The purpose of the present disclosure is to provide a wet wipe which achieves both wet-strength and water-dissolvability. The wet wipe comprises the following configuration. This water-dissolving wet wipe (1) comprises a multi-layer sheet (4) provided with a first sheet (2) and a second sheet (3), said wet wipe (1) being characterized in that: the first sheet (2) comprises a first hydrophilic fiber-containing layer (2a) and a first hydrophobic fiber-containing layer (2b), and the second sheet (3) comprises a second hydrophilic fiber-containing layer (3a) and a second hydrophobic fiber-containing layer (3b); the multi-layer sheet (4) has a plurality of junction parts (5) at predetermined intervals; the plurality of junction parts (5) occupy 0.5% to 12.0% of the surface area; the first sheet (2) and the second sheet (3) each have a separability of less than or equal to 100 seconds; the multi-layer sheet (4) has a bending resistance of less than or equal to 150 mm; and the wet wipe (1) has a tensile strength of greater than or equal to 1.0 N/25 mm.

![Diagram](image)
Description

Technical Field

[0001] The present disclosure relates to a wet tissue and to a method of producing the wet tissue.

Background Art

[0002] Wet tissues of the type that can be flushed in toilets have been developed and are commercially available. For flushing in a toilet, a wet tissue must have a prescribed level of wet strength, considering how it is to be used, and a prescribed level of water disintegratability, considering that it is to be flushed in a toilet. In the relevant technical field, it is common to achieve both wet strength for use and water disintegratability by addition of chemical agents.

[0003] For example, PTL 1 describes a water disintegratable sheet containing a water-soluble polymer (methyl cellulose, hydroxypropyl methyl cellulose or the like) and at least one type of compound containing a benzene nucleus substituted with at least two hydroxyl groups (resorcin, pyrocatechol, pyrogallol, phloroglucinol or the like), and a water disintegratable wet tissue.

[0004] Also, PTL 2 describes a layered nonwoven fabric having at least two different types of nonwoven fabrics, a water disintegratable nonwoven fabric composed of water disintegratable fibers including ionic fibers formed from a resin composition containing a cationic resin (for example, cationized cellulose, cationized starch, cationized guar gum, cationized dextrin or polydimethylimidazolium chloride), and an anionic resin (for example, a polyacrylic acid salt, carboxymethyl cellulose, carboxymethyl starch, alginic acid, xanthan gum or a polymethacrylic acid salt), and a staple fiber nonwoven fabric formed from staple fibers, layered in a water disintegratable manner.

[0005] Furthermore, PTL 3 describes a water disintegratable cleaning article comprising a water disintegratable sheet obtained by high-pressure water jet spray treatment of a wet web containing wood pulp, biodegradable synthetic fiber, a water-soluble binder with a carboxyl group and a cationic polymer, which is impregnated with an aqueous cleaning agent containing one or more different metal ions selected from among alkaline earth metals, manganese, zinc, cobalt and nickel, and an organic solvent, the water disintegratable sheet having a multi-ply structure obtained by stacking and embossing of two or more monolayer sheets, the monolayer sheet composing the outermost layer being subjected to high-pressure water jet spray treatment from each surface, and being stacked so that the treated surface is facing outward.

[0006] In addition, PTL 4 describes a water disintegratable sheet employing an anionic adhesive (carboxymethyl cellulose sodium, carrageenan, sodium polyuronate and the like) and a cationic oligomer represented by formula (1) or (2).

[0007] Moreover, as a wet tissue of a type using no chemical agent, PTL 5 describes a water disintegratable fiber sheet including unbeaten pulp (a) with a beating degree of 700 mL or greater, beaten pulp (b) with a beating degree of 400 to 650 mL, regenerated cellulose (c) with a beating degree of 700 mL or greater and refined fibrillated cellulose (d) with a beating degree of 0 to 400 mL.

Citation List

Patent Literature

[0008]

PTL 1 Japanese Unexamined Patent Publication No. 2001-3297
PTL 2 Japanese Unexamined Patent Publication No. 2001-138424
PTL 5 Japanese Unexamined Patent Publication No. 2010-285718

Summary of Invention

Technical Problem

[0009] The wet tissues with water disintegratability described in PTL 1 to 4 exhibit both wet strength and water disintegratability by the action of chemical agents. However, considering that a wet tissue is to contact human skin, it is desirable to develop a wet tissue that exhibits both wet strength and water disintegratability without including chemical agents.

[0010] Furthermore, while the water disintegratable fiber sheet described in PTL 5 achieves both wet strength and water disintegratability by addition of refined fibrillated cellulose, there is demand for a wet tissue that exhibits both wet...
strength and water disintegratability by different methods.

[0011] It is therefore an object of the present disclosure to provide a wet tissue that exhibits both wet strength and water disintegratability.

Solution to Problem

[0012] The inventors have discovered a wet tissue with water disintegratability, including a multilayer sheet comprising a first sheet and a second sheet, wherein the first sheet includes a first hydrophilic fiber-containing layer including hydrophilic fibers at 95 to 100 mass% and a first hydrophobic fiber-containing layer including hydrophobic fibers at 5 to 30 mass%, and the second sheet includes a second hydrophilic fiber-containing layer including hydrophilic fiber at 95 to 100 mass% and a second hydrophobic fiber-containing layer including hydrophobic fiber at 5 to 30 mass%, the first hydrophobic fiber-containing layer being disposed adjacent to the second hydrophobic fiber-containing layer, the multilayer sheet having a plurality of connected sections, disposed across spacings, where the first hydrophobic fiber-containing layer and the second hydrophobic fiber-containing layer are connected, the spacings between the plurality of connected sections being 0.6 times or above the mean fiber length of the hydrophobic fibers of the first hydrophobic fiber-containing layer and 0.6 times or above the mean fiber length of the hydrophobic fibers of the second hydrophobic fiber-containing layer, the plurality of connected sections having an area ratio of 0.5 to 12.0% with respect to the multilayer sheet, and each of the first sheet and second sheet, which is separated from the multilayer sheet, having a disintegratability of 100 seconds or less in a disintegration test, the multilayer sheet having a bending resistance of 150 mm or less, and the wet tissue having a tensile strength of 1.0N or greater per 25 mm width.

Advantageous Effects of Invention

[0013] The wet tissue of the present disclosure exhibits both wet strength and water disintegratability.

Brief Description of Drawings

[0014] Fig. 1 is a plan view of a wet tissue according to one embodiment of the present disclosure.
Fig. 2 is a cross-sectional view along plane II-II of Fig. 1.
Fig. 3 is a schematic diagram for illustration of the relationship between the connected section spacings and the fiber length.
Fig. 4 is a cross-sectional view of a wet tissue according to another embodiment of the present disclosure.
Fig. 5 is a schematic diagram for illustration of a method of producing a wet tissue according to one embodiment of the present disclosure.
Fig. 6 is a schematic diagram for illustration of a method of producing a wet tissue according to one embodiment of the present disclosure.

Description of Embodiments

[Definitions]

[0015] Several terms will be defined before describing the wet tissue of the present disclosure.

- "Mean fiber length"

[0016] As used herein, the mean fiber length of the fibers including the hydrophilic fibers and hydrophobic fibers is the weight-weighted average fiber length, and it is the L(w) value measured using Kajaani fiber Lab fiber properties (off-line)] by Metso Automation.

- "Melting point"

[0017] As used herein, the term "melting point" of hydrophobic fibers refers to the peak top temperature for the endothermic peak during conversion from solid to liquid, upon measurement with a differential scanning calorimetry analyzer at a temperature-elevating rate of 10°C/min. The differential scanning calorimetry analyzer used may be, for example, a DSC-60-type DSC measuring apparatus by Shimadzu Corp.

[0018] When the hydrophobic fiber includes multiple components, the melting point is measured for each component.
"Machine direction" and "cross-machine direction"

As used herein, the machine direction is the machine direction during production, and the cross-machine direction is the direction perpendicular to the machine direction during production.

"Spacing" for connected sections

As used herein, the "spacing" of the connected sections is the distance (inner distance) from one inner side to the other inner side between one connected section and the connected section located nearest to that connected section. In Fig. 3, the spacing I is the inner distance between a connected section 5d and a connected section 5e located nearest to the connected section 5d.

"Pitch" for connected sections

As used herein, the "pitch" between the connected sections is the center distance between one connected section and the connected section located nearest to that connected section. In Fig. 3, the pitch P is the center distance between the connected section 5d and the connected section 5e located nearest to the connected section 5d.

The wet tissue of the present disclosure includes a multilayer sheet with water disintegratability, comprising a first sheet and a second sheet.

