of the tissue sample is then adhered to the other side of the glass slide with a second strip of tape 63 as illustrated in cross-section in Figure 1B. Bending the tissue over the slide exposes protruding fibers 64 (fiber size is greatly exaggerated for purposes of illustration) which are to be measured by the Profile Index. Two plain microslides 65 and 66 (1 mm thick, 25 x 75 mm) are then placed on both sides of the U-folded sample. The first microslide 65 is taped onto one side of the sample with tape 67 as shown in Figure 1C. The second microslide 66 is taped to the sample and the first microslide with additional tape 68 as shown in Figure 1D. This composite "sandwich" arrangement exposes protruding fibers along a linear edge of the tissue surface at the fold line of the sample. The composite is placed on a microscope stage in the path of transmitted light to view the exposed fold edge of the sample from the side. The prepared sample and resulting image appears generally as illustrated in Figure 2. The image is then input to the Q-10 through the video camera. An actual photograph as viewed by the

Q-10, magnified about 40x, is shown in Figure 3. The area defined by the white box within the photograph is the measurement frame. Figure 4 is the same as Figure 3, except that the actual area detected by the Q-10 for measuring the Profile Index is highlighted in white.

5 In carrying out the Profile Index measurement, the specimen slide is placed on the microscopic stage such that the top of the field is clear and the bottom of the field is blocked by the sample on the slide. A measurement frame with dimensions of 1.2 mm in height and 2.6 mm in width are electronically placed around the image
10 such that the tissue edge separating the slide from the clear field is very near to the bottom of this frame. The microscope is focused manually to give the sharpest contrast at the surface of the tissue edge. Individual fibers protruding from the edge are ignored during focusing to avoid biasing results. Next, the microscope illumination
15 is adjusted so that the bright portions of the image (the clear part of the field) exhibit gray levels in the range of 52 to 56 (bright white has a gray level of 63). At this point, the solid dark regions of the image should be perfectly black (gray level zero). If this is not the case, the gain and offset of the analog-to-digital converter
20 must be adjusted until both the dark and light grey levels are met. The test is then started over. (On the particular Q-10 image analyzer used for the Examples, the gain and offset were set to 15 and zero respectively. This equates to maximum gain and minimum offset. It must be noted that not all Q-10 image analyzers use the
25 same analog-to-digital converter. These must be set to achieve the desired grey level range. Once the proper gain and offset are found, they will not need to be reset). Finally, the image is shade-corrected.

30 In order to calculate the Profile Index, several common image analysis functions are performed on the detected image. First, the image is thresholded or segmented. This step causes all pixels that have gray levels between approximately 2 and 45 to be identified. All other pixels are ignored. Following detection, all features (objects composed of contiguous identified pixels) less than three
35 pixels in total width are eliminated. If done properly, these steps leave a single feature bounded by the outline of the specimen surface

with all protruding fibers. The computer next measures the area of the feature(s) by counting the number of pixels identified. This area is composed of all pixels around the boundary of the specimen, up to the measurement and image frames. The area of all identified
 5 fibers/fibrils protruding away from the edge of the specimen in the plane of focus is included. When properly imaged and segmented, the image will appear as shown in Figure 4.

The Profile Index is calculated as the difference between the identified area, as measured above, and the number of pixels a
 10 perfectly straight edge would form, divided by the number of pixels on said edge. An ideal imaging system would create a boundary of 512 pixels for such an edge. Experimentation has shown that the equipment used for this measurement doubles some pixels in a perfect boundary so that a sharp edge, on average, gives an area of about 650
 15 pixels for a tissue web. To account for this, the Profile Index is calculated in accordance with the formula:

$$\text{Profile Index} = (\text{AREA} - 650) / 650.$$

wherein AREA is the pixel area identified by the Q-10. In order to accurately characterize a particular tissue sample, 52 different
 20 images are measured for individual Profile Index values and the 52 different Profile Index measurements are averaged.

Examples

Example 1: Milkweed Floss Fibers

25 In order to illustrate the improved softness obtained using low coarseness fibers, tissue sheets were made using the seed hairs or floss of the common milkweed plant (*Asclepias syriaca*). These fibers are the white, glossy fibers found within the milkweed seed pod which develops in late summer. These fibers have an extremely
 30 low Coarseness Index of about 3 or less due to their lightweight, hollow, thin-walled morphology. Because these fibers are naturally hydrophobic, slurring them for papermaking required prior surface treatment with a nonionic surfactant (a 1% aqueous solution of Triton X100).

35 The surface-treated milkweed floss fibers were cut to an average length of about 1.5 mm and blended with hardwood or softwood

kraft papermaking fibers to form an aqueous slurry. A tissue basesheet having a dry basis weight of 7.5 pounds per 2880 square feet was then made in a conventional manner on a laboratory scale continuous tissue-making machine operating at a speed of about 60 feet per minute. More specifically, the fiber furnish was wet laid onto a forming wire, dewatered, adhered to a Yankee dryer, dried, creped and wound onto a roll. The rolled tissue basesheet was then converted into two-ply tissue samples for testing. The results are illustrated in Table 1 below.

TABLE 1.

		Fiber Species Coarseness Index	Furnish Coarseness Index	Tensile ⁽¹⁾ {GMT}	Softness	Profile Index	Absorbency
15	Furnish ⁽²⁾						
	100% NSK	11.2	11.2	650	7.0	2.33	8.7
20	85% NSK	11.2 ⁽³⁾	7.1	650	9.6	5.26	11.31
	15% Milkweed	2.3					
	70% NSK	11.2	5.2	560	10.2	5.16	12.24
	30% Milkweed	2.3			(9.9) ⁽⁴⁾		
25	50% NSK	11.2	9.2	650	8.2	3.21	8.8
	50% Eucalyptus	7.8					
	50% NSK	11.2	10.6	640	8.2	3.76	8.4
30	50% NHK ⁽⁵⁾	10.0					
	50% NSK	11.2	6.9	500	10.2	4.88	11.04
	35% NHK	10.0			9.7 ⁽⁶⁾		
	15% Milkweed	2.3					

⁽¹⁾
GMT (Geometric Mean Tensile) = $\sqrt{\text{MDT} \times \text{CDT}}$

where MDT = the tensile strength (grams) of the web in the machine direction (MD) and CDT = the tensile strength (grams) of the web in the cross-machine direction (CD), expressed as grams.

⁽²⁾
Northern softwood kraft fibers (average fiber length of 1.5 mm. using the Kajaani FS-100)

⁽³⁾
Estimated value based on a Coarseness Index measurement of 3.6 obtained by the direct weighing method.

⁽⁴⁾
Softness corrected to 650 GMT

(5) Northern hardwood kraft fibers (average fiber length of 0.6 mm. using the Kajaani FS-100)

(6) Softness corrected to 640 GMT

5 These results show the significantly increased softness, surface depth, and absorbency imparted to a tissue by the addition of milkweed floss fibers. As shown, it is not necessary to utilize large amounts of low coarseness fibers. In fact, because of cost
10 considerations, blends with conventional furnish fibers are preferred. As illustrated by Table 1, the use of milkweed floss fibers at a level of only 15% provided a substantial softness improvement over a furnish blend containing 50% eucalyptus, which is the hardwood fiber species currently being used on a commercial basis
15 to improve tissue softness over conventional hardwood/softwood blends. Preferred levels of milkweed floss fiber content are from about 5 to about 40 dry weight percent of the tissue product, more specifically from about 5 to about 30 dry weight percent, and still more specifically from about 5 to about 15 dry weight percent.

20 In the same manner as described in connection with the foregoing example, single-ply creped tissue having a dry basis weight of 14.5 pounds per 2880 square feet was made with two different furnishes, including 15 weight percent milkweed floss fiber. The results are as follows:

25

TABLE 2

30	<u>Furnish</u>	<u>Fiber Species Coarseness Index</u>	<u>Furnish Coarseness Index</u>	<u>Tensile (GMT)</u>	<u>Softness</u>	<u>Profile Index</u>
	50% NSK	11.2	9.2	880	-0.2	3.67
	50% Eucalyptus	7.8				
35	85% NSK	11.2	7.1	875	4.5	4.61
	15% Milkweed	2.3				

40 Although *Asclepias syriaca* is a preferred seed hair fiber source, other seed hair-bearing milkweed species are also suitable low coarseness fiber sources, including, without limitation,

A. incarnata, A. curassavica, A. fruticosa, A. glaucophylla, A. semilunata, and A. subulata.

Example 2: Abaca Fibers

As an example of a different low Coarseness Index fiber, two-ply tissue samples having a dry basis weight of 7.5 pounds per 2880 square feet per ply were prepared with abaca leaf fibers in a conventional manner on the laboratory scale tissue machine as described in Example 1, except that a preliminary surface treatment of the abaca fibers with surfactant was not necessary. The properties of the resulting two-ply tissue products are summarized in Table 3 below:

TABLE 3

	<u>Furnish</u>	<u>Fiber Species Coarseness Index</u>	<u>Furnish Coarseness Index</u>	<u>Tensile (GMT)</u>	<u>Softness</u>
20	50% NSK 50% NHK ⁽¹⁾	11.2 10.0	10.6	1250	6.2
	20% Abaca 40% NSK 40% NHK	8.4 11.2 10.0	9.2	1250	6.7

(1)

Northern hardwood kraft fibers (average fiber length of 0.6 mm. using the Kajaani FS-100)

As illustrated, substituting abaca fibers for 10% of the hardwood fibers and 10% of the softwood fibers improved the softness from 6.2 to 6.7 at equal strengths.

In order to further illustrate the advantage of using abaca fibers, a handsheet study was conducted to measure the ratio between the dry tensile strength (GMT) and the specific modulus as an indicator of softness. In preparing handsheets for purposes of demonstrating the advantage of using low Coarseness Index fibers, it is necessary to avoid degradation of the fibers, particularly the grasses such as abaca. Hence the beating time and intensity of the

furnish must be only as necessary to achieve good fiber distribution.
The results are set forth below in Table 4.

TABLE 4

	<u>Furnish</u>	<u>Coarseness Index</u>	<u>Furnish Coarseness Index</u>	<u>Tensile⁽¹⁾</u>	<u>Modulus</u>	<u>Tensile/ Modulus Ratio</u>
5						
10	100% NSK	11.2	11.2	1192	146.5	8.14
	75% NSK	11.2	10.3	1590	177.9	8.94
	25% Abaca	8.4				
15	50% NSK	11.2	9.6	1959	198.4	9.87
	50% Abaca	8.4				
	25% NSK	11.2	8.9	1976	199.4	9.91
20	75% Abaca	8.4				
	100% Abaca	8.4	8.4	2309	230.2	10.03

(1)

Tensile strength for handsheets was only measured in one direction. All directions are expected to exhibit the same properties since there is no machine direction or cross-machine direction for handsheets. The same is true for the specific modulus.

The results of the handsheet study illustrate increasing Tensile/Modulus Ratio, and hence softness, with increasing abaca content. All of the foregoing data support the conclusion that the addition of low-Coarseness Index fibers (abaca fibers) to a furnish can provide measurable objective and subjective improvements to the softness of tissue products.

To further illustrate the advantage of using low-Coarseness Index fibers, additional two-ply tissue samples (7.5 pounds per 2880 square feet per ply) were prepared as described above. The results are summarized in Table 5.

TABLE 5

	Furnish	Fiber Species Coarseness Index	Furnish Coarseness Index	Tensile (GMT)	CD Modulus	CD Tensile/ CD Modulus Ratio	Softness
10	40% NSK 60% Eucalyptus	11.2 7.8	8.9	426 ⁽¹⁾	3.10	105.2	8.8
	40% NSK 60% Eucalyptus	11.2 7.8	8.9	601 ⁽¹⁾	4.30	101.4	8.4
15	20% NSK 20% Abaca 60% Eucalyptus	11.2 8.4 7.8	8.4	496 ⁽³⁾	1.93	163.7	9.2
20	-----						
	⁽¹⁾ MD Tensile = 557; CD Tensile = 326						
	⁽²⁾ MD Tensile = 828; CD Tensile = 436						
25	⁽³⁾ MD Tensile = 779; CD Tensile = 316						

The first and second samples of Table 5 are control samples representing conventional tissue products having the same furnish but differing strengths, due in part to differing levels of refining and wet strength additives. The third sample represents a tissue product in accordance with this invention, in which half of the NSK fibers were replaced with abaca fibers. The data illustrate an increase in softness attributable to the addition of the abaca fibers. The data also confirm the correlation between softness and the Tensile/Modulus Ratio for tissue.

Example 4: Pineapple Leaf Fibers

In order to further illustrate the softness benefit of using fibers of a species having a low average Coarseness Index, handsheets were prepared with different furnishes, including abaca and pineapple leaf fibers (average fiber length of about 1 to 2 millimeters), as set forth below in Table 6. In preparing

handsheets for purposes of demonstrating the advantages of using low-Coarseness Index fibers for purposes of this invention, it is necessary to avoid degradation of the fibers, particularly the grasses such as abaca. Hence the beating time and intensity of the furnish must be only as necessary to achieve good fiber distribution.

TABLE 6

<u>Furnish</u>	<u>Fiber Species Coarseness Index</u>	<u>Furnish Coarseness Index</u>	<u>Tensile⁽¹⁾</u>	<u>Modulus</u>	<u>Tensile/Modulus Ratio</u>
50% Eucalyptus	7.8	9.2	1649	174	9.5
50% NSK	11.2				
50% Eucalyptus	7.8	8.1	2243	204	11.0
50% Abaca	8.4				
50% Eucalyptus	7.8	5.4	2193	175	12.6
50% Pineapple	4.1				

⁽¹⁾ Tensile strength for handsheets was only measured in one direction. All directions are expected to exhibit the same properties since there is no machine direction or cross-machine direction for handsheets. The same is true for the elastic modulus.

These results clearly show a correlation of increasing Tensile/Modulus Ratio (softness) with decreasing Furnish Coarseness Index.

Example 5: Synthetic Fibers

In order to illustrate the usefulness of synthetic fibers in connection with this invention, handsheets having a basis weight of 11 pounds per 2880 square feet were prepared with a mixture of NSK fibers and synthetic fibers. The synthetic fibers were poly(ethylene terephthalate) (PET) fibers having a denier of 0.5 and a fiber length of 5 millimeters. The results are summarized below:

TABLE 7

5	Furnish	Fiber Species Coarseness Index	Furnish Coarseness <u>Index</u>	Tensile	Modulus	Tensile/ Modulus Ratio
10	100% NSK	11.2	11.2	631	203.0 ⁽¹⁾	3.11
	75% NSK	11.2 ⁽²⁾	4.3	1023	55.9	18.3
	25% PET	1.4				

15 (1) Standard deviation = 63.76

20 (2) Measurement of the Coarseness Index on the Kajaani FS-100 required the use of denatured alcohol for all sample dilutions. In addition, the sample was diluted more than that used in the typical procedure - the final sample run on the Kajaani FS-100 was 0.00025 grams versus 0.001 grams.

25 These results further illustrate the improvement in softness achieved with synthetic fibers having a low Coarseness Index.

30 It will be appreciated that the foregoing examples, shown for purposes of illustration, are not to be construed as narrowing the scope of this invention, which is defined by the following claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE
PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

- 5 1. A tissue product comprising from about 5 to about 50 dry weight percent fibers of a nonwoody species having an average Coarseness Index of 9.0 or less, said tissue product having a geometric mean tensile strength of about 500 grams or greater and an increased Tensile/Modulus Ratio compared to the same tissue product without any of said fibers.
2. The tissue product of Claim 1 wherein all species of fibers comprising the tissue product have a Coarseness Index of 9.0 or less.
3. The tissue product of Claim 1 wherein the fibers have an average fiber length less than 6 millimeters.
4. The tissue product of Claim 1 wherein the fiber species is selected from the group consisting of sabai grass, rice straw, banana leaf fiber, and bast fibers from paper mulberry.
5. The tissue product of Claim 1 wherein the fiber species is abaca leaf fibers.
6. The tissue product of Claim 1 wherein the fiber species is pineapple leaf fibers.
7. The tissue product of Claim 1 wherein the fiber species is esparto grass fibers.
- 5 8. A tissue product comprising from about 5 to about 30 weight percent seed floss fibers of the genus *Asclepias*, wherein the absorbent capacity of the tissue product is greater than the absorbent capacity of the same tissue product without said fibers.

- 5
9. The tissue product of Claim 8 wherein the amount of seed floss fibers is from about 5 to about 15 weight percent of the tissue product.
 10. The tissue product of Claim 8 wherein the *Asclepias* species is *Asclepias syriaca*.
 11. A tissue product formed from a fiber furnish having a Furnish Coarseness Index of 7.5 or less.
 12. A tissue product comprising first and second fiber species and having from about 5 to about 50 dry weight percent of the first fiber species, wherein the first fiber species has an average fiber length greater than 1 millimeter and a Coarseness Index of 10 or less and wherein the second fiber species has an average fiber length less than 1 millimeter.
 13. The tissue product of Claim 12 wherein the first fiber species is a nonwoody fiber species.
 14. The tissue product of Claim 12 wherein the first fiber species has a Coarseness Index of 9 or less.
 15. The tissue product of Claim 12 wherein the first fiber species has a Coarseness Index of 8 or less.
 16. The tissue product of Claim 12 wherein the first fiber species has a Coarseness Index of 7 or less.
 17. The tissue product of Claim 12 wherein the second fiber species has a Coarseness Index of 7 or less.
 18. The tissue product of Claim 12 wherein the second fiber species is selected from the group consisting of sabai

grass fibers, rice straw fibers, pineapple leaf fibers, esparto grass fibers and bast fibers from paper mulberry, and mixtures thereof.

19. The tissue product of Claim 12 wherein the first fiber species is selected from the group consisting of abaca leaf fibers, banana leaf fibers, milkweed seed floss fibers, and mixtures thereof.
20. A tissue product comprising from about 5 to about 30 weight percent seed floss fibers of the genus *Asclepias*, wherein the Profile Index is about 4.0 or greater.
21. The tissue product of Claim 20 wherein the Profile Index is about 5 or greater.
22. The tissue product of Claim 20 further comprising abaca leaf fibers.
23. A tissue product comprising a layered fibrous sheet having first and second layers, said first layer being the outer surface of the tissue product, said first layer comprising at least about 5 dry weight percent fibers of a nonwoody species having an average Coarseness Index of 7.5 or less.
24. The tissue product of Claim 23 wherein the nonwoody fiber species is milkweed seed floss fibers.
25. The tissue product of Claim 23 wherein the nonwoody fiber species is pineapple leaf fibers.
26. The tissue product of Claim 23 wherein the first or second layer comprises abaca leaf fibers.

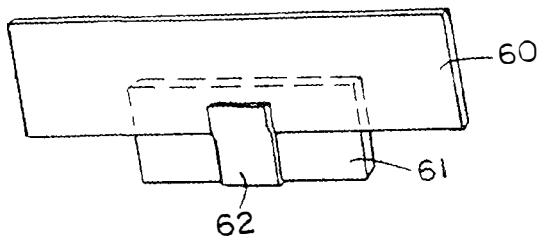


FIG. 1A

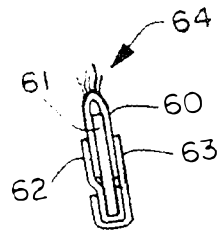


FIG. 1B

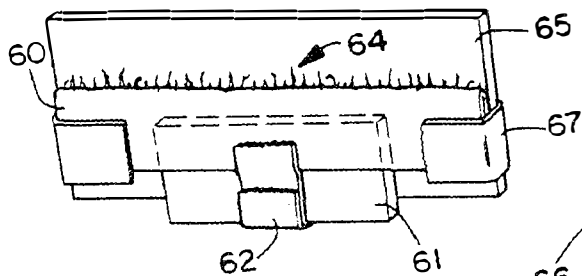


FIG. 1C

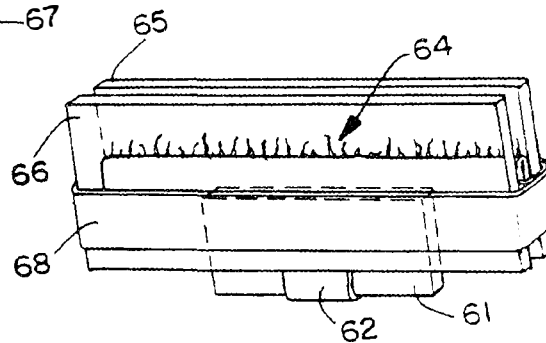


FIG. 1D

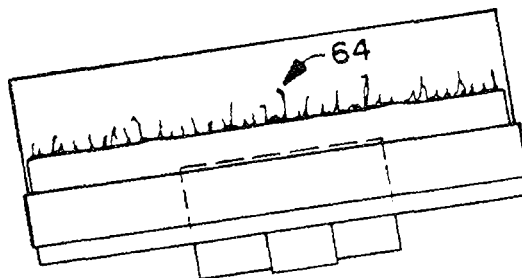


FIG. 2

Scott G. Apple

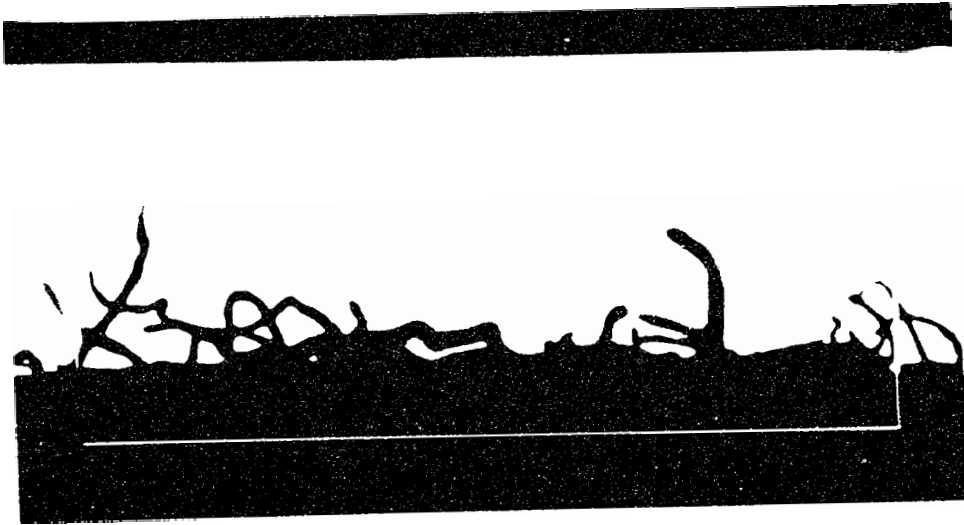


FIG. 3



FIG. 4

Scott & Sykes



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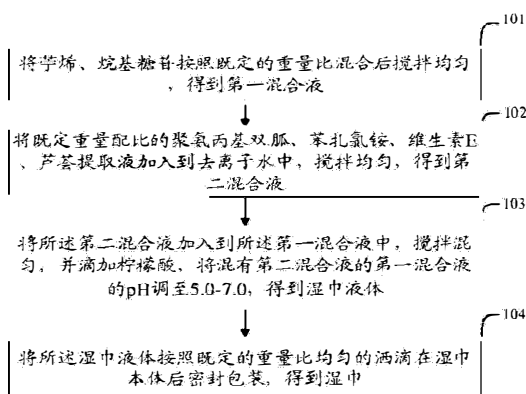
权利要求书1页 说明书6页 附图1页

(54) 发明名称

一种湿巾及其制备方法

(57) 摘要

本发明涉及日常生活领域,具体而言,涉及一种湿巾及其制备方法。该湿巾,包括湿巾本体和喷滴在湿巾本体上且重量为湿巾本体2-3倍的湿巾液体;其中,按照重量百分数计,在湿巾液体中,其组份包括苧烯0.10%-1.0%、烷基糖苷0.60%-6.0%、聚氧丙基双胍0.10%-0.30%、苯扎氯铵0.05%-0.10%、维生素E 0.05%-0.3%、芦荟提取液0.10%-1.0%、柠檬酸0.005%-0.15%、去离子水91.45%-98.995%。本发明提供的该湿巾通过对湿巾液体的处方进行改进,克服了现有技术中存在的安全隐患(刺激性、腐蚀性或致癌性等),从而为人们的日常清洁提供一种真正安全无毒的湿巾。



1. 一种湿巾,其特征在于,包括湿巾本体和喷滴在所述湿巾本体上且重量为所述湿巾本体 2-3 倍的湿巾液体;

其中,按照重量百分数计,在所述湿巾液体中,其组份包括苧烯 0.10% -1.0%、烷基糖苷 0.60% -6.0%、聚氮丙基双胍 0.10% -0.30%、苯扎氯铵 0.05% -0.10%、维生素 E 0.05% -0.3%、芦荟提取液 0.10% -1.0%、柠檬酸 0.005% -0.15%、去离子水 91.45% -98.995%。

2. 根据权利要求 1 所述的湿巾,其特征在于,所述苧烯从柑橘类水果中提取获得。

3. 根据权利要求 1 或 2 所述的湿巾的制备,其特征在于,所述烷基糖苷从玉米或椰子油中提取获得。

4. 根据权利要求 3 所述的湿巾的制备,其特征在于,所述烷基糖苷为辛基 / 癸基葡萄糖苷。

5. 根据权利要求 4 所述的湿巾,其特征在于,所述湿巾本体为水刺无纺布。

6. 一种根据权利要求 1 所述的湿巾的制备方法,其特征在于,包括以下步骤:

(1)、配置湿巾液体;

(2)、将所述湿巾液体按照既定的重量比均匀的洒滴在湿巾本体后密封包装,得到湿巾。

7. 根据权利要求 6 所述的湿巾的制备方法,其特征在于,在步骤 (1) 中,具体包括:

将苧烯、烷基糖苷按照既定的重量比混合后搅拌均匀,得到第一混合液;

将既定重量配比的聚氮丙基双胍、苯扎氯铵、维生素 E、芦荟提取液加入到去离子水中,搅拌均匀,得到第二混合液;

将所述第二混合液加入到所述第一混合液中,搅拌混匀,并滴加柠檬酸,将混有第二混合液的第一混合液的 pH 调至 5.0-7.0,得到湿巾液体。

8. 根据权利要求 7 所述的湿巾的制备方法,其特征在于,在所述将苧烯、烷基糖苷按照既定的重量比混合后搅拌均匀,得到第一混合液的步骤中:

所述混合时的温度为 20-30℃。

9. 根据权利要求 8 所述的湿巾的制备方法,其特征在于,在所述将苧烯烷基糖苷按照既定的重量比混合后搅拌均匀,得到第一混合液的步骤中:

所述搅拌的转速为 1500-2000 转 / 分钟、时间为 10-20 分钟。

10. 根据权利要求 6-9 任一项所述的湿巾的制备方法,其特征在于,在所述将所述第二混合液加入到所述第一混合液中,搅拌混匀,并滴加柠檬酸,将混有第二混合液的第一混合液的 pH 调至 5.0-7.0,得到湿巾液体的步骤中:

所述搅拌的转速为 1000-1500 转 / 分钟、时间为 10-20 分钟。

一种湿巾及其制备方法

技术领域

[0001] 本发明涉及日常生活领域,具体而言,涉及一种湿巾及其制备方法。

背景技术

[0002] 湿巾作为一种清洁产品已经被广泛的应用的人们的日常生活中。一般而言,其包括湿巾本体和喷敷在湿巾本体上的消毒液组成。而对于消毒液,其一般由有机溶剂、表面活性剂、以及具有杀菌防腐效果的化学试剂组成。

[0003] 在相关技术中,家居清洁类产品(包括构成湿巾的消毒液)多为 pH 值呈强酸性或强碱性产品,因此,其在使用的过程中对皮肤的刺激性较强,还具有较大的腐蚀性。对于有机溶剂,大多为有机合成所得,其去污力强同时对物品刺激、腐蚀性大。且大多溶剂含有毒性。其脂溶性可经完整的皮肤迅速吸收,长期接触,难免对人体健康产生不利影响。对于表面活性剂,相关技术中常用石油基表面活性剂,该表面活性剂在合成的过程中难免产生毒副产物-二恶烷、环氧乙烷或亚硝胺等;长期使用,难免对人体的健康产生不利的影响;另外,这种石油基表面活性剂其对塑料家居具有一定的腐蚀性,因此,使用其长期擦拭塑料家居时,会对塑料家居产生一定损伤。对于具有杀菌防腐效果的化学试剂,目前常用 DMDM 乙内酰脲、甲基异噻唑啉酮/甲基氯异噻唑啉酮(卡松)、布罗波尔、IPBC 或尼泊金酯类等;然而,DMDM 乙内酰脲是甲醛释放体、甲基异噻唑啉酮/甲基氯异噻唑啉酮(卡松)含氯,可能会刺激皮肤、布罗波尔可能会导致致癌物质亚硝胺的形成、IPBC 在使用的过程中可能会导致碘摄入、尼泊金酯类含有苯环,其在体内累计后,容易增加女性患乳腺癌的危险。

[0004] 综上,相关技术中常见的湿巾,其消毒液组成存在一定的安全隐患(具有刺激性、腐蚀性或致癌性等);因此,为人们的日常清洁(厨房清洁、浴室清洁、家具清洁)提供一种安全无毒的湿巾是本领域技术人员亟待解决的一个技术问题。

发明内容

[0005] 本发明的目的在于提供一种湿巾,以解决上述的技术问题。本发明的另一个目的在于提供一种上述湿巾的制备方法。

[0006] 在本发明的实施例中提供了湿巾,包括湿巾本体和喷滴在所述湿巾本体上且重量为所述湿巾本体 2-3 倍的湿巾液体;其中,按照重量百分数计,在所述湿巾液体中,其组份包括苧烯 0.10% -1.0%、烷基糖苷 0.60% -6.0%、聚氨丙基双胍 0.10% -0.30%、苯扎氯铵 0.05% -0.10%、维生素 E 0.05% -0.3%、芦荟提取液 0.10% -1.0%、柠檬酸 0.005% -0.15%、去离子水 91.45% -98.995%。

[0007] 本发明提供的这种湿巾,其由湿巾本体和重量为其 2-3 倍的湿巾液体组成,其中,在湿巾液体中,其包含了苧烯、烷基糖苷、聚氨丙基双胍、苯扎氯铵、维生素 E、芦荟提取液等有效组份。

[0008] 具体的,苧烯是一种绿色环保溶剂,具有甜橙的芬芳香味,同时具有较强的去污效果,且具有天然的杀菌作用,天然、无毒、无公害。用其替代目前使用的各种有机溶剂,改变

相关技术中的化工制品有毒有害或具有刺激性或者腐蚀性这的缺陷。

[0009] 烷基糖苷湿润力强、去污力强、泡沫丰富细腻、无毒、无害、对皮肤无刺激,生物降解迅速彻底,是国际公认的首选“绿色”功能性表面活性剂。用其替代现有石油基表面活性剂,不含有毒副产物二恶烷、环氧乙烷和亚硝胺等,且与塑料制品有很好的相容性,进而克服了现有技术中由于石油基表面活性剂有毒或者腐蚀性以及损伤塑料家居的技术缺陷。

[0010] 聚氮丙基双胍及苯扎氯铵复配杀菌体系,两成分均属非氧化性杀菌剂,通过影响微生物细胞的渗透压,使细胞膜破裂,收缩和失水,从而达到杀菌的作用。其中,聚氮丙基双胍为一新型消毒杀菌防腐剂,对细菌,酵母菌和霉菌具有广谱的抑菌活性。它具有温和的天然性质,可用于粘膜类包括眼部粘膜产品。而苯扎氯铵为一传统消毒杀菌剂,对细菌霉菌有广谱的抑制作用。两组份复配后,达到协同增效的作用,经实验室进行杀菌试验检测,其对大肠杆菌、金黄色葡萄球菌、绿脓杆菌、肺炎克雷伯菌等菌种,接触状态为 5min,其杀菌率达 99.99%,同时对黑曲霉有抑菌作用;因此可以有效的作为本申请的湿巾液体中的防腐杀菌消毒剂。

[0011] 此外,既定重量百分数维生素 E 具有滋润皮肤的效果,不伤手,安全无毒;芦荟提取液具有在皮肤表面形成透气保护膜,轻松隔离外部污染对手部的侵害,清洁同时,具有使皮肤收敛、抗过敏、保湿、消炎等功效,而既定重量百分数的柠檬酸其可以使得整个湿巾液体的 pH 维持在 5.0-7.0 之间(呈弱酸性),该范围贴近人体皮肤的 pH,进而使其不伤害皮肤保护膜,共同达到呵护双手的效果。