As used herein, "wet tissue" and "multilayer sheet" differ in that a "wet tissue" includes a chemical solution while a "multilayer sheet" does not include a chemical solution.

Also, in the drawings for the wet tissue of the present disclosure, the second sheet will sometimes appear to be stacked on the first sheet, but this appearance is not intended to restrict the use of the wet tissue. That is, the surface of the first sheet opposite the second sheet is capable of wiping off dirt, while the surface of the second sheet opposite the first sheet is also capable of wiping off dirt.

In the wet tissue of the present disclosure, the first sheet includes a first hydrophilic fiber-containing layer including hydrophilic fibers at 95 to 100 mass% and a first hydrophobic fiber-containing layer including hydrophobic fibers at 5 to 30 mass%, while the second sheet includes a second hydrophilic fiber-containing layer including hydrophilic fibers at 5 to 100 mass% and a second hydrophobic fiber-containing layer including hydrophobic fibers at 5 to 30 mass%. Moreover, in the wet tissue of the present disclosure, the first hydrophobic fiber-containing layer is disposed adjacent to the second hydrophilic fiber-containing layer, and the multilayer sheet has a plurality of connected sections, disposed across spacings, that connect the first hydrophobic fiber-containing layer and second hydrophobic fiber-containing layer. These will now be explained with reference to Fig. 1 to Fig. 3.

Fig. 1 shows a plan view of a wet tissue according to an embodiment of the present disclosure, and Fig. 2 shows a cross-sectional view along plane II-II of Fig. 1. In the wet tissue 1 depicted in Fig. 1 and Fig. 2, the first sheet includes a first hydrophilic fiber-containing layer 2a including hydrophilic fibers (not shown) at 95 to 100 mass% and a first hydrophobic fiber-containing layer 2b including hydrophobic fibers (not shown) at 5 to 30 mass%, while the second sheet 3 includes a second hydrophilic fiber-containing layer 3a including hydrophilic fibers (not shown) at 95 to 100 mass% and a second hydrophobic fiber-containing layer 3b including hydrophobic fibers (not shown) at 5 to 30 mass%.

Moreover, in the wet tissue 1 depicted in Fig. 1 and Fig. 2, the first hydrophobic fiber-containing layer 2b is disposed adjacent to the second hydrophobic fiber-containing layer 3b, and the multilayer sheet 4 has a plurality of connected sections 5 formed by connecting the first hydrophobic fiber-containing layer 2b and second hydrophobic fiber-containing layer 3b. Specifically, in the wet tissue 1 of Fig. 1 and Fig. 2, the multilayer sheet 4 has a plurality of embossed sections 5' formed by embossing the first hydrophobic fiber-containing layer 2b and the second hydrophobic fiber-containing layer 3b. In the multilayer sheet 4, the plurality of embossed sections 5' are configured in a zigzag fashion.

In the embodiment shown in Fig. 1 and Fig. 2, the connected sections are embossed sections, but the connected sections in the wet tissue of the present disclosure are not limited to being embossed sections. In a wet tissue according to several other embodiments of the present disclosure, the connected sections are, for example, adhesive sections formed by an adhesive, or pressure-sensitive adhesive sections formed by a pressure-sensitive adhesive.

The connected sections may be formed by connecting the surface of the first sheet, and specifically the surface of the first hydrophobic fiber-containing layer that is opposite the first hydrophilic fiber-containing layer, and the surface of the second sheet, and specifically the surface of the second hydrophobic fiber-containing layer that is opposite the second hydrophilic fiber-containing layer, but preferably the connected sections are formed by further connecting the fibers inside either the first hydrophobic fiber-containing layer or the second hydrophobic fiber-containing layer, and
more preferably they are formed by further connecting the fibers inside both the first sheet and the second sheet. This is from the viewpoint of the wet strength of the wet tissue.

[0031] From the viewpoint of connecting the fibers inside either or both the first hydrophobic fiber-containing layer and the second hydrophobic fiber-containing layer, the connected sections are preferably embossed sections. When the connected sections are embossed sections, the hydrophobic fibers of the first hydrophobic fiber-containing layer and second hydrophobic fiber-containing layer preferably include heat-fusible fibers, and more preferably they include heat-fusible fibers comprising composite fibers that include a low-melting-point component and a high-melting-point component having a higher melting point than the low-melting-point component (hereunder also referred to as "heat-fusible fibers comprising composite fibers that include a low-melting-point component and a high-melting-point component").

[0032] In the embossed sections, preferably at least some of the hydrophobic fibers of the first hydrophobic fiber-containing layer (the low-melting-point component of the heat-fusible fibers) are fused with the hydrophobic fibers of the second hydrophobic fiber-containing layer, and when the second hydrophobic fiber-containing layer includes the hydrophilic fibers described below, preferably at least some of the (low-melting-point component of the) heat-fusible fibers of the first hydrophobic fiber-containing layer are fused with the hydrophilic fibers of the second hydrophobic fiber-containing layer. This is from the viewpoint of the wet strength of the wet tissue.

[0033] From the same viewpoint, in the embossed sections, preferably at least some of the hydrophobic fibers of the second hydrophobic fiber-containing layer (the low-melting-point component of the heat-fusible fibers) are fused with the hydrophobic fibers of the first hydrophobic fiber-containing layer, and when the first hydrophobic fiber-containing layer includes the hydrophilic fibers described below, preferably at least some of the (low-melting-point component of the) heat-fusible fibers of the second hydrophobic fiber-containing layer are fused with the hydrophilic fibers of the first hydrophobic fiber-containing layer.

[0034] From the same viewpoint, when the connected sections are adhesive sections, preferably the viscosity of the adhesive is reduced so that it seeps into either or both the first hydrophobic fiber-containing layer and the second hydrophobic fiber-containing layer, and preferably the adhesive bonds with the fibers contained in either or both the first hydrophobic fiber-containing layer and the second hydrophobic fiber-containing layer. This also applies when the connected sections are pressure-sensitive adhesive sections.

[0035] In the wet tissue of the present disclosure, the connected sections may have connecting of the fibers, such as the hydrophilic fibers, included in the first hydrophilic fiber-containing layer and/or the second hydrophilic fiber-containing layer, but preferably the connected sections are not present on the outermost surface (the use-surface) of the multilayer sheet. This is because the connected sections, or embossed sections, for example, tend to be harder than the nonwoven fabric sections, and when the connected sections are present on the outermost surface (use-surface) of the multilayer sheet, the user will tend to sense a feeling of hardness.

[0036] If the wet tissue has the aforementioned connected sections, the wet tissue, when wet, will tend to exhibit wet strength that is a combination of the wet strength of the first sheet and the wet strength of the second sheet, and when disintegrated by water, it will tend to exhibit the individual water disintegratability of the first sheet and second sheet.

[0037] For example, when the first sheet and second sheet are the same sheet, the wet tissue of the present disclosure will tend to exhibit twice the wet strength of the first sheet, and to exhibit the same water disintegratability as the first sheet.

[0038] In the wet tissue of the present disclosure, the spacing between the plurality of connected sections is 0.6 times or above, preferably 0.7 times or above, more preferably 0.8 times or above, even more preferably 1.0 times or above, yet more preferably 1.5 times or above, and even yet more preferably 2.0 times or above the mean fiber length of the hydrophobic fibers of the first hydrophobic fiber-containing layer.

[0039] Also, in the wet tissue of the present disclosure, the spacing between the plurality of connected sections is 0.6 times or above, preferably 0.7 times or above, more preferably 0.8 times or above, even more preferably 1.0 times or above, yet more preferably 1.5 times or above, and even yet more preferably 2.0 times or above the mean fiber length of the hydrophobic fibers of the second hydrophobic fiber-containing layer.

[0040] The reason for which the spacing between the plurality of connected sections is 0.6 times or above the mean fiber length of the hydrophobic fibers in both the first hydrophobic fiber-containing layer and the second hydrophobic fiber-containing layer will now be explained with reference to Fig. 3.

[0041] Fig. 3 is a schematic diagram for illustration of the relationship between the connected section spacings and the fiber length. Fig. 3 is a plan view of region III of Fig. 1, the second sheet 3 being omitted for ease of explanation. Also in Fig. 3, the only hydrophobic fibers of the first hydrophobic fiber-containing layer 2b shown are the hydrophobic fibers 6a, 6b and 6c connected to the connected sections 5a, 5b and 5c.

[0042] If the spacing I between the connected sections 5 is longer than the mean fiber length of the hydrophobic fibers 6 of the first hydrophobic fiber-containing layer 2b, the hydrophobic fibers 6a connected to the connected section 5a, for example, will not connect with the adjacent connected section 5b (or 5c) even if they are tangled with the hydrophobic fibers 6b (or 6c) connected to the adjacent connected section 5b (or 5c) at a tangled point 7ab (or 7ac). In other words, the adjacent connected sections 5a to 5c are not connected by the hydrophobic fibers 6a to 6c. Therefore, when the wet tissue has been discarded in a flush toilet, the connected sections 5a to 5c easily separate into separate fragments
so that the water disintegratability of the wet tissue is less likely to be reduced.

[0043] The relationship between the spacing between the connected sections and the fiber lengths is the same as for the second hydrophobic fiber-containing layer.

[0044] In a nonwoven fabric, such as a wet tissue, the fibers composing the nonwoven fabric generally do not exist in a straight linear form, but are tangled with other fibers and meandering. Thus, even when the spacing between the connected sections is shorter than the mean fiber length of the hydrophobic fibers, the connected sections will often be separable into different fragments when discarded in a flush toilet or the like.

[0045] It has been confirmed by the present inventors that if the spacing of the connected sections is 0.6 times or above the mean fiber length of the hydrophobic fibers in both the first hydrophobic fiber-containing layer and the second hydrophobic fiber-containing layer, it is possible to achieve disintegratability of 100 seconds or less in a disintegration test.

[0046] Thus, in consideration of water disintegratability, the plurality of connected sections must have a spacing of 0.6 times or above the mean fiber length of the hydrophobic fibers in both the first hydrophobic fiber-containing layer and the second hydrophobic fiber-containing layer.

[0047] In the wet tissue of the present disclosure, when the first hydrophobic fiber-containing layer and/or the second hydrophobic fiber-containing layer includes a fiber type other than hydrophobic fibers (for example, hydrophilic fibers), the spacing between the plurality of connected sections is preferably 0.6 times or above, more preferably 0.7 times or above, even more preferably 0.8 times or above, yet more preferably 1.0 times or above, even yet more preferably 1.5 times or above, and most preferably 2.0 times or above the mean fiber length of each of the fibers types in the first hydrophobic fiber-containing layer and the second hydrophobic fiber-containing layer.

[0048] Incidentally, since the hydrophilic fibers are connected by hydrogen bonding with the other fibers, and particularly the hydrophilic fibers, the connecting points by hydrogen bonding with the other fibers readily disappear upon disposal in a flush toilet or the like. Thus, the mean fiber length of the hydrophilic fibers has less of an effect on the water disintegratability of the wet tissue than the mean fiber length of synthetic fibers, especially when the connected sections are embossed sections.

[0049] In the wet tissue of the present disclosure, the lower limit for the area ratio of the connected sections with respect to the multilayer sheet will differ depending on the area of the individual connected sections, but it is generally 0.5% or greater, preferably 1.0% or greater, more preferably 1.2% or greater and even more preferably 1.5% or greater. If the area ratio is less than 0.5%, connection between the first sheet and the second sheet will be insufficient, resulting in reduced wet strength of the wet tissue and possible tearing of the wet tissue during use.

[0050] The upper limit for the area ratio will also differ depending on the area of the individual connected sections and the number density of the connected sections, but it is generally 12% or less, preferably 10.0% or less, more preferably 8.0% or less, and even more preferably 5.0% or less. If the area ratio is greater than 12.0%, connection between the first hydrophobic fiber-containing layer and the second hydrophobic fiber-containing layer will be strong and the wet strength of the wet tissue will be increased, but when the wet tissue has been discarded in a flush toilet, the first hydrophobic fiber-containing layer and the second hydrophobic fiber-containing layer will have difficulty separating, the water disintegratability of the wet tissue may be reduced, and the bending resistance of the wet tissue will tend to increase (the wet tissue will become hard).

[0051] This upper limit is preferred when the number density of the connected sections is low, such as when the connected sections have a number density of preferably 10 to 1,000/m² and more preferably 50 to 500/m².

[0052] As an example where the number density of the connected sections is low, there may be mentioned a working example in which the connected sections are linear connected sections.

[0053] When the number density of the connected sections is high, such as when the connected sections have a number density of 1,000 to 100,000/m² and more preferably 10,000 to 70,000/m², the upper limit for the area ratio is preferably 5.0% or less, more preferably 4.5% or less, even more preferably 4.0% or less, and yet more preferably 3.8% or less. As an example where the number density of the connected sections is high, there may be mentioned a working example in which the connected sections are punctiform connected sections.

[0054] The area ratio of the connected sections is calculated by the following formula.

\[
\text{Area ratio of connected sections} = 100 \times \left( \frac{\text{total area of connected sections}, \ mm^2}{\text{area of multilayer sheet}, \ mm^2} \right)
\]

[0055] The number density of the connected sections is the number of connected sections per 1 m² of the multilayer sheet.

[0056] The form of the connected sections is not particularly restricted, and examples of connected sections include punctiform connected sections, for example, connected sections with circular, elliptical, rectangular or triangular shapes, star shapes, heart shapes or any desired character shapes or symbol shapes.
Furthermore, when the connected sections are embossed sections, and the area is less than 0.4 mm², the connecting layer includes hydrophobic fibers and hydrophilic fibers, respectively, at 5 to 30 mass% and 70 to 95 mass%. When the first hydrophobic fiber-containing layer includes hydrophilic fibers, the first hydrophobic fiber-containing layer may further include hydrophilic fibers. This is from the viewpoint of retentivity of chemical solutions.

Each of the first hydrophobic fiber-containing layer and the second hydrophobic fiber-containing layer preferably and the second hydrophobic fiber-containing layer by the embossed sections will be reduced and the wet strength of the wet tissue will tend to be reduced.

Furthermore, when the connected sections are linear connected sections, the connected sections have widths of preferably 0.3 to 3.0 mm, more preferably 0.5 to 2.5 mm and even more preferably 1.0 to 2.0 mm. If the widths are less than 0.3 mm, connection between the first sheet and the second sheet may be insufficient, and the wet strength of the wet tissue may be insufficient. If it exceeds 3.0 mm, the wet strength of the wet tissue will increase but the water disintegratability of the wet tissue will tend to be reduced.

Moreover, when the connected sections are embossed sections, and the widths are less than 0.3 mm, the protrusions of the embossing rolls for formation of the embossed sections will be more acute angles, which may potentially open holes in the wet tissue, and when the number of embossed sections is increased to increase the wet strength it will become difficult to ensure the spacing between the embossed sections, while if the area is greater than 9.0 mm², the skin of the user will tend to sense the hardness of the embossed sections.

When the connected sections are linear connected sections, the connected sections have widths of preferably 0.3 to 3.0 mm, more preferably 0.5 to 2.5 mm and even more preferably 1.0 to 2.0 mm. If the widths are less than 0.3 mm, connection between the first sheet and the second sheet may be insufficient, and the wet strength of the wet tissue may be insufficient. If it exceeds 3.0 mm, the wet strength of the wet tissue will increase but the water disintegratability of the wet tissue will tend to be reduced.

In the wet tissue of the present disclosure, the area per each connected section also varies depending on the area ratio of the connected sections, the shapes of the connected sections, and other factors, but when the connected sections are punctiform connected sections, each of the connected sections has an area of preferably 0.4 to 9.0 mm², more preferably 0.4 to 7.0 mm² and even more preferably 1.0 to 5.0 mm². If the area is less than 0.4 mm², connection between the first sheet and the second sheet may be insufficient, and if the area is greater than 9.0 mm², the wet strength of the wet tissue will tend to be reduced.

When the hydrophobic fibers are heat-fusible fibers and the connected sections are embossed sections, the protrusions on the embossing roll for formation of the embossed sections will be more acute angles which may open holes in the wet tissue, and when the number of embossed sections is increased to increase the wet strength it will become difficult to ensure the spacing between the embossed sections, while if the area is greater than 9.0 mm², the skin of the user will tend to sense the hardness of the embossed sections.

In the wet tissue of this disclosure, each of the first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer includes a prescribed amount of hydrophilic fibers, and each of the first hydrophobic fiber-containing layer and second hydrophobic fiber-containing layer includes a prescribed amount of hydrophobic fibers.

As used herein, the simple term “fiber” refers to all of the types of fibers in the first sheet, the second sheet, the first hydrophilic fiber-containing layer or second hydrophilic fiber-containing layer, or in the first hydrophobic fiber-containing layer or second hydrophobic fiber-containing layer.

In the wet tissue of this disclosure, each of the first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer includes hydrophilic fibers at 95 to 100 mass%, preferably include hydrophilic fibers at 97 to 100 mass% and more preferably include hydrophilic fibers at 100 mass%. If the first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer include hydrophilic fibers in such amounts, the layer will have excellent feel on the skin. Also, when the hydrophobic fibers are heat-fusible fibers and the connected sections are embossed sections, the embossing roll used to form the embossed sections will be less likely to be fouled, while the user will not directly contact the embossed sections so that the user will be less likely to feel the hardness of the embossed sections.