[0012] 因此,与现有技术相比,本申请的湿巾通过对湿巾液体的处方进行改进,并设定特定的配伍关系,使得制成的湿巾克服了现有技术中存在的安全隐患(刺激性、腐蚀性或致癌性等),从而为人们的日常清洁(厨房清洁、浴室清洁、家具清洁)提供一种真正安全无毒的湿巾。

[0013] 可选的,所述苧烯从柑橘类水果中提取获得。

[0014] 可选的,所述烷基糖苷从玉米或椰子油中提取获得。

[0015] 可选的,所述烷基糖苷为辛基/癸基葡糖苷。

[0016] 可选的,所述湿巾本体为水刺无纺布。

[0017] 本发明实施例还提供了一种根据上述湿巾的制备方法,包括以下步骤:

[0018] (1)、配置湿巾液体;

[0019] (2)、将所述湿巾液体按照既定的重量比均匀的洒滴在湿巾本体后密封包装,得到湿巾。

[0020] 可选的,在步骤(1)中,具体包括:将苧烯、烷基糖苷按照既定的重量比混合后搅拌均匀,得到第一混合液;

[0021] 将既定重量配比的聚氮丙基双胍、苯扎氯铵、维生素 E、芦荟提取液加入到去离子水中,搅拌均匀,得到第二混合液;

[0022] 将所述第二混合液加入到所述第一混合液中,搅拌混匀,并滴加柠檬酸,将混有第二混合液的第一混合液的 pH 调至 5.0-7.0,得到湿巾液体。

[0023] 可选的,在所述将苧烯、烷基糖苷按照既定的重量比混合后搅拌均匀,得到第一混合液的步骤中:所述混合时的温度为 20-30℃。

[0024] 可选的,在所述将苧烯、烷基糖苷按照既定的重量比混合后搅拌均匀,得到第一混

合液的步骤中：

[0025] 所述搅拌的转速为 1500-2000 转 / 分钟、时间为 10-20 分钟。

[0026] 可选的,在所述将所述第二混合液加入到所述第一混合液中,搅拌混匀,并滴加柠檬酸,将混有第二混合液的第一混合液的 pH 调至 5.0-7.0,得到湿巾液体的步骤中：

[0027] 所述搅拌的转速为 1000-1500 转 / 分钟、时间为 10-20 分钟。

附图说明

[0028] 为了更清楚地说明本发明具体实施方式或现有技术中的技术方案,下面将对具体实施方式或现有技术描述中所需要使用的附图作简单地介绍,显而易见地,下面描述中的附图是本发明的一些实施方式,对于本领域普通技术人员来讲,在不付出创造性劳动的前提下,还可以根据这些附图获得其它的附图。

[0029] 图 1 为本发明实施例四提供的湿巾的制备流程示意图。

具体实施方式

[0030] 为使本发明的目的、技术方案和优点更加清楚,下面将对本发明的技术方案进行清楚、完整的描述,基于本发明中的具体实施方式,本领域普通技术人员在没有做出创造性劳动的前提下所得到的所有其它实施方式,都属于本发明所保护的范围。

[0031] 本发明提供的这种湿巾,包括湿巾本体和喷滴在所述湿巾本体上且重量为所述湿巾本体 2-3 倍的湿巾液体；

[0032] 其中,按照重量百分数计,在所述湿巾液体中,其组份包括苧烯 0.10% -1.0%、烷基糖苷 0.60% -6.0%、聚氨丙基双胍 0.10% -0.30%、苯扎氯铵 0.05% -0.10%、维生素 E 0.05% -0.3%、芦荟提取液 0.10% -1.0%、柠檬酸 0.005% -0.15%、去离子水 91.45% -98.995%；另外,作为优选的方案,所述苧烯从柑橘类水果中提取获得；和或所述烷基糖苷从玉米或椰子油中提取获得；另外,烷基糖苷优选为辛基 / 癸基葡糖苷。并且,所述湿巾本体为水刺无纺布,如为黏胶纤维或涤纶或两者按任意比例混合的材质,单位克重为 30-150 克 / m²。

[0033] 此外,本发明还结合上述的内容,对湿巾的组成提供了以下具体的实施例：

[0034] 实施例一

[0035] 本实施例的湿巾,包括湿巾本体和喷滴在所述湿巾本体上且重量为所述湿巾本体 2-3 倍的湿巾液体；其中,按照重量百分数计,在所述湿巾液体中,其组份包括苧烯 0.1%、辛基 / 癸基葡糖苷 0.6%、聚氨丙基双胍 0.1%、苯扎氯铵 0.1%、维生素 E 0.05%、芦荟提取液 1.0%、柠檬酸 0.01%、去离子水 98.04%。

[0036] 实施例二

[0037] 本实施例的湿巾,包括湿巾本体和喷滴在所述湿巾本体上且重量为所述湿巾本体 2-3 倍的湿巾液体；其中,按照重量百分数计,在所述湿巾液体中,其组份包括苧烯 0.5%、辛基 / 癸基葡糖苷 3.3%、聚氨丙基双胍 0.2%、苯扎氯铵 0.07%、维生素 E 0.2%、芦荟提取液 0.55%、柠檬酸 0.07%、去离子水 95.11%。

[0038] 实施例三

[0039] 本实施例的湿巾,包括湿巾本体和喷滴在所述湿巾本体上且重量为所述湿巾本体

2-3 倍的湿巾液体；其中，按照重量百分数计，在所述湿巾液体中，其组份包括苧烯 1.0%、辛基 / 癸基葡糖苷 6.0%、聚氨丙基双胍 0.3%、苯扎氯铵 0.05%、维生素 E 0.3%、芦荟提取液 0.10%、柠檬酸 0.1%、去离子水 92.15%。

[0040] 另外，基于上述所有实施例中，作为进一步可替代的方案，辛基 / 癸基葡糖苷可以由等重量的他烷基糖苷替代，如 APG0814, APG0816, APG1214, APG1216 等碳链组分不一的烷基糖苷类表面活性剂。此外，上述所有实施例中，优选的，苧烯选择从柑橘类水果中提取获得，从柑橘类水果中提取获得苧烯其具有甜橙的芬芳香味同时具有较强的去污效果，且具有天然的杀菌作用，天然、无毒、无公害。在国际上已被认定为食品香料添加剂，为美国食品及药物管理局 (FDA) 的免检产品，安全性高；烷基糖苷从玉米和椰子油中提取获得；玉米来源较易，可为其制备提供充分的保障。

[0041] 为了使得本发明上述实施例的湿巾得到更好的应用，更加有效应用到家具清洁消毒的领域中，本发明还在上述实施例的基础之上提供了实施例四，实施例四给出了上述实施例的湿巾的制作方法，现做详细的阐述和解释，请参考图 1：

[0042] 实施例四

[0043] 请参考图 1，在本实施例中，湿巾的制备方法包括以下步骤：

[0044] 步骤 101：将苧烯、烷基糖苷按照既定的重量比混合后搅拌均匀，得到第一混合液；

[0045] 由于苧烯为脂溶性物质，要将其应用到水溶性体系（后续第二混合液）中，需得到 O/W 型乳化体系，本实施例采用亲水亲油平衡值 (HLB) 法，选择 HLB 值为 14-16 的天然 APG（烷基糖苷）作为乳化剂，与苧烯以 6:1 的重量比混合，搅拌混匀后得到第一混合液。

[0046] 在步骤 101 中，为了实现将苧烯乳化充分、且快速混匀的效果，所述混合时的温度为 20-30℃（在该温度范围内，由于烷基糖苷 HLB 值较高，在 20-30℃ 范围内，即可发挥其活性，将其较大极性基团伸向水相，非极性的碳氢键深入油相，降低其界面张力，形成一层保护膜，将内向油完全包围起来，形成 O/W 乳液。传统乳化产品则需要在 75℃-85℃ 的范围内乳化，本产品乳化工艺简易，在提高生产效率的同时降低了生产成本）；所述搅拌的转速为 1500-2000 转 / 分钟、时间为 10-20 分钟。

[0047] 步骤 102：将既定重量配比的聚氨丙基双胍、苯扎氯铵、维生素 E、芦荟提取液加入到去离子水中，搅拌均匀，得到第二混合液；

[0048] 具体的，通过一个预先装有去离子水的容器，然后分别将聚氨丙基双胍、苯扎氯铵、维生素 E、芦荟提取液加入，搅拌混匀之后，得到第二混合液。

[0049] 步骤 103：将所述第二混合液加入到所述第一混合液中，搅拌混匀，并滴加柠檬酸，将混有第二混合液的第一混合液的 pH 调至 5.0-7.0，得到湿巾液体；

[0050] 在步骤 103 中，所述搅拌的转速为 1000-1500 转 / 分钟、时间为 10-20 分钟。

[0051] 步骤 104：将所述湿巾液体按照既定的重量比均匀的洒滴在湿巾本体后密封包装，得到湿巾。

[0052] 具体的，在洒滴的过程中，湿巾液体的重量为湿巾本体的 2-3 倍。另外，本发明还提供了上述实施例提供的湿巾的去污能力测试、杀菌效果测试、黑曲霉菌防腐挑战性测试、与塑胶类产品相容性测试；具体的，为进一步说明本发明的实际使用效果，采用几例典型试验案例进行说明：

[0053] 1、去污能力测试：

[0054] 试验一：受试物为厨房瓷砖墙壁以及大理石台面，有中度油污，用实施例一提供的湿巾擦拭厨房瓷砖墙壁以及大理石台面。擦拭完毕，厨房瓷砖墙壁以及大理石台面无油污，操作者感觉对皮肤无刺激性。

[0055] 试验二：受试物体为玻璃茶几，以及家用电器（冰箱、电视机）外壳，有轻微茶渍以及污垢，用实施例二提供的湿巾擦拭受试物体表面。擦拭完毕，茶渍以及污垢完全被清除，操作者感觉对皮肤无刺激性。

[0056] 试验三：受试物为浴室瓷砖墙壁以及卫浴设备，有皂垢、水垢、人体污垢，用实施例三提供的湿巾擦拭物体，擦拭完毕后，浴室墙壁以及卫浴设备污垢基本清除，操作者感觉对皮肤无刺激性。

[0057] 2、杀菌效果测试：

[0058] 用实施例一和三提供的样品，分别标记为：厨房清洁消毒湿巾 1#，厨房清洁消毒湿巾 2#。经第三方权威检测机构根据 GB15979/2002《一次性使用卫生用品卫生标准》的标准，对大肠杆菌、金黄色葡萄球菌、绿脓杆菌、肺炎克雷伯菌进行杀菌测试。对黑曲霉菌进行防腐挑战性测试。测试结果如下：

[0059] 表 1 本发明各实施例的湿巾对不同菌种的杀菌效果测试

[0060]

测试微生物	作用时间	杀菌率	
		实施例一	实施例三
金黄色葡萄球菌 ATCC6538	5min	>99.99%	>99.99%
大肠杆菌 ATCC8739	5min	>99.99%	>99.99%
绿脓杆菌 ATCC9027	5min	>99.99%	>99.99%
肺炎克雷伯菌 ATCC4352	5min	>99.99%	>99.99%

[0061] 3、黑曲霉菌防腐挑战性测试：

[0062] 表 2 本发明各实施例的湿巾对黑曲霉菌防腐测试

[0063]

		48 小时	7 天	14 天	28 天
初始菌浓度	空白样	7.50×10^4	2.00×10^4	1.20×10^4	6.00×10^3
活菌数量	实施例一	<100	<100	<100	<100
	实施例三	<100	<100	<100	<100

[0064] 4、与塑胶类产品相容性测试：

[0065] 选择一块中间钉有不锈钢钢钉（形成张力）的塑料（聚甲基丙烯酸甲酯）测试条，每天短时间浸入待测溶液，一定时间后观察测试条的情况。评估等级分为：无变化；形成裂

缝 ; 明显裂缝 ; 断裂。

[0066] 表 3 本发明各实施例的湿巾与塑胶类产品相容性测试

[0067]

	4 小时	3 天	7 天	14 天
实施例一	无变化	无变化	无变化	无变化
实施例三	无变化	无变化	无变化	无变化

[0068] 以上所述仅为本发明的优选实施例而已,并不用于限制本发明,对于本领域的技术人员来说,本发明可以有各种更改和变化。凡在本发明的精神和原则之内,所作的任何修改、等同替换、改进等,均应包含在本发明的保护范围之内。

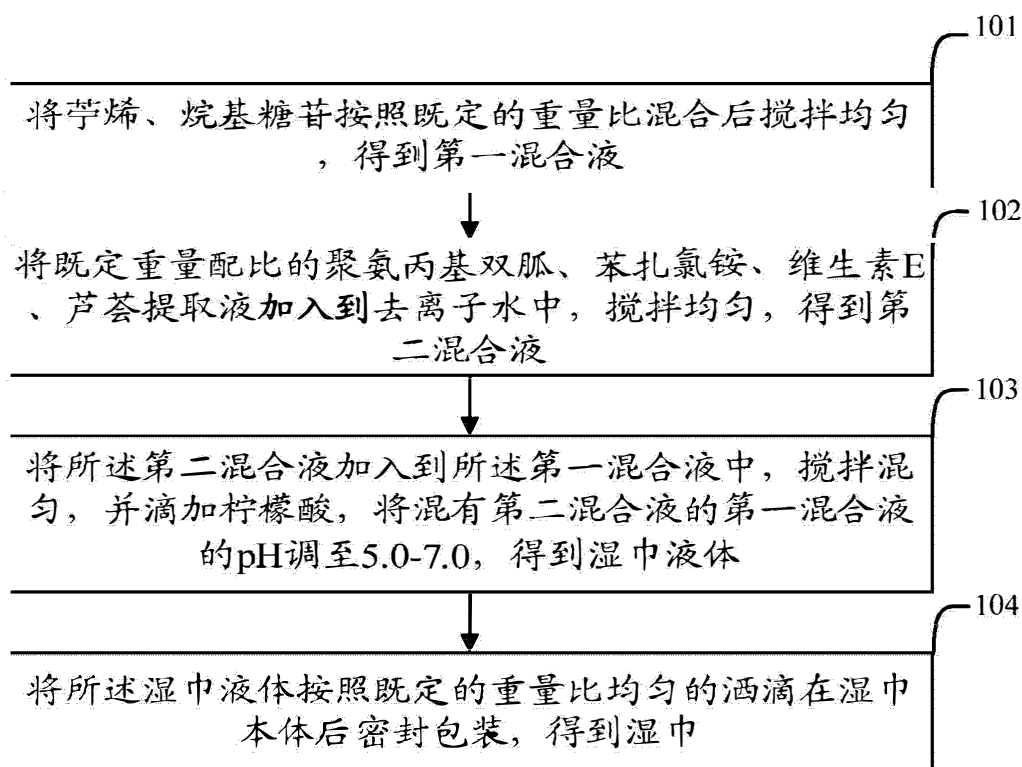


图 1

Wet tissue and preparation method thereof

Abstract

The invention relates to the field of daily life, in particular to a wet tissue and a preparation method of the wet tissue. The wet tissue comprises a wet tissue body and wet tissue liquid sprayed on the wet tissue body, and the weight of the wet tissue liquid is 2 times-3 times that of the wet tissue body. The wet tissue liquid comprises, by weight, 0.1-1.0% of limonene, 0.6-6.0% of alkyl glycoside, 0.1-0.3% of polyaminopropyl biguanide, 0.05-0.1% of benzalkonium chloride, 0.05-0.3% of vitamin E, 0.1-1.0% of an aloe extracting solution, 0.005-0.15% of citric acid and 91.45-98.995% of deionized water. According to the wet tissue, the formula of the wet tissue liquid is improved, so that potential safety hazards (such as irritation, corrosivity and carcinogenicity) existing in the prior art are eliminated, and the really safe and nontoxic wet tissue is supplied to people for daily cleanness.

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Claims (10)

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1. a wet tissue, is characterized in that, comprises that wet tissue body and spray drop on described wet tissue body and weight is described wet tissue body 2-3 wet tissue liquid doubly;

Wherein, according to percentage by weight meter, in described wet tissue liquid, its component Bao Kuo limonene 0.10%-1.0%, APG 0.60%-6.0%, polyaminopropyl biguanide 0.10%-0.30%, benzalkonium chloride 0.05%-0.10%, vitamin E 0.05%-0.3%, extract solution from aloe 0.10%-1.0%, citric acid 0.005%-0.15%, deionized water 91.45%-98.995%.

2. wet tissue according to claim 1, is characterized in that, Suo Shu limonene extracts and obtains from citrus fruit

3. the preparation of wet tissue according to claim 1 and 2, is characterized in that, described APG extracts and obtains from corn or coconut oil.

4. the preparation of wet tissue according to claim 3, is characterized in that, described APG is octyl group/Plantacare 818.

5. wet tissue according to claim 4, is characterized in that, described wet tissue body is spunlace non-woven cloth.

6. a preparation method for wet tissue according to claim 1, is characterized in that, comprises the following steps:

(1), configuration wet tissue liquid;

(2), described wet tissue liquid is split uniformly after dropping in wet tissue body and packed according to set weight ratio, obtain wet tissue.

7. the preparation method of wet tissue according to claim 6, is characterized in that, in step (1), specifically comprises:

After limonene, APG mix according to set weight ratio, stir, obtain the first mixed liquor;

The polyaminopropyl biguanide of set weight proportion, benzalkonium chloride, vitamin E, extract solution from aloe are joined in deionized water, stir, obtain the second mixed liquor;

Described the second mixed liquor is joined in described the first mixed liquor; stir and evenly mix, and drip citric acid, the pH of the first mixed liquor that is mixed with the second mixed liquor is adjusted to 5.0-7.0, obtain wet tissue liquid.

8. the preparation method of wet tissue according to claim 7, is characterized in that, stirs after limonene. APG mix according to set weight ratio described, obtains in the step of the first mixed liquor:

Temperature when described mixing is 20-30 DEG C.

9. the preparation method of wet tissue according to claim 8. is characterized in that, stir after limonene APG mixes according to set weight ratio described, obtains in the step of the first mixed liquor.

The rotating speed of described stirring is that 1500-2000 rev/min, time are 10-20 minute.

10. according to the preparation method of the wet tissue described in claim 6-9 any one, it is characterized in that, described, described the second mixed liquor is joined in described the first mixed liquor, stir and evenly mix, and drip citric acid, the pH of the first mixed liquor that is mixed with the second mixed liquor is adjusted to 5.0-7.0, obtains in the step of wet tissue liquid.

The rotating speed of described stirring is that 1000-1500 rev/min, time are 10-20 minute.

Description

A kind of wet tissue and preparation method thereof

Technical field

The present invention relates to daily sphere of life, in particular to a kind of wet tissue and preparation method thereof.

Background technology

In the daily life that wet tissue has been widely used as a kind of cleaning products. Generally speaking, it comprises wet tissue body and the sprayed coating thimerosal composition on wet tissue body. And for thimerosal, it is generally made up of organic solvent, surfactant and the chemical reagent with sterilization and anticorrosion effect.

In correlation technique, household cleaning series products (comprising the thimerosal that forms wet tissue) mostly is pH value and is highly acid or strong basicity product, and therefore, it is stronger to the excitant of skin in the process using, and also has larger corrosivity. For organic solvent, be mostly organic synthesis gained, its strong detergency simultaneously to article stimulate, corrosivity is large. And large multi-solvent contains toxicity. Its fat-soluble can absorption rapidly through complete skin. Long Term Contact, has a negative impact to health unavoidably. For surfactant, conventional petroleum base surfactant in correlation technique, this surfactant is unavoidable toxic byproduct dioxanes, oxirane or the nitrosamine etc. of producing in synthetic process; When long-term use, unavoidably the health of human body is produced to adverse influence; In addition, it has certain corrosivity to plastics household. This petroleum base surfactant, therefore, while using its long-term wiping plastic household, can produce certain damage to plastics household. For the chemical reagent with sterilization and anticorrosion effect, conventional DMDMH, the different plug azoles of methyl quinoline ketone/methyl chloride different plug azoles quinoline ketone (Kathon CG), Bronopol, IPBC or parabens etc. at present; But, DMDMH is that formaldehyde releaser, the different plug azoles of methyl quinoline ketone/methyl chloride different plug azoles quinoline ketone (Kathon CG) are chloride, may cause, Bronopol may cause formation, the 913C of carcinogen nitrosamine in the process using, may cause that iodine is taken in, parabens contains phenyl ring, it easily increases the danger that women suffers from breast cancer after adding up in vivo.

To sum up, common wet tissue in correlation technique, there is certain potential safety hazard (therein are excitant, corrosivity or carcinogenicity etc.) in its thimerosal composition; Therefore be, those skilled in the art's technical problems urgently to be resolved hurriedly for people's daily cleaning (kitchen cleaning, bathroom cleaner, furniture clean) provides a kind of wet tissue of safety non-toxic.

Summary of the invention

The object of the present invention is to provide a kind of wet tissue, to solve above-mentioned technical problem. Another object of the present invention is to provide a kind of preparation method of above-mentioned wet tissue.

Wet tissue is provided in an embodiment of the present invention, has comprised that wet tissue body and spray drop on described wet tissue body and weight is described wet tissue body 2-3 wet tissue liquid doubly; Wherein, according to percentage by weight meter, in described wet tissue liquid, its component Bao Yue limonene 0.10%-1.0%, APG 0.60%-6.0%, polyaminopropyl biguanide 0.10%-0.30%, benzalkonium chloride 0.05%-0.10%, vitamin E 0.05%-0.3%, extract solution from aloe 0.10%-1.0%, citric acid 0.005%-0.15%, deionized water 91.45%-98.985%.

This wet tissue provided by the invention, it is that its 2-3 wet tissue liquid doubly forms by wet tissue body and weight, wherein, in wet tissue liquid, it comprises the active principles such as limonene, APG, polyaminopropyl biguanide, benzalkonium chloride, vitamin E, extract solution from aloe.

Ju body, limonene is a kind of green and environment-friendly solvent, has the fragrant fragrance of a sweet orange, has stronger clean effect simultaneously, and has natural bactericidal action, natural, nontoxic, nuisanceless. Substitute with it various organic solvents that use at present, change the heavy chemicals poisonous and harmful in correlation technique or there is excitant or this defect of corrosivity.

APG wetting power is strong, strong detergency, foam are abundant fine and smooth, nontoxic, harmless, non-stimulated to skin, and biodegradation is thorough rapidly, is internationally recognized first-selection "green" functional surface activating agent. Substitute existing petroleum base surfactant with it, do not contain toxic byproduct dioxanes, oxirane and nitrosamine etc., and there is good compatibility with plastic products, and then overcome in prior art because petroleum base surfactant is poisonous or the technological deficiency of corrosivity and damage plastics household.

Polyaminopropyl biguanide and benzalkonium chloride compound sterilizing system, two compositions all belong to non oxidizing bactericide, by affecting the osmotic pressure of microbial cell, make membranolysis, shrink and dehydration, thereby reach the effect of sterilization. Wherein, polyaminopropyl biguanide is a Novel sterilizing sterilization antiseptic, and to bacterium, saccharomycete and mould have the bacteriostatic activity of wide spectrum. It has gentle natural character, can be used for mucous membrane class and comprises eye mucous membrane product. And benzalkonium chloride is a traditional disinfectant, bacterium mould is had to the inhibitory action of wide spectrum. After two components are composite, reach the effect of Synergistic, carry out BA detection through laboratory, it is to bacterial classifications such as Escherichia coli, staphylococcus aureus, Pseudomonas aeruginosa, Klebsiella Pneumoniae, contact condition is 5min, and its sterilizing rate reaches 99.99%, aspergillus niger is had to bacteriostasis simultaneously; Therefore can be effectively as the antiseptics and sterilization disinfectant in the application's wet tissue liquid.

In addition, set percentage by weight vitamin E has the effect of skin care, does not hinder hand, safety non-toxic; Extract solution from aloe has at skin surface formation air-permeable protective film; easily isolating exterior pollutants the infringement to hand; simultaneously clean, there is the effects such as the skin contraction of making, anti-aging, moisturizing, anti-inflammatory; and the citric acid of set percentage by weight its can make the pH of whole wet tissue liquid maintain between 5.0-7.0 (to be faintly acid); this scope is pressed close to the pH of human body skin, and then makes it not injure skin sparing film, jointly reaches the effect of care both hands.

Therefore, compared with prior art, the application's wet tissue is by improving the prescription of wet tissue liquid, and set specific compatibility relationship, make the wet tissue of making overcome the potential safety hazard (excitant, corrosivity or carcinogenicity etc.) existing in prior art, thereby provide a kind of wet tissue of real safety non-toxic for people's daily cleaning (kitchen cleaning, bathroom cleaner, furniture are clean).

Optionally, Suc Shu limonene extracts and obtains from citrus fruit.

Optionally, described APG extracts and obtains from corn or coconut oil.

Optionally, described APG is octyl group/Plantacare 818.

Optionally, described wet tissue body is spunlace non-woven cloth.

It is a kind of according to the preparation method of above-mentioned wet tissue that the embodiment of the present invention also provides, and comprises the following steps:

(1), configuration wet tissue liquid;

(2), described wet tissue liquid is split uniformly after dropping in wet tissue body and packed according to set weight ratio, obtain wet tissue.

Optionally, in step (1), specifically comprise that: stir after limonene, APG mix according to set weight ratio, obtains the first mixed liquor;

The polyaminopropyl biguanide of set weight proportion, benzalkonium chloride, vitamin E, extract solution from aloe are joined in deionized water, stir, obtain the second mixed liquor;

Described the second mixed liquor is joined in described the first mixed liquor, stir and evenly mix, and drip citric acid, the pH of the first mixed liquor that is mixed with the second mixed liquor is adjusted to 5.0-7.0, obtain wet tissue liquid.

Optionally, stir after limonene, APG mix according to set weight ratio described, obtain in the step of the first mixed liquor, temperature when described mixing is 20-30 DEG C.

Optionally, stir after limonene, APG mix according to set weight ratio described, obtain in the step of the first mixed liquor.

The rotating speed of described stirring is that 1500-2000 rev/min, time are 10-20 minute.

Optionally, described, described the second mixed liquor is joined in described the first mixed liquor, stir and evenly mix, and drip citric acid, the pH of the first mixed liquor that is mixed with the second mixed liquor is adjusted to 5.0-7.0, obtain in the step of wet tissue liquid.

The rotating speed of described stirring is that 1000-1500 rev/min, time are 10-20 minute.

Brief description of the drawings

In order to be illustrated more clearly in the specific embodiment of the invention or technical scheme of the prior art, to the accompanying drawing of required use in detailed description of the invention or description of the Prior Art be briefly described below, apparently, accompanying drawing in the following describes is some embodiments of the present invention, for those of ordinary skill in the art, do not paying under the prerequisite of creative work, can also obtain according to these accompanying drawings other accompanying drawing.

The preparation flow schematic diagram of the wet tissue that Fig. 1 provides for the embodiment of the present invention four.

Detailed description of the invention

For making the object, technical solutions and advantages of the present invention clearer, to technical scheme of the present invention be carried out to clear, complete description below; based on the detailed description of the invention in the present invention; all other embodiments that those of ordinary skill in the art obtain under the prerequisite of not making creative work, all belong to the scope that the present invention protects.

This wet tissue provided by the invention, comprises that wet tissue body and spray drop on described wet tissue body and weight is described wet tissue body 2-3 wet tissue liquid doubly;

Wherein, according to percentage by weight meter, in described wet tissue liquid, its component Bao Kuo limonene 0.10%-1.0%, APG 0.50%-6.0%, polyaminopropyl biguanide 0.10%-0.30%, benzalkonium chloride 0.05%-0.10%, vitamin E 0.05%-0.3%, extract solution from aloe 0.10%-1.0%, citric acid 0.005%-0.15%, deionized water 91.45%-98.995%; in addition, as preferred scheme, Suo Shu limonene extracts and obtains from citrus fruit; With or described APG from corn or coconut oil, extract and obtain; In addition, APG is preferably octyl group/Plantacare E118. And described wet tissue body is spunlace non-woven cloth, as being viscose fiber or terylene or material that both mix in any proportion, unit grammes per square metre is 30-180 Ke/m².

In addition, the present invention, also in conjunction with above-mentioned content, provides following specific embodiment to the composition of wet tissue:

Embodiment mono-

The wet tissue of the present embodiment, comprises that wet tissue body and spray drop on described wet tissue body and weight is described wet tissue body 2-3 wet tissue liquid doubly; Wherein, according to percentage by weight meter, in described wet tissue liquid, its component Bao Kuo limonene 0.1%, octyl group/Plantacare E118 0.6%, polyaminopropyl biguanide 0.1%, benzalkonium chloride 0.1%, vitamin E 0.05%, extract solution from aloe 1.0%, citric acid 0.01%, deionized water 98.04%.

Embodiment bis-

The wet tissue of the present embodiment, comprises that wet tissue body and spray drop on described wet tissue body and weight is described wet tissue body 2-3 wet tissue liquid doubly; Wherein, according to percentage by weight meter, in described wet tissue liquid, its component Bao Kuo limonene 0.5%, octyl group/Plantacare E118 3.3%, polyaminopropyl biguanide 0.2%, benzalkonium chloride 0.07%, vitamin E 0.2%, extract solution from aloe 0.55%, citric acid 0.07%, deionized water 95.11%.

Embodiment tri-

The wet tissue of the present embodiment, comprises that wet tissue body and spray drop on described wet tissue body and weight is described wet tissue body 2-3 wet tissue liquid doubly; Wherein, according to percentage by weight meter, in described wet tissue liquid, its component Bao Kuo limonene 1.0%, octyl group/Plantacare E118 6.0%, polyaminopropyl biguanide 0.3%, benzalkonium chloride 0.05%, vitamin E 0.3%, extract solution from aloe 0.10%, citric acid 0.1%, deionized water 92.15%.

In addition, in above-mentioned all embodiment, as further alternative scheme, octyl group/Plantacare E118 can by etc. his APG of weight substitute, ss APG2814, APG2816, APG1214, the APG class surfactant that the carbochain components such as APG1216 differ. In addition, in above-mentioned all embodiment, preferred limonene is selected to extract and obtain from citrus fruit, from citrus fruit, extract its fragrant fragrance with sweet orange of 1-40 get limonene and there is stronger clean effect simultaneously, and there is natural bactericidal action, natural, nontoxic, nuisanceless. Be identified as in the world food flavor additive, for the freed-from-inspection product of U.S. food and FAD (FDA), safe; APG extracts and obtains from corn and coconut oil; Oam source is easier, can be its preparation sufficient guarantee is provided.

For the wet tissue that makes the above embodiment of the present invention is better applied, more effectively be applied in the field of furniture cleaning-sterilizing, the present invention also provides embodiment tetra-on the basis of above-described embodiment, embodiment tetra-has provided the preparation method of the wet tissue of above-described embodiment, now be described in detail and explain, please refer to Fig. 1:

Embodiment tetra-

Please refer to Fig. 1, in the present embodiment, the preparation method of wet tissue comprises the following steps:

Step 101: stir after limonene, APG mix according to set weight ratio, obtains the first mixed liquor,

You Yu limonene is liposoluble substance, apply it in water-soluble system (follow-up the second mixed liquor), need obtain O/W type emulsification system, the present embodiment adopts hydrophilic lipophilic balance (HLB) method, select the natural A PG (APG) that HLB value is 14-16 to mix with the weight ratio of 5:1 Yu limonene as emulsifying agent, after stirring and evenly mixing, obtain the first mixed liquor.

In step 101: in order to realize Jiang limonene emulsification fully and the effect mixing fast, temperature when described mixing be 20-30 DEG C (in this temperature range, because APG HLB value is higher; within the scope of 20-30 DEG C, can bring into play its activity, its larger polar group is stretched to water, nonpolar hydrocarbon key goes deep into oil phase; reduce its interfacial tension; form layer protecting film, be surrounded completely to oil interior, form O/W emulsion. Conventional emulsification product need to be at the scope internal emulsification of 75 DEG C-85 DEG C, and this product emulsifying process is simple and easy, has reduced production cost in enhancing productivity); The rotating speed of described stirring is that 1500-2000 rev/min, time are 10-20 minute.

Step 102: the polyaminopropyl biguanide of set weight proportion, benzalkonium chloride, vitamin E, extract solution from aloe are joined in deionized water, stir, obtain the second mixed liquor;

Concrete, by a container that deionized water is housed in advance, then respectively polyaminopropyl biguanide, benzalkonium chloride, vitamin E, extract solution from aloe are added, after stirring and evenly mixing, obtain the second mixed liquor.

Step 103: described the second mixed liquor is joined in described the first mixed liquor, stir and evenly mix, and drip citric acid, the pH of the first mixed liquor that is mixed with the second mixed liquor is adjusted to 5.3-7.0, obtain wet tissue liquid;

In step 103, the rotating speed of described stirring is that 1000-1500 rev/min, time are 10-20 minute.

Step 104: described wet tissue liquid is spilt uniformly after dropping in wet tissue body and packed according to set weight ratio, obtain wet tissue.

Concrete, spilling in the process of dripping, the weight of wet tissue liquid be wet tissue body 2-3 doubly. In addition, the present invention also provide the dirt-removing power test, bactericidal effect test, the test of black-koji mould preservation challenge of the wet tissue that above-described embodiment provides, with the compatibility test of plastics product; Concrete, for further illustrating practical effect of the present invention, adopt several routine type testing cases to describe:

1, dirt-removing power test:

Test one: tested material is kitchen tile wall and marble countertop, has moderate greasy dirt, the wet tissue wiping kitchen tile wall and the marble countertop that provide with embodiment mono-. Wiping is complete, and kitchen tile wall and marble countertop are without greasy dirt, and operator feels skin nonirritant.

Test two: tested object is glass tea table, and household electrical appliance (refrigerator, television set) shell, has slight tea stain and dirt, the wet tissue wiping tested material surface providing with embodiment bis-. Wiping is complete, and tea stain and dirt are eliminated completely, and operator feels skin nonirritant.

Test three: tested material is bathroom tile wall and sanitary bath equipment, have soap scum, incrustation scale, human body dirt, the wet tissue wiping object providing with embodiment tri-. after wiping, shower wall and sanitary bath equipment dirt are removed substantially, and operator feels skin nonirritant.

2, bactericidal effect test:

The sample providing with embodiment mono- and three, is labeled as respectively: kitchen cleaning pasteurization towelette 1#, kitchen cleaning pasteurization towelette 2#. According to the standard of GB15979/20132 "disposable use amenities sanitary standard", Escherichia coli, staphylococcus aureus, Pseudomonas aeruginosa, Klebsiella Pneumoniae are carried out to sterilization test through third party authority testing agency. Black-koji mould is carried out to preservation challenge test. Test result is as follows:

The bactericidal effect test of the wet tissue of table 1 various embodiments of the present invention to different strain

3, black-koji mould preservation challenge test:

The wet tissue of table 2 various embodiments of the present invention is to black-koji mould preservative challenge testing

4, with the compatibility test of plastics product:

In the middle of selecting one, nail has plastics (polymethyl methacrylate) test-strips of STAINLESS STEEL NAILS (formation tension force), and short time every day is immersed solution to be measured, the situation of observation test bar after certain hour. Evaluation grade is divided into: unchanged; Form crack; Obviously crack; Fracture.

The wet tissue of table 3 various embodiments of the present invention and the compatibility test of plastics product

?	4 hours	3 days	7 days	14 days	Embodiment mono-	Unchanged	Unchanged	Unchanged	Unchanged
Embodiment tri-	Unchanged	Unchanged	Unchanged	Unchanged					

The foregoing is only the preferred embodiments of the present invention, be not limited to: the present invention, for a person skilled in the art, the present invention can have various modifications and variations. Within the spirit and principles in the present invention all, any amendment of doing, be equal to replacement, improvement etc., within all should being included in protection scope of the present invention.

Patent Citations (7)

Publication number	Priority date	Publication date	Assignee	Title
CN101230310A *	2007-01-25	2008-07-30	3M创新有限公司	Cleaning method and combination
EP2250245A1 *	2008-02-29	2010-11-17	Buck-Chemie GmbH	Adhesive agent for application on a sanitary object
CN102423249A *	2011-11-25	2012-04-25	迈迪普维生物科技股份有限公司	Medical nursing wet tissue with functions of deodorizing and preventing bedsores and preparation method thereof
CN102895715A *	2012-07-23	2012-12-05	北京天派空间生物医药研发有限公司	Washing-free skin cleaning care product and preparation method thereof
CN102846257A *	2012-08-29	2013-01-02	迈迪普维生物科技股份有限公司	Hard surface cleaning disinfecting wet tissue
CN103505394A *	2013-10-11	2014-01-15	金红叶纸业集团有限公司	Antiallergic composition and paper

CN103520929A *	2013-09-22	2014-01-22	天津市中科建研材料技术有限公司	Method for producing dry disinfection towel
Family To Family Citations				

* Cited by examiner, † Cited by third party

Cited By (16)

Publication number	Priority date	Publication date	Assignee	Title
CN104825093A *	2015-04-30	2015-08-12	威莱(广州)日用品有限公司	Non-marking glass cleaning wet tissue and preparation method for same
CN106038356A *	2016-07-04	2016-10-26	苏州金丽洁日化有限公司	Physical antibacterial wet wipe and preparation method thereof
CN106421217A *	2016-11-14	2017-02-22	汕头保税医药有限公司	Benzalkonium chloride solution and preparation method thereof
CN106420991A *	2016-09-05	2017-02-22	北京蓝色柔感科技有限公司	Wet tissue containing fermented supernatant fluid of lactic acid bacteria and special wet tissue solution for wet tissue containing fermented supernatant fluid of lactic acid bacteria
CN107440985A *	2017-06-16	2017-12-08	广州白云山邦德生物医药有限公司	A kind of efficient sterilizing wet sanitary napkins containing plant component and preparation method thereof
WO2018080492A1 *	2016-10-27	2018-05-03	Kimberly-Clark Worldwide, Inc.	Fibrous structures comprising volatile agave compounds
CN108192748A *	2017-12-28	2018-06-22	泉州市晋江恒安卫生科技有限公司	A kind of impregnated wipe and preparation method thereof
US10428465B2	2016-10-27	2019-10-01	Kimberly-Clark Worldwide, Inc.	High strength and low stiffness agave tissue
CN110477792A *	2019-09-05	2019-11-22	林建广	A kind of nonalcoholic wet tissue and preparation method thereof can be used for breathing mask cleaning-sterilizing
JP2019219553A *	2018-06-01	2019-12-12	大塚化成株式会社	Antiviral fiber finishing agent and treatment liquid, antiviral fiber product finished and treated thereby, and method for producing the same
CN110555031A *	2019-10-18	2019-12-20	海安康瑞纺织有限公司	Wet tissue for cleaning, removing sweat and disinfecting skin after exercise and preparation method thereof
CN110731936A *	2019-10-18	2020-01-31	海安康瑞纺织有限公司	Wet towel for cleaning, disinfecting and deodorizing pet body
CN111888316A *	2020-09-11	2020-11-06	芬康	Antibacterial high-moisturizing hand cream and preparation method thereof
CN112852556A *	2021-01-07	2021-05-28	茂名张氏科技发展有限公司	Household sterilizing, cleaning and mite-removing wet tissue
US11059643B2	2017-02-22	2021-07-06	Kimberly-Clark Worldwide, Inc.	Layered tissue comprising non-wood fibers
US11261568B2	2016-10-27	2022-03-01	Kimberly-Clark Worldwide, Inc.	High bulk wet-pressed agave tissue
Family To Family Citations				

* Cited by examiner, † Cited by third party, ‡ Family to family citation

Similar Documents

Publication	Publication Date	Title
CN104116454A	2014-10-29	Wet tissue and preparation method thereof
CN104263566B	2017-05-18	A kind of stain removal bactericidal multifunctional cleaning cream and preparation method thereof
CN105623903A	2016-05-01	High-dirt-removing-power antibacterial protective laundry detergent and preparation method thereof
TW201527516A	2015-07-16	Laundry detergent and stain remover compositions including fermented fruit solutions and methods for making and using the same
CN105820883A	2016-08-03	Antibacterial laundry detergent and preparation method thereof
CN103340584A	2013-10-09	Wet tissue for kitchen cleaning and disinfection
CN103948520A	2014-07-30	Guanidyl composite disinfection and cleaning hand sanitizer and preparation method for same
CN106695486A	2017-05-10	Kitchen oil cleaning agent
CN104382807A	2015-02-04	Alcohol-free washing-free antibacterial hand sanitizer and preparation method thereof

CN105670840A	2016-06-15	Environment-friendly screen detergent
WO2015124943A1	2015-08-27	Cleaning composition
CN107854329B	2019-02-01	A kind of antibacterial moisturizing foam hand cleanser of easy wash type and preparation method thereof
CN104207970A	2014-12-17	Medical skin-care disinfection hand-cleaning liquid and preparation method thereof
CN106726956A	2017-05-31	A kind of antibacterial skin moisturizing liquid soap and preparation method thereof
CN106590983A	2017-04-26	Safe and environment-friendly bactericidal detergent for kitchen and preparation method of bactericidal detergent
CN104257971B	2015-07-22	Medical skin-disinfection and -nursing hand-cleaning liquid and preparation method thereof
CN105726358A	2016-07-06	Antibacterial bath cream containing cybopogon essential oil and preparing method thereof
CN105550123A	2016-05-11	Pure natural moisturizing facial cleanser
CN108004047A	2018-05-08	Closestool cleanser and preparation method thereof
CN108392439A	2018-05-14	A kind of hand cleanser with refrigerant skin care effect
CN106867711A	2017-06-20	A kind of solidifying pearl of degerming laundry and preparation method and application
CN101653435A	2010-02-24	Sanitizer and preparation method and application thereof
JP2008156389A	2008-07-10	Treating agent for bio-film
CN105255620A	2016-01-20	Leather detergent
CN106919819A	2016-09-07	Multi-ion water-based infantile hip-care wet wipe

Priority And Related Applications

Priority Applications (1)

Application	Priority date	Filing date	Title
CN201410403669.5A	2014-08-15	2014-08-15	A kind of wet tissue and preparation method thereof

Applications Claiming Priority (1)

Application	Filing date	Title
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2014-12-03	SE01	Entry into force of request for substantive examination	
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2020-01-07	TR01	Transfer of patent right	
2020-01-07	TR01	Transfer of patent right	<p>Effective date of registration: 20191219</p> <p>Address after: No. 88, Changda Avenue, high tech Industrial Development Zone, Maoming City, Guangdong Province</p> <p>Patentee after: MAOMING ZHANG TECHNOLOGY DEVELOPMENT CO., LTD.</p> <p>Address before: Baoan District manhole Street Ho Shenzhen city 518125 Guangdong Province Second Industrial Zone building, third storey high slope</p> <p>Patentee before: SHENZHEN HUANSHENG HOUSEWARE Co., Ltd.</p>
2022-12-30	PE01	Entry into force of the registration of the contract for pledge of patent right	
2022-12-30	PE01	Entry into force of the registration of the contract for pledge of patent right	<p>Denomination of invention: Wet towel and its preparation method</p> <p>Effective date of registration: 20221213</p>

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(54) Title: MANUFACTURING METHOD OF BAMBOO CHIP AND MANUFACTURING METHOD BAMBOO FIBER USING THE BAMBOO CHIP



(57) Abstract: There are provided a method for manufacturing a bamboo chip used to manufacture a natural fiber and a method for manufacturing a natural fiber using the bamboo chip. The method for manufacturing a bamboo chip includes steps of obtaining a soluble pulp from a bamboo chip; and manufacturing a rayon stable fiber from the soluble pulp using a viscose process as known in the prior art; and directly extracting only alpha-cellulose, in the form of fiber, from the bamboo chip by treating the bulky bamboo chip prepared in the present invention at a certain condition without undergoing a complicated process using raw materials for fiber articles as the rayon stable fiber. The alpha-cellulose in the form of fiber according to the present invention may be useful to apply to a variety of fields such as fibers, nonwoven fabrics and other sanitary articles, etc.

WO 2008/063014 A1

Description

MANUFACTURING METHOD OF BAMBOO CHIP AND MANUFACTURING METHOD BAMBOO FIBER USING THE BAMBOO CHIP

Technical Field

- [1] The present invention relates to a method for manufacturing a bamboo chip used to manufacture a natural fiber and a method for manufacturing a bamboo fiber using the bamboo chip, and more particularly to a method for manufacturing a bamboo chip including steps of obtaining a soluble pulp from a bamboo chip; and manufacturing a rayon stable fiber from the soluble pulp using a viscose process as known in the prior art; and directly extracting only alpha-cellulose, in the form of fiber, from the bamboo chip by treating the bulky bamboo chip prepared in the present invention at a certain condition without undergoing a complicated process using raw materials for fiber articles as the rayon stable fiber, wherein the alpha-cellulose in the form of fiber according to the present invention may be useful to apply to a variety of fields such as fibers, nonwoven fabrics and other sanitary articles, etc.

[2]

Background Art

- [3] Generally, a cotton fiber is mainly obtained as natural cellulose fiber from cotton plants, but the cultivation of the cotton plants has decreased due to a variety of reasons such as environmental changes. Therefore, there has been an urgent need for novel natural cellulose fibers.
- [4] Accordingly, there have been attempts to obtain natural fiber materials from bamboo, hemp, rice straw, corn stalk and the like in addition to the natural cellulose obtained from the cotton plant. Among them, there has been the most active attempt using a bamboo, but the studies using bamboo stems have been mainly attempted and a study as fiber materials is unsatisfactory until now.
- [5] Meanwhile, bamboo mainly grows and cultivates in Southeast Asian nations, and may be used as natural resources since the bamboo grows very rapidly for a short period.
- [6] A process of manufacturing fiber materials from a bamboo, as known in the art, will be described schematically.
- [7] First, a bamboo is harvested, bamboo leaves and stems are removed from the bamboo to obtain a cylindrical bamboo, and the cylindrical bamboo is then cut to obtain a flat fragmental chip.
- [8] The flat fragmental chip has an approximately size with a width of 20 to 30 mm, a

length of 30 to 40 mm and thickness of 2 to 4 mm, as shown in FIG. 4, and includes a hard bark region, an inner bark and a joint region. In this case, a soluble pulp may be prepared by treating the fragmental chip 1 with chemical agents under a various conditions.

[9] As a result, a large amount of the chemical agents are increasingly used to penetrate the chemical agents into the hard fragmental chip 1 in the above-mentioned chemical treatment process, and therefore the treatment process may be uneconomic due to the increase in the treatment temperature and time.

[10] Also, even when the bamboo chip 1 is treated under the condition as described above, the content of alpha-cellulose, which is required for fibrosis, is low due to the insufficient delignification and the low efficiency to remove unnecessary components such as hemicellulose, and therefore it is difficult to manufacture a good soluble pulp.

[11] Furthermore, when the above-mentioned technique is used herein, a yield of a soluble pulp is very low with a level of 30 to 37%, based on the total amount of the bamboo chip, and thus this process is not efficient.

[12] In addition, a soluble pulp is gelled when the unnecessary components such as lignin and hemicellulose, which act as obstacles to fibrosis, is removed insufficiently, and then spun through a spinning process to obtain a filament yarn, or the soluble pulp is cut in a constant length to manufacture a stable fiber. However, the soluble pulp is increasingly cut finely since the components acting as obstacles to fibrosis are present in a large amount, and physical properties of fiber, such as strength, uniformity and productivity, may be deteriorated, which leads to the poor articles.

[13] In particular, it is more difficult to manufacture a filament yarn as a long fiber using the poor soluble pulp as described above.

[14] In addition to the above-mentioned problems, large base facilities such as chemical treatment facilities, spinning facilities, energy supply facilities and waste-water purifying facilities are required in a fibrosis process using the soluble pulp, but some of the nations in the world inhibit the operations of the base facilities since waste water and environmental pollutions are seriously caused in the operations of the base facilities.

[15] Therefore, there is an urgent demand for a method capable of solving the obstacles to fibrosis industries of bamboo that may grow in a large scale and be used as natural resources due to the rapid growth rate, as well as having a more excellent antimicrobial activity than cotton fiber and excellent feeling sense, and therefore the above obstacles remains to be solved.

[16]

Disclosure of Invention

Technical Problem

- [17] Accordingly, the present invention is designed to solve the above problems, and therefore it is an object of the present invention to provide a method for manufacturing a bamboo chip, wherein bamboo fibers may be easily prepared through the simplified fibrosis process (a dissolution process is omitted) by extracting alpha-cellulose from a bamboo and manufacturing the alpha-cellulose into fibers, the method is environment-friendly, the facility investment and maintenance costs are high, and it is possible to mass-produce good bamboo fiber materials with the low cost.

Technical Solution

- [18] In order to accomplish the above object, one embodiment of the present invention provides a method for manufacturing a bamboo chip used to manufacture a natural fiber, the method including steps of obtaining a cylindrical bamboo 10 by removing leaves and twigs from harvested bamboo; obtaining a bamboo 12 having only bamboo stems by cutting and removing bamboo joints 11 from the cylindrical bamboo 10; and tearing the bamboo 12 into pieces in a longitudinal direction so as to give bulkiness by pressing the bamboo 12 with a pressure roller and a convex roller to crush the bamboo 12 in a longitudinal direction.
- [19] In order to accomplish the above object, another embodiment of the present invention provides a method for manufacturing a natural fiber using a bamboo chip, the method including steps of adding the bamboo chip 20 prepared in the method as defined in claim 1 and water in a solution ratio of 1:2.5 to 3.5 to a cooking container, heating the bamboo chip 20 at 160 to 180°C for 100 to 180 minutes, and discharging steam and prehydrolyzing the bamboo chip 20 under a reduced pressure; washing the prehydrolyzed bamboo chip 20; adding 16 to 26% by weight of caustic soda (NaOH) (in a solution ratio of 1:2.5 to 3.5) and 0.1 to 1.0% by weight of anthraquinone to a cooking container based on the total weight of the bamboo chip, and heating the mixture of the washed bamboo chip 20 at 130 to 150°C for 60 to 120 minutes, heating the mixture at 155 to 175°C for 60 to 120 minutes once more, and discharging steam at a reduced pressure; and washing the cooked bamboo chip.
- [20] Also, additional processes includes steps of arranging and cutting the obtained bamboo fiber (alpha-cellulose fiber) into pieces having a constant length, undergoing a reeling process and a concentration process, bleaching the fibers several times, acid-treating the bleached fibers, washing the fibers, and concentrating, pressing, drying and packaging the washed fibers.

[21]

Advantageous Effects

- [22] As described above, the method for manufacturing a bamboo fiber from a bamboo

according to the present invention may be useful to easily dissolve and remove impurities except for hemicellulose or alpha-cellulose such as lignin and pantoic acid that are unnecessary in the fibrosis process using a bamboo chip manufactured from a cylindrical bamboo in which bamboo joints are removed from a bamboo since chemical agents are easily penetrated into the bamboo chip in a prehydrolysis and cooking process by pressing the bamboo with a pressure roller or a convex roller to crush the bamboo and tearing the bamboo into pieces with scratches in a longitudinal direction so as to give rich bulkiness to the bamboo chip. Also, the manufacturing according to the present invention may be useful to mass-produce good and environment-friendly bamboo fibers without any investment of expensive facilities since a bamboo fiber may be directly extracted from the above-mentioned bamboo chip in the prehydrolysis and cooking process, and the bamboo fiber may be then spun to produce a yarn, or used for various fiber articles such as nonwoven fabrics, sanitary articles, etc.

Brief Description of the Drawings

[23] These and other features, aspects, and advantages of preferred embodiments of the present invention will be more fully described in the following detailed description, taken accompanying drawings. In the drawings:

[24] FIG. 1 is a configuration view showing a cylindrical bamboo used in the present invention,

[25] FIG. 2 is a cross-sectional view showing a joint-free bamboo as shown in FIG. 1,

[26] FIG. 3 is a cross-sectional view showing a bamboo chip having bulkiness through the pressing of the bamboo as shown in FIG. 2, and

[27] FIG. 4 is a diagram showing a rectangular fragmental chip used in the convention method for manufacturing a bamboo fiber.

Best Mode for Carrying Out the Invention

[28] Hereinafter, preferred embodiments of the present invention will be described in detail referring to the accompanying drawings. Prior to the description, it should be understood that the terms used in the specification and appended claims should not be construed as limited to general and dictionary meanings, but interpreted based on the meanings and concepts corresponding to technical aspects of the present invention on the basis of the principle that the inventor is allowed to define terms appropriately for the best explanation. Therefore, the description proposed herein is just a preferable example for the purpose of illustrations only, not intended to limit the scope of the invention, so it should be understood that other equivalents and modifications could be made thereto without departing from the spirit and scope of the invention.

[29]

[30] Step 1: Preparation of materials,

[31] Well-grown bamboo is harvested, and branches and leaves are removed from the harvested bamboo to obtain a cylindrical bamboo 10. Then, the cylindrical bamboo 10 is cut, and a region of bamboo joint 11 is removed from the cylindrical bamboo 10 to obtain a bamboo 12 that does not have a joint 11 (see FIG. 2).

[32] In this case, the length of the resulting bamboo 12 is varied according to the growth conditions and states of the harvested bamboo, but the bamboo 12 has a length of about 15 to 50 cm.

[33] However, there is no particular limitation on the length of the cut bamboo 12, but the bamboo 12 obtained by cutting off the joint 11 of the harvested cylindrical bamboo 10 is generally used as it is. Therefore, the length of the bamboo is preferably selected depending on the use and purpose of the resulting bamboo fiber.

[34]

[35] Step 2: Manufacture of bamboo chip

[36] This process is important for the bamboo fiber provided in the present invention. In this process, a bamboo chip 20 having bulkiness is obtained by pressing the bamboo 12 prepared in the Step 1 with a pressure roller or a convex roller with protrusions to crush the bamboo 12 and tearing the bamboo 12 into pieces with scratches in a longitudinal direction (see FIG. 3).

[37] As shown in FIG. 3, the subsequent process is preferably effectively carried out by pressing the entire bamboo 12 to crush the entire part of the bamboo 12 while making scratches to the bamboo 12, and the bamboo 12 is simultaneously torn in a longitudinal direction to give bulkiness.

[38] Articles, which are manufactured under the conditions as described in the Korean Patent Application No. 2006-99406 filed by the present inventors, may be used herein without manufacturing a bamboo chip under the conditions as described above in the present invention.

[39] Referring to the context of the prior application filed by the present inventors, a bamboo from which leaves and twigs are removed is pressed with a plurality of convex rollers to tear the bamboo while crushing the bamboo in a longitudinal direction, thereby to give bulkiness to the bamboo, and the bamboo is cut into pieces having desired length using a cutting machine. In the crushing and cutting processes, joints, thin-walled tissues and silicated cuticles of the bamboo, which are obstacles to a pulping process, are crushed and removed partially.

[40]

[41] Step 3: Washing process,

[42] This process is to remove foreign substances attached to the bamboo chip and cleanly wash impurities such as small fragments and dusts generated in the process of

manufacturing a bamboo chip at the same time.

[43]

[44] Step 4: Prehydrolysis process,

[45] This process is to maximize a yield of fibrous alpha-cellulose included in the bamboo chip by dissolving hemicellulose and lignin in the bamboo chip.

[46] In order to treat the bamboo chip, the prepared bamboo chip and water are added to a cooking container and treated at a hot temperature for a suitable period.

[47] In this case, a mixing ratio of the added bamboo chip and water ranges from 1 : 2.5 to 3.5 % by weight, and the bamboo chip is sufficiently immersed in water in the cooking container. The bamboo chip is treated at a temperature of 160 to 180°C for 100 to 180 minutes, a steam is discharged into a reduced pressure, and the bamboo chip treated in the cooking container is transferred into a washing process.

[48] When the bamboo chip 20 is added to the cooking container together with the bamboo chip 20 and treated at high temperature and high pressure for an extended time as described above, hemicellulose and some of lignin in the bamboo chip are structurally changed, dissociated and dissolved by the heating.

[49] At the same time, pantoic acid that is present at a large amount of about 20 % is also removed from the bamboo.

[50] Particularly, the bulkiness is given to the bamboo chip used in the present invention since the bamboo chip is crushed in a longitudinal direction and simultaneously torn into pieces with scratches during the pressing process. Therefore, it is possible to easily dissolve hemicellulose or lignin and pantoic acid in the prehydrolysis.

[51]

[52] Step 5: Washing process,

[53] This process is to wash dissolved hemicellulose or partially dissolved lignin and pantoic acid in the prehydrolysis process so as to facilitate a cooking process.

[54]

[55] Step 6: Cooking process

[56] This process is to remove lignin, which is not dissolved in the prehydrolysis process, in the most effective manner, but to extract only pure alpha-cellulose without any damage to the alpha-cellulose in the bamboo chip.

[57] Therefore, a process using caustic soda (NaOH) and anthraquinone may apply to this process to improve the strength and yield of the alpha-cellulose.

[58] That is to say, the bamboo chip undergoing the prehydrolysis and washing processes is added to a cooking container together with a suitable amount of caustic soda and a small amount of anthraquinone, and then treated at a high temperature to sufficiently dissolve lignin and pantoic acid that are not dissolved and removed in the prehydrolysis process. As a result, only the pure fibrous alpha-cellulose remains in the

cooking container.

[59] In the above treatment conditions, the alkaline compound is added at a ratio of 16 to 26%, based on the compound (NaOH) used in the bamboo chip undergoing the pre-hydrolysis process. In this case, a solution ratio of the medicinal fluid (water, caustic soda and anthraquinone) ranges from about 1 : 2.5 to 3.5, based on the bamboo chip.

[60] Also, the added anthraquinone is used to facilitate the removal of lignin but prevent the dissolution of alpha-cellulose, and the ratio of the added anthraquinone ranges from about 0.1 to 1.0% by weight, based on the total weight of the bamboo chip.

[61] The caustic soda and the anthraquinone are added to a cooking container together with bamboo chip under the conditions as described above, and then primarily treated at 130 to 150°C for about 60 to 120 minutes and secondarily at 155 to 175°C for 60 to 120 minutes.

[62] Only the fibrous alpha-cellulose remains in the cooking container since the lignin and pentoic acid that are not dissolved in the prehydrolysis process are sufficiently dissolved in the heat treatment process.

[63] When the bamboo chip is completely cooked under the above-mentioned conditions, a steam is discharged into a reduced pressure, and the fibrous product including only alpha-cellulose is then harvested from the cooking container, followed by undergoing a washing process.

[64]

[65] Step 7: Washing process.

[66] This process is to selectively extract the fibrous alpha-cellulose, for example a bamboo fiber, by washing the dissolved lignin and pentoic acid in the cooking process with water.

[67] During the washing process (Step 7), a desired bamboo fiber according to the present invention is actually obtained.

[68] That is to say, a fibrous alpha-cellulose, that is, a bamboo fiber is extracted from the bamboo chip. Then, the bamboo fiber may be spun to obtain a thread, or used to obtain various articles such as nonwoven fabrics and sanitary articles.

[69] However, the subsequent process is required to obtain a good bamboo fiber.

[70]

[71] Step 8: Alignment and Length adjustment

[72] This process is to align the bamboo fiber extracted in the previous process and adjust any length of the bamboo fiber as the same time.

[73]

[74] Step 9: Removal of Foreign substances,

[75] This process is to remove other foreign substances such as sands in the bamboo fiber by centrifuging the bamboo fiber aligned with any of lengths.

[76] The centrifugation is carried out in a centrifuge under conditions including a concentration of 0.5 to 0.8% and a pressure of 2 kg/□, and therefore it is possible to effectively remove the foreign substances that have a higher specific gravity than the bamboo fiber.

[77]

[78] Step 10: Concentration process,

[79] The foreign substance-free bamboo fiber prepared in the Step 9 is concentrated into a density of 2 to 3.5%.

[80]

[81] Step 11: Bleaching process,

[82] This is a bleaching process to obtain a good bamboo fiber by removing pigments in the bamboo fiber to improve brightness.

[83] The bamboo fiber is primarily bleached with chlorine. In this case, the bleaching condition is as follows: 3.0 to 3.5% by weight of the bamboo fiber is treated in 60% of the total amount of used chlorine for a chlorinating time of 40 to 60 minutes, and then washed several time until the remaining chlorine is 0.20g/l and pH of the bamboo fiber is $\text{pH} < 2$.

[84] The primarily chlorine-bleached chlorine bamboo fiber undergoes a secondary bleaching process.

[85] In this case, the secondary bleaching condition is as follows: = 5.0% by weight of the bamboo fiber is treated in 2.0 to 2.5% of an alkaline compound (based on a dry fiber) at a temperature of 50 to 90°C for 60 to 90 minutes, and then washed until the remaining alkaline compound is =50g/□.

[86] The secondarily bleached bamboo fiber undergoes the third bleaching process.

[87] The third bleaching condition is as follows: the secondarily bleached bamboo fiber is treated in 40% of the total amount of a used chlorine solution including =250g/□ of an alkaline compound at a temperature of 38 to 45°C for a chlorinating time of 120 to 240 minutes, and then washed several time until a desired brightness is =75%, a content of alpha-cellulose fiber is =93% and the remaining alkaline compound is =50g/□.

[88] The bleached bamboo fiber has an excellent brightness and a good quality.

[89]

[90] Step 12: Acid-treatment process,

[91] This process is to stably maintain the brightness of the bamboo fiber bleached in the bleaching process. In this case, the bleached bamboo fiber is treated in 2.0 to 5.0% of used acid (HCl) (based on a dry fiber) at a room temperature for 40 to 60 minutes, and then washed until the remaining acid is =50g/□.

[92]

[93] Step 13: Concentration process,

[94] The acid-treated bamboo fiber is concentrated to a density of 3.0 to 3.5% using a concentrator.

[95]

[96] Step 14: Pressing and drying process

[97] The concentrated bamboo fiber is pressed using a pressure roller to remove more than 80% of water from the bamboo fiber, and the water-remove bamboo fiber is dried into a dryness of about 8.5 to 10% using a hot-wind dryer.

[98]

[99] Step 15: Packaging process,

[100] The suitably dried bamboo fiber is pressed into a reduced volume and packed with easy handling and transportation at the same time. Therefore, the manufacture of the bamboo chip according to the present invention and the bamboo fiber extracted from the bamboo chip are completed.

[101]

Mode for the Invention

[102] As described above, as a substitute natural fiber from a cotton plant whose cultivation tends to decrease, a natural fiber having more excellent antimicrobial activity than the cotton fiber and a smooth feeling sense is extracted from a bamboo for use. In this case, articles having excellent physical properties such as tensile strength, feeling sense and antimicrobial activity may be mass-produced by manufacturing a bamboo chip so that the bamboo can be treated in the process of extracting a bamboo fiber without using the complicated process, investing the expensive facilities and causing the environment friend- associated problems, thereby to directly extract a bamboo fiber from a bamboo in a simple process, followed by directly extracting a bamboo fiber including only alpha-cellulose from the bamboo chip, which is used later in a spinning process or for nonwoven fabrics. That is to say, the use of the bamboo fiber in the spinning process or for the nonwoven fabrics means that a bamboo fiber is spun as it is, or manufactured into a nonwoven fabric without undergoing a conventional rayon viscose process (pulp dissolution-spinning-cutting processes).

[103] For the present invention, the condition of the bamboo chip is very important to directly extract a bamboo fiber including only alpha-cellulose from the bamboo.

[104] That is to say, the bamboo chip used in the present invention is not a conventional hard and fragment-type bamboo chip, but it is easily manufactured by crushing a joint-free cylindrical bamboo with a length of 15 to 40 cm while pressing the cylindrical bamboo in a pressing unit, and tearing the cylindrical bamboo into fine chips in a longitudinal direction, thereby to give bulkiness, which makes it easy to remove foreign

substances, which is unnecessary in the fibrosis, such as hemicellulose or lignin, and pantoic acid, which are included in the bamboo, during the prehydrolysis and cooking process.

[105] In particular, the bamboo fiber according to the present invention may be useful to obtain a good bamboo fiber using a simple manufacturing process of directly extracting a bamboo fiber from a bamboo chip through the prehydrolysis and cooking process, the bamboo chip being prepared by pressing a long bamboo whose joints are removed from a cylindrical bamboo to crush the bamboo and tearing the bamboo in a longitudinal direction, unlike the conventional process of obtaining a soluble pulp from a fragment-type hard bamboo chip; gelating the soluble pulp; obtaining a stable fiber using a viscose process and using the stable fiber as a fiber article material.