Each of the first hydrophobic fiber-containing layer and second hydrophobic fiber-containing layer includes hydrophobic fibers at 5 to 30 mass%, preferably include hydrophobic fibers at 6 to 25 mass%, and more preferably include hydrophobic fibers at 7 to 20 mass%. If the proportion of hydrophobic fibers is less than 5 mass%, the wet strength of the wet tissue will tend to be reduced, and if the proportion of hydrophobic fibers exceeds 30 mass%, the water disintegratability will tend to be reduced.

Furthermore, when the hydrophobic fibers are heat-fusible fibers and the connected sections are embossed sections, and the proportion of hydrophobic fibers is less than 5 mass%, the connecting force between the first hydrophobic fiber-containing layer and the second hydrophobic fiber-containing layer by the embossed sections will be reduced and the water disintegratability of the wet tissue will increase, but the wet strength will also be reduced, tending to result in tearing during use, and also tending to reduce the bending resistance (resulting in softness).

Furthermore, when the hydrophobic fibers are heat-fusible fibers and the connected sections are embossed sections, and the proportion of hydrophobic fibers is greater than 30 mass%, the connecting force between the first hydrophobic fiber-containing layer and the second hydrophobic fiber-containing layer by the embossed sections will be increased and the wet strength of the wet tissue will increase, but the water disintegratability will also tend to be inferior and the bending resistance will tend to increase (result in hardness).

Each of the first hydrophobic fiber-containing layer and the second hydrophobic fiber-containing layer preferably further include hydrophilic fibers. This is from the viewpoint of retentivity of chemical solutions.

When the first hydrophobic fiber-containing layer includes hydrophilic fibers, the first hydrophobic fiber-containing layer includes hydrophobic fibers and hydrophilic fibers, respectively, at 5 to 30 mass% and 70 to 95 mass%,
preferably 6 to 25 mass% and 75 to 94 mass% and more preferably 7 to 20 mass% and 80 to 93 mass%.

[0072] When the second hydrophobic fiber-containing layer includes hydrophilic fibers, the preferred proportion of hydrophobic fibers and hydrophilic fibers in the second hydrophobic fiber-containing layer is as explained above for the first hydrophobic fiber-containing layer.

[0073] The hydrophilic fibers are not particularly restricted so long as they are fibers with hydrophilicity and capable of retaining water on the surface or in the interiors. For example, the hydrophilic fibers may be cellulosic fibers, examples of cellulosic fibers including pulp and regenerated cellulose fibers.

[0074] Examples of pulp include wood pulp and nonwood pulp. Examples of wood pulp include conifer pulp and broadleaf tree pulp. Examples of nonwood pulp include straw pulp, bagasse pulp, reed pulp, kenaf pulp, mulberry pulp, bamboo pulp, hemp pulp and cotton pulp (such as cotton linter).

[0075] Also, the pulp may be non-beaten pulp that has not been subjected to beating treatment, beaten pulp that has been subjected to beating treatment, or a combination thereof.

[0076] Non-beaten pulp preferably has a Canadian Standard Freeness of 700 mL, or greater.

[0077] The Canadian Standard Freeness (CSF) is measured according to JIS P 8121-222012, "Pulp Freeness Test Method - Part 2: Canadian Standard Freeness Method".

[0078] The mean fiber length of the non-beaten pulp is not particularly restricted but is generally preferred to be 2 to 4 mm from the viewpoint of economy and productivity.

[0079] Beaten pulp is pulp obtained by beating non-beaten pulp by a method, such as free beating or wet beating, and it has main body sections and microfiber sections extending from the main body sections. If the wet tissue includes beaten pulp, the wet strength and dry strength of the wet tissue will be increased.

[0080] The beaten pulp preferably has a Canadian Standard Freeness of 400 to 650 mL, and more preferably it has a Canadian Standard Freeness of 400 to 600 mL.

[0081] The regenerated cellulose fibers may be a rayon, such as viscose rayon obtained from viscose, polynosic and modal, or cuprammonium rayon obtained from cuprammonium salt solutions of cellulose, (also known as "cupra"); or lyocell, such as Tencel®R, which are not via cellulose derivatives, obtained by organic solvent spinning methods using organic solvents that are mixed solutions of organic compounds and water.

[0082] The regenerated cellulose fibers are preferably rayon and especially viscose rayon, from the viewpoint of water absorption, ease of forming the first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer, and economy.

[0083] Furthermore, the cellulosic fibers may be, for example, semi-synthetic cellulose fibers, such as acetate fibers, among which triacetate fibers and diacetate fibers may be mentioned.

[0084] The hydrophobic fibers may be ones commonly used in the technical field, and are preferably synthetic fibers. The synthetic fibers may be ones containing only a single component, such as simple fibers, or ones containing multiple components, such as composite fibers.

[0085] Examples of the components include polyolefin-based polymers, such as polyethylene and polypropylene; polyester-based polymers, for example, terephthalate-based polymers, such as polyethylene terephthalate (PET), polybutylene terephthalate and polypentylene terephthalate; polyamide-based polymers, such as nylon 6 and nylon 6,6; acrylic polymers; polyacrylonitrile-based polymers; and their modified forms.

[0086] When the connected sections are embossed sections, the hydrophobic fibers preferably include heat-fusible fibers, and more preferably they include heat-fusible fibers comprising composite fibers that include a low-melting-point component and a high-melting-point component having a higher melting point than the low-melting-point component.

[0087] In the heat-fusible fibers, the low-melting-point component has a melting point of preferably 120 to 180°C, more preferably 130 to 170°C and even more preferably 140 to 160°C. If the melting point is lower than 120°C, the drying temperature of the first sheet and/or second sheet will need to be lowered to below the melting point of the low-melting-point component in order to prevent fusion of the low-melting-point component, and the productivity of the wet tissue will tend to be reduced.

[0088] In the heat-fusible fibers, the high-melting-point component has a melting point of preferably 170 to 300°C, more preferably 180 to 290°C, even more preferably 200 to 270°C and yet more preferably 220 to 260°C. If the melting point is lower than 170°C, not only the low-melting-point component but also the high-melting-point component will undergo melting during the embossing step, and the embossed sections will become hard, sometimes lowering the feel of the wet tissue on the skin. The melting point is preferably not higher than 300°C from the viewpoint of economy.

[0089] In the heat-fusible fibers, the low-melting-point component and high-melting-point component have a difference in melting point of preferably 50 to 110°C, more preferably 60 to 100°C and even more preferably 70 to 90°C. If the difference in melting point is less than 50°C, it will tend to be difficult to melt only the low-melting-point component in the embossing step, while if the difference in melting point is greater than 110°C, the melting point of the low-melting-point component will be lower, often resulting in melting of the low-melting-point component during drying of the first sheet and/or second sheet, or the melting point of the high-melting-point component will be high, which is undesirable in terms of economy.
The wet tissue of the present disclosure, each of the first sheet and second sheet separated from the multilayer sheet exhibits, in a disintegration test as an indicator of water disintegratability, a disintegratability of 100 seconds or less, and preferably exhibits a disintegratability of 90 seconds or less, more preferably 80 seconds or less, and even more preferably 70 seconds or less. If the disintegratability exceeds 100 seconds, toilet pipes etc. may become clogged, depending on their thickness. There is no particular lower limit on the disintegratability.

In Table 1 of "2. Quality" for toilet paper in JIS P 4501:1993 it is stated that toilet paper should satisfy the standard of a disintegratability of no more than 100 seconds, and considering that the wet tissue of the present disclosure is to be discarded in a flush toilet, it preferably has disintegratability equivalent to that of toilet paper.

For the purpose of the present disclosure, the water disintegratability of the first sheet and second sheet separated from the multilayer sheet is used because when the wet tissue is discarded in a flush toilet, usually the water stream strips off the first sheet and second sheet at a relatively early stage, followed by the fragments.

In Table 1 of "2. Quality" for toilet paper in JIS P 4501:1993, it is stated that the aforementioned disintegratability standard is applied for each single sheet when two or more sheets are wound together.

The multilayer sheet is obtained by drying of the wet tissue for 24 hours under conditions of 20 ±5°C, 65 ±5% RH, and vaporizing off the chemical solution from the wet tissue.

The wet tissue of the present disclosure preferably also has a disintegratability of 100 seconds or less in a disintegration test for the wet tissue itself, assuming that the first sheet and second sheet will not separate when discarded in a flush toilet, such as when the water stream is weak.