[106] Referring again to the conventional process of extracting a bamboo fiber, the conventional process includes a four-step process including a bamboo chip - a soluble pulp - a bamboo stable fiber in a viscose process - a fiber article, but the process according to the present invention includes a three-step process including a bamboo chip - a bamboo fiber - a fiber article (treads, nonwoven fabrics, sanitary articles). Therefore, the process according to the present invention is carried out in a simple manner since the articles are produced without manufacturing a stable fiber using the viscose process.

[107] In addition, a process for manufacturing a stable fiber using a conventional viscose process may be omitted in the present invention since a bamboo fiber is directly extracted from the bamboo chip, and therefore it is possible to mass-produce a bamboo fiber with low expense without any of the environmental pollutions and the deterioration of productivity and quality that are caused by the huge investment and operation of the facilities.

[108] The results obtained by comparing the conventional method for manufacturing a bamboo fiber with the manufacturing method according to the present invention are listed in the following Table 1.

[109] Table 1

Comparison of the conventional method and the inventive method

	Conventional method	Inventive method
Bamboo chip shape	Hard and rectangular	Torn in a longitudinal direction with bulkiness
Hard bark, inner bark and joint	Very rich	Very low
Bulkiness	Very hard but not bulky	Bulkiness by scratches

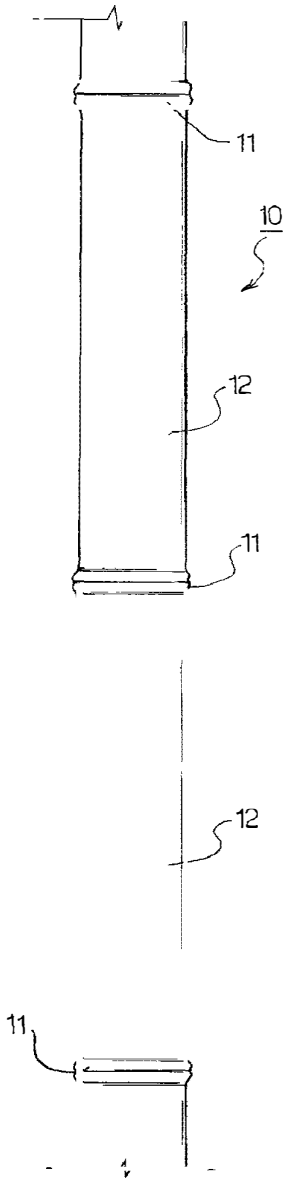
Cooking time	Long	Short
Dose of agents	Large	Small
Alpha-cellulose	Highly damaged	Rarely damaged
Tensile strength	Weak	Strong
No. of Processes	4 Processes	3 Processes (a stable fiber process omitted)
Manufacturing cost and other expenses	Expensive	Cheap (about 37%)
Peeling	High	Low
Antimicrobial activity	Low	High
Feeling	Mediocre	Very smooth
Rarity	Under production	First development
Application	Restricted	Various

[110] The present invention has been described in detail. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

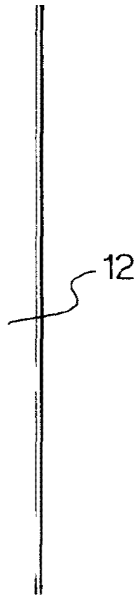
Claims

- [1] A method for manufacturing a bamboo chip used to manufacture a natural fiber, the method comprising:
obtaining a cylindrical bamboo 10 by removing leaves and twigs from harvested bamboo;
obtaining a bamboo 12 having only bamboo stems by cutting and removing bamboo joints 11 from the cylindrical bamboo 10; and
tearing the bamboo 12 into pieces in a longitudinal direction so as to give bulkiness by pressing the bamboo 12 with a pressure roller and a convex roller to crush the bamboo 12 in a longitudinal direction,
wherein the joint 11-free bamboo 12 has a length of 15 to 50 cm.
- [2] A method for manufacturing a natural fiber using a bamboo chip, the method comprising:
adding the bamboo chip 20 prepared in the method as defined in claim 1 and water in a solution ratio of 1:2.5 to 3.5 to a cooking container, heating the bamboo chip 20 at 160 to 180°C for 100 to 180 minutes, and discharging steam and prehydrolyzing the bamboo chip 20 under a reduced pressure;
washing the prehydrolyzed bamboo chip 20;
adding 16 to 26% by weight of caustic soda (NaOH) (in a solution ratio of 1:2.5 to 3.5) and 0.1 to 1.0% by weight of anthraquinone to a cooking container based on the total weight of the bamboo chip, and heating the mixture of the washed bamboo chip 20 at 130 to 150°C for 60 to 120 minutes, heating the mixture at 155 to 175°C for 60 to 120 minutes once more, and discharging steam at a reduced pressure; and
washing the cooked bamboo chip.
- [3] The method for manufacturing a natural fiber according to claim 2, further comprising a step of bleaching the washed bamboo chip so as to improve brightness of a fiber after the step of washing the cooked bamboo chip.

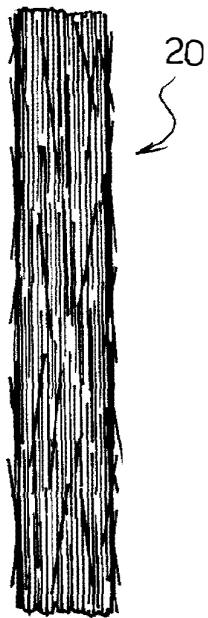
[Fig. 1]



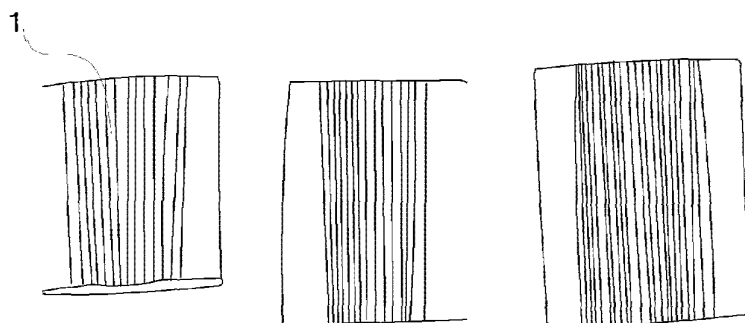
[Fig. 2]



[Fig. 3]



[Fig. 4]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2007/005891

A. CLASSIFICATION OF SUBJECT MATTER

D01B 1/10(2006.01)i

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)

IPC 8 D01B1/10

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

Korean utility models and applications for utility models since 1975

Japanese utility models and applications for utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKIPASS(KIPO internal) "bamboo fiber"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 16-167730 A (YASUJIMA KK) 17 June 2004 (17.06.2004) see abstract and figures	1-3
A	JP 06-15616 A (SANSHIN THERMAL INSULATION COM & ASK CORP) 25 January 1994 (25.01.1994) see abstract and claims	1-3
A	JP 04-216007 A (SANSHIN THERMAL INSULATION COM & ASK CORP) 06 August 1992 (06.08.1992) see abstract and claims	1-3

☐ Further documents are listed in the continuation of Box C.

☒ 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
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- "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
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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT
Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 16-167730 A	17.06.2004	CN 1500606 A JP 16-167730 A	02.06.2004 17.06.2004
JP 06-15616 A	25.01.1994	CN 1083760 A GB 2268515 A US 5397067 A JP 06-15616 A	16.03.1994 12.01.1994 14.03.1995 25.01.1994
JP 04-216007 A	06.08.1992	GB 2251002 A JP 04-216007 A	24.06.1992 06.08.1992



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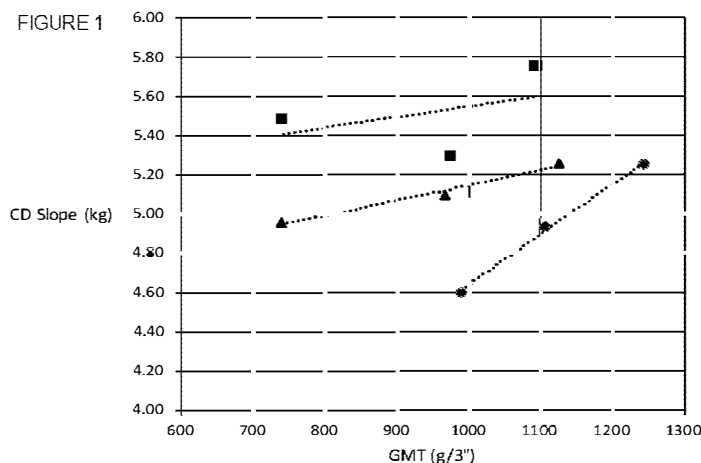
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(54) Title: LAYERED TISSUE COMPRISING NON-WOOD FIBERS



(57) Abstract: The present invention provides multi-layered tissue webs, and tissue products comprising the same, the multi-layered webs comprising wood fibers and non-wood cellulosic fibers where the non-wood cellulosic fibers are selectively deposited in one or more outer layers of the multi-layered web. Surprisingly disposing non-wood cellulosic fibers in the outer layers, even in relatively modest amounts, alters the machine and/or cross-machine direction properties of the resulting web, such that MD:CD tensile ratio may be reduced.

LAYERED TISSUE COMPRISING NON-WOOD FIBERS

BACKGROUND OF THE DISCLOSURE

Papermakers, and in particular tissue paper makers, have long sought to balance the strength and softness of paper products by treating or altering the papermaking furnish. For example, one
5 common practice in the manufacture of tissue products is to provide two furnishes (or sources) of wood pulp fiber. Sometimes, a two-furnish system is used in which the first furnish comprises a wood pulp fiber having a relatively short fiber length, such as a hardwood kraft pulp fiber, and the second furnish is made of wood pulp fiber having a relatively long fiber length, such as softwood kraft pulp fiber. The short fiber furnish may be used to provide the finished product with a softer handfeel, while the long fiber
10 furnish may be used to provide the finished product with strength.

While surface softness in tissue products is an important attribute, a second element in the overall softness is stiffness. Stiffness can be measured from the tensile slope of stress-strain tensile curve. The lower the slope the lower the stiffness and the better overall softness the product will display. Stiffness and tensile strength are positively correlated, however at a given tensile strength shorter fibers
15 will display a greater stiffness than long fibers. While not wishing to be bound by theory, it is believed that this behavior is due to the higher number of hydrogen bonds required to produce a product of a given tensile strength with short fibers than with long fibers. Thus, easily collapsible, low coarseness long fibers, such as those provided by Northern Softwood Kraft (NSWK) fibers typically supply the best combination of durability and softness in tissue products when those fibers are used in combination with
20 hardwood Kraft fibers such as Eucalyptus hardwood Kraft fibers. While Northern Softwood Kraft Fibers have a higher coarseness than Eucalyptus fibers their small cell wall thickness relative to lumen diameter combined with their long length makes them the ideal candidate for optimizing durability and softness in tissue.

Unfortunately, supply of NSWK is under significant pressure both economically and
25 environmentally. As such, prices of NSWK fibers have escalated significantly creating a need to find alternatives to optimize softness and strength in tissue products. Another type of softwood fiber is Southern Softwood Kraft (SSWK) widely used in fluff pulp containing absorbent products such as diapers, feminine care absorbent products and incontinence products. Unfortunately while not under the same supply and environmental pressures as NSWK, fibers from SSWK are too coarse for tissue
30 products and are unsuitable for making soft tissue products. While having long fiber length, the SSWK fibers have too wide a cell wall width and too narrow a lumen diameter and thus create stiffer, harsher feeling products than NSWK.

The tissue maker who is able to identify fibers having a desirable combination of fiber length and coarseness from fiber blends generally regarded as inferior with respect to average fiber properties may reap significant cost savings and/or product improvements. For example, the tissue maker may wish to make a tissue paper of superior strength without incurring the usual degradation in softness which accompanies higher strength. Alternatively, the papermaker may wish a higher degree of paper surface bonding to reduce the release of free fibers without suffering the usual decrease in softness which accompanies greater bonding of surface fibers. As such, a need currently exists for a tissue product formed from a fiber that will improve durability without negatively affecting other important product properties, such as softness.

SUMMARY OF THE DISCLOSURE

It has now been surprisingly discovered that the short, low-coarseness fiber fraction of the tissue making furnish may be substituted with non-wood fibers and more specifically non-wood cellulosic fibers having an average fiber length from about 1.0 to about 2.0 mm, without negatively affecting important tissue properties such as strength and stiffness. In some instances tissue product properties may actually be improved by substituting short, low-coarseness fiber with non-wood cellulosic fibers. For example, in one embodiment, the present invention provides a soft and durable tissue comprising from about 10 to about 50 percent non-wood cellulosic fiber and having a ratio of machine direction tensile strength (MD Tensile) to cross-machine direction tensile strength (CD Tensile) of less than about 2.0 and a geometric mean tear strength greater than about 12.0 N. Surprisingly, the foregoing properties are comparable or better than those observed in similarly manufactured tissue products consisting essentially of short wood pulp fibers and long, low-coarseness wood pulp fibers.

Accordingly, in one embodiment, the present disclosure provides a multi-layered tissue web comprising a fabric contacting fibrous layer and a non-fabric contacting, also referred to as the air-side layer, fibrous layer, wherein the fabric contacting fibrous layer comprises wood pulp fibers and the non-fabric contacting fibrous layer comprises a blend of non-wood cellulosic fibers and wood pulp fibers. Preferably the fabric contacting layer is substantially free of non-wood cellulosic fibers and the tissue web comprises from about 5 to about 30 weight percent non-wood cellulosic fibers. In a particularly preferred embodiment the fabric contacting fibrous layer comprises softwood kraft fibers and the non-fabric contacting fibrous layer comprises non-wood cellulosic fibers and hardwood kraft fibers.

In yet other embodiments the present disclosure provides a multi-layered tissue web comprising a fabric contacting fibrous layer and a non-fabric contacting fibrous layer, wherein the fabric contacting fibrous layer consists essentially of wood pulp fibers and is substantially free of non-wood cellulosic fibers and the non-fabric contacting fibrous layer comprises from about 5 to about 30 weight percent

non-wood cellulosic fibers, the tissue web having a basis weight greater than about 20 grams per square meter (gsm) a MD:CD Tensile Ratio less than about 2.0 and a geometric mean tear strength greater than about 12.0 N.

5 In other embodiments the present invention provides a tissue product comprising at least one multi-layered tissue web having first and second outer layers and a middle layer disposed there-between, the web comprising from about 5 to about 30 weight percent non-wood cellulosic fibers having an average fiber length from about 1.0 to about 2.0 mm, the product having a MD:CD Tensile Ratio less than about 2.0, a geometric mean tensile (GMT) greater than about 700 g/3" and a MD Slope less than about 10.0 kg.

10 In still other embodiments the present disclosure provides a method of forming a tissue web comprising the steps of dispersing a wood pulp fiber and a non-wood cellulosic fiber in water to form a first fiber slurry, dispersing a wood pulp fiber to form a second fiber slurry, depositing the second fiber slurry onto a forming fabric, depositing the first fiber slurry adjacent to the second fiber slurry to form a wet web, dewatering the wet web to a consistency from about 20 to about 30 percent, and drying the
15 wet web to a consistency of greater than about 90 percent thereby forming a dry tissue web, the dry tissue web comprising from about 5 to about 30 weight percent non-wood cellulosic fibers.

In yet other embodiments the present disclosure provides a method of modifying at least one cross-machine direction property of a tissue web comprising the steps of dispersing hardwood kraft pulp and a non-wood cellulosic fiber selected from the group consisting of *Hesperaloe funifera*, *Hesperaloe nocturna*, *Hesperaloe parviflora*, *Hesperaloe chiangii*, *Agave tequilana*, *Agave sisalana*, *Agave fourcroydes*, *Phyllostachys edulis*, *Bambusa vulgaris*, *Phyllostachys nigra* and combinations thereof, in
20 water to form a first fiber slurry, dispersing softwood kraft pulp fiber to form a second fiber slurry, depositing the second fiber slurry onto a forming fabric, depositing the first fiber slurry adjacent to the second fiber slurry to form a wet web, dewatering the wet web to a consistency from about 20 to about
25 30 percent, and drying the wet web to a consistency of greater than about 90 percent thereby forming a dry tissue web, the dry tissue web comprising from about 5 to about 30 weight percent non-wood cellulosic fibers and having a CD tensile, CD slope, CD tear or CD tensile energy absorption different than a similarly manufactured tissue web substantially free from non-wood cellulosic fiber. In certain embodiments first fiber slurry is not subject to refining and the second fiber slurry is optionally refined.

30 DESCRIPTIONS OF THE DRAWINGS

Figure 1 is a graph of CD slope (y-axis) versus geometric mean tensile (GMT, x-axis) for three different tissue products manufactured at three different geometric mean tensile strengths, - ● - are

tissue products having three layers and comprising 40% NSWK and 60% EHWK, -▲- are tissue products having three layers and comprising 40% NSWK, 45% EHWK and 15% bamboo; and -■- are tissue products having three layers and comprising 40% NSWK, 30% EHWK and 30% bamboo;

Figure 2 is a graph of MD slope (y-axis) versus geometric mean tensile (GMT, x-axis) for three different tissue products manufactured at three different geometric mean tensile strengths, -●- are tissue products having three layers and comprising 40% NSWK and 60% EHWK, -▲- are tissue products having three layers and comprising 40% NSWK, 45% EHWK and 15% bamboo; and -■- are tissue products having three layers and comprising 40% NSWK, 30% EHWK and 30% bamboo; and

Figure 3 is a graph of GM tear (y-axis) versus geometric mean tensile (GMT, x-axis) for three different tissue products manufactured at three different geometric mean tensile strengths, -●- are tissue products having three layers and comprising 40% NSWK and 60% EHWK, -▲- are tissue products having three layers and comprising 40% NSWK, 45% EHWK and 15% bamboo; and -■- are tissue products having three layers and comprising 40% NSWK, 30% EHWK and 30% bamboo.

DEFINITIONS

As used herein, the term "Average Fiber Length" means the length weighted average fiber length (LWAFL) of fibers determined utilizing OpTest Fiber Quality Analyzer, model FQA-360 (OpTest Equipment, Inc., Hawkesbury, ON). According to the test procedure, a pulp sample is treated with a macerating liquid to ensure that no fiber bundles or shives are present. Each pulp sample is disintegrated into hot water and diluted to an approximately 0.001 percent solution. Individual test samples are drawn in approximately 50 to 100 ml portions from the dilute solution when tested using the standard OpTest Fiber Quality Analyzer fiber analysis test procedure. The weighted average fiber length may be expressed by the following equation:

$$\sum_{x_i=0}^k (x_i \times n_i) / n$$

where k = maximum fiber length

x_i = fiber length

n_i = number of fibers having length x_i

n = total number of fibers measured.

As used herein, the term "Coarseness" means the fiber mass per unit of unweighted fiber length reported in units of milligrams per one hundred meters of unweighted fiber length (mg/100 m) as

measured using a suitable fiber coarseness measuring device such as the above OpTest Fiber Quality Analyzer. The coarseness of the pulp is an average of three coarseness measurements of three fiber specimens taken from the pulp. The operation of the analyzer for measuring coarseness is similar to the operation for measuring fiber length described above.

5 As used herein the term "Fiber" means an elongate particulate having an apparent length greatly exceeding its apparent width. More specifically, and as used herein, fiber means such fibers suitable for a papermaking process and more particularly the tissue paper making process.

As used herein the term "Cellulosic Fiber" means a fiber composed of or derived from cellulose.

10 As used herein, the term "Long Cellulosic Fibers" means a cellulosic fiber having an average fiber length greater than 1.2 mm and more preferably greater than about 1.5 mm and still more preferably greater than about 1.8 mm, such as from about 1.2 to about 3.0 mm and more preferably from about 1.5 to about 2.5 mm.

15 As used herein the term "Short Cellulosic Fibers" means a cellulosic fiber having an average length less than about 1.2 mm, such as from about 0.4 to about 1.2 mm, such as from about 0.5 to about 0.75 mm, and more preferably from about 0.6 to about 0.7 mm. One example of short cellulosic fibers are hardwood pulp fibers, which may be derived from hardwoods selected from the group consisting of Acacia, Eucalyptus, Maple, Oak, Aspen, Birch, Cottonwood, Alder, Ash, Cherry, Elm, Hickory, Poplar, Gum, Walnut, Locust, Sycamore and Beech.

20 As used herein the term "Non-Wood Cellulosic Fiber" means a fibers derived from non-wood plants including, for example, non-wood plants in the genus *Hesperaloe* in the family Agavaceae including, such as *H. funifera*, *H. nocturna*, *H. parviflora*, and *H. changii*, non-wood plants in the genus *Agave*, of the family Asparagaceae including, for example *A. tequilana*, *A. sisalana* and *A. fourcroydes* and non-wood plants in the genus *Phyllostachys* or *Bambusa*, of the family Poaceae including, for example, *Phyllostachys edulis*, *Bambusa vulgaris* and *Phyllostachys nigra* variant Henon.

25 As used herein, the term "Tissue Product" means products made from tissue webs and includes, bath tissues, facial tissues, paper towels, industrial wipers, foodservice wipers, napkins, medical pads, and other similar products.

As used herein, the term "Tissue Web" means a fibrous sheet material suitable for use as a tissue product.

30 As used herein, the term "Ply" means a discrete product element. Individual plies may be 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, bath tissue, paper towel, wipe, or napkin.

As used herein, the term "Layer" means a plurality of strata of fibers, chemical treatments, or the like, within a ply.

As used herein, the terms "Layered," "Multi-Layered," and the like, refer to fibrous sheets prepared from two or more layers of aqueous papermaking furnish which are preferably comprised of different fiber types. The layers are preferably formed from the deposition of separate streams of dilute fiber slurries, upon one or more endless foraminous screens. If the individual layers are initially formed on separate foraminous screens, the layers are subsequently combined (while wet) to form a layered composite web.

As used herein the term "Basis Weight" means the bone dry weight per unit area of a tissue and is generally expressed as grams per square meter (gsm). Basis weight is measured using TAPPI test method T-220. While basis weight may be varied, tissue products prepared according to the present invention and comprising one, two or three plies, generally have a basis weight greater than about 30 gsm, such as from about 30 to about 60 gsm and more preferably from about 35 to about 45 gsm.

As used herein the term "Caliper" is the representative thickness of a single sheet (caliper of tissue products comprising two or more plies is the thickness of a single sheet of tissue product comprising all plies) measured in accordance with TAPPI test method T402 using an EMVECO 200-A Microgage automated micrometer (EMVECO, Inc., Newberg, OR). The micrometer has an anvil diameter of 2.22 inches (56.4 mm) and an anvil pressure of 132 grams per square inch (per 6.45 square centimeters) (2.0 kPa). The caliper of a tissue product may vary depending on a variety of manufacturing processes and the number of plies in the product, however, tissue products prepared according to the present invention generally have a caliper greater than about 500 μm , more preferably greater than about 575 μm and still more preferably greater than about 600 μm , such as from about 500 to about 800 μm and more preferably from about 600 to about 750 μm .

As used herein the term "Sheet Bulk" refers to the quotient of the caliper (generally having units of μm) divided by the bone dry basis weight (generally having units of gsm). The resulting sheet bulk is expressed in cubic centimeters per gram (cc/g). Through-air dried tissue products prepared according to the present invention generally have a sheet bulk greater than about 8 cc/g, more preferably greater than about 10 cc/g and still more preferably greater than about 12 cc/g, such as from about 8 to about 20 cc/g and more preferably from about 12 to about 18 cc/g. Creped wet pressed tissue products prepared according to the present invention generally have a sheet bulk greater than about 7 cc/g, more preferably greater than about 9 cc/g, such as from about 7 to about 10 cc/g.

As used herein, the term "Geometric Mean Tensile" (GMT) refers to the square root of the product of the machine direction tensile strength and the cross-machine direction tensile strength of the

tissue product. While the GMT may vary, tissue products prepared according to the present invention generally have a GMT greater than about 500 g/3", more preferably greater than about 600 g/3" and still more preferably greater than about 800 g/3", such as from about 500 to about 1,200 g/3".

5 As used herein, the term "Slope" refers to the slope of the line resulting from plotting tensile versus stretch and is an output of the MTS TestWorks™ in the course of determining the tensile strength as described in the Test Methods section herein. Slope is reported in the units of grams (g) per unit of sample width (inches) and is measured as the gradient of the least-squares line fitted to the load-corrected strain points falling between a specimen-generated force of 70 to 157 grams (0.687 to 1.540 N) divided by the specimen width. Slopes are generally reported herein as having units of grams (g) or
10 kilograms (kg).

As used herein, the term "Geometric Mean Slope" (GM Slope) refers to the square root of the product of machine direction slope and cross-machine direction slope. GM Slope generally is expressed in units of kilograms (kg). While the GM Slope may vary, tissue products prepared according to the present invention generally have a GM Slope less than about 10.0 kg, more preferably less than about
15 8.0 kg and still more preferably less than about 6.0 kg.

As used herein, the term "Stiffness Index" refers to GM Slope (having units of kg), divided by GMT (having units of g/3") multiplied by 1,000. While the Stiffness Index may vary, tissue products prepared according to the present invention generally have a Stiffness Index less than about 10.0 and more preferably less than about 8.0, such as from about 6.0 to about 10.0.

20 As used herein, the term "Geometric Mean Tensile Energy Absorption" (GM TEA) refers to the square root of the product MD TEA and CD TEA, which are measured in the course of determining tensile strength as described below. GM TEA has units of gm*cm/cm².

As used herein the term "Substantially Free" when used in reference to a given layer of a multi-layered fibrous web means the given layer comprises less than about 0.25 percent of the subject fiber,
25 by weight of the layer. The foregoing amounts of fiber are generally considered negligible and do not affect the physical properties of the layer. Moreover the presence of negligible amounts of subject fibers in a given layer generally arise from fibers disposed in an adjacent layer, and have not been purposefully disposed in a given layer. For example where a given layer of a multi-layered tissue web is said to be substantially free of wood pulp fibers, the given layer generally comprises less than about 0.25 percent
30 wood pulp fiber, by weight of the layer.

DETAILED DESCRIPTION OF THE DISCLOSURE

The present invention provides multi-layered tissue webs, and tissue product comprising the same, the multi-layered webs comprising wood fibers and non-wood cellulosic fibers where the non-wood cellulosic fibers are selectively deposited in one or more outer layers of the multi-layered web.

5 Surprisingly disposing non-wood cellulosic fibers in the outer layers, even in relatively modest amounts, alters the machine and/or cross-machine direction properties of the resulting web, such that MD:CD tensile ratio may be reduced. For example, in one embodiment, the present invention provides a method of manufacturing a tissue web comprising the steps of dispersing hardwood kraft pulp and a non-wood cellulosic fiber in water to form a first fiber slurry, dispersing softwood kraft pulp fiber to form a second
10 fiber slurry, depositing the second fiber slurry onto a forming fabric, depositing the first fiber slurry adjacent to the second fiber slurry to form a wet web, dewatering the wet web to a consistency from about 20 to about 30 percent, and drying the wet web to a consistency of greater than about 90 percent thereby forming a dry tissue web, the dry tissue web comprising from about 5 to about 30 weight percent non-wood cellulosic fibers and having a MD:CD tensile ratio less than about 2.0. In particularly preferred
15 embodiments the first fiber slurry is not refined, that is neither the hardwood kraft pulp nor the non-wood cellulosic fibers are refined. The second fiber slurry may optionally be refined to modify the strength of the resulting tissue web.

Tissue webs and products of the present invention generally comprise at least about 5.0 weight percent non-wood cellulosic fibers and more preferably at least about 10 weight percent, such as from
20 about 5.0 to about 30 percent and more preferably from about 10 to about 25 weight percent. In particularly preferred embodiments the inventive tissue products comprise a multi-layered web comprising a first layer, such as a fabric contacting layer, and a second layer, such as an air layer, where the first layer comprises non-wood cellulosic fiber and wood pulp fibers, preferably short wood fibers, and the second layer comprises wood pulp fibers and is substantially free from non-wood cellulosic
25 fibers.

Non-wood cellulosic fibers useful in the present invention are generally derived from non-wood plants in the genus *Hesperaloe* in the family Agavaceae including, for example *H. funifera*, *H. nocturna*, *H. parviflora*, and *H. changii*, non-wood plants in the genus *Agave*, of the family Asparagaceae including, for example *A. tequilana*, *A. sisalana* and *A. fourcroydes* and non-wood plants in the genus
30 *Phyllostachys* or *Bambusa*, of the family Poaceae including, for example, *Phyllostachys edulis*, *Bambusa vulgaris* and *Phyllostachys nigra* variant Henon. Preferably the non-wood cellulosic fiber has an average fiber length greater than about 1.0 mm, more preferably greater than about 1.2 mm and still more preferably greater than about 1.4 mm, such as an average fiber length from about 1.0 to about 3.0 mm

and more preferably from about 1.2 to about 2.8 mm. In certain embodiments the tissue webs and products may comprise two or more different non-wood cellulosic fibers.

In particularly preferred embodiments the non-wood cellulosic fiber is a bamboo fiber derived from one or more bamboo fiber species selected from the group consisting of *Acidosasa* sp.,
 5 *Ampleocalamus* sp., *Arundinaria* sp., *Bambusa* sp., *Bashania* sp., *Borinda* sp., *Brachystachyum* sp.,
Cephalostachyum sp., *Chimonobambusa* sp., *Chusquea* sp., *Dendrocalamus* sp., *Dinochloa* sp.,
Drepanostachyum sp., *Eremitis* sp., *Fargesia* sp., *Gaoligongshania* sp., *Gelidocalamus* sp.,
Gigantochloa sp., *Guadua* sp., *Hibanobambusa* sp., *Himalayacalamus* sp., *Indocalamus* sp., *Indosasa*
 10 *sp.*, *Lithachne* sp., *Melocanna* sp., *Menstruocalamus* sp., *Nastus* sp., *Neohouzeaua* sp.,
Neomicrocalamus sp., *Ochlandra* sp., *Oligostachyum* sp., *Olmeca* sp., *Otatea* sp., *Oxytenanthera* sp.,
Phyllostachys sp., *Pleioblastus* sp., *Pseudosasa* sp., *Raddia* sp., *Rhipidocladum* sp., *Sasa* sp., *Sasaella*
sp., *Sasamorpha* sp., *Schizostachyum* sp., *Semiarundinaria* sp., *Shibatea* sp., *Sinobambusa* sp.,
Thamnocalamus sp., *Thyrsostachys* sp., and *Yushania* sp.

Tissue webs and products made in accordance with the present disclosure are formed from a
 15 stratified fiber furnish producing layers within the web or product. Stratified base webs can be formed
 using equipment known in the art, such as a multi-layered headbox. For example, in certain
 embodiments, the tissue products may be prepared from multi-layered webs having a first outer layer, a
 middle layer and a second outer layer. In one embodiment the first and second outer layers may
 comprise non-wood cellulosic fiber and short cellulosic fiber, such as hardwood pulp fibers. The short
 20 cellulosic fibers can be mixed, if desired, with paper broke in an amount up to about 10 percent by weight
 and/or long cellulosic fiber in an amount up to about 10 percent by weight. The middle layer, which is
 generally positioned in between the first outer layer and the second outer layer may comprise wood
 fibers, and more preferably long, low coarseness wood pulp fibers, such as Northern softwood kraft pulp
 fibers (NSWK). Preferably the middle layer is substantially free from non-wood cellulosic fibers.

In other embodiments the non-wood cellulosic fibers are utilized in the tissue web as a
 25 replacement for short wood fibers such as hardwood kraft pulp fibers and more specifically Eucalyptus
 kraft fibers. In one particular embodiment, non-wood cellulosic fibers are incorporated into a multi-
 layered web having an air contacting layer (non-fabric contacting layer) and a fabric contacting layer
 where the air contacting layer comprises a blend of hardwood fibers and non-wood cellulosic fibers and
 30 the fabric contacting layer comprises long wood fibers. In the foregoing embodiment the non-wood
 cellulosic fiber may be added to the air contacting layer such that the total web comprises about 5.0 to
 about 30 percent, by total weight of the web, non-wood cellulosic fibers. Further, it may be preferred to

selectively dispose the non-wood cellulosic fibers in the air layer such that the fabric contacting layer is substantially free from non-wood cellulosic fibers.