Throughout the present specification, the disintegration test is conducted according to "4.5 Disintegratability" for toilet paper of JIS P 4501:1993. Specifically, it is as follows.

A 300 mL beaker containing 300 mL of water (water temperature: 20°C ±5°C) is placed in a magnetic stirrer, and the rotational speed of the rotor (discoid rotor with diameter: 35 mm, thickness: 12 mm) is adjusted to 600 ±10 rpm. A test strip with 114 ±2 mm sides is loaded into a beaker, and a stopwatch is activated. The rotational speed of the rotor first falls to about 500 rpm due to the resistance of the test strip, the rotational speed increasing as the test strip becomes loose, and upon recovering to 540 rpm, the stopwatch is stopped and the time is measured in second units. The results of disintegratability are expressed as a mean value for 5 tests.

The wet tissue of the present disclosure before impregnation of the chemical solution, i.e. the multilayer sheet, has a bending resistance of 150 mm or less, preferably a bending resistance of 145 mm or less, and more preferably 140 mm or less, and more preferably it has a bending resistance of preferably 135 mm or less. If the bending resistance is greater than 150 mm, the user will tend to feel hardness in the wet tissue. There is no particular lower limit for the bending resistance, but it will generally be 20 mm or above.

As used herein, the bending resistance is measured according to "6.7.3 41.5 Cantilever method" of the general test methods for nonwoven fabrics of JIS L 1913:2010, except that the length of the test strip was changed from "(25 ±1) mm x (250 ±1) mm" to "(25 ±1) mm x (200 ±1) mm".

The bending resistance is preferably within the range specified above in any direction of the multilayer sheet, for example, in both the longitudinal and widthwise directions according to the aforementioned JIS standard, such as in both the machine direction and the cross-machine direction during production of the first sheet and the second sheet.

The wet tissue of the present disclosure has a tensile strength of 1.0N or greater and preferably 1.1 N or greater per 25 mm width. If the tensile strength is lower than 1.0N per 25 mm width, the wet tissue can potentially tear when the wet tissue is removed.

Throughout the present specification, the tensile strength of the wet tissue may be referred to as the "wet strength" of the wet tissue, and the units of the tensile strength per 25 mm width of the wet tissue may be expressed as "N/25 mm".

The tensile strength is preferably within the range specified above in any direction of the wet tissue, such as in both the machine direction and the cross-machine direction during production of the first sheet and second sheet.

The tensile strength is measured according to "7.1 General method" of the Wet Tensile Strength Test Methods for Paper or Boards" of JIS P 8135:1998, except for the difference specified below.

A multilayer sheet is cut to 25 mm width x 150 mm length to prepare a sample, which is immersed in distilled water with a mass ratio of 250 mass%, after which the sample is set on a wire mesh for 1 minute. Next, under conditions with an atmosphere of 20°C and 65% relative humidity, the sample is set in a Tensilon tensile tester with a chuck spacing of 100 mm, and the sample is subjected to a tensile test at a pull rate of 100 mm/min, measuring the tensile strength (N) when the sample is torn.
In the wet tissue of the present disclosure, the fiber density of the first hydrophobic fiber-containing layer is preferably 30 to 90 g/m², more preferably 40 to 80 g/m², even more preferably 50 to 70 g/m² and yet more preferably if the mean fiber length is smaller than 2.0 mm, the wet strength of the first sheet and second sheet will be reduced, and the mean fiber length of preferably 2.0 mm or greater, more preferably 2.5 mm or greater and even more preferably 3.0 mm or greater.

If the mean fiber length is longer, the absolute number of tangled points between the fibers in the first sheet and second sheet will increase, tending to lower the water disintegratability. The mean fiber length of the hydrophobic fibers and the mean fiber length of the hydrophilic fibers are preferably 6.5 mm or less, more preferably 6.0 mm or less, and even more preferably 5.5 mm or less. If the mean fiber length is greater than 6.5 mm, the absolute number of tangled points between the fibers in the first sheet and second sheet will increase, tending to lower the water disintegratability.

If the mean fiber length is longer, the absolute number of tangled points between the fibers will increase, thereby tending to lower the water disintegratability and increase the wet strength.

The basis weight is calculated by dividing the mass of each layer that has been separated, by the area. The thickness of each layer, second hydrophobic fiber-containing layer, first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer) by the thickness of each layer, and is compared.

The thickness of the multilayer sheet is the thickness in the region of the multilayer sheet where the connected sections are not present. The thickness of the first sheet and the second sheet, when containing no chemical solution, each have a basis weight of preferably 7 to 23 g/m², more preferably 10 to 20 g/m², even more preferably 15 to 45 g/m², more preferably 20 to 40 g/m², even more preferably 25 to 35 g/m² and yet more preferably 27 to 33 g/m². If the basis weight is lower than 15 g/m², the wet tissue may tear when the wet tissue is removed, and when the basis weight is greater than 90 g/m², the user may feel hardness when using the wet tissue.

The thickness is measured by immersing the first sheet (or second sheet) in liquid nitrogen and folding it in two, and observing the cross-section with a microscope.

The fiber density is calculated by dividing the basis weight of each layer (the first hydrophobic fiber-containing layer, second hydrophobic fiber-containing layer, first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer) by the thickness of each layer, and is compared.

As mentioned above, the multilayer sheet is obtained by drying of the wet tissue for 24 hours under conditions of 20 ±5°C, 65 ±5% RH, and vaporizing off the chemical solution from the wet tissue.

In the wet tissue of the present disclosure, each of the fibers in the first sheet and second sheet, for example, the hydrophobic fibers and hydrophilic fibers, and preferably the hydrophilic fibers other than pulp, has a mean fiber length of preferably 2.0 mm or greater, more preferably 2.5 mm or greater and even more preferably 3.0 mm or greater. If the mean fiber length is smaller than 2.0 mm, the wet strength of the first sheet and second sheet will be reduced, and the wet tissue may tear during use.

The thickness is measured by immersing the first sheet (or second sheet) in liquid nitrogen and folding it in two, and observing the cross-section with a microscope.

The basis weight is calculated by dividing the mass of each layer that has been separated, by the area. The thickness of each layer, second hydrophobic fiber-containing layer, first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer) by the thickness of each layer, and is compared.

If the mean fiber length is longer, the absolute number of tangled points between the fibers in the first sheet and second sheet will increase, tending to lower the water disintegratability.

If the mean fiber length is longer, the absolute number of tangled points between the fibers will increase, thereby tending to lower the water disintegratability and increase the wet strength.

The basis weight is calculated by dividing the mass of each layer that has been separated, by the area. The thickness of each layer, second hydrophobic fiber-containing layer, first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer) by the thickness of each layer, and is compared.

If the mean fiber length is longer, the absolute number of tangled points between the fibers will increase, thereby tending to lower the water disintegratability and increase the wet strength.

The thickness of the multilayer sheet, second hydrophobic fiber-containing layer, first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer) by the thickness of each layer, and is compared.

The basis weight is calculated by dividing the mass of each layer that has been separated, by the area. The thickness of each layer, second hydrophobic fiber-containing layer, first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer) by the thickness of each layer, and is compared.

If the mean fiber length is longer, the absolute number of tangled points between the fibers in the first sheet and second sheet will increase, tending to lower the water disintegratability.

If the mean fiber length is longer, the absolute number of tangled points between the fibers will increase, thereby tending to lower the water disintegratability and increase the wet strength.

The basis weight is calculated by dividing the mass of each layer that has been separated, by the area. The thickness of each layer, second hydrophobic fiber-containing layer, first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer) by the thickness of each layer, and is compared.

If the mean fiber length is longer, the absolute number of tangled points between the fibers will increase, thereby tending to lower the water disintegratability and increase the wet strength.

The thickness of the multilayer sheet, second hydrophobic fiber-containing layer, first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer) by the thickness of each layer, and is compared.

If the mean fiber length is longer, the absolute number of tangled points between the fibers will increase, thereby tending to lower the water disintegratability and increase the wet strength.

The basis weight is calculated by dividing the mass of each layer that has been separated, by the area. The thickness of each layer, second hydrophobic fiber-containing layer, first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer) by the thickness of each layer, and is compared.

If the mean fiber length is longer, the absolute number of tangled points between the fibers will increase, thereby tending to lower the water disintegratability and increase the wet strength.

The basis weight is calculated by dividing the mass of each layer that has been separated, by the area. The thickness of each layer, second hydrophobic fiber-containing layer, first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer) by the thickness of each layer, and is compared.

If the mean fiber length is longer, the absolute number of tangled points between the fibers will increase, thereby tending to lower the water disintegratability and increase the wet strength.

The thickness of the multilayer sheet, second hydrophobic fiber-containing layer, first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer) by the thickness of each layer, and is compared.