In a particularly preferred embodiment, the present disclosure provides a tissue web having modified machine and/or cross-machine direction physical properties and a MD:CD tensile ratio less than about 2.0. For example, the invention provides a tissue product having a GMT greater than about 500 g/3", such as from about 500 to about 1,200 g/3", and more preferably from about 700 to about 1,000 g/3", a MD:CD tensile ratio less than about 2.0, such as from about 1.5 to about 2.0 and more preferably from about 1.6 to about 1.80 and a reduced MD Slope, such as a MD Slope less than about 10.0 kg, and more preferably less than about 8.0 kg, such as from about 6.0 to about 10.0 kg and more preferably from about 6.0 to about 8.0 kg.

In other embodiments, the addition of non-wood fibers to one or more outer layers of a multi-layered tissue web may alter the CD Slope and in some instances may increase the CD Slope, compared to a similarly manufactured tissue web that is substantially free from non-wood fibers. For example, a tissue multi-layered web comprising from about 10 to about 50 percent non-wood fiber, where the non-wood fiber is selectively incorporated in one or more outer layers may have a CD Slope from about 4.5 to about 6.0 kg.

In still other embodiments, the present disclosure provides tissue products having enhanced durability, such as improved tear strength. For example, tissue products prepared as described herein may have a geometric mean tear (GM tear) greater than about 12.0 N and more preferably greater than about 14.0 N and still more preferably greater than about 16.0 N, such as from about 12.0 to about 20.0 at geometric mean tensile strengths from about 700 to about 1,200 g/3".

The increase in durability is generally achieved without a corresponding increase in stiffness, such that the instant tissue products are durable, yet flexible and soft. For example, tissue products prepared as described herein may have a GM Slope less than about 8.0 and more preferably less than about 7.0, such as from about 5.0 to about 8.0. The foregoing GM Slopes are generally achieved at GMTs from about 700 to about 1,200 g/3" and more preferably from about 750 to about 1,000 g/3" yielding Stiffness Indexes less than about 9.0, and more preferably less than about 8.0 and still more preferably less than about 7.0, such as from about 6.0 to about 9.0.

Webs prepared as described herein may be converted into either single or multi-ply rolled tissue products that have improved properties over the prior art. In one embodiment the present disclosure provides a rolled tissue product comprising a spirally wound tissue web having at least two layers wherein the air contacting layer comprises at least about 5 percent, by weight of the web, non-wood

cellulosic fiber and wherein the tissue web has a bone dry basis weight greater than about 35 gsm, a sheet bulk greater than about 10 cc/g and a Stiffness Index less than about 9.0.

The tissue webs may also be incorporated into tissue products that may be either single- or multi-ply, where one or more of the plies may be formed by a multi-layered tissue web having non-wood cellulosic fiber selectively incorporated in one of its layers. In one embodiment the tissue product is constructed such that the non-wood cellulosic fibers are brought into contact with the user's skin in-use. For example, the tissue product may comprise two multi-layered through-air dried webs wherein each web comprises a fabric contacting fibrous layer substantially free from non-wood cellulosic fiber and a non-fabric contacting fibrous layer comprising non-wood cellulosic fiber. The webs are plied together such that the outer surface of the tissue product is formed from the fabric contacting fibrous layers of each web, such that the surface brought into contact with the user's skin in-use comprises non-wood cellulosic fiber.

If desired, various chemical compositions may be applied to one or more layers of the multi-layered tissue web to further enhance softness and/or reduce the generation of lint or slough. For example, in some embodiments, a wet strength agent can be utilized to further increase the strength of the tissue product when wet. As used herein, a "wet strength agent" is any material that when added to pulp fibers can provide a resulting web or sheet with a wet geometric tensile strength to dry geometric tensile strength ratio in excess of about 0.1. Typically these materials are termed either "permanent" wet strength agents or "temporary" wet strength agents. As is well known in the art, temporary and permanent wet strength agents may also sometimes function as dry strength agents to enhance the strength of the tissue product when dry.

Wet strength agents may be applied in various amounts depending on the desired characteristics of the web. For instance, in some embodiments, the total amount of wet strength agents added can be between about 1 to about 60 pounds per ton (lbs/T), in some embodiments between about 5 to about 30 lbs/T, and in some embodiments between about 7 to about 13 lbs/T of the dry weight of fibrous material. The wet strength agents can be incorporated into any layer of the multi-layered tissue web.

A chemical debonder can also be applied to soften the web. Specifically, a chemical debonder can reduce the amount of hydrogen bonds within one or more layers of the web, which results in a softer product. Depending on the desired characteristics of the resulting tissue product, the debonder can be utilized in varying amounts. For example, in some embodiments, the debonder can be applied in an amount between about 1 to about 30 lbs/T, in some embodiments between about 3 to about 20 lbs/T,

and in some embodiments, between about 6 to about 15 lbs/T of the dry weight of fibrous material. The debonder can be incorporated into any layer of the multi-layered tissue web.

Any material capable of enhancing the soft feel of a web by disrupting hydrogen bonding can generally be used as a debonder in the present invention. In particular, as stated above, it is typically
5 desired that the debonder possess a cationic charge for forming an electrostatic bond with anionic groups present on the pulp. Some examples of suitable cationic debonders can include, but are not limited to, quaternary ammonium compounds, imidazolinium compounds, bis-imidazolinium compounds, diquaternary ammonium compounds, polyquaternary ammonium compounds, ester-functional quaternary ammonium compounds (e.g., quaternized fatty acid trialkanolamine ester salts), phospholipid
10 derivatives, polydimethylsiloxanes and related cationic and non-ionic silicone compounds, fatty and carboxylic acid derivatives, mono and polysaccharide derivatives, polyhydroxy hydrocarbons, etc. For instance, some suitable debonders are described in U.S. Pat. Nos. 5,716,498, 5,730,839, 6,211,139, 5,543,067, and WO/0021918, all of which are incorporated herein in a manner consistent with the present disclosure.

15 Still other suitable debonders are disclosed in U.S. Pat. Nos. 5,529,665 and 5,558,873, both of which are incorporated herein in a manner consistent with the present disclosure. In particular, U.S. Pat. No. 5,529,665 discloses the use of various cationic silicone compositions as softening agents.

Tissue webs of the present disclosure can generally be formed by any of a variety of papermaking processes known in the art. Preferably the tissue web is formed by through-air drying and
20 be either creped or uncreped. For example, a papermaking process of the present disclosure can utilize adhesive creping, wet creping, double creping, embossing, wet-pressing, air pressing, through-air drying, creped through-air drying, uncreped through-air drying, as well as other steps in forming the paper web. Some examples of such techniques are disclosed in U.S. Pat. Nos. 5,048,589, 5,399,412, 5,129,988 and 5,494,554 all of which are incorporated herein in a manner consistent with the present
25 disclosure. When forming multi-ply tissue products, the separate plies can be made from the same process or from different processes as desired.

For example, in one embodiment, tissue webs may be creped through-air dried webs formed using processes known in the art. To form such webs, an endless traveling forming fabric, suitably supported and driven by rolls, receives the layered papermaking stock issuing from the headbox. A
30 vacuum box is disposed beneath the forming fabric and is adapted to remove water from the fiber furnish to assist in forming a web. From the forming fabric, a formed web is transferred to a second fabric, which may be either a wire or a felt. The fabric is supported for movement around a continuous path by a

plurality of guide rolls. A pick up roll designed to facilitate transfer of web from fabric to fabric may be included to transfer the web.

Preferably the formed web is dried by transfer to the surface of a rotatable heated dryer drum, such as a Yankee dryer. The web may be transferred to the Yankee directly from the throughdrying fabric or, preferably, transferred to an impression fabric which is then used to transfer the web to the Yankee dryer. In accordance with the present disclosure, the creping composition of the present disclosure may be applied topically to the tissue web while the web is traveling on the fabric or may be applied to the surface of the dryer drum for transfer onto one side of the tissue web. In this manner, the creping composition is used to adhere the tissue web to the dryer drum. In this embodiment, as the web 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 is then removed from the dryer drum by a creping blade. The creping web as it is formed further reduces internal bonding within the web and increases softness. Applying the creping composition to the web during creping, on the other hand, may increase the strength of the web.

In other embodiments, the base web is formed by an uncreped through-air drying process such as those described, for example, in U.S. Pat. Nos. 5,656,132 and 6,017,417, both of which are hereby incorporated by reference herein in a manner consistent with the present disclosure. The uncreped through-air drying process may comprise a twin wire former having a papermaking headbox which injects or deposits a furnish of an aqueous suspension of wood fibers onto a plurality of forming fabrics, such as an outer forming fabric and an inner forming fabric, thereby forming a wet tissue web. The forming process may be any conventional forming process known in the papermaking industry. Such formation processes include, but are not limited to, Fourdriniers, roof formers such as suction breast roll formers, and gap formers such as twin wire formers and crescent formers.

The wet tissue web forms on the inner forming fabric as the inner forming fabric revolves about a forming roll. The inner forming fabric serves to support and carry the newly-formed wet tissue web downstream in the process as the wet tissue web is partially dewatered to a consistency of about 10 percent based on the dry weight of the fibers. Additional dewatering of the wet tissue web may be carried out by known paper making techniques, such as vacuum suction boxes, while the inner forming fabric supports the wet tissue web. The wet tissue web may be additionally dewatered to a consistency of at least about 20 percent, more specifically between about 20 to about 40 percent, and more specifically about 20 to about 30 percent.

The forming fabric can generally be made from any suitable porous material, such as metal wires or polymeric filaments. For instance, some suitable fabrics can include, but are not limited to,

Albany 84M and 94M available from Albany International (Albany, N.Y.) Asten 856, 866, 867, 892, 934, 939, 959, or 937; Asten Synweave Design 274, all of which are available from Asten Forming Fabrics, Inc. (Appleton, Wis.); and Voith 2164 available from Voith Fabrics (Appleton, Wis.). The wet web is then transferred from the forming fabric to a transfer fabric while at a solids consistency of between about 10
5 to about 35 percent and, particularly, between about 20 to about 30 percent. As used herein, a "transfer fabric" is a fabric that is positioned between the forming section and the drying section of the web manufacturing process.

Transfer to the transfer fabric may be carried out with the assistance of positive and/or negative pressure. For example, in one embodiment, a vacuum shoe can apply negative pressure such that the
10 forming fabric and the transfer fabric simultaneously converge and diverge at the leading edge of the vacuum slot. Typically, the vacuum shoe supplies pressure at levels between about 10 to about 25 inches of mercury. As stated above, the vacuum transfer shoe (negative pressure) can be supplemented or replaced by the use of positive pressure from the opposite side of the web to blow the web onto the next fabric. In some embodiments, other vacuum shoes can also be used to assist in drawing the fibrous
15 web onto the surface of the transfer fabric. The wet tissue web is then transferred from the transfer fabric to a throughdrying fabric.

While supported by the throughdrying fabric, the wet tissue web is dried to a final consistency of about 94 percent or greater by a throughdryer. The drying process can be any noncompressive drying method which tends to preserve the bulk or thickness of the wet web including, without limitation,
20 throughdrying, infra-red radiation, microwave drying, etc. Because of its commercial availability and practicality, throughdrying is well known and is one commonly used means for noncompressively drying the web for purposes of this invention. Suitable throughdrying fabrics include, without limitation, fabrics with substantially continuous machine direction ridges whereby the ridges are made up of multiple warp strands grouped together, such as those disclosed in U.S. Pat. No. 6,998,024. Other suitable
25 throughdrying fabrics include those disclosed in U.S. Pat. No. 7,611,607, which is incorporated herein in a manner consistent with the present disclosure, particularly the fabrics denoted as Fred (t1207-77), Jetson (t1207-6) and Jack (t1207-12). The web is preferably dried to final dryness on the throughdrying fabric, without being pressed against the surface of a Yankee dryer, and without subsequent creping.

Additionally, webs prepared according to the present disclosure may be subjected to any
30 suitable post processing including, but not limited to, printing, embossing, calendering, slitting, folding, winding, combining with other tissue webs, and the like. Post processing of the web generally results in a tissue product that is intended for use by a consumer.

TEST METHODS

Sheet Bulk

Sheet Bulk is calculated as the quotient of the dry sheet caliper (μm) divided by the basis weight (gsm). Dry sheet caliper is the measurement of the thickness of a single tissue sheet measured in accordance with TAPPI test methods T402 and T411 om-89. The micrometer used for carrying out T411 om-89 is an Emveco 200-A Tissue Caliper Tester (Emveco, Inc., Newberg, OR). The micrometer has a load of 2 kilo-Pascals, a pressure foot area of 2500 square millimeters, a pressure foot diameter of 56.42 millimeters, a dwell time of 3 seconds and a lowering rate of 0.8 millimeters per second.

Tear

Tear testing was carried out in accordance with TAPPI test method T-414 "Internal Tearing Resistance of Paper (Elmendorf-type method)" using a falling pendulum instrument such as Lorentzen & Wettre Model SE 009. Tear strength is directional and MD and CD tear are measured independently.

More particularly, a rectangular test specimen of the sample to be tested is cut out of the tissue product or tissue basesheet such that the test specimen measures 63 ± 0.15 mm (2.5 ± 0.006 inches) in the direction to be tested (such as the MD or CD direction) and between 73 and 114 millimeters (2.9 and 4.6 inches) in the other direction. The specimen edges must be cut parallel and perpendicular to the testing direction (not skewed). Any suitable cutting device, capable of the prescribed precision and accuracy, can be used. The test specimen should be taken from areas of the sample that are free of folds, wrinkles, crimp lines, perforations or any other distortions that would make the test specimen abnormal from the rest of the material.

The number of plies or sheets to test is determined based on the number of plies or sheets required for the test results to fall between 20 to 80 percent on the linear range scale of the tear tester and more preferably between 20 to 60 percent of the linear range scale of the tear tester. The sample preferably should be cut no closer than 6 mm (0.25 inch) from the edge of the material from which the specimens will be cut. When testing requires more than one sheet or ply the sheets are placed facing in the same direction.

The test specimen is then placed between the clamps of the falling pendulum apparatus with the edge of the specimen aligned with the front edge of the clamp. The clamps are closed and a 20-millimeter slit is cut into the leading edge of the specimen usually by a cutting knife attached to the instrument. For example, on the Lorentzen & Wettre Model SE 009 the slit is created by pushing down on the cutting knife lever until it reaches its stop. The slit should be clean with no tears or nicks as this slit will serve to start the tear during the subsequent test.

The pendulum is released and the tear value, which is the force required to completely tear the test specimen, is recorded. The test is repeated a total of ten times for each sample and the average of the ten readings reported as the tear strength. Tear strength is reported in units of grams of force (gf). The average tear value is the tear strength for the direction (MD or CD) tested. The "geometric mean tear strength" is the square root of the product of the average MD tear strength and the average CD tear strength. The Lorentzen & Wettre Model SE 009 has a setting for the number of plies tested. Some testers may need to have the reported tear strength multiplied by a factor to give a per ply tear strength. For basesheets intended to be multiple ply products, the tear results are reported as the tear of the multiple ply product and not the single ply basesheet. This is done by multiplying the single ply basesheet tear value by the number of plies in the finished product. Similarly, multiple ply finished product data for tear is presented as the tear strength for the finished product sheet and not the individual plies. A variety of means can be used to calculate but in general will be done by inputting the number of sheets to be tested rather than number of plies to be tested into the measuring device. For example, two sheets would be two 1-ply sheets for 1-ply product and two 2-ply sheets (4-ply) for 2-ply products.

15 Tensile

Tensile testing was done in accordance with TAPPI test method T-576 "Tensile properties of towel and tissue products (using constant rate of elongation)" wherein the testing is conducted on a tensile testing machine maintaining a constant rate of elongation and the width of each specimen tested is 3 inches. More specifically, samples for dry tensile strength testing were prepared by cutting a 3 ± 0.05 inches (76.2 ± 1.3 mm) wide strip in either the machine direction (MD) or cross-machine direction (CD) orientation using a JDC Precision Sample Cutter (Thwing-Albert Instrument Company, Philadelphia, PA, Model No. JDC 3-10, Serial No. 37333) or equivalent. The instrument used for measuring tensile strengths was an MTS Systems Sintech 11S, Serial No. 6233. The data acquisition software was an MTS TestWorks® for Windows Ver. 3.10 (MTS Systems Corp., Research Triangle Park, NC). The load cell was selected from either a 50 Newton or 100 Newton maximum, depending on the strength of the sample being tested, such that the majority of peak load values fall between 10 to 90 percent of the load cell's full scale value. The gauge length between jaws was 4 ± 0.04 inches (101.6 ± 1 mm) for facial tissue and towels and 2 ± 0.02 inches (50.8 ± 0.5 mm) for bath tissue. The crosshead speed was 10 ± 0.4 inches/min (254 ± 1 mm/min), and the break sensitivity was set at 65 percent. The sample was placed in the jaws of the instrument, centered both vertically and horizontally. The test was then started and ended when the specimen broke. The peak load was recorded as either the "MD tensile strength" or the "CD tensile strength" of the specimen depending on direction of the sample being tested. Ten representative specimens were tested for each product or sheet and the arithmetic average of all

individual specimen tests was recorded as the appropriate MD or CD tensile strength the product or sheet in units of grams of force per 3 inches of sample. The geometric mean tensile (GMT) strength was calculated and is expressed as grams-force per 3 inches of sample width. Tensile energy absorbed (TEA) and slope are also calculated by the tensile tester. TEA is reported in units of gm*cm/cm². Slope is recorded in units of kg. Both TEA and Slope are directional dependent and thus MD and CD directions are measured independently. Geometric mean TEA and geometric mean slope are defined as the square root of the product of the representative MD and CD values for the given property.

Multi-ply products were tested as multi-ply products and results represent the tensile strength of the total product. For example, a 2-ply product was tested as a 2-ply product and recorded as such. A basesheet intended to be used for a 2-ply product was tested as two plies and the tensile recorded as such. Alternatively, a single ply may be tested and the result multiplied by the number of plies in the final product to get the tensile strength.

EXAMPLES

Base sheets were made using a through-air dried papermaking process commonly referred to as "uncreped through-air dried" ("UCTAD") and generally described in U.S. Pat. No. 5,607,551, the contents of which are incorporated herein in a manner consistent with the present invention. Initially, northern softwood kraft (NSWK) pulp was dispersed in a pulper for 30 minutes at 4 percent consistency at about 100°F. The NSWK pulp was then transferred to a dump chest and subsequently diluted to approximately 3 percent consistency. The NSWK pulp was refined at about 1 HP-days/MT as set forth in Table 2, below. The softwood fibers were added to the middle side layer in the 3-layer tissue structure. The virgin NSWK fiber content contributed approximately 40 percent of the final sheet weight.

Eucalyptus hardwood kraft (EHWK) pulp was dispersed in a pulper for 30 minutes at about 4 percent consistency at about 100°F. The EHWK pulp was then transferred to a dump chest and subsequently diluted to about 3 percent consistency. The EHWK was not refined.

The non-wood cellulosic fibers were bamboo kraft pulp, which had the following properties:

TABLE 1

Non-wood cellulosic fiber	Average Fiber Length (mm)	Coarseness (mg/100 m)
Bamboo Kraft Pulp	1.30	9.17

Bamboo pulp fibers were dispersed in a pulper for 30 minutes at 4 percent consistency at about 100°F. The bamboo pulp was then transferred to a dump chest and subsequently diluted to approximately 3 percent consistency. The bamboo pulp was not refined.

In certain instances starch (Redibond 2038A, Ingredion Incorporated, Englewood, CO) was added to each furnish layer prior to formation of the web. Starch was added to the machine chest where it was mixed prior to the headbox. Starch addition levels are set forth in Table 2.

5 The pulp fibers from the machine chests were pumped to the headbox at a consistency of about 0.1 percent. Pulp fibers from each machine chest were sent through separate manifolds in the headbox to create a 3-layered tissue structure. The specific furnish layer splits are set forth in Table 2.

TABLE 2

Sample	Middle Layer (Wt. %)	Outer Layers (Wt. %)		Redibond 2038A Starch (kg/MT)	Refining (min.)
Control 1	NSWK (40%)	EHWK (60%)	-	-	3
Control 2	NSWK (40%)	EHWK (60%)	-	1	3
Control 3	NSWK (40%)	EHWK (60%)	-	2	3
Inventive 1	NSWK (40%)	EHWK (45%)	Bamboo (15%)	-	0
Inventive 2	NSWK (40%)	EHWK (45%)	Bamboo (15%)	2	0
Inventive 3	NSWK (40%)	EHWK (45%)	Bamboo (15%)	4	0
Inventive 4	NSWK (40%)	EHWK (30%)	Bamboo (30%)	-	0
Inventive 5	NSWK (40%)	EHWK (30%)	Bamboo (30%)	2	0
Inventive 6	NSWK (40%)	EHWK (30%)	Bamboo (30%)	4	0

The tissue web was formed on a Voith Fabrics TissueForm V forming fabric, vacuum dewatered to approximately 25 percent consistency and then subjected to rush transfer when transferred to the transfer fabric. The layer splits, by weight of the web, are detailed in Table 2, above. The transfer fabric was the fabric described as t1207-11 (commercially available from Voith Fabrics, Appleton, WI). The web was then transferred to a through-air drying fabric. Transfer to the through-drying fabric was done using vacuum levels of greater than 10 inches of mercury at the transfer. The web was then dried to approximately 98 percent solids before winding.

15 The base sheet webs were converted into rolled bath products by calendering using a conventional polyurethane/steel calender comprising a 4 P&J polyurethane roll on the air side of the sheet and a standard steel roll on the fabric side. The finished product comprised a single ply of base sheet. The finished products were subjected to physical testing, the results of which are summarized in Tables 3 and 4, below.

TABLE 3

Code	Basis Weight (gsm)	Caliper (microns)	Sheet Bulk (cc/g)	MD:CD Tensile Ratio	MD:CD Slope Ratio	GMT	GM Slope	Stiffness Index
Control 1	36.5	476	13.1	2.07	2.22	989	6.80	6.88
Control 2	36.3	499	13.8	1.98	2.19	1108	7.27	6.57
Control 3	37.1	534	14.4	1.98	2.11	1245	7.61	6.11
Inventive 1	36.7	506	13.8	1.83	1.57	741	6.19	8.36
Inventive 2	37.1	492	13.3	1.78	1.82	968	6.82	7.04
Inventive 3	36.7	525	14.3	1.78	1.86	1128	7.15	6.34
Inventive 4	36.3	455	12.5	1.72	1.28	742	6.17	8.31
Inventive 5	36.3	498	13.7	1.80	1.69	975	6.88	7.05
Inventive 6	36.2	489	13.5	1.65	1.66	1094	7.37	6.74

TABLE 4

Code	CD Tensile (g/3")	CD Slope (kg)	MD Tensile (g/3")	MD Slope (kg)	GM TEA (g*cm/cm ²)	GM Tear (N)
Control 1	690	4.60	1421	10.10	10.67	14.22
Control 2	790	4.93	1556	10.74	12.11	16.28
Control 3	885	5.25	1753	11.03	13.97	17.71
Inventive 1	549	4.95	1002	7.76	7.74	12.17
Inventive 2	727	5.10	1292	9.16	10.72	15.30
Inventive 3	846	5.26	1503	9.76	13.25	17.17
Inventive 4	567	5.49	972	6.95	7.84	11.76
Inventive 5	729	5.30	1305	8.93	11.06	15.95
Inventive 6	853	5.75	1404	9.46	12.92	18.31

The foregoing represents several examples of inventive tissue products prepared according to the present disclosure. In other embodiments, such as a first embodiment, the present invention provides a tissue product comprising at least one multi-layered tissue web comprising a first air contacting layer and a second fabric contacting layer, wherein the first air contacting layer comprises from about 5 to about 30 weight percent, by weight of the web, non-wood cellulosic fibers and the tissue product has a geometric mean tensile from about 500 to about 1,200 g/3" and a MD:CD Tensile ratio less than about 2.0.

In a second embodiment the present invention provides the tissue product of the first embodiment wherein the fabric contacting layer is substantially free from non-wood cellulosic fiber.

In a third embodiment the present invention provides the tissue product of the first or second embodiments wherein the non-wood cellulosic fiber is derived from a non-wood plant selected from the group consisting of *Hesperaloe funifera*, *Hesperaloe nocturna*, *Hesperaloe parviflora*, *Hesperaloe chiangii*, *Agave tequilana*, *Agave sisalana*, *Agave fourcroydes*, *Phyllostachys edulis*, *Bambusa vulgaris*, *Phyllostachys nigra* and combinations thereof.

In a fourth embodiment the present invention provides the tissue product of any one of the first through third embodiments wherein the non-wood cellulosic fiber has an average fiber length from about 1.0 to about 3.0 mm.

5 In a sixth embodiment the present invention provides the tissue product of any one of the first through fifth embodiments having a GMT from about 700 to about 1,000 g/3" and a MD Slope from about 6.0 to about 10.0 kg.

In a seventh embodiment the present invention provides the tissue product of any one of the first through sixth embodiments having a GMT from about 700 to about 1,000 g/3" and a Stiffness Index from about 6.0 to about 9.0.

10 In an eighth embodiment the present invention provides the tissue product of any one of the first through seventh embodiments wherein the product has a MD:CD slope ratio less than 2.0, such as from about 1.5 to about 2.0 and more preferably from about 1.5 to about 1.75.

In a ninth embodiment the present invention provides the tissue product of any one of the first through eighth embodiments wherein the tissue product has a GM Tear from about 12 to about 20 N.

15 In a tenth embodiment the present invention provides the tissue product of any one of the first through ninth embodiments wherein the tissue product has a GM TEA greater than about 7.0 g*cm/cm², such as from about 7.0 to about 14.0 g*cm/cm² and more preferably from about 9.0 to about 12.0 g*cm/cm².

20 In an eleventh embodiment the present invention provides the tissue product of the first through tenth embodiments wherein the product has a MD:CD tensile ratio from about 1.50 to about 1.80.

In a twelfth embodiment the present invention provides the tissue product of the first through eleventh embodiments wherein the product has a GM Slope from about 6.0 to about 10.0 kg.

25 In a thirteenth embodiment the present invention provides the tissue product of the first through twelfth embodiments wherein the non-wood cellulosic fiber is derived from a non-wood plant selected from *Phyllostachys edulis*, *Bambusa vulgaris*, *Phyllostachys nigra* and combinations thereof and has an average fiber length from about 1.2 to about 1.6 mm.

30 In a fourteenth embodiment the present invention provides a tissue product comprising at least one multi-layered tissue web comprising a first and a second outer layer and a middle layer disposed therebetween, wherein the outer layers comprise from about 5 to about 30 percent, by weight of the web, non-cellulosic fiber and the tissue product has a geometric mean tensile from about 500 to about 1,200 g/3" and a MD:CD Tensile ratio less than about 2.0.

In a fifteenth embodiment the present invention provides the tissue product of the fourteenth embodiment wherein the middle layer is substantially free from non-wood cellulosic fiber.

In a sixteenth embodiment the present invention provides the tissue product of the fourteenth or fifteenth embodiments wherein the non-wood cellulosic fiber has an average fiber length from about 1.0
5 to about 3.0 mm.

In a seventeenth embodiment the present invention provides the tissue product of any one of the fourteenth through sixteenth embodiments wherein the tissue product has a MD:CD slope ratio less than 2.0, such as from about 1.5 to about 2.0 and more preferably from about 1.5 to about 1.75.

In an eighteenth embodiment the present invention provides the tissue product of any one of
10 the fourteenth through seventeenth embodiments wherein the tissue product has a GM Tear greater than about 12 N, such as from about 12 to about 20 N.

In a nineteenth embodiment the present invention provides a method of forming a soft and durable wet laid tissue product comprising the steps of (a) providing a first fiber furnish consisting essentially of short wood pulp fibers and non-wood cellulosic fibers; (b) providing a second fiber furnish
15 consisting essentially of long wood pulp fibers; (c) depositing the first and second fiber furnish on a forming fabric to form a wet tissue web; (d) partially dewatering the wet tissue web; (e) drying the tissue web; and (f) converting the tissue web into a tissue product, wherein the product comprises from 5 to 30 weight percent non-wood cellulosic fiber and has a geometric mean tensile from about 500 to about 1,200 g/3" and a MD:CD Tensile ratio less than 2.0.

In a twentieth embodiment the present invention provides the method of the nineteenth embodiment wherein the converting step comprises calendering, embossing, printing, or combinations thereof.

In a twenty-first embodiment the present invention provides the method of the nineteenth or twentieth embodiments further comprising the step of refining the second fiber furnish and wherein the
25 first fiber furnish is not refined.

WHAT IS CLAIMED IS:

1. A tissue product comprising at least one multi-layered tissue web comprising a first air contacting layer and a second fabric contacting layer, wherein the first air contacting layer comprises from about 5 to about 30 weight percent, by weight of the web, non-wood cellulosic fibers and the tissue
5 product has a geometric mean tensile from about 500 to about 1,200 g/3" and a MD:CD Tensile ratio less than about 2.0.
2. The tissue product of claim 1 wherein the fabric contacting layer is substantially free from non-wood cellulosic fiber.
3. The tissue product of claim 1 wherein the non-wood cellulosic fiber is derived from a
10 non-wood plant selected from the group consisting of *Hesperaloe funifera*, *Hesperaloe nocturna*, *Hesperaloe parviflora*, *Hesperaloe chiangii*, *Agave tequilana*, *Agave sisalana*, *Agave fourcroydes*, *Phyllostachys edulis*, *Bambusa vulgaris*, *Phyllostachys nigra* and combinations thereof.
4. The tissue product of claim 1 wherein the non-wood cellulosic has an average fiber length from about 1.0 to about 3.0 mm.
- 15 5. The tissue product of claim 1 having a GMT from about 700 to about 1,000 g/3" and a MD Slope from about 6.0 to about 10.0 kg.
6. The tissue product of claim 1 having a GMT from about 700 to about 1,000 g/3" and a Stiffness Index from about 6.0 to about 9.0.
7. The tissue product of claim 1 having a MD:CD slope ratio less than 2.0.
- 20 8. The tissue product of claim 1 having a GM Tear from about 12 to about 20 N.
9. The tissue product of claim 1 having a GM TEA from about 9.0 to about 12.0 g*cm/cm².
10. The tissue product of claim 1 having a MD:CD tensile ratio from about 1.5 to about 1.80.
11. The tissue product of claim 1 having a GMT from about 700 to about 1,000 g/3" and a GM Slope from about 6.0 to about 10.0 kg.
- 25 12. The tissue product of claim 1 wherein the non-wood cellulosic fiber is derived from a non-wood plant selected from *Phyllostachys edulis*, *Bambusa vulgaris*, *Phyllostachys nigra* and

combinations thereof and the non-wood cellulosic fiber has an average fiber length from about 1.2 to about 1.6 mm.

13. A tissue product comprising at least one multi-layered tissue web comprising a first and a second outer layer and a middle layer disposed therebetween, wherein the outer layers comprise from
5 about 5 to about 30 percent, by weight of the web, non-cellulosic fiber and the tissue product has a geometric mean tensile from about 500 to about 1,200 g/3" and a MD:CD Tensile ratio less than 2.0.

14. The tissue product of claim 13 wherein the middle layer is substantially free from non-wood cellulosic fiber.

15. The tissue product of claim 13 wherein the non-wood cellulosic fiber has an average
10 fiber length from about 1.0 to about 3.0 mm.

16. The tissue product of claim 13 having a MD:CD slope ratio from about 1.5 to about 1.75.

17. The tissue product of claim 13 having a GM Tear greater than about 12 N.

18. The tissue product of claim 13 having a GMT from about 700 to about 1,000 g/3" and a MD Slope from about 6.0 to about 10.0 kg.

15 19. A method of forming a soft and durable wet laid tissue product comprising the steps of:

a. providing a first fiber furnish consisting essentially of short wood pulp fibers and non-wood cellulosic fibers;

b. providing a second fiber furnish consisting essentially of long wood pulp fibers;

c. depositing the first and second fiber furnish on a forming fabric to form a wet
20 tissue web;

d. partially dewatering the wet tissue web;

e. drying the tissue web; and

f. converting the tissue web into a tissue product, wherein the product comprises from 5 to 30 weight percent non-wood cellulosic fiber and has a geometric mean tensile from
25 about 500 to about 1,200 g/3" and a MD:CD Tensile ratio less than 2.0.

20. The method of claim 19 wherein the converting step comprises calendering, embossing, printing, or combinations thereof.

21. The method of claim 19 wherein the non-wood cellulosic fiber is derived from a non-wood plant selected from the group consisting of *Hesperaloe funifera*, *Hesperaloe nocturna*, *Hesperaloe parviflora*, *Hesperaloe chiangii*, *Agave tequilana*, *Agave sisalana*, *Agave fourcroydes*, *Phyllostachys edulis*, *Bambusa vulgaris*, *Phyllostachys nigra* and combinations thereof..

- 5 22. The method of claim 21 wherein the non-wood cellulosic fiber has an average fiber length from about 1.0 to about 3.0 mm.

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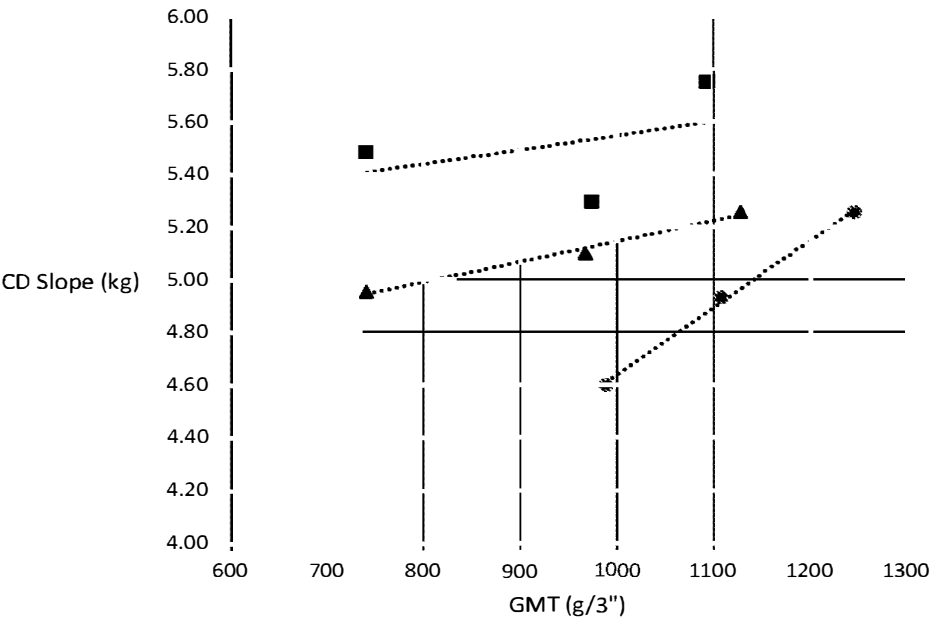


FIGURE 1

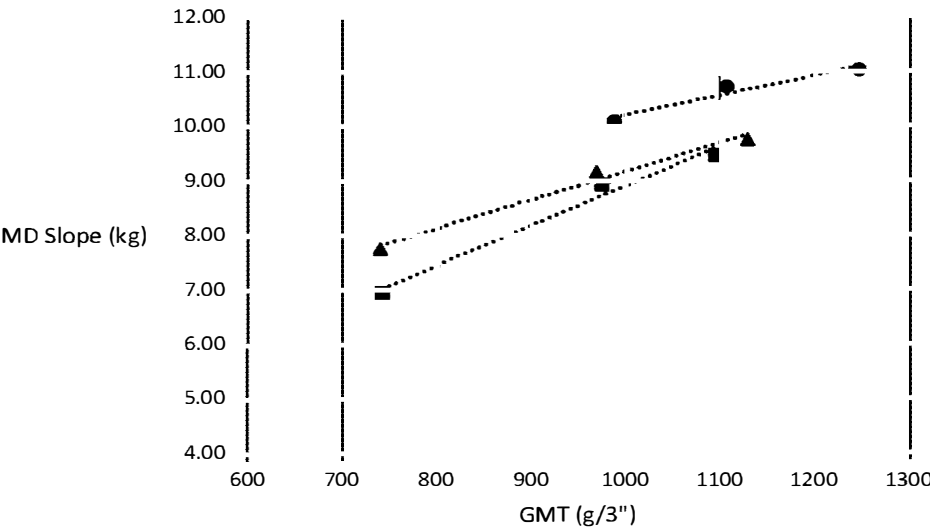


FIGURE 2

2/2

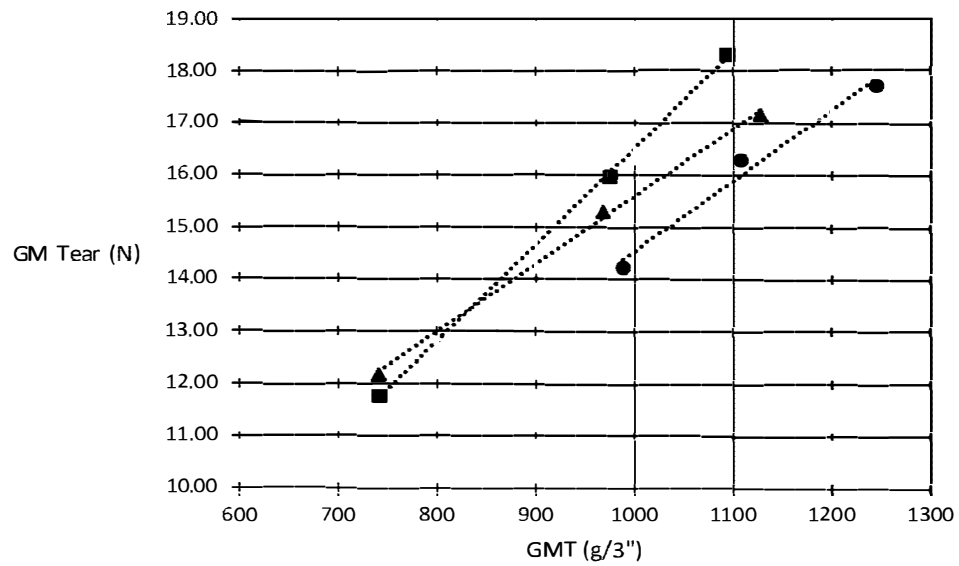


FIGURE 3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2017/018822**A. CLASSIFICATION OF SUBJECT MATTER****D21H 11/12 (2006.01) D21F 11/04 (2006.01) A47K 10/16 (2006.01) D21H 27/00 (2006.01)**

According to International Patent Classification (IPC)

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D21H, A47K

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)

EPODOC/WPIAP: layer, tissue, toilet and like terms.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2014/200455 A1 (KIMBERLY-CLARK WORLDWIDE, INC.) 18 December 2014	1-2, 5-11, 13-14, 16-20
A	See samples 24-26 in tables 4-6, GMT values in table 5, MD tensile values in table 6, pg 12 line 5 - pg 13 line 13, pg 14 lines 4-14, pg 16 line 26 - pg 17 line 6 and pg 19 lines 8-31.	21
X	US 8574400 B1 (SHANNON, T. G. ET AL.) 5 November 2013 See sample 9 in Table 10 and 11, col 9 lines 7-67, col 10 lines 35-49, col 12 lines 21-39, col 12 lines 63-67 and col 20 line 45 - col 21 line 10, col 12 lines 63-67	1, 5-11, 13-14, 16-20
X	US 2013/0071678 A1 (SHANNON, T. G.) 21 March 2013 See [0052]-[0056], [0059], [0072], [0111], table 1, samples 9 and 10 in tables 3 and 6	1, 3-13, 15-18

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

*Special categories of cited documents:

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

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Date of the actual completion of the international search

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Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2017/018822**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 2013/0071655 A1 (ZWICK, K. J. ET AL.) 21 March 2013 See table 1 and sample 4 in table 3 and table 6, [0086]-[0093]	1-2, 4-11, 13-20, 22
X	US 2011/0168342 A1 (MOHAMMADI, K. P.) 14 July 2011 See table 1, [0139]-[0152]	1-2, 4-11, 13-20, 22
X	US 2016/0130762 A1 (RAMARATNAM, K. ET AL.) 12 May 2016 See [0084]-[0089]	1-2, 5-11, 13-20
X	US 2007/0011762 A1 (VINSON, K. D. ET AL.) 11 January 2007 See [0131]-[0142]	1-2, 5-11, 13-20
X	US 2006/0288639 A1 (VINSON, K. D. ET AL.) 28 December 2006 See [0118]-[0129]	1-2, 5-11, 13-20
A	CA 2076615 A1 (KIMBERLY-CLARK CORPORATION) 4 October 1993 See pg 3 lines 16-34, pg 15 line 35 – pg 16 line 9	
A	WO 2014/200456 A1 (KIMBERLY-CLARK WORLDWIDE, INC.) 18 December 2014 See sample 2 in tables 3-4, sample 8 in tables 8-10, pg 17 line 17 - pg 18 line 9	
A	US 2011/0297343 A1 (LI, H. ET AL.) 8 December 2011 See [0062] and [0065]	
A	US 6174412 B1 (PATERSON-BROWN, T. ET AL.) 16 January 2001 See col 7 lines 46-60	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2017/018822

Note: This Annex lists known patent family members relating to the patent documents cited in this International Search Report. This Authority is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2014/200455 A1	18/12/2014	EP 3008243 A1	20/04/2016
		KR 20160019470 A	19/02/2016
		US 2015/0144280 A1	28/05/2015
US 8574400 B1	05/11/2013	EP 2855769 A1	08/04/2015
		KR 20150014933 A	09/02/2015
		US 2014/0034255 A1	06/02/2014
		WO 2013/175331 A1	28/11/2013
US 2013/0071678 A1	21/03/2013	CN 103814173 A	21/05/2014
		EP 2758593 A2	30/07/2014
		KR 20140068073 A	05/06/2014
		US 2013/0299107 A1	14/11/2013
		US 2014/0284010 A1	25/09/2014
		US 2016/0069029 A1	10/03/2016
		WO 2013/041986 A2	28/03/2013
US 2013/0071655 A1	21/03/2013	EP 2758597 A2	30/07/2014
		KR 20140068998 A	09/06/2014
		WO 2013/041987 A2	28/03/2013
US 2011/0168342 A1	14/07/2011	US 2011/0308749 A1	22/12/2011
		US 2011/0226430 A1	22/09/2011
		US 2013/0213595 A1	22/08/2013
		US 2013/0220563 A1	29/08/2013
		WO 2011/087975 A1	21/07/2011
US 2016/0130762 A1	12/05/2016	WO 2016/077594 A1	19/05/2016
US 2007/0011762 A1	11/01/2007	US 2010/0319250 A1	23/12/2010
		US 2012/0058890 A1	08/03/2012
		US 2013/0025808 A1	31/01/2013
		US 2013/0299111 A1	14/11/2013
		US 2014/0083637 A1	27/03/2014
		WO 2006/137041 A2	28/12/2006
US 2006/0288639 A1	28/12/2006	WO 2006/137040 A1	28/12/2006
CA 2076615 A1	04/10/1993	US H1672 H	05/08/1997
WO 2014/200456 A1	18/12/2014	EP 3008242 A1	20/04/2016
		KR 20160018586 A	17/02/2016
		US 2016/0138224 A1	19/05/2016
US 2011/0297343 A1	08/12/2011	CN 201250368 Y	03/06/2009
		EP 2374930 A1	12/10/2011
		WO 2010/066195 A1	17/06/2010
US 6174412 B1	16/01/2001	CN 1299426 A	13/06/2001
		EP 1058751 A1	13/12/2000
		JP 2002-506138 A	26/02/2002
		WO 99/45204 A1	10/09/1999



(51) International Patent Classification:

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A47K 10/00 (2006.01)

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,

(54) Title: TISSUE PAPER MATERIAL AND TISSUE PAPER PRODUCT

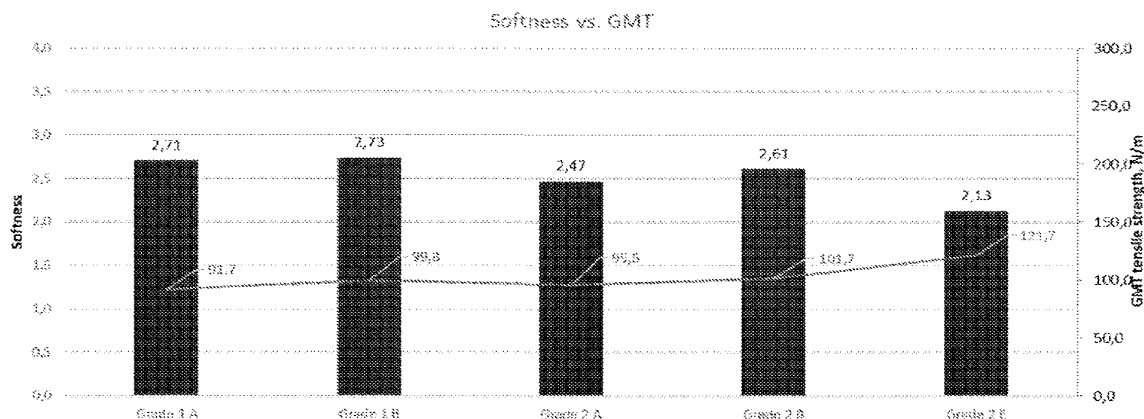


Fig. 1

(57) Abstract: The present disclosure relates to a single-ply tissue paper material having a basis weight less than 40 gsm and a GMT tensile strength of at least 60 N/m, comprising a non-wood tissue ply, comprising non-wood cellulose pulp fibres being present in an amount of at least 10% by dry weight of the of the non-wood tissue ply. The disclosure also relates to a single-ply tissue paper product and to a multi-ply tissue paper product comprising at least one non-wood tissue ply.

[Continued on next page]



MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
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TISSUE PAPER MATERIAL AND TISSUE PAPER PRODUCT

TECHNICAL FIELD

The present disclosure relates to a single-ply tissue paper material, to a single-ply tissue
5 paper product, and to a multi-ply tissue paper product, comprising at least one non-wood
tissue ply comprising non-wood cellulose pulp fibres.

BACKGROUND

Tissue paper materials find extensive use in modern society. Toilet paper, and paper
10 towels such as hand towels or household (kitchen) towels, facial tissues, tissue
handkerchiefs, napkins, and industrial wipes are staple items of commerce. These
products are typically made from papermaking pulp comprising wood fibres, such as
hardwood and softwood fibres.

15 In the following, a “tissue paper product” relates to an absorbent paper product based on
cellulose wadding which is also called tissue paper material or tissue paper base-sheet in
this field of technology.

Tissue paper material is defined as a soft absorbent paper material having a low basis
weight, of for example 8 to 45 g/m², preferably 10 to 35 g/m² per ply. The total basis
20 weight of multi-ply tissue paper products may preferably be up to a maximum of 110 g/m²,
more preferably to a maximum of 80 g/m². Its density is typically below 0.6 g/cm³,
preferably below 0.30 g/cm³ and more preferably in the range of 0.02 g/cm³ and 0.20
g/cm³. The production of tissue paper material is distinguished from conventional paper
production, e.g. printing paper production, by its relatively low basis weight and relatively
25 high tensile energy absorption index (see ISO 12625-4). Conventional paper and tissue
paper also differ in general with regard to the modulus of elasticity that characterises the
stress/strain properties of these generally planar products as a material parameter.

The fibres contained in the tissue paper are mainly cellulosic fibres, such as pulp fibres
from chemical pulp (e.g. Kraft or sulphite), or mechanical pulp (e.g. ground wood, thermo
30 mechanical pulp, chemo-mechanical pulp and/or chemo- thermo-mechanical pulp
/CTMP). Pulps derived from both deciduous (hardwood) and coniferous (softwood) can be
used. Fibres may also come from non-wood plants e.g. cereal, bamboo, jute, or sisal. The

fibres or a portion of the fibres may be recycled fibres, which may belong to any or all of the above categories. The fibres can be treated with additives, e.g. fillers, softeners, such as, but not limited to, quaternary ammonium compounds and binders, conventional dry-strength agents, temporary wet strength agents or wet-strength agents, in order to
5 facilitate the original paper making or to adjust the properties thereof.

Tissue paper products in particular for use as hygiene- or wiping products primarily include all kinds of tissue paper materials including dry-creped tissue paper material, wet-creped tissue paper material, NTT (flat), TAD-paper material (Through Air Drying), tissue paper material based on structured or textured technologies such as ATMOS, NTT
10 (textured), UCTAD, eTAD, QRT, PrimeLineTEX etc. and cellulose or pulp-wadding, or combinations, laminates or mixtures thereof. Typical properties of these hygiene- and wiping products include the ability to absorb tensile stress energy, their drapability, good textile-like flexibility, properties which are frequently referred to as bulk softness, a high surface softness and a high specific volume with a perceptible thickness. A liquid
15 absorbency as high as possible and, depending on the application, a suitable wet and dry strength as well as an appealing visual appearance of the outer product's surfaces are desired. These properties, among others, allow these hygiene and wiping products to be used, for example, as cleaning wipes such as windscreen cleaning wipes, industrial wipes, kitchen paper or the like; as sanitary products such as for example bathroom
20 tissue, handkerchiefs, household towels, towels and the like; as cosmetic wipes such as for example facials and as serviettes or napkins, just to mention some of the products that can be used. Furthermore, the hygiene- and wiping products can be dry, moist, wet, printed or pre-treated in any manner. In addition, the hygiene- and wiping products may be folded, interleaved or individually placed, stacked or rolled, connected or not, in any
25 suitable manner.

The products described above can be used for personal and household use as well as commercial and industrial use. They are adapted to absorb fluids, remove dust, and for other cleaning purposes.

If tissue paper material is to be made out of pulp, the process essentially comprises a
30 forming step that includes a headbox- and a forming wire section, and a drying section, e.g. including through air drying or conventional drying on a Yankee cylinder. The production process can also include a crepe process for tissue paper and, finally, typically a monitoring and winding area.

Tissue paper material can be formed by placing the fibres, in an oriented or random manner, on one or between two endless continuously rotating wires or felts of a paper making machine while simultaneously removing water.

Further dewatering and drying the formed primary fibrous web occur in one or more steps
5 by mechanical and thermal means until a final dry-solid content of usually about 90 to 99% has been reached.

In case of creped tissue paper material making, this stage is followed by the crepe process which influences the properties of the finished tissue paper product in conventional processes. The conventional dry crepe process involves creping on a
10 usually 3.0 to 6.5 m diameter drying cylinder, the so-called Yankee cylinder, by means of a crepe doctor blade with the aforementioned final dry-solids content of the raw tissue paper. Wet creping can be used as well, if lower demands are made of the tissue quality. The creped, finally dry raw tissue paper material, the so-called base tissue, is then available for further processing into the tissue paper product.

15 Instead of the conventional tissue making process described above, the use of a modified technique is possible in which an improvement in specific volume is achieved by a special kind of drying which leads to an improvement in the e.g. caliper, bulk, softness, etc. of the tissue paper material. This process, which exists in a variety of subtypes, is herein generally termed the structured tissue technique. Examples of structured tissue
20 techniques are TAD ATMOS®, NTT(textured), UCTAD, eTAD, QRT, PrimeLineTex etc.

The processing step from the tissue paper material to the finished tissue paper product occurs in processing machines (converting machines) which include operations such as unwinding the tissue paper material (base tissue), calendering of the tissue, laminating, printing or embossing.

25 Several plies may be combined together by a combining operation of a chemical nature (e.g. by adhesive bonding), or of a mechanical nature (e.g. by knurling or so-called edge-embossing), or a combination of both. Examples of such process steps for combining plies together will be described in more detail in the below.

Further, the processing to finished tissue paper product may involve e.g. longitudinal cut,
30 folding, cross cut etc. Moreover, individual tissue paper products may be positioned and brought together to form stacks, which may be individually packaged. Such processing

steps may also include application of substances like scents, lotions, softeners or other chemical additives.

When several plies are combined together using adhesive bonding, a film of adhesive is deposited over some or all of the surface of at least one of the plies, then the adhesive-
5 treated surface is placed in contact with the surface of at least one other ply.

When several plies are combined together using mechanical bonding, the plies may be combined by knurling, by compression, by edge-embossing, union embossing and/or ultrasonic.

Mechanical and adhesive bonding may also be combined to combine several plies
10 together to form a multi-ply product.

Embossing is to change the shape of a sheet from flat to shaped, so that there are areas that are raised and/or recessed from the rest of the surface. It therefore constitutes a deformation of the previously relatively flat sheet, and results in a ply having a particular relief. The thickness of the ply or of the multiple plies is in most cases increased after
15 embossing compared with its initial thickness.

An embossing process is carried out between an embossing roll and an anvil roll. The embossing roll can have protrusions or depressions on its circumferential surface leading to embossed protrusions/depressions in the paper web. Anvil rolls may be softer than the corresponding embossing roll and may consist of rubber, such as natural rubber, or
20 plastic materials, paper or steel. If the anvil roll is made of a softer material like rubber, a contact area/nip can be formed between the embossing roll (e.g. steel roll) and the anvil roll by the deformation of the softer roll.

By embossing, a pattern can be applied to a tissue paper fulfilling a decorative and/or functional purpose.

25 A functional purpose may be to improve the properties of the hygiene paper product, that is, the embossment may improve the product thickness, absorbency, bulk, softness etc.

A functional purpose may also be to provide a joint to another ply in a multi-ply product.

Tissue paper products display a number of physical properties which are of importance for their use for example as toilet paper, hand towels, kitchen towels, facial tissues,
30 handkerchiefs, napkins, wipe or the like. Examples of such properties are their strength, softness, and absorbency (primarily for aqueous systems). These physical properties are

generally tuned for addressing common consumer demand in view of the intended use of the tissue paper product.

For example, tissue paper products need to retain their strength at least for a time period
5 of use e.g. for wiping liquids or moisture.

At the same time, there are requirements regarding tactile properties such as softness as tissue paper products may be intended to come in intimate contact with the body and skin. Accordingly, it is desired that tissue paper products shall exhibit sufficient softness in
10 order to ensure consumer's comfort.

However, some of the desired physical properties of tissue paper products are generally conflicting properties. One example is strength and softness. Often, as strength in a tissue paper product rises, the softness declines.

15

Hence, it is desired to provide a tissue paper product providing a good balance between required properties. For example, it is desired to provide a tissue paper product achieving a satisfactory balance between softness and strength.

20 Further, there is a desire to reduce the consumption of wood fibre to produce tissue paper products. This desire is advocated by e.g. rising costs for wood fibre, concerns involving sustainable forest management, and other environmental reasons such as carbon foot print.

25 To this end, attempts have been made to replace some or all of the wood fibre in tissue paper products with for example recycled fibres and/or with non-wood fibres. However, since the fibre content in the pulp will naturally impact the above-mentioned physical properties of the resulting tissue paper material, the replacement of virgin wood fibres with other fibres in the pulp is not uncomplicated.

30

Thus, there is a need for improvement and/or alternatives for tissue paper products in view of one or more of the above-mentioned desires.

SUMMARY

An object of the present invention is to fulfill said need for improvement and/or alternatives.

- 5 To this end, it is proposed herein to use non-wood cellulose pulp fibres in tissue paper materials and tissue paper products.

The non-wood cellulose pulp fibres may be chemical pulp fibres.

- 10 Optionally, the non-wood cellulose pulp fibres may be never-dried fibres. "Never-dried" means herein that the fibres have not been subject to drying before use in the tissue making process. It is believed that the non-wood cellulose pulp fibres being never-dried may contribute to the non-wood cellulose pulp fibres being suitable for use in tissue paper materials and tissue paper products.

15

Optionally, the non-wood cellulose pulp fibres contain at least 15% hemicellulose. It is believed that such a hemicellulose content may contribute to the non-wood cellulose pulp fibres being suitable for use in tissue paper materials and tissue paper products.

- 20 Optionally, the non-wood cellulose pulp fibres contain no more than 15 % lignin. For example, the non-wood cellulose pulp fibres may contain no more than 12 % lignin. In yet another example, the non-wood cellulose pulp fibres may contain no more than 10% lignin. It is believed that such a lignin content may contribute to the non-wood cellulose pulp fibres being suitable for use in tissue paper materials and tissue paper products.

25

For example, the non-wood cellulose pulp fibres may contain at least 15% hemicellulose and no more than 15 % lignin, such as no more than 12 % lignin or no more than 10% lignin.

- 30 Optionally, the non-wood cellulose pulp fibres are pre-treated, to obtain the desired amounts of lignin and/or hemicellulose.

Further, the non-wood cellulose pulp fibres may have a relatively low average fibre length.

Optionally, the non-wood cellulose pulp fibres have an average fibre length of less than 1700 μm .

Optionally, the non-wood cellulose pulp fibres have an average fibre length of less than
5 1200 μm .

Optionally, the non-wood cellulose pulp fibres have an average fibre length of less than 1000 μm .

10 Optionally, the non-wood cellulose pulp fibres have an average fibre length of less than 900 μm .

Further, it is believed that the non-wood cellulose pulp fibres having a relatively high breaking length, may contribute to the non-wood cellulose pulp fibres being suitable for
15 use in tissue paper materials and tissue paper products. The breaking length is the initial breaking length of the non-wood cellulose pulp fibres as measured on the non-wood cellulose pulp fibres after the pulping process.

Optionally, the non-wood cellulose fibres have a breaking length of more than 3000 m.
20

For example, the non-wood cellulose fibres may have a breaking length of more than 3000 m and an average fibre length of less than 1700 μm , such as less than 1200 μm or less than 900 μm .

25 Also, it is believed that the non-wood cellulose pulp fibres having a relatively high ratio between breaking length, and average fibre length may contribute to the non-wood cellulose pulp fibres being suitable for use in tissue paper materials and tissue paper products.

30 Optionally, the non-wood cellulose fibres have a breaking length/average fibre length of more than 3.7.

Optionally, the non-wood cellulose fibres have a breaking length/average fibre length ratio of more than 4.0.

35

Optionally, the non-wood cellulose fibres have a breaking length/average fibre length ratio of more than 4.5.

For example, the non-wood cellulose fibres may have a breaking length/average fibre length ratio of more than 5, such as more than 5.5.

For example, the non-wood cellulose fibres may have a breaking length/average fibre length ratio of more than 3.7 such as more than 4 and an average fibre length of less than 1700 μm , such as less than 1200 μm , less than 1000 μm , or less than 900 μm .

10

For comparison, it may be mentioned that different types of conventional hardwood and softwood pulps display lower breaking length/average fibre length ratios, than those suggested in the above for the non-wood cellulose fibres. This applies also to examples of never-dried hardwood and softwood pulps. Average ratios as calculated for different types

of hardwood and softwood pulps are indicated in the table in the below.

Type of pulps	Average ratio
BEK	2.4
BHK	2.0
BSK	1.0
BSS	0.6
NBHK	2.3
NBSK	1.2
Never-dried HW	0.9
Never-dried SW	1.0

(BEK – Bleached Eucalyptus Pulp, BHK – Bleached Hardwood Kraft, BSK – Bleached Softwood Kraft, BSS – Bleached Softwood Sulfite, Northern Bleached Hardwood Kraft, Northern Bleached Softwood Kraft. The never-dried Hardwood (HW) and Softwood (SW) are sulfite.)

Also, several types of previously used non-wood cellulose pulp fibres have been found to display lower breaking length/average fibre length ratio than what is proposed in the above. For example, tested samples of dried bagasse fibre pulp was found to have an average ratio of 2.6, dried bamboo fibre pulp an average ratio of 1.2 and dried wheat fibre pulp an average ratio of 3.5.

For example, the non-wood cellulose fibres may be never-dried non-wood cellulose pulp fibres and the non-wood cellulose fibres may have a breaking length/average fibre length ratio of more than 3.7, such as more than 4.0 or more than 4.5.

5

The non-wood cellulose pulp fibres as proposed herein may be used together with hardwood cellulose pulp fibres and/or softwood cellulose pulp fibres.

As mentioned in the above, optionally, a portion of or all non-wood cellulose pulp fibres
10 are never-dried non-wood cellulose pulp fibres.

Optionally, the non-wood cellulose fibres are used with softwood cellulose pulp fibres. In this case, a portion of or all softwood cellulose fibres may be never-dried softwood cellulose pulp fibres.

15

For example, the softwood cellulose pulp fibres may comprise never-dried hardwood cellulose pulp fibres and/or dried softwood cellulose pulp fibres.

Optionally, the non-wood cellulose fibres are used with hardwood cellulose pulp fibres. In
20 this case, a portion of or all hardwood cellulose fibres may be never-dried hardwood cellulose pulp fibres.

For example, the hardwood cellulose pulp fibres may comprise never-dried hardwood cellulose pulp fibres and/or dried hardwood cellulose pulp fibres.

25

Optionally, the non-wood cellulose pulp fibres as proposed herein may be achieved by treatment by a non-pressurised process.

Optionally, the non-wood cellulose pulp fibres as proposed herein may be achieved by
30 treatment by a process with no use of sulfur.

For example, the non-wood cellulose pulp fibres may be achieved by treatment using methods similar to the methods described EP 2 048281 A1, EP 2 247781 B1, US20130129573 A1, EP 2 034 090 A1, US20110281298 A1, and/or US20130129573 A1.

35

Additionally or alternatively, the non-wood cellulose pulp fibres may be achieved by treatment using methods similar to the methods described in WO2020264311 A1, WO2020264322 A1, US20190091643 A1, US2592983.

- 5 For example, the non-wood cellulose pulp fibres may be achieved by the Phoenix Process TM, of Sustainable Fiber Technologies Inc.

It will be understood that the features as discussed in the above as being contributing to the non-wood cellulose pulp fibres being suitable for use in tissue paper materials and
10 tissue paper products may be used separately or in different combinations.

Optionally, the non-wood cellulose pulp fibres are derived from agricultural waste or byproduct.

- 15 Optionally, the non-wood cellulose pulp fibres are derived from a member of the Poaceae family. For example, the non-wood cellulose pulp fibres may be derived from wheat straw, rice straw, barley straw, oat straw, rye grass, coastal Bermuda grass, Arundo donax, miscanthus, bamboo, and/or sorghum. Another example of a member of the Poaceae family is sugar cane, from which non-wood cellulose pulp fibres may be derived, for
20 example from sugar cane bagasse.

Optionally, the non-wood cellulose pulp fibres are derived from a member of the Cannabaceae family. For example, the non-wood cellulose pulp fibres may be derived from hemp and/or hop.

25

- Optionally, the non-wood cellulose pulp fibres are derived from agricultural waste or byproducts. For example, the non-wood cellulose pulp fibres may be derived from agricultural waste or byproducts of the members of the Poaceae family and/or Cannabaceae family such as exemplified in the above, i.e. including agricultural waste or
30 byproducts from wheat straw, rice straw, barley straw, oat straw, rye grass, sugar cane bagasse, hemp or hop. In another example, the non-wood cellulose pulp fibres may be derived from agricultural waste or byproducts such as banana harvest residue (belongs to the family Musaceae), pineapple residue (belongs to the family Bromeliaceae), nut shell waste, bagasse from agave, hop residue and/or corn stover.

35

Optionally, the non-wood cellulose pulp fibres are derived from kenaf (belongs to the family Malvaceae), switchgrass, succulents, alfalfa (belongs to the family Fabaceae.), flax straw (belongs to the family Linaceae), palm fruits (Elaeis or Arecaceae), and/or avocado (Lauraceae).

5

Optionally, the non-wood cellulose pulp fibres are derived from one or more of wheat straw, rice straw, barley straw, oat straw, rye grass, costal Bermuda grass, Arundo donax, miscanthus, bamboo, sorghum, banana harvest residue, pineapple residue, nut shell waste, sugar-cane bagasse, industrial hemp, and/or members of the Cannabaceae family,

10 kenaf, switchgrass, succulents, alfalfa, corn stover, and flax straw.

Optionally, the non-wood cellulose pulp fibres are derived from wheat straw, oat straw, barley straw, and/or rye grass. For example, the non-wood cellulose pulp fibres may be derived from agricultural waste or byproducts of wheat straw, oat straw, barley straw,

15 and/or rye grass.

For example, the non-wood cellulose pulp fibres may be derived from wheat straw, such as from agricultural waste or byproducts of wheat.

20 Optionally, the non-wood cellulose pulp fibres are derived from residues from sugar production. For example, the non-wood cellulose pulp fibres may be residues from beet.

Optionally, the non-wood cellulose pulp fibres are derived from sugarcane bagasse.

25 Optionally, the non-wood cellulose pulp fibres are derived from agave. For example, the non-wood cellulose pulp fibres may be derived from residues from agave syrup production or derived from agave bagasse.

30 Although the present disclosure relates primarily to tissue paper made of non-wood fibres, it is understood that the non-wood cellulose pulp fibres as described herein may also find use in other applications e.g. in wound care, in absorbent articles, for example diapers, sanitary napkins, and incontinence articles, in beauty care, and/or in nonwoven materials and products.