If the mean fiber length is longer, the absolute number of tangled points between the fibers will increase, thereby tending to lower the water disintegratability and increase the wet strength.

The basis weight is calculated by dividing the mass of each layer that has been separated, by the area. The thickness of each layer, second hydrophobic fiber-containing layer, first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer) by the thickness of each layer, and is compared.

If the mean fiber length is longer, the absolute number of tangled points between the fibers will increase, thereby tending to lower the water disintegratability and increase the wet strength.

The thickness of the multilayer sheet, second hydrophobic fiber-containing layer, first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer) by the thickness of each layer, and is compared.

If the mean fiber length is longer, the absolute number of tangled points between the fibers will increase, thereby tending to lower the water disintegratability and increase the wet strength.

The basis weight is calculated by dividing the mass of each layer that has been separated, by the area. The thickness of each layer, second hydrophobic fiber-containing layer, first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer) by the thickness of each layer, and is compared.

If the mean fiber length is longer, the absolute number of tangled points between the fibers will increase, thereby tending to lower the water disintegratability and increase the wet strength.

The thickness of the multilayer sheet, second hydrophobic fiber-containing layer, first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer) by the thickness of each layer, and is compared.

If the mean fiber length is longer, the absolute number of tangled points between the fibers will increase, thereby tending to lower the water disintegratability and increase the wet strength.

The basis weight is calculated by dividing the mass of each layer that has been separated, by the area. The thickness of each layer, second hydrophobic fiber-containing layer, first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer) by the thickness of each layer, and is compared.

If the mean fiber length is longer, the absolute number of tangled points between the fibers will increase, thereby tending to lower the water disintegratability and increase the wet strength.

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sections are not present.

[0123] As mentioned above, the multilayer sheet is obtained by drying of the wet tissue for 24 hours under conditions of 20 ±5°C, 65 ±5% RH, and vaporizing off the chemical solution. Also, the first sheet and second sheet are obtained by detaching the first sheet and second sheet from the multilayer sheet.

[0124] The thicknesses of the first sheet and second sheet, and of the multilayer sheet, are measured using an FS-60DS by Daike Kagaku Seiki Mfg. Co., Ltd., under the conditions, probe: 15 cm², measuring load: 3 gf/cm².

[0125] In a wet tissue according to another embodiment of the present disclosure, the first hydrophilic fiber-containing layer and the second hydrophilic fiber-containing layer are disposed on the surface layer of a multilayer sheet, the multilayer sheet having a ridge-furrow structure formed by spraying a high-pressure water jet onto one or both surfaces of the multilayer sheet.

[0126] Fig. 4 is a diagram illustrating such an embodiment, corresponding to a cross-sectional view along plane II-II of Fig. 1. In the wet tissue 1 shown in Fig. 4, the first hydrophilic fiber-containing layer 2a and second hydrophilic fiber-containing layer 3a are disposed on the surface layer of the multilayer sheet 4, and the multilayer sheet 4 has a ridge-furrow structure including a plurality of ridges 8 and a plurality of furrows 9 formed by spraying a high-pressure water jet on both surfaces of the multilayer sheet 4, and specifically the surface 10’ and surface 10”. If the wet tissue has a ridge-furrow structure as shown in Fig. 4, the dirt removal property will be improved on both surfaces of the wet tissue.

[0127] The steps for forming ridges and furrows in the first sheet and/or second sheet will be explained under "Method of producing wet tissue".

[0128] A wet tissue according to yet another embodiment of the present disclosure has a fold structure formed by crepe treatment of the first sheet and/or second sheet. By having a fold structure, the feel of the wet tissue on the skin will improve and the dirt removal property will improve.

[0129] The steps for forming a fold structure in the wet tissue will be explained under "Method of producing wet tissue".

[0130] For the wet tissue of the present disclosure, chemical solutions with which the multilayer sheet may be impregnated include those used as chemical solutions for wet tissues in the technical field, and are not particularly restricted, with examples including aqueous solutions containing antimicrobial agents, detergents, antiseptic agents and the like, and the chemical solution may even be distilled water.

<Method of producing wet tissue>

[0131] The method of producing the wet tissue of the present disclosure includes the following steps.

(1) A step of forming first sheet
(2) A step of forming second sheet
(3) A step of stacking the second sheet on the first sheet with the first hydrophobic fiber-containing layer and second hydrophobic fiber-containing layer facing each other, to form a stacked sheet, and connecting the stacked sheet to form a multilayer sheet having a plurality of connected sections.

[0132] The steps of (1) to (3) above will also be referred to as step (1) to step (3), respectively.

Step (1) can be further divided into the following steps.

[0133]

(1 a) A step of supplying an aqueous dispersion of a starting material for the first hydrophilic fiber-containing layer onto a support, and forming a web of the first hydrophilic fiber-containing layer on the support.
(1 b) A step of spraying a high-pressure water jet onto the web of the first hydrophilic fiber-containing layer on the support from a high-pressure water jet nozzle, to tangle the fibers and form a first hydrophilic fiber-containing layer.
(1 c) A step of supplying an aqueous dispersion of a starting material for the first hydrophobic fiber-containing layer onto a support, and forming a web of the first hydrophobic fiber-containing layer on the support.
(1 d) A step of stacking the web of the first hydrophobic fiber-containing layer onto a surface of the first hydrophilic fiber-containing layer that has not been sprayed with the high-pressure water jet, and forming a water-including first sheet.
(1e) A step of drying the water-including first sheet.

[0134] The steps of (1 a) to (1e) above will also be referred to as step (1 a) to step (1e), respectively.
Step (2) can be further divided into the following steps.

[0135]

(2a) A step of supplying an aqueous dispersion of a starting material for the second hydrophilic fiber-containing layer onto a support, and forming a web of the second hydrophilic fiber-containing layer on the support.
(2b) A step of spraying a high-pressure water jet onto the web of the second hydrophilic fiber-containing layer on the support from a high-pressure water jet nozzle, to tangle the fibers and form a second hydrophilic fiber-containing layer.
(2c) A step of supplying an aqueous dispersion of a starting material for the second hydrophobic fiber-containing layer onto a support, and forming a web of the second hydrophobic fiber-containing layer on the support.
(2d) A step of stacking the web of the second hydrophobic fiber-containing layer onto a surface of the second hydrophilic fiber-containing layer that has not been sprayed with the high-pressure water jet, and forming a water-including second sheet.
(2e) A step of drying the water-including second sheet.

[0136] The steps of (2a) to (2e) above will also be referred to as step (2a) to step (2e), respectively.

[0137] In step (1a) and step (2a), following a method known in the technical field, the aqueous dispersion of starting material for each of the first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer is supplied onto the support, forming the respective webs of the first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer on the support.

[0138] In step (1b) and step (2b), the web of each of the first hydrophilic fiber-containing layer and the web of the second hydrophilic fiber-containing layer is sprayed with a high-pressure water jet discharged from a high-pressure water jet nozzle, to form the first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer. The web of the first hydrophilic fiber-containing layer and the web of the second hydrophilic fiber-containing layer are subjected to energy of preferably 0.03 to 0.25 kW/m², more preferably 0.04 to 0.20 kW/m², even more preferably 0.05 to 0.15 kW/m², yet more preferably 0.06 to 0.12 kW/m², and even yet more preferably 0.07 to 0.10 kW/m².

[0139] If the energy is lower than 0.03 kW/m², the degree of intertangling of the fibers will be insufficient, tending to result in lower wet strength. Moreover if the energy is higher than 0.25 kW/m², tangling of the fibers will progress, increasing the wet strength, but the water disintegratability will tend to be lower, and the bending resistance will tend to be higher.

[0140] The high-pressure water jet energy is calculated by the following formula.

\[
\text{High-pressure water jet energy (kW/m}^2\) = 1.63 \times \text{spray pressure (kg/cm}^2\) \times \text{spray flow rate (m}^3/\text{min)} / \text{transport speed (M/min)} / 60
\]

[0141] The value of the spray flow rate (m³/min) is calculated by the following formula.

\[
\text{Spray flow rate (m}^3/\text{min)} = 750 \times \text{orifice total open area (m}^2\) \times \text{spray pressure (kg/cm}^2\)^{0.495}
\]

[0142] The spray pressure is the pressure inside the nozzle at the point of spraying from the high-pressure water jet nozzles, the spray flow rate is the total flow per minute of the high-pressure water jet sprayed from the high-pressure water jet nozzles, and the orifice total open area is the total nozzle area of the high-pressure water jet nozzles.