Herein, the non-wood cellulose pulp fibres as described in the above are proposed to be used to form a non-wood tissue ply, comprising non-wood cellulose pulp fibres in an amount of at least 10% by dry weight of the non-wood tissue ply.

- 5 Optionally, said non-wood tissue ply comprises non-wood cellulose pulp fibres in an amount of at least 15% by dry weight of the non-wood tissue ply.

Optionally, said non-wood tissue ply comprises non-wood cellulose pulp fibres in an amount of at least 20% by dry weight of the non-wood tissue ply.

10

Optionally, said non-wood tissue ply comprises non-wood cellulose pulp fibres in an amount of at least 30% by dry weight of the non-wood tissue ply.

Optionally, said non-wood tissue ply comprises non-wood cellulose pulp fibres in an

- 15 amount of at least 40% by dry weight of the non-wood tissue ply.

Optionally, said non-wood tissue ply comprises non-wood cellulose pulp fibres in an amount from 20 to 50% by dry weight of the non-wood tissue ply.

- 20 Optionally, said non-wood tissue ply comprises non-wood cellulose pulp fibres in an amount from 25 to 35% by dry weight of the non-wood tissue ply.

Optionally, said non-wood tissue ply comprises non-wood cellulose pulp fibres in an amount of less than 70 % by dry weight of the non-wood tissue ply.

25

Optionally, said non-wood tissue ply comprises non-wood cellulose pulp fibres in an amount of less than 60 % by dry weight of the non-wood tissue ply.

Optionally, the non-wood tissue ply further comprises wood pulp fibres, such as hardwood

- 30 cellulose pulp fibres and/or softwood cellulose pulp fibres.

Optionally, the non-wood tissue ply further comprises wood pulp fibres in an amount such that the wood pulp fibre amount plus the non-wood fibre amount constitutes 100% dry weight of the tissue paper ply.

35

Optionally, the hardwood/softwood dry weight proportion of the wood pulp fibres in the non-wood tissue ply is less than 95/5.

Optionally, the hardwood/softwood dry weight proportion of the wood pulp fibres in the
5 non-wood tissue ply is less than 90/10.

Optionally, the hardwood/softwood dry weight proportion of the wood pulp fibres in the non-wood tissue ply is less than 80/20.

10 Optionally, said non-wood cellulose pulp fibres are present throughout the non-wood tissue ply. In other words, at least some non-wood cellulose pulp fibres may be found in all parts of the ply, e.g. in all layers of the ply. The non-wood cellulose pulp fibres need not be uniformly distributed, but may be a result of e.g. stratified distribution of the non-wood cellulose pulp fibres. For example, the non-wood cellulose pulp fibres may be
15 homogenously distributed in the ply. In another example, the non-wood cellulose pulp fibres may be heterogeneously distributed in the ply.

Optionally, when said non-wood tissue ply comprises two or more layers, at least one layer of the non-wood tissue ply comprises non-wood fibres. For example, said at least
20 one layer maybe an outer layer of the non-wood tissue ply.

Optionally, when said non-wood tissue ply comprises two or more layers, each out of said two or more layers may comprise non-wood fibres.

25 Optionally, the non-wood tissue ply is produced by conventional wet press technology (CWP). By "is produced" means that the tissue paper material has been manufactured using conventional wet press technology, i.e. the tissue paper material is a CWP tissue paper material. For example, the tissue paper material may be a dry crepe tissue paper material.

30

Optionally, the non-wood tissue ply is produced by structured tissue technology. By "is produced" means that the tissue paper material has been manufactured using structured tissue technology, i.e. the tissue paper material is a structured tissue paper material.

35 Optionally, the non-wood tissue ply is produced by TAD (Through Air Drying) technology.

Optionally, the non-wood tissue ply is produced by ATMOS technology.

Optionally, the non-wood tissue ply is produced by UCTAD technology.

Optionally, the non-wood tissue ply is produced by textured NTT technology.

Optionally, the non-wood tissue ply is produced by eTAD technology, such as Advantage

5 eTAD technology from Valmet.

Optionally, the non-wood tissue ply is produced by QRT technology.

Optionally, the non-wood tissue ply is produced by PrimeLine TEX technology.

In accordance with the invention, there is provided tissue paper materials and tissue
10 paper products including the non-wood tissue ply as described in the above with the non-wood cellulose pulp fibres as described in the above.

Thus, in a first aspect, there is provided a single-ply tissue paper material according to claim 1.

15

Thus, there is provided a single-ply tissue paper material having a basis weight less than 40 gsm and a GMT tensile strength of at least 60 N/m, the tissue paper material comprising a non-wood tissue ply. The non-wood tissue ply comprises non-wood cellulose pulp fibres being present in an amount of at least 10% by dry weight of the tissue paper
20 material.

Optionally, the tissue paper material has a GMT tensile strength of at least 70 N/m.

Optionally, the tissue paper material has a GMT tensile strength of at least 80 N/m.

25

Optionally, the tissue paper material has a basis weight of less than 30 gsm.

Optionally, the tissue paper material has a basis weight of less than 25 gsm.

30 Optionally, the tissue paper material has a basis weight greater than 10 gsm.

Optionally, the tissue paper material has a basis weight in the range from 14 gsm to 25 gsm.

In a second aspect, there is provided a single-ply tissue paper product comprising a single-ply tissue paper material according to the first aspect. This implies that the single-ply tissue paper product may consist of the single-ply tissue paper material.

- 5 In a third aspect, there is provided a multi-ply tissue paper product in accordance with claim 7. Thus there is provided a multi-ply tissue paper product comprising two or more plies, wherein an average basis weight of the plies is less than 40 g/m², and the multi-ply tissue paper product having a GMT tensile strength of at least 100 N/m, wherein at least one ply is a non-wood tissue ply, said non-wood tissue ply comprising non-wood cellulose
10 pulp fibres, said non-cellulose pulp fibres being present in an amount of at least 10% by dry weight of the non-wood tissue ply.

Optionally, the multi-ply tissue paper product has a GMT tensile strength of at least 120 N/m, such as at least 150 N/m.

15

Optionally, the multi-ply tissue paper product according to the second aspect or the single-ply tissue paper product according to the first aspect, has an absorbency of at least 7 g/g.

- 20 Optionally, the multi-ply tissue paper product according to the second aspect or the single-ply tissue paper product according to the first aspect, has an absorbency of at least 8 g/g.

- Optionally, the multi-ply tissue paper product according to the second aspect or the
25 single-ply tissue paper product according to the first aspect, has an absorbency of less than 20 g/g, such as less than 18 g/g.

Optionally, the multi-ply tissue paper product or the single ply tissue paper product has an absorbency of 7 to 20 g/g.

30

Optionally, the multi-ply tissue paper product or the single ply tissue paper product has an absorbency of 8 to 15 g/g.

- Optionally, a majority of the plies of the multi-ply tissue paper material are non-wood
35 tissue plies.

Optionally, all of the plies of the multi-ply tissue paper material are non-wood tissue plies.

Optionally, the multi-ply tissue paper product comprises non-wood cellulose pulp fibres in
5 an amount of at least 10% by dry weight of the multi-ply tissue paper product.

Optionally, the multi-ply tissue paper product comprises non-wood cellulose pulp fibres in
an amount of at least 15% by dry weight of the multi-ply tissue paper product.

10 Optionally, the multi-ply tissue paper product comprises non-wood cellulose pulp fibres in
an amount of at least 20% by dry weight of the multi-ply tissue paper product.

Optionally, the multi-ply tissue paper product comprises non-wood cellulose pulp fibres in
an amount of at least 30% by dry weight of the multi-ply tissue paper product.

15

Optionally, the multi-ply tissue paper product comprises non-wood cellulose pulp fibres in
an amount of at least 40% by dry weight of the multi-ply tissue paper product.

Optionally, the multi-ply tissue paper product comprises non-wood cellulose pulp fibres in
20 an amount of no more than 70% by dry weight of the multi-ply tissue paper product.

Optionally, the multi-ply tissue paper product comprises non-wood cellulose pulp fibres in
an amount of no more than 60% by dry weight of the multi-ply tissue paper product.

25 Optionally, the multi-ply tissue paper product comprises non-wood cellulose pulp fibres in
an amount in a range from 15 % to 50% by dry weight of the multi-ply tissue paper
product.

Optionally, the multi-ply tissue paper product comprises non-wood cellulose pulp fibres in
30 an amount in a range from 15 % to 40% by dry weight of the multi-ply tissue paper
product.

Optionally, the multi-ply tissue paper product comprises non-wood cellulose pulp fibres in
an amount in a range from 25 % to 35% by dry weight of the multi-ply tissue paper
35 product.

Optionally, the multi-ply tissue paper product comprises two to five plies.

Optionally, each of the plies of the multi-ply tissue paper product comprises the same
5 amount of non-wood cellulose pulp fibres.

Optionally, at least two plies in said multi-ply tissue paper product comprise different amounts of non-wood cellulose pulp fibres.

10 Optionally, when at least two plies in said multi-ply tissue paper product comprise different amounts of non-wood cellulose pulp fibres, the amounts differ by at least 5% dry weight.

Optionally, when at least two plies in said multi-ply tissue paper product comprise different amounts of non-wood cellulose pulp fibres, the amounts differ by at least 10% dry weight.

15

Optionally, when at least two plies in said multi-ply tissue paper product comprise different amounts of non-wood cellulose pulp fibres, the amounts differ by at least 20% dry weight.

Optionally, the multi-ply tissue paper product comprises one or more plies with no non-
20 wood cellulose pulp fibres.

Optionally, said at least one non-wood tissue ply is an outer ply of said multi-ply tissue paper product.

25 Optionally, the multi-ply tissue paper product comprises at least two non-wood tissue plies, wherein the non-wood tissue plies form a first and a second outer ply of the multi-ply tissue paper product.

Optionally, for each of the alternatives relating to a multi-ply tissue paper product in the
30 above, the non-wood ply may be such as defined in the above in any one of the options relating to the first aspect.

Optionally, the at least one non-wood tissue ply of the multi-ply tissue paper product comprises a single-ply tissue paper material in accordance with the first aspect as
35 described in the above.

The single-ply tissue paper product and the multi-ply tissue paper product as disclosed herein may for example be a tissue paper product for personal hygiene.

- 5 Optionally, the single-ply tissue paper product and the multi-ply tissue paper product disclosed herein may for example be toilet paper, hand wipes, paper napkins, facial tissue, handkerchiefs, or a kitchen towel or an industrial wipe.

The single-ply tissue paper product and the multi-ply tissue paper product may be
10 embossed and/or calendared as is known in the art.

Optionally, the plies of the multi-ply product may be joined by ply bonding, such as for example embossing or knurling. For example, the multi-ply product may be joined by nesting.

15

Optionally, the plies of the multi-ply product may be joined by Goffra-Incolla technology.

Further advantages and advantageous features of the invention are disclosed in the following description and in the dependent claims.

20

BRIEF DESCRIPTION OF THE DRAWINGS

With reference to the appended drawings, below follows a more detailed description of embodiments of the invention cited as examples.

25

In the drawings:

Fig. 1 is a diagram illustrating softness and GMT tensile strength for a number of base sheet samples including various amounts of non-wood fibre;

- 30 Fig. 2 is a diagram illustrating softness versus GMT tensile strengths for the base sheet samples of Fig. 1 comprising 0% non-wood fibre and 30% non-wood fibre;

Fig. 3 is a diagram illustrating softness and GMT tensile strength for a number of multiply tissue samples including various amounts of non-wood fibre;

Fig. 4 is a diagram illustrating the absorption for the tissue samples of Fig. 3; and

- 35 Fig. 5 is a diagram illustrating the thickness for the tissue samples of Fig. 3.

DETAILED DESCRIPTION

The description in the below relates to examples of tissue paper materials and tissue paper products as obtained using the non-wood cellulose pulp fibres as proposed herein.

5

Single-ply tissue paper materials (base sheets)

Five different tissue paper materials were prepared.

The five different tissue paper materials are base sheets and suitable for forming

10 bathroom tissue.

The samples were prepared using CWP technology to provide a dry creped tissue.

Two different grades of tissue were targeted:

15 Grade 1 (G1): soft bathroom tissue

Grade 2 (G2): standard bathroom tissue

The original fibre recipe for the two grades, without any non-wood fibre content is:

Trial ref	Reference furnish
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Grade G1	50% softwood (never-dried pulp) – 50% hardwood (Eucalyptus – dried pulp)
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Grade G2	70% softwood (never-dried pulp) – 30% hardwood (never-dried pulp)
----------	---

20

The trial aimed at introducing different levels of non-wood fibrous pulp instead of standard wood pulp to assess base paper properties and consequently finished product quality.

The tissue machine is a Crescent former with suction press roll configuration, with a 2

25 layers Headbox: 50% Top Layer, 50% Bottom Layer.

The G1 grade was run in a stratified mode (different recipes on the 2 layers of the base paper), the G2 grade was run in homogenous mode (same recipe on both layers of the base paper), with target specifications as in the below:

30

G1:

Headbox: 2 layers

Blade: 20° ceramic

Basis weight: 16.5 g/m²

5 Thickness (10p): 0.97 mm/10 plies

MD dry tensile/ ply: 140 N/m

CD dry tensile/ply: 50 N/m

MD stretch: 18%

10 **G2:**

Headbox: 1 layer

Blade: 10° ceramic

Basis weight: 16 g/m²

Thickness (10p): 1.15 mm/10 plies

15 MD dry tensile/ ply: 150 N/m

CD dry tensile/ply: 60 N/m

MD stretch: 16%

The amount of non-wood fibres introduced ranged from 0 to 50% of the total blend. The compositions of the various base sheets are indicated in the table in the below:

Grade Trial	Grade Trial	Grade 1		Grade 2			
		G 1A	G1B	G 2A	G2B	G2D	G2E
Overall furnish	hardwood (dried pulp)	50%	50%				
	softwood (never-dried pulp)	50%	30%	70%	50%	40%	30%
	hardwood (never-dried pulp)			30%	30%	30%	20%
	non-wood fibre (never-dried pulp)	0%	20%	0%	20%	30%	50%

25 The non-wood cellulose fibre pulp was derived from wheat straw, being treated according to the Phoenix TM process by Sustainable Fiber Solutions Inc. The non-wood fibre pulp was never-dried pulp. The non-wood fibre pulp had a lignin content of 12.8% and a hemicellulose content of 18.0%.

The conventional short fibre content was made out of Hardwood dried pulp being a Eucalyptus dried pulp, and Hardwood never-dried pulp being a hardwood never-dried sulfite pulp.

- 5 The conventional long fibre content was made out of Softwood. In this example, the Softwood fibre pulp was also never-dried sulfite pulp. The breaking length, average fibre length, and ratio breaking length/average fibre length of the hardwood never-dried pulp, softwood never-dried pulp and hardwood dried pulp (eucalyptus) were as indicated in the table below:

10

	Non-wood	Hardwood (dried)	Softwood (never-dried)	Hardwood (never-dried)
Breaking length (m)	3775	1724	1755	882
Average fibre length (μm)	748	714	2165	929
Ratio breaking length/fibre length (- /micro)	5.05	2.41	0.81	0.95

The non-wood cellulose pulp fibres substituted mostly conventional long fibre both for its intrinsic strength properties and the tensile developed after refining. Despite this,

- 15 additional strength generated needed a decrease on the long fibre refining line.

Grade	Grade	Grade 1			Grade 2		
Trial	Trial	G 1A	G1B	G 2A	G2B	G2D	G2E
Long fibre line	softwood (never-dried pulp)	100%	100%	100%	100%	80%	60%
	non-wood fibre					20%	40%
	Refining kwh/T	60	50	70	32	32	37
Short fibre line	hardwood (dried pulp)	100%	70%				

22

	hardwood (never-dried pulp)			100%	60%	60%	40%
	non-wood fibre		30%		40%	40%	60%
	Refining		none	none	15	18	48
Headbox	Configuration	Stratified	Stratified	Homogenous	Homogenous	Homogenous	Homogenous
	Yankee layer	100% SF	100% SF	30% SF + 70% LF	50% SF + 50% LF	50% SF + 50% LF	50% SF + 50% LF
	Hood layer	100% LF	40% SF + 60% LF	30% SF + 70% LF	50% SF + 50% LF	50% SF + 50% LF	50% SF + 50% LF

The content of non-wood fibres, conventional long fibres, and conventional short fibres in each of the tissue paper materials is indicated in the table in the below:

5

Grade	Trial reference	Non wood fibre content	Long fibre content %	Short fibre content %	Long fibre line refining kwh/T	Short fibre line refining kwh/T
Grade 1 (soft grade)	G1-A	0%	50%	50%	60	0
	G1-B	20%	30%	50%	50	0
Grade 2 (standard grade)	G2-A	0%	70%	30%	70	0
	G2-B	20%	50%	30%	32	15
	G2-D	30%	40%	30%	32	18
	G2-E	50%	30%	20%	37	48

Dry tensile strength in CD and MD directions and panel softness, were measured for the various samples, with the results as indicated in the table in the below and in Figs. 1 and

10 2.

	Basis weight g/m ²	MD dry tensile N/m - 1 ply	CD dry tensile N/m - 1 ply	GMT dry tensile N/m - 1 ply	MD stretch %	Panel
G1 - A	16.8	145	51	86	20.1	2.7
G1 - B	17.2	151	56	92	18.6	2.7
G2 - A	16.1	130	54	83	19.2	2.5
G2 - B	16.2	156	64	100	18.2	2.6
G2 - E	16.5	192	81	125	18.8	2.1

Fig. 1 is a combined bar chart and linear chart, where the bars represent the softness values and the line indicates the GMT tensile strength of the tissue paper materials G1-A, G1-B, G2-A, G2-B, and G2-E of Table 1.

5

The samples of the different Grades denoted A, are all samples with no non-wood fibre content, whereas the samples of the different Grades denoted with other letters comprise increasing amounts of non-wood fibre content (in alphabetical order).

10 No general trend for the relationship between the GMT strength and the softness in view of the non-wood cellulose fibre content may be seen which is valid for all of the different Grades. For the grade G1 being the softer grade, the softness values with or without non-wood fibres are similar. For the grade G2 being the standard grade, the softness values deviate more, but the GMT strength is increasing with increasing non-wood content.

15

Surprisingly the GMT strength is seen to increase with increasing content of non-wood fibre in the two different grades. Turning to Fig. 2, the basesheet softness and strength are again visualized, this time for samples including 0% non-wood versus samples including 30% non-wood. The samples with 30% non-wood display advantageous

20 softness and GMT tensile strength.

Further, another surprising result is that all of the Grades display a GMT strength and a softness which is within limits rendering them useful for tissue paper products.

25

Multi-ply products

Three different types of multi-ply products, MP1, MP2 and MP3 were prepared. For each type of multi-ply product, samples were made with different overall non-wood fibre content, using the base sheets of different grades and non-wood fibre content as

30 described in the above.

The plies of the multi-ply products were assembled by means of Goffra-Incolla technology. All converting parameters were the same for the different non-wood content of each of the products MP1, MP2, MP3.

35

MP1:

4-ply product

	Embossing top ply	Basesheet Top ply	Basesheet Middle ply	Basesheet Middle ply 2	Basesheet Bottom ply
MP1 0%	Feather (RT 20D)	Grade 1 A	Grade 2 A	Grade 2 A	Grade 1 A
MP1 32%	Feather (RT 20D)	Grade 1 B	Grade 2 E	Grade 2 E	Grade 1 B

5

MP2:

4-ply product

	Embossing top ply	Basesheet Top ply	Basesheet Middle ply	Basesheet Middle ply 2	Basesheet Bottom ply
MP2 0%	Ornament (RT71D)	Grade 1 A	Grade 2 A	Grade 2 A	Grade 1 A
MP2 20%	Ornament (RT71D)	Grade 1 B	Grade 2 B	Grade 2 B	Grade 1 B
MP2 30%	Ornament (RT71D)	Grade 1 B	Grade 2 E	Grade 2 E	Grade 1 B

10 **MP3:**

3-ply product

	Embossing top ply	Basesheet Top ply	Basesheet Middle ply	Basesheet Middle ply 2	Basesheet Bottom ply
MP3 0%	Seven (RT305)	Grade 1 A	Grade 2 A	-	Grade 1 A
MP3 20%	Seven (RT305)	Grade 1 B	Grade 2 B	-	Grade 1 B
MP3 30%	Seven (RT305)	Grade 1 B	Grade 2 E	-	Grade 1 B

The resulting multi-ply tissues were tested for various parameters, and the results are displayed in the below table.

	Number of plies	Non-wood dry weight (average) %	Firmness	Basis weight (g/m ²)	Thickness (1 sheet) mm	GMT N/m	Softness Panel	Absorption g/g	5
MP1 0%	4	0	61	63,8	0,58	267	1,7	9,0	
MP1 32%	4	32	60	64,8	0,57	335	1,7	8,6	10
MP2 0%	4	0	59	63,0	0,53	255	1,7	9,3	
MP2 20%	4	20	55	65,8	0,55	309	1,6	8,8	
MP2 30%	4	30	54	65,9	0,55	329	1,5	9,0	
MP3 0%	3	0	54	46,3	0,43	167	1,6	9,6	15
MP3 20%	3	20	47	48,2	0,44	200	1,6	9,0	
MP3 30%	3	30	48	48,2	0,44	206	1,6	9,3	

The results will be further discussed in the below with reference to Figs. 3 to 6.

- 20 Fig. 3 is a combined bar chart and linear chart, where the bars represent the softness values of the samples and the line indicates the GMT tensile strength.

In Fig. 3, as well as in the following Figs 4 to 6, for each type of multiply tissue paper material MP1, MP2, MP3, the samples are presented from left to right and with the
 25 sample having 0 percentage non-wood content to the left, and in increasing order of non-wood content towards the right in the figures.

As demonstrated by Fig. 3, the softness values for each type of multiply tissue paper material MP1, MP2, and MP3 is relatively constant or decreases only insignificantly with
 30 increasing amount of non-wood content. (A significant difference in the softness values (panel softness) would be about 0.2 points.) Thus, the results indicate that the softness is

not significantly affected in the samples comprising various amounts of non-wood as compared to the samples comprising no non-wood.

Further, for each of the types MP1, MP2, and MP3, the GMT tensile strength increases
5 with increasing amount of non-wood content. The increase in GMT tensile strength is significant, which was surprising. Thus, the results indicate that the GMT tensile strength is significantly increased in the samples comprising various amounts of non-wood as compared to the samples comprising no non-wood.

10 Thus, the results indicate that the balance between the softness and GMT strength in the samples comprising various amounts of non-wood, is better than for the samples with no non-wood content, i.e. increased GMT strength is achieved at about the same softness.

A satisfactory result for a tissue paper product comprising non-wood would be a balance
15 being about the same as for a tissue paper product with no non-wood content. Based on the tests performed, it may therefore be assumed that the non-wood cellulose pulp fibres used herein are useful for replacing wood fibres in numerous different multi-ply and single ply tissue paper products while achieving at least satisfactory results in terms of softness and strength.

20

Turning to absorption, Fig. 4 is a bar chart illustrating the absorption g/g of the different samples of the three types of tissue paper material MP1, MP2, and MP3. As seen in the results, for each of the types MP1, MP2, and MP3, the highest value for absorption is obtained for the sample with no non-wood content. However, no general trend regarding
25 the impact of increasing non-wood amount on the absorption values may be seen.

Further, the variations in the measured absorption values are mainly insignificant, as a significant difference for absorption is about 0,5 g/g.

Thus, the results indicate that the absorption is not significantly affected in the samples
30 comprising various amounts of non-wood, and instead the absorption is as good in the samples with various amounts of non-wood content as in the sample comprising no non-wood.

Turning to thickness, Fig. 5 is a bar chart illustrating the thickness (mm) of the different
35 samples of the three types of tissue paper material MP1, MP2, and MP3. The results

indicate that the thickness is not significantly affected in the samples comprising various amounts of non-wood as compared to the samples comprising no non-wood.

Thus, in summary, the results indicate that introduction of various amounts of the non-wood cellulose fibres into different tissue paper materials results in acceptable or insignificant changes in parameters relevant for the function of the tissue paper material, such as the GMT strength, the softness, the absorption and/or the thickness, as compared to the same tissue paper material without non-wood fibre content.

The advantageous results are believed to be at least partially due to the use of the non-wood fibres, and in particular the various features which may be contributing to the advantageous properties of tissue paper materials and products including the non-wood fibres as set out in the above.

For example, as in the samples in the above, the non-wood cellulose pulp fibre may have a breaking length/average fibre length ratio greater than 4. Also, the non-wood pulp fibres may be never-dried. Further, the non-wood cellulose pulp fibres may be derived from agricultural waste or byproducts such as one out of wheat straw, oat straw, barley straw, and/or rye grass, for example wheat.

20

However, other combinations of features as described in the above for the non-wood cellulose fibres may be made by a person skilled in the art to provide the tissue materials and tissue products as proposed herein.

Hence, the results, although relating to specific examples of tissue paper materials and tissue paper products are believed to indicate that the non-wood fibres as such may be used to provide advantageous results in for a wider range of tissue paper materials and tissue paper products.

30 DEFINITIONS

Tissue paper material: The term “tissue paper material” as used herein refers to the one-ply base tissue as obtained from a tissue machine.

Layer: The tissue paper material may comprise one or more layers, i.e. it may be a single-layered or a multi-layered web. The term “layer” refers to a stratum within the web having a defined fibre composition. The one or more layers is/are formed by depositing one or more streams of pulp furnishes onto a wire with a pressurized single-or multi-layered

5 headbox.

Ply: The term “ply” as used herein refers to the one or more plies of tissue paper material in the final tissue paper product as are obtained after processes, i.e. converting, one or more base tissue webs. Each individual ply consists of a tissue paper material comprising

10 one or more layers, e.g. one, two, or three layers.

Hardwood:_ As hardwood we understand herein fibrous pulp derived from the woody substance of deciduous trees (angiosperms). For example, hardwood includes eucalyptus. Typically, hardwood fibres are relatively short fibres. For example, the

15 hardwood fibres may have an average fibre length less than 1700 μm . The hardwood fibres may for example have a diameter of 15 to 40 μm and a wall thickness of 3 to 5 μm .

Softwood:_as softwood we understand fibrous pulp derived from the woody substance of coniferous trees (Gymnosperms). Typically, softwood fibres are relatively long fibres. For example, the softwood fibres may have an average fibre length above 1700 μm , such as above 1950 micron, for example the soft wood fibres may have an average fibre length in a range from 1700 to 2500. μm . The softwood fibres may for example have a diameter of from 30 to 80 μm , and a wall thickness of from 2 to 8 μm .

25 Conventional short fibres:_As conventional short fibres we understand herein hardwood fibres as described in the above. Generally, the conventional short fibres may have an average fibre length less than 1700 μm .

Conventional long fibres:_As conventional long fibres we understand herein softwood fibres as described in the above. Generally, the conventional long fibres may have an average fibre length greater than 1700 μm .

CWP & structured tissue technology:

As described in the above, paper tissue webs can be produced in several ways. Conventional paper machines have been used for many years for that purpose, to produce such conventional webs at a relatively low cost.

An example of a conventional paper tissue web process is the dry crepe process which involves creping on a drying cylinder, the so-called yankee cylinder, by means of a crepe doctor. Wet creping can be used as well, if there are lower demands on the tissue quality. The creped, finally dry raw tissue paper, the so-called base tissue, is then available for further processing into the paper product for a tissue paper product.

Recently, more advanced methods have been developed, such as e.g. Through Air Drying (TAD), Advanced Tissue Molding System (ATMOS) and similar methods for producing structured tissue webs. A common feature for these latter methods is that they result in a more structured web with a lower density than a web produced on a conventional paper machine.

As used herein the term CWP technology (Conventional Wet Pressed technology) refers to conventional paper web processes, in which the tissue is formed on a forming fabric and dewatered by pressing with one or more pressure roll nips. The process may involve transfer of the sheet to a Yankee dryer and removing the sheet from the Yankee surface by a doctor blade in a creping process. CWP technology as used herein includes for example dry crepe technology, wet crepe technology, and flat NTT (New Tissue Technology).

As used herein, the term structured tissue technology relates to the newer technologies for producing a structured tissue web. Such methods will not employ the high pressure used to dewater the web in the CWP process. Therefore, structured tissue technology is sometimes referred to as non-compressing de-watering technology. The structured tissue technology may for example be TAD (Thru-Air-Dried), UCTAD (Uncreped-Through-Air-Dried) or ATMOS (Advanced-Tissue- Molding-System), textured NTT, QRT, PrimeLineTEX technology and eTAD technology.

The structured tissue technology methods are known from prior art, for example TAD is known from US5853547; and ATMOS from US 7744726, US7550061 and US7527709; and UCTAD from EP 1 156925 and WO 02/40774.

TAD technology has been developed since the 1960's and is well known to a person skilled in the art. It generally involves developing functional properties of the tissue by moulding the fibre mat on a structured fabric. This results in the fibre mat forming a structured tissue which may acquire high bulk and absorption due to air passing through the web while drying the web when still on the structured fabric.

ATMOS technology is a production method developed by Voith and which is also well known to a person skilled in the art.

Another example is textured NTT (New Tissue Technology). Textured NTT was designed to overcome some of the limitations of ATMOS by pressing at even higher pressures before transferring to the Yankee. A shoe press is used in the first pressing section between the former felt and a belt with cells designed to provide absorptive capacity and increase strength. The NTT technology may reduce the Yankee Hood drying load as compared to ATMOS.

Yet other examples are Prime Line Tex technology as rendered available by Andritz for production of textured tissue, and eTAD technology as rendered available by Valmet.

METHODS

Lignin content:

The measurement of residual lignin content in the pulp fibres has been carried out according to the draft standard ISO/DIS 21436: Pulps-Determination of lignin content – Method of acid hydrolysis 1), which includes:

- i) the gravimetric measurement of the residue after acid hydrolysis (AIL : Acid Insoluble Lignin or Klason Lignin), also described in the Tappi T222 om-02 method 2 ; and
- ii) the measurement of soluble lignin (ASL : Acid Soluble Lignin), also described in the technical note Tappi UM2503 .

3.1) Sample preparation: The samples were disintegrated with a grinder/mixer. Their dry matter contents were determined before analysis, by drying in an oven of an aliquot of 2-3 g at 105°C, according to the ISO 638 standard 4 .

3.2) Measurement of acid insoluble lignin (AIL or Klason lignin) after acid hydrolysis An aliquot of ~1 g was hydrolysed with a solution of sulfuric acid, firstly at ambient temperature (2 h) and then under reflux during 4 h (Procedure B of the future standard).

- 5 After cooling, the suspension was filtered and washed and the solid residue was collected, dried and weighted. The acid insoluble lignin content in the sample was determined by difference between the dry hydrolysis residue weight and the ash weight, reported to the dry mass content of the initial sample. Note 1 : Detection limit (DL) ~0.1% ; Quantification limit (QL) ~0.5%.

10

3.3) Measurement of acid soluble lignin. The absorbance at 205 nm of the hydrolysate (i.e. the filtrate collected during the filtration of the suspension, cf 3.2), were measured. The acid soluble lignin content (ASL) was determined according to the predefined extinction coefficient of the lignin (i.e. 110 L/g.cm). Note 2 : : Detection limit (DL) ~0.1% ; Quantification Limit (QL) ~0.5% Remark: This quantification method is sensitive to the contaminants being present into the sample. Each compound other than hemicelluloses and cellulose and the acid insoluble minerals are susceptible to interfere with the measurement of the hydrolysis residue and with the acid soluble lignin.

20 Hemicellulose

The determination of the contents of the main polysaccharides in the pulp (arabinane, galactane, glucane, xylene, and mannane) has been made by using high performance anion exchange chromatography with a pulsed amperometric detector, HPAE/PAD-Dionex® analysis of free monosaccharides (arabinose, galactose, glucose, xylose and mannose) after sulphuric acid hydrolysis of the sample pulp. The cellulose and the hemicellulose content in the pulp sample is determined according to standard method ISO / DIS21437 – Pulps: Determination of carbohydrate (under publication) after calibration. The samples studied are chemical pulp which has not required extraction of acetone beforehand. In contrast, the samples have been dried. However, considering the pulp state (wet lap sheets), samples were grinded before analysis. Dry content of the grinded samples was measured according to NF EN ISO 638:2008.

30

Basically the method is quantifying the amounts of sugars (monosaccharides) after hydrolysis of cellulose and hemicellulose using the ISO / DIS 21437 – Pulps: Determination of

carbohydrate. Then, calculation is made backwards to estimate level of hemicelluloses (knowing proportion of sugars in hemi and cellulose)

Basis weight

- 5 Basis weight is determined in accordance with ISO 12625-6: 2016.

The basis weight is determined in g/m^2 .

Thickness per sheet:

Thickness is determined in accordance with ISO 12625-3.

GMT strength:

- 10 GMT strength (Geometric Mean Tensile strength) refers to the square root of the product of the machine direction dry tensile strength and the cross-direction dry tensile strength of a tissue web/product.

The GMT strength is determined in accordance with ISO 12625-4.

A load cell of 100N was used.

- 15 Absorption:

Absorption is herein the water absorption capacity of the tissue paper. Water absorption capacity is the amount of water the sample is able to absorb, reported in g/g (i.e. g water / g material in sample).

Absorption was measured according to ISO12625-8:2011.

- 20 The water is deionized water, conductivity $\leq 0.25 \text{ mS/m}$ at 25°C , in accordance with ISO14487.

Softness panel:

Panel softness is determined by evaluation made by panel members. The panelists rank products in terms of softness. The Softness Panel values are therefore comparative

- 25 values enabling a comparison between the samples tested, rather than an absolute parameter.

The softer the product/tissue base sheet is rated the higher the value will be.

Softness values of tissue paper products (finished goods) and tissue base sheets are not directly comparable as there are different scales/reference products.

Each sample is composed of one product, i.e. a multi-ply tissue paper product.

The dimensions of the samples are therefore the dimensions of the finished products.

- 5 Samples are placed in MD before the panelists.

Samples are conditioned for minimum 2 hours in a controlled area at 23°C and 50% relative humidity.

The different samples are comfort rated by ten panelists, and an average comfort rating for each product is determined over the panelists.

- 10 Hence, softness panel values are comparative values within a test and indicate the perceived softness of a product.

For the purpose of this application, softness panel values given in one and the same table are comparable and indicate the perceived relative softness of the products tested. The higher the value of the rating, the more comfortable is the product.

15

Average fibre length measurement:

Fibre length measurement was made using the standard for fibre analyser: ISO 16065-2:2014: Pulps – Determination of fibre length by automated optical analysis – Part 1: Unpolarized light method.

20

Length-weighted mean length was used and the average of the length – weighted fibre-length distribution.

Breaking length measurement

- 25 The breaking length is the calculated upper limit of length of a uniform paper strip that would support its own weight if it were suspended at one end. Breaking length (m) = $102 \times T/R$, where T = Tensile strength, N/m, and R = basis weight, g/m².

The breaking length is a pulp characteristic obtained by tensile strength and basis weight

- 30 measurements as measured on lab handsheets produced in accordance with EN ISO 5269-2. (Tensile strength: ISO 12625-4; basis weight: ISO 12625-6: 2016)

Ratio of breaking length measurement/average fibre length measurement

The ratio of breaking length/average fibre length is herein using the values of the fibre
5 length measurement and the breaking length measurements as achieved according to the
methods in the above, the average fibre length measurement being reported in μm , and
the breaking length being reported in m.

It may be noted that the breaking length, as well as the average fibre length, are pulp
10 characteristics. Accordingly, the measurements of these properties are to be performed
on the pulp as received from the pulping process, before reaching the papermaking
process, such as before entering the stock preparation in a paper machine. Thus, the
measurements are done prior to any mechanical and/or chemical and/or enzymatic
treatment for strength adjustment which may occur during the paper making process.

15

CLAIMS

1. A single-ply tissue paper material having a basis weight less than 40 gsm and a GMT tensile strength of at least 60 N/m, comprising a non-wood tissue ply, said non-wood tissue ply comprising non-wood cellulose pulp fibres in an amount of at least 10% by dry weight of the of the non-wood tissue ply.
2. A single-ply tissue paper material according claim 1, wherein the tissue paper material has a GMT tensile strength of at least 70 N/m.
3. A single-ply tissue paper material according claim 1 or 2, wherein the tissue paper material has a GMT tensile strength of at least 80 N/m.
4. A single-ply tissue paper material according to any one of the preceding claims, having a basis weight of less than 30 gsm.
5. A single-ply tissue paper material according to any one of the preceding claims, having a basis weight of less than 25 gsm.
6. A single-ply tissue paper product consisting of a single-ply tissue paper material according to any one of the claims 1 to 5.
7. A multi-ply tissue paper product comprising two or more plies, wherein an average basis weight of the plies is less than 40 gsm, and the multi-ply tissue paper product having a GMT tensile strength of at least 100 N/m, wherein at least one ply is a non-wood tissue ply, said non-wood tissue ply comprising non-wood cellulose pulp fibres in an amount of at least 10% by dry weight of the of the non-wood tissue ply.
8. A multi-ply tissue paper product according to claim 7, wherein the multi-ply tissue paper product has a GMT tensile strength of at least 120 N/m.

9. A multi-ply tissue paper product according to claim 7 or 8, wherein the multi-ply tissue paper product has a GMT tensile strength of at least 150 N/m.
10. A multi-ply tissue paper product according to any one of the claims 7 to 9,
5 wherein at least 50 % of the plies in said multi-ply tissue paper products are non-wood tissue plies, each non-wood tissue ply comprising non-wood cellulose pulp fibres in an amount of at least 10% by dry weight of the of the non-wood tissue ply.
11. A multi-ply tissue paper product according to any one of the claims 7 to 10,
10 wherein all of the plies in said multi-ply tissue paper products are non-wood tissue plies, each non-wood tissue ply comprising non-wood cellulose pulp fibres in an amount of at least 10% by dry weight of the of the non-wood tissue ply.
12. A multi-ply tissue paper product according to any one of the claims 7 to 11, the
15 multi-ply tissue paper product comprising non-wood cellulose pulp fibres in an amount of at least 10% by dry weight of the multi-ply tissue paper product.
13. A multi-ply tissue paper product according to any one of the claims 7 to 12, the
20 multi-ply tissue paper product comprising non-wood cellulose pulp fibres in an amount of at least 15% by dry weight of the multi-ply tissue paper product.
14. A multi-ply tissue paper product according to any one of the claims 7 to 13, the
25 multi-ply tissue paper product comprising non-wood cellulose pulp fibres in an amount of at least 20% by dry weight of the multi-ply tissue paper product.
15. A multi-ply tissue paper product according to any one of the claims 7 to 14,
30 wherein said multi-ply tissue paper material or product comprises two to five plies.
16. A multi-ply tissue paper product according to any one of the claims 7 to 15,
35 wherein each ply of the multi-ply product comprises the same amount of non-wood cellulose pulp fibres.

17. A multi-ply tissue paper product according to any one of the claims 7 to 15,
wherein at least two plies comprise different amounts of non-wood cellulose pulp
fibres.
- 5 18. A multi-ply tissue paper product according to any one of the claims 7 to 17,
wherein said at least one non-wood tissue ply is an outer ply of said multi-ply
tissue paper material.
- 10 19. A multi-ply tissue paper product according to claim 18, wherein the multi-ply
tissue paper material comprises at least two non-wood tissue plies, the non-
wood tissue plies forming a first and a second outer ply of the multi-ply tissue
paper product.
- 15 20. A multi-ply tissue paper product according to any one of the claims 7 to 19,
wherein said non-wood tissue ply is formed by a single-ply tissue paper material
in accordance with any one of claims 1 to 5.
- 20 21. A single-ply tissue paper product or a multi-ply tissue paper product according to
any one of the claims 6 to 20, wherein the tissue paper product has an
absorbency of at least 7 g/g.
- 25 22. A single-ply tissue paper product or a multi-ply tissue paper product according
to any one of the claims 6 to 21, wherein the tissue paper product has an
absorbency of at least 8 g/g.
- 30 23. A single-ply tissue paper material, a single-ply tissue paper product or a multi-
ply tissue paper product according to any one of the preceding claims, wherein
the non-wood cellulose pulp fibres contains at least 15% hemicellulose.
- 35 24. A single-ply tissue paper material, a single-ply tissue paper product or a multi-
ply tissue paper product according to any one of the preceding claims, wherein
the non-wood cellulose pulp fibres contains no more than 15 % lignin.
25. A single-ply tissue paper material, a single-ply tissue paper product or a multi-
ply tissue paper product according to any one of the preceding claims, wherein

the non-wood cellulose pulp fibres have an average fibre length of less than 1700 μm .

5 26. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to any one of the preceding claims, wherein the non-wood cellulose pulp fibres have an average fibre length of less than 1200 μm .

10 27. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to any one of the preceding claims, wherein the non-wood cellulose pulp fibres have an average fibre length of less than 900 μm .

15 28. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to any one of the preceding claims, wherein the non-wood cellulose fibres have a breaking length of more than 3000 m.

20 29. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to any one of the preceding claims, wherein the non-wood cellulose fibres have a breaking length/average fibre length ratio of more than 3.7.

25 30. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to any one of the preceding claims, wherein the non-wood cellulose fibres have a breaking length/average fibre length ratio of more than 4.0.

30 31. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to any one of the preceding claims, wherein the non-wood cellulose fibres have a breaking length/average fibre length ratio of more than 4.5.

35 32. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to any one of the preceding claims, wherein the non-wood cellulose pulp fibres are derived from a member of the Poaceae family, such as from wheat straw, rice straw, barley straw, oat straw, rye grass,

costal Bermuda grass, Arundo donax, miscanthus, bamboo, sugar cane bagasse and/or sorghum.

5 33. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to any one of the preceding claims, wherein the non-wood cellulose pulp fibres are derived from a member of the Cannabaceae family, such as from hemp and/or hop.

10 34. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to any one of the preceding claims, wherein the non-wood cellulose pulp fibres are agricultural waste or byproduct, such as derived from agricultural waste or byproduct of the Poaceae family and/or Cannabaceae family such as exemplified in the above, including agricultural waste or byproduct from wheat straw, rice straw, barley straw, oat straw, rye
15 grass, sugar cane bagasse, hemp or hop and/or wherein the non-wood cellulose pulp fibres are derived from agricultural waste or byproduct such as banana harvest residue (belongs to the family Musaceae), pineapple residue (belongs to the family Bromeliaceae), nut shell waste, bagasse from agave, hop residue and/or corn stover.

20 35. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to any one of the preceding claims, wherein the non-wood cellulose pulp fibres are derived from kenaf (belongs to the family Malvaceae), switchgrass, succulents, alfalfa (belongs to the family Fabaceae.), flax straw (belongs to the family Linaceae), palm fruits (Elaeis or
25 Arecaceae), and/or avocado (Lauraceae).

30 36. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to any one of the preceding claims, wherein said non-wood tissue ply or plies comprises said non-wood cellulose pulp fibres in an amount of at least 15%.

35 37. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to any one of the preceding claims, wherein said non-wood tissue ply or plies comprises said non-wood cellulose pulp fibres in an amount of at least 20% by dry weight.

38. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to any one of the preceding claims, wherein said non-wood tissue ply or plies comprises said non-wood cellulose pulp fibres in an amount of less than 70 % by dry weight.

39. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to any one of the preceding claims, wherein said non-wood tissue ply or plies comprises said non-wood cellulose pulp fibres in an amount of less than 60 % by dry weight.

40. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to any one of the preceding claims, wherein said non-wood tissue ply further comprises wood pulp fibres, such as hardwood cellulose pulp fibres and/or softwood cellulose pulp fibres.

41. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to claim 40, wherein said non-wood tissue ply comprises wood pulp fibres in an amount such that the wood pulp fibre amount plus the non-wood fibre amount constitutes 100% dry weight of the non-wood tissue ply.

42. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to claim 40 or 41, wherein the hardwood/softwood dry weight proportion of the wood pulp fibres in said non-wood tissue ply is less than 95/5.

43. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to any one of the claims 40 to 42, wherein the hardwood/softwood dry weight proportion of the wood pulp fibres in said non-wood tissue ply is less than 90/10.

44. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to any one of the claims 40 to 43, wherein the hardwood/softwood dry weight proportion of the wood pulp fibres in said non-wood tissue ply is less than 80/20.

- 5 45. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to any one of the preceding claims, wherein said non-wood cellulose pulp fibres are present throughout the non-wood tissue ply or plies.
- 10 46. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to any one of the preceding claims, wherein said non-wood tissue ply or plies comprises two or more layers, and at least one layer comprises non-wood fibres.
- 15 47. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to any one of the preceding claims, said non-wood tissue ply or plies being produced by conventional wet press technology (CWP).
- 20 48. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to any one of the preceding claims, said non-wood tissue ply or plies being produced by structured tissue technology, for example TAD (Through Air Drying), ATMOS, NTT(textured), UCTAD, QRT, eTAD or PrimeLineTEX.
- 25 49. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to any one of the preceding claims, wherein a portion of or all non-wood cellulose pulp fibres are never-dried non-wood cellulose pulp fibre.
- 30 50. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to any one of the preceding claims, comprising softwood cellulose pulp fibres and wherein a portion of or all softwood cellulose fibres are never-dried softwood cellulose pulp fibre.
- 35 51. A single-ply tissue paper material, a single-ply tissue paper product or a multi-ply tissue paper product according to any one of the preceding claims, comprising hardwood cellulose pulp fibres and wherein a portion of or all hardwood cellulose fibres are never-dried hardwood cellulose pulp fibre.

52. Single-ply tissue paper product or multi-ply tissue paper product according to any one of the claims 6 to 51, the tissue paper product being for personal hygiene, such as toilet paper, hand wipes, paper napkins, facial wipes,
5 handkerchiefs or the tissue paper product being a kitchen towel or industrial wipe.

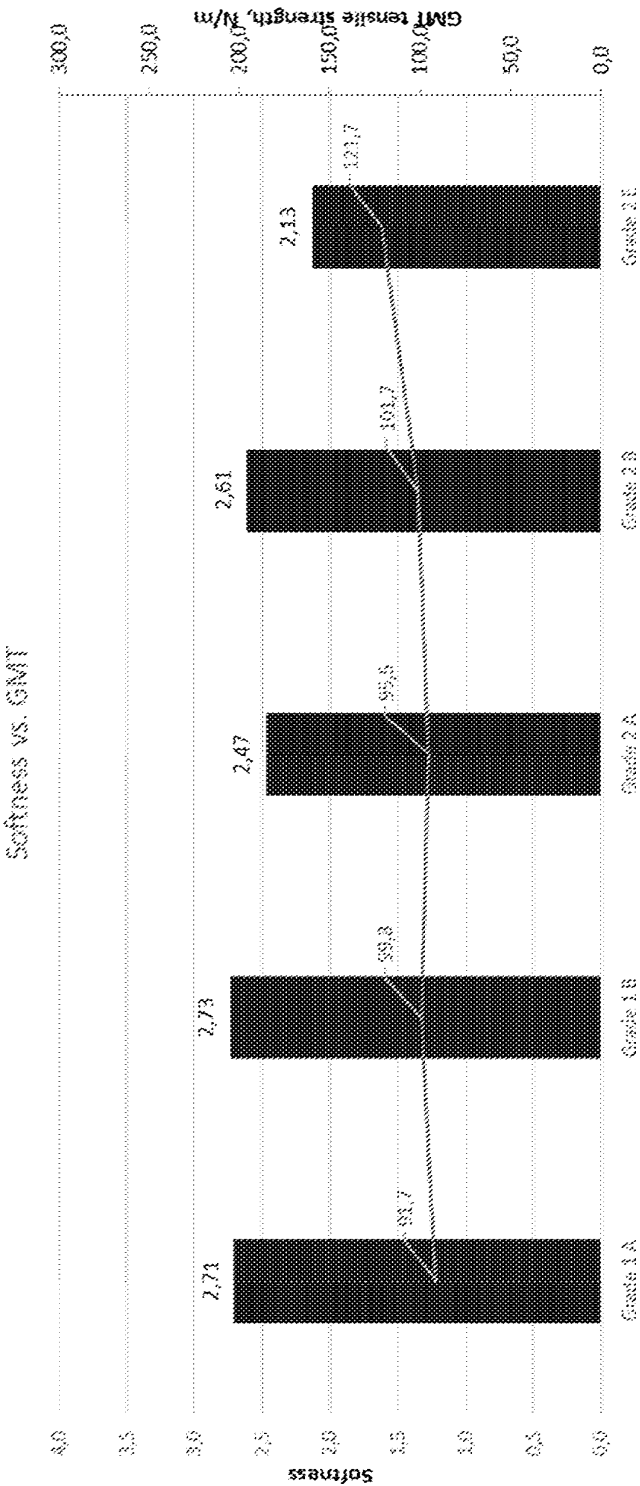


Fig. 1

2/5

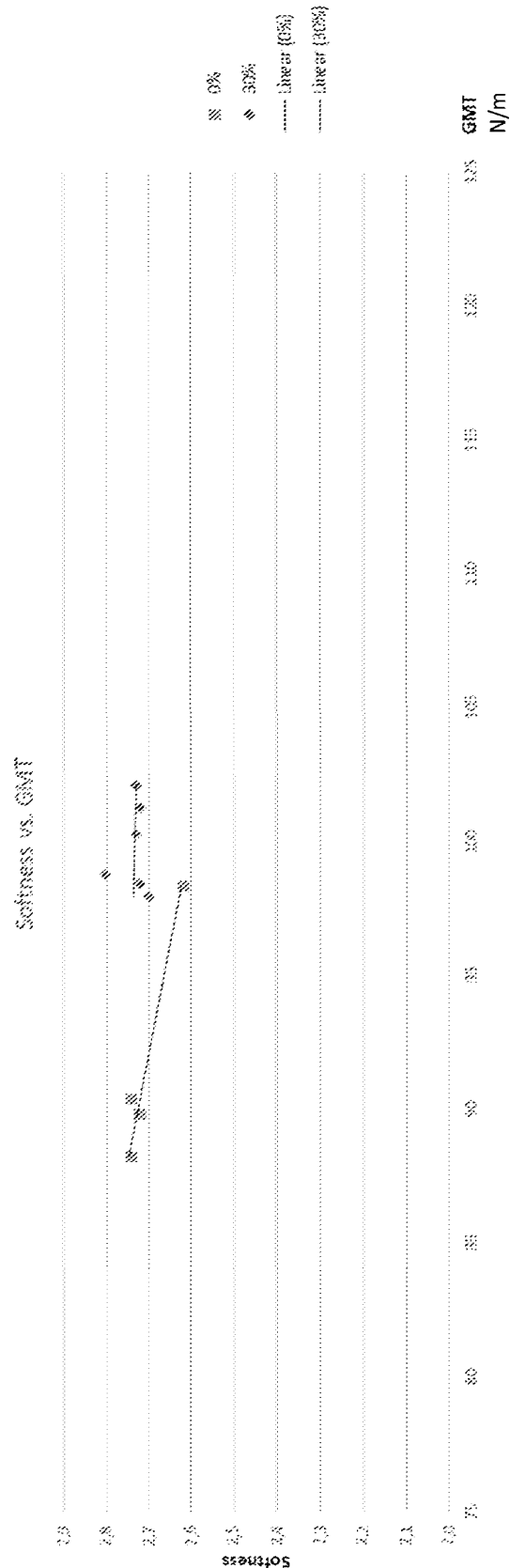


Fig. 2

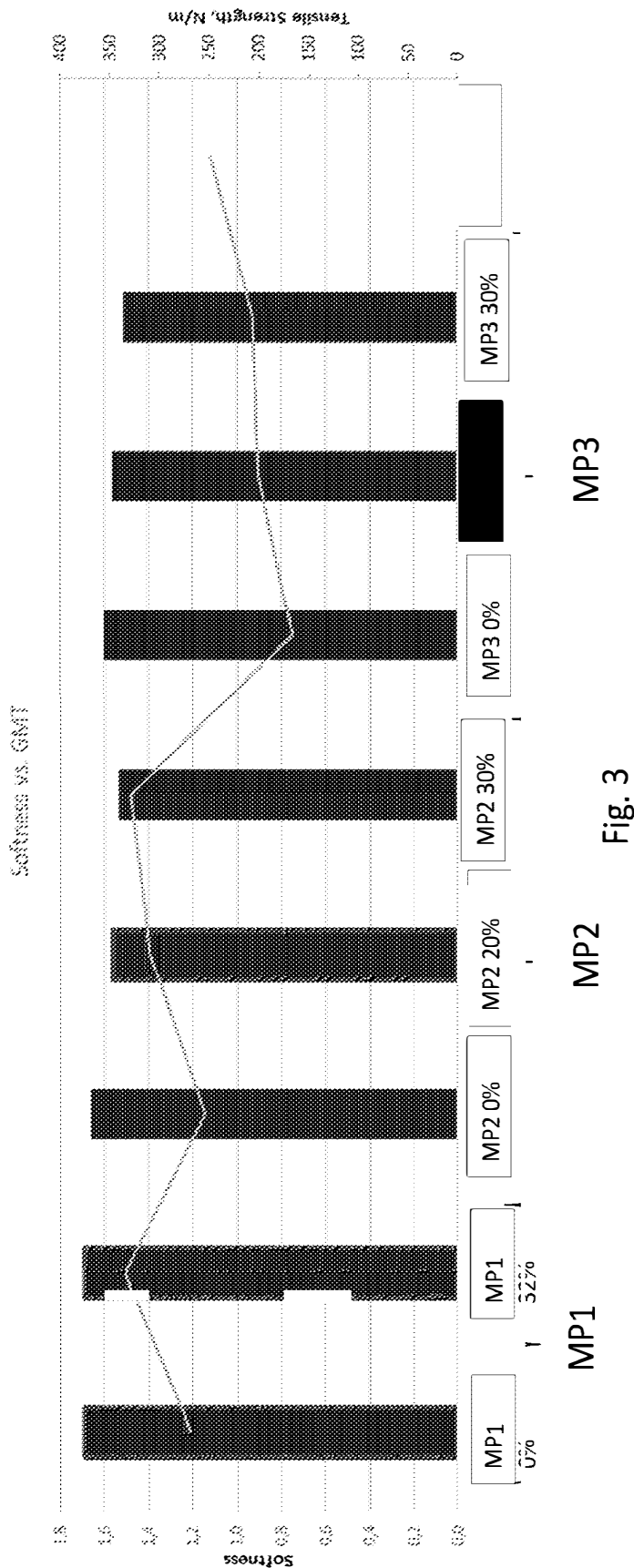


Fig. 3

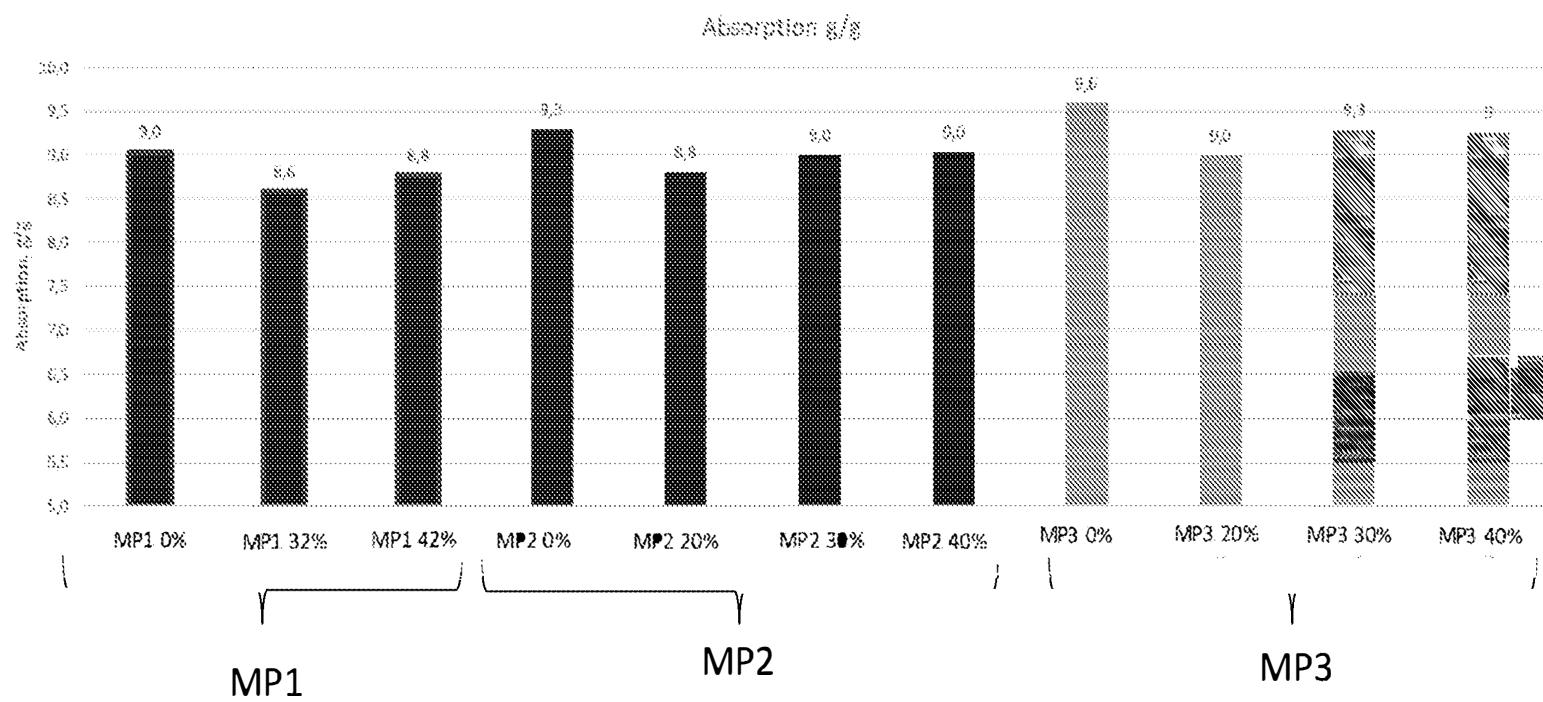


Fig. 4

5/5

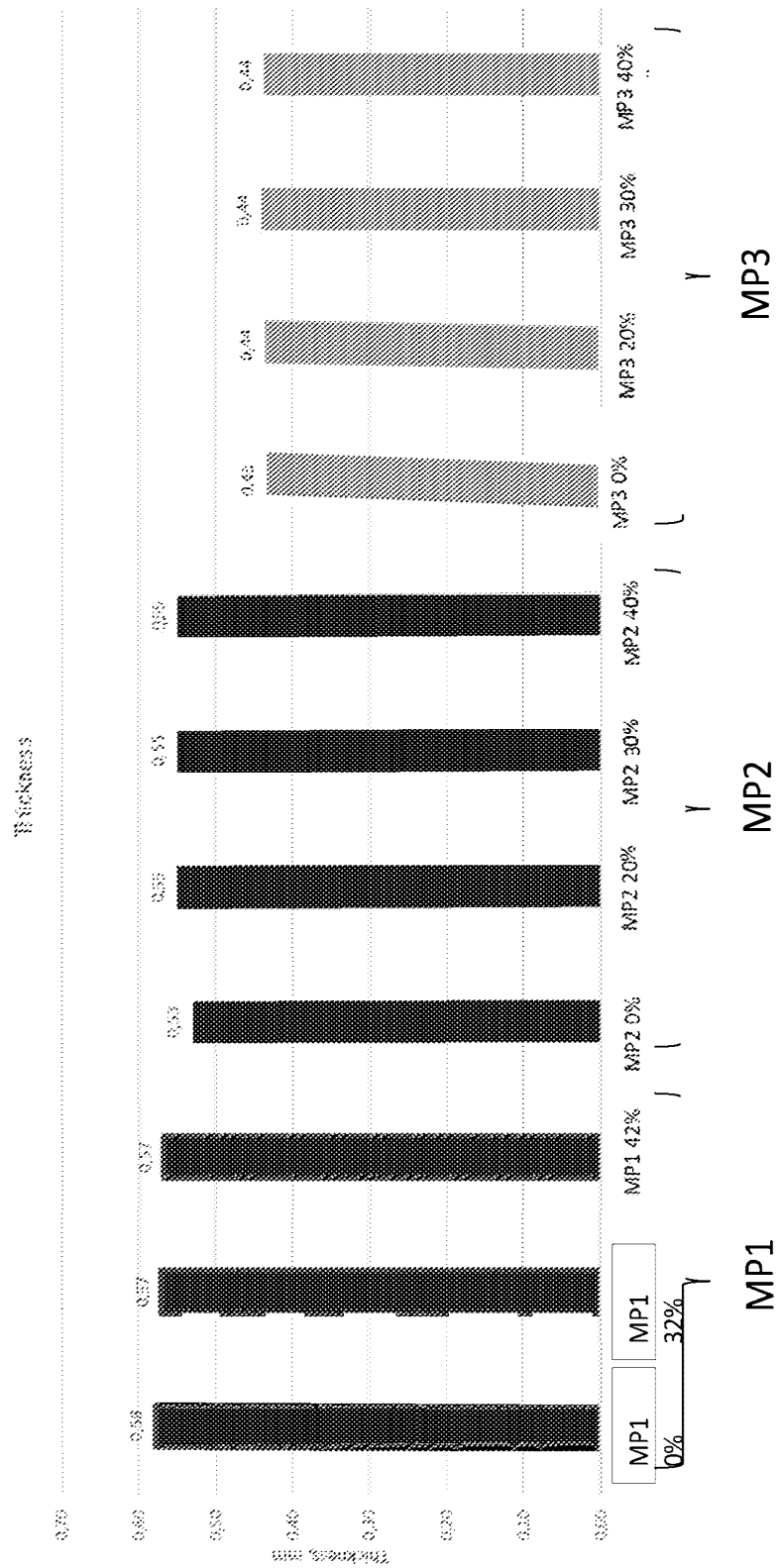


Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2021/050715

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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)

IPC: A47K, D21H

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

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of database and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 20180142419 A1 (ROUSE KAYLA ELIZABETH ET AL), 24 May 2018 (2018-05-24); paragraphs [0001], [0047], [0066]; Table 4	1-3, 21-23, 27-31, 33-35, 42-44, 46-48, 50-52
A	--	4-20, 24-26, 32, 36-41, 45, 49
X	US 20200232166 A1 (ROUSE KAYLA ELIZABETH ET AL), 23 July 2020 (2020-07-23); paragraphs [0005], [0010], [0021], [0052], [0069]-[0073]; claim 1; Tables 2-3	7-10, 12-15, 17-19, 21-23, 25-27-35, 38-48, 50-52
A	--	1-6, 11, 16, 20, 24, 36-37, 49



Further documents are listed in the continuation of Box C.



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

"D" document cited by the applicant in the international application

"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

27-01-2022

Date of mailing of the international search report

31-01-2022

Name and mailing address of the ISA/SE

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INTERNATIONAL SEARCH REPORT

 International application No.
 PCT/SE2021/050715

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 20130071678 A1 (SHANNON THOMAS GERARD), 21 March 2013 (2013-03-21); paragraphs [0057], [0107]; claims 9,16; Table 6	1, 4-9, 11-17, 20-23, 27-31, 33-37, 42-44, 46-51
A	--	2-3, 10, 18-19, 24-26, 32, 38-42, 45
X	US 20190100878 A1 (SHANNON THOMAS GERARD ET AL), 4 April 2019 (2019-04-04); paragraphs [0017], [0026], [0050]; claims 14,16	1, 6, 12-13, 23-24, 27-31, 33-35, 42-44, 46-48, 50-51
A	--	2-5, 7-11, 14-22, 25-26, 32, 36-41, 45, 49, 52
X	US 10428465 B2 (ROUSE KAYLA ELIZABETH ET AL), 1 October 2019 (2019-10-01); column 13, line 40 - column 14, line 18; column 15, line 54 - column 15, line 56; claims 1,4	1, 6, 23-24, 27-31, 33-35, 42-44, 46, 50-51
A	--	2-5, 7-22, 25-26, 36-41, 45, 47-49, 52
X	US 20180135248 A1 (COLLINS LYNDA ELLEN ET AL), 17 May 2018 (2018-05-17); paragraph [0051]; claims 1,12,15; Table 5	1, 6, 23-24, 27-31, 33-35, 42-44, 46-48, 50-51
A	--	2-5, 7-22, 25-26, 36-41, 45, 49, 52
X	US 20180142421 A1 (ROUSE KAYLA ELIZABETH ET AL), 24 May 2018 (2018-05-24); paragraph [0045]; claims 1,7-8	7, 23, 27-31, 33-35, 42-44, 46-48, 50-51
A	--	1-6, 8-22, 24-26, 36-41, 45, 49, 52