[0143] The high-pressure water jet nozzle preferably has hole diameters of 70 to 130 μm. If the hole diameters are smaller than 70 μm the nozzle may tend to become clogged, and if the hole diameters are larger than 130 μm the efficiency of fiber tangling will tend to be reduced.

[0144] The high-pressure water jet nozzle pitch will generally be in the range of 0.3 to 1.0 mm.

[0145] The high-pressure water jet nozzle sprays the high-pressure water jet onto the web from a distance of preferably 0.5 to 3.0 cm, more preferably 0.5 to 2.0 cm and even more preferably 0.5 to 1.0 cm. If the spacing is less than 0.5 cm the web may tear, and if the spacing is greater than 3.0 cm the tangling of fibers in the web will tend to be insufficient.

[0146] In step (1c) and step (2c), following a method known in the technical field, the aqueous dispersion of the starting material for the first hydrophobic fiber-containing layer and the aqueous dispersion of the second hydrophobic fiber-containing layer are supplied onto the support, respectively forming a web of the first hydrophobic fiber-containing layer...
and a web of the second hydrophobic fiber-containing layer on the support.

[0147] In step (1d), the web of the first hydrophobic fiber-containing layer is stacked onto the surface of the first hydrophilic fiber-containing layer that has not been sprayed with the high-pressure water jet, and a water-including first sheet is formed. By stacking the first hydrophilic fiber-containing layer and the first hydrophobic fiber-containing layer before drying, the fibers contained therein become entangled, thereby connecting the first hydrophobic fiber-containing layer and the first hydrophilic fiber-containing layer.

[0148] From the viewpoint of the connecting strength between the first hydrophobic fiber-containing layer and the first hydrophilic fiber-containing layer, the first hydrophobic fiber-containing layer preferably further includes hydrophilic fibers. This is because in the subsequent step (1e), the hydrophilic fibers of the first hydrophobic fiber-containing layer and the hydrophilic fibers of the first hydrophilic fiber-containing layer form hydrogen bonds, and the first hydrophobic fiber-containing layer and first hydrophilic fiber-containing layer are become connected by them.

[0149] Step (2d) is similar to step (1d), and from the viewpoint of the connecting strength between the second hydrophobic fiber-containing layer and the second hydrophilic fiber-containing layer, the second hydrophobic fiber-containing layer preferably further includes hydrophilic fibers.

[0150] In step (1e) and step (2e), the sheet is dried by a method known in the technical field. The first sheet and second sheet are each preferably dried at a temperature that is lower, more preferably a temperature of at least 10°C lower, even more preferably a temperature of at least 20°C lower and yet more preferably a temperature of at least 30°C lower than the melting point of the hydrophobic fibers. If the drying temperature is close to the melting point of the hydrophobic fibers, the hydrophobic fibers may melt during drying, and the hydrophobic fibers may fuse with the other fibers, lowering the water disintegratability of the wet tissue.

[0151] When the hydrophobic fibers include multiple components, the melting point is the lowest among the melting points of the multiple components.

[0152] When the first sheet includes heat-fusible fibers comprising composite fibers that include a low-melting-point component and a high-melting-point component, as the hydrophobic fibers, the first sheet is dried in step (1e) at a temperature that is preferably lower, more preferably a temperature of at least 10°C lower, even more preferably a temperature of at least 20°C lower and yet more preferably a temperature that is at least 30°C lower, than the melting point of the low-melting-point component in the first sheet. If the drying temperature is close to the melting point of the low-melting-point component, the low-melting-point component may melt during drying, and the heat-fusible fibers may fuse with the other fibers, lowering the water disintegratability of the wet tissue.

[0153] The same applies when the second sheet includes heat-fusible fibers comprising composite fibers that include a low-melting-point component and a high-melting-point component as the hydrophobic fibers.

[0154] Incidentally, step (1e) and step (2e) can be carried out using a dryer known in the technical field, for example, a roll-type dryer, such as a Yankee dryer. When a roll-type dryer is used to dry the first sheet, preferably the first sheet is dried in such a manner that the first hydrophobic fiber-containing layer does not contact with the roll of the roll-type dryer, or in other words, the first sheet is dried with the first hydrophilic fiber-containing layer contacting the roll of the roll-type dryer. This is in order to prevent fouling of the roll due to fusion of the hydrophobic fibers. The same applies for the second sheet as well.

[0155] In step (3), using a method known in the technical field, the second sheet is stacked on the first sheet with the first hydrophobic fiber-containing layer and second hydrophobic fiber-containing layer facing each other, to form a stacked sheet, and the stacked sheet is connected to form a multilayer sheet having a plurality of connected sections.

[0156] For example, in an embodiment in which the connected sections are embossed sections and the hydrophobic fibers are heat-fusible fibers comprising composite fibers that include a low-melting-point component and a high-melting-point component, preferably the stacked sheet is embossed at a temperature of at least the melting point of the low-melting-point component and below the melting point of the high-melting-point component, or more preferably the stacked sheet is embossed at a temperature of at least 10°C higher than the melting point of the low-melting-point component and more than 10°C below the melting point of the high-melting-point component, even more preferably the stacked sheet is embossed at a temperature of at least 20°C higher than the melting point of the low-melting-point component and more than 20°C below the melting point of the high-melting-point component, and even yet more preferably the stacked sheet is embossed at a temperature of at least 30°C higher than the melting point of the low-melting-point component and more than 30°C below the melting point of the high-melting-point component.

[0157] If the embossing temperature is close to the melting point of the low-melting-point component, melting of the low-melting-point component will be insufficient, and connection between the first sheet and second sheet will also be sufficient, or the time for the embossing step will tend to be longer. If the embossing temperature is close to the melting point of the high-melting-point component, the high-melting-point component will melt and the embossed sections may become hard.

[0158] For example, when the connected sections are adhesive sections or pressure-sensitive adhesive sections, the adhesive or pressure-sensitive adhesive may be coated on the first hydrophobic fiber-containing layer and/or second hydrophobic fiber-containing layer, and the first sheet may be stacked on the second sheet with the first hydrophobic
The method of producing the wet tissue of the present disclosure may include, after step (3), the following step:

(4) a step of impregnating the multilayer sheet with a chemical solution.

The step of (4) above will also be referred to as step (4).

A method of producing the wet tissue of the present disclosure will now be explained with reference to the drawings.

Fig. 5 is a schematic diagram for illustration of a method of producing a wet tissue according to one embodiment of the present disclosure, and specifically of step (1) and step (2).

In the production apparatus 101 shown in Fig. 5, an aqueous dispersion of the starting material for the first hydrophilic fiber-containing layer is supplied onto a support 103 from a starting material supply head 102, and a web 104 of the first hydrophilic fiber-containing layer is formed on the support 103.

Next, the web 104 is dewatered by a suction box 107, and the web 104 is passed between two high-pressure water jet nozzles 105 disposed over the support 103, and two suction boxes 107 that collect water sprayed from the high-pressure water jet nozzles 105, disposed at locations facing the high-pressure water jet nozzles 105 in a manner sandwiching the support 103. During passage, the web 104 receives a high-pressure water jet from the high-pressure water jet nozzle 105, tangling the fibers together and forming a first hydrophilic fiber-containing layer 106 that contains water.

Depending on the spacing of the high-pressure water jet nozzles 105, the energy received from the high-pressure water jets, etc., ridges and furrows will sometimes be formed on the surface of the first hydrophilic fiber-containing layer 106 facing the high-pressure water jet nozzles 105.

Concomitantly with formation of the first hydrophilic fiber-containing layer 106, an aqueous dispersion of the starting material for the first hydrophobic fiber-containing layer is supplied onto the support 113 from a starting material supply head 112, and a web 114 of the first hydrophobic fiber-containing layer is formed on the support 113. Next, the web 114 is dewatered by a suction box 117 and the dewatered web 114 is transferred onto a transport conveyor 121.

The web 114 of the first hydrophobic fiber-containing layer transported by the transport conveyor 121 is then stacked on the first hydrophilic fiber-containing layer 106 to form a first sheet 122.

Next, the first sheet 122 is transferred to the transport conveyor 123, after which it is transferred to a dryer 124. The dryer 124 may be a yankee dryer, for example. The dried first sheet 122 is then wound onto a wind-up roll 125.

The second sheet can be produced using the production apparatus 101 shown in Fig. 5, similar to the first sheet, and therefore it will not be explained here. By adjusting the starting material composition and starting material supply rate for production, it is possible to adjust the fiber composition, basis weight, etc. of the second sheet.

Fig. 6 is a schematic diagram for illustration of a method of producing a wet tissue according to one embodiment of the present disclosure, and specifically of step (3) and step (4).

In the production apparatus 101’ shown in Fig. 6, the second sheet 127 wound out from the wind-up roll 125 is stacked onto the first sheet 122 wound out from the wind-up roll 125, with the first hydrophobic fiber-containing layer (not shown) and the second hydrophobic fiber-containing layer (not shown) facing each other, to form the stacked sheet 128.

The stacked sheet 128 is then passed between a pair of embossing rolls 129 that are heated, to form a multilayer sheet 130 having a plurality of embossed sections (not shown). In the multilayer sheet 130, a plurality of embossed sections (not shown) are formed connecting the first hydrophobic fiber-containing layer (not shown) and second hydrophobic fiber-containing layer (not shown).

The multilayer sheet 130 is then cut to a prescribed size and the cut sheet is folded and impregnated with a chemical solution to complete the wet tissue.
Examples

[0179] The present disclosure will now be explained in fuller detail by examples, with the understanding that it is not meant to be limited to the examples.

[Starting materials]

[Hydrophilic fibers]

- Non-beaten pulp

[0180] Northern bleached Kraft pulp (NBKP, CSF: 740 mL) was prepared.

- Beaten pulp

[0181] The Northern bleached Kraft pulp was mixed with a mixer to obtain beaten pulp having a CSF of 600 mL.

- Rayon (A)

[0182] Corona (mean fiber length: 5 mm, 0.7 dtex) by Daiwabo Rayon Co., Ltd. was prepared.

- Rayon (B)

[0183] Rayon (mean fiber length: 7 mm, 0.7 dtex) by OmiKenshi Co., Ltd. was prepared.

[Hydrophobic fibers]

- Heat-fusible fibers

[0184] Core-sheath composite fibers (trade name: Tepilus, type: TJ04BN, cut length: 5 mm, 2.2 dtex) by Teijin, Ltd. were prepared. The core was PET with a melting point of 265°C, and the sheath was terephthalate-based fiber with a melting point of 150°C.

[Production Example 1]

[0185] Aqueous dispersion No. 1 as the starting material for the first hydrophilic fiber-containing layer, containing 70 parts by mass of beaten pulp and 30 parts by mass of rayon (A), was prepared. In the production apparatus shown in Fig. 5, aqueous dispersion No. 1 as the starting material for the first hydrophilic fiber-containing layer was supplied onto the support (OS80 by Nippon Filcon Co., Ltd.) from the starting material supply head, and dewatering was carried out from a suction box to form web No. 1 of the first hydrophilic fiber-containing layer.

[0186] Next, a high-pressure water jet was sprayed onto web No. 1 of the first hydrophilic fiber-containing layer from a high-pressure water jet nozzle, while suctioning the water by suction from below the support, to obtain first hydrophilic fiber-containing layer No. 1. The high-pressure water jet nozzles were situated at a distance of about 2 cm from above web No. 1 for the first sheet, and they had hole diameters of 92 μm and hole pitches of 0.5 mm. The energy received by the high-pressure water jet was 0.088 (KW/m²).

[0187] Concomitant with production of web No. 1 for the first hydrophilic fiber-containing layer, aqueous dispersion No. 1 was prepared as the starting material for the first hydrophobic fiber-containing layer, containing 60 parts by mass of beaten pulp, 32 parts by mass of non-beaten pulp and 8 parts by mass of heat-fusible fiber. In the production apparatus shown in Fig. 5, aqueous dispersion No. 1 as the starting material for the first hydrophilic fiber-containing layer was supplied onto the support (OS80 by Nippon Filcon Co., Ltd.) from the starting material supply head, and dewatering was carried out from a suction box to form web No. 1 of the first hydrophilic fiber-containing layer.

[0188] Web No. 1 for the hydrophobic fiber-containing layer was stacked over hydrophilic fiber-containing layer No. 1, to form first sheet No. 1 containing water, and first sheet No. 1 was dried for about 4 seconds with a yankee dryer kept at 120°C. The dried first sheet No. 1 had hydrophobic fiber-containing layer No. 1 and hydrophilic fiber-containing layer No. 1 connected by hydrogen bonding, for example.

[0189] Second sheet No. 1 was obtained by the same production method as for first sheet No. 1.

[0190] Second sheet No. 1 was stacked onto first sheet No. 1 with the first hydrophobic fiber-containing layer No. 1 and second hydrophobic fiber-containing layer No. 1 facing each other, to form stacked sheet No. 1, and then the stacked
sheet No. 1 was passed through a pair of embossing rolls that had been heated to 160°C, to form multilayer sheet No. 1 having a plurality of embossed sections. The pair of embossing rolls had rotational axis lines in the direction perpendicular to the machine direction, and had protrusions with diameters of 2.2 mm disposed on the outer peripheral surface of the upper roll in a square zigzag fashion at a pitch of 20 mm in the machine direction and 20 mm in the cross-machine direction, while the surface of the lower roll was flat.

[0191] Multilayer sheet No. 1 had embossed sections with diameters of 2.2 mm (area: approximately 3.8 mm²) arranged in a square zigzag fashion at a pitch of 20 mm in the machine direction and 20 mm in the cross-machine direction, the spacing of the embossed sections was approximately 12 mm, and the embossed sections had an area ratio of 1.7% with respect to the multilayer sheet.

[0192] Multilayer sheet No. 1 was cut to approximately 20 cm x 13 cm and impregnated with a chemical solution to produce wet tissue No. 1.

[Comparative Production Example 1]

[0193] A wet tissue was produced according to the method described in PTL 5. Specifically, 26 parts by mass of beaten pulp (CSF: 600 mL), 50 parts by mass of non-beaten pulp (CSF: 740 mL), 21 parts by mass of rayon (B) and 3 parts by mass of fibrillated cellulose fiber were mixed together with water, and a square sheet machine was used to produce a fiber web by a wet paper forming method.

[0194] The fiber web was placed on a 100 mesh plastic net, and the fiber web was sprayed with a high-pressure water jet from high-pressure water jet nozzles (nozzle diameter: 92 μm, 0.5 mm pitch) while suctioning off the water by suction from below, after which it was dried with a rotary dryer to obtain sheet No. 2. Sheet No. 2 was impregnated with a chemical solution to obtain wet tissue No. 2. The energy received by the high-pressure water jet was 0.285 (KW/m²).

[0195] Incidentally, the fibrillated cellulose fiber was prepared by wet beating Tencel (trade name of Lenzing (Austria), mean fiber length: 3 mm, 1.7 dtex) with a batch macerator (pulper by Aikawa Iron Works Co.) and a continuous macerator (B-type Top Finer by Aikawa Iron Works Co.), and the fiber length in the peak of the weight-weighted average fiber length distribution of the fibrillated cellulose was 3 mm, the mass of the microfiber portion was 1.54 mass%, and the Canadian Standard Freeness was 200 mL.

[Example 1 and Comparative Example 1]

[0196] The physical properties of the first sheets, second sheets, multilayer sheets and wet tissues produced in Production Example 1 and Comparative Production Example 1 were evaluated.

[0197] The results are shown in Table 1.

[0198] In Table 1, the "basis weight" was calculated by dividing the mass of the sheet by the area.

[0199] The "thickness" was measured using an FS-60DS by Daiel Kagaku Seiki Mfg. Co., Ltd. (probe: 15 cm², measuring load: 3 gf/cm²), and the mean value of the thickness at 3 locations was used.

[0200] The "wet strength" for the wet tissue was measured by the method described in the present specification, and for the first sheet and second sheet it was measured in the same manner as for the wet tissue, after allowing the sheet to absorb 250 mass% of distilled water. The tensile strength was measured using an AGS-1kNG autograph by Shimadzu Corp.

[0201] The "disintegratability" was measured by the method described in the present specification. For the first sheet and second sheet, the first sheet and second sheet were separated after embossing was formed in the multilayer sheet, and were supplied to a disintegration test. For the wet tissue, it was supplied directly to the disintegration test. The disintegratability was measured using a TTP stirrer for paper disintegration testing, by As One Corp.

[0202] The "bending resistance" was measured by the method described in the present specification.

[0203] In Table 1, the indication "wet" is for samples measured while containing chemical solution or distilled water, while "dry" is for samples measured without containing chemical solution or distilled water.

Table 1

<table>
<thead>
<tr>
<th>Example No.</th>
<th>Example 1</th>
<th>Comp. Example 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>First sheet and second sheet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sheet No.</td>
<td>No.1</td>
<td>No.2</td>
</tr>
<tr>
<td>Sheet type</td>
<td>First</td>
<td>Second</td>
</tr>
</tbody>
</table>
Table 1 shows that in Example 1, the tensile strength of the wet tissue in the machine direction and cross-machine direction was greater than 1.0 N/25 mm, while the disintegratability of the first sheet and second sheet was less than 100 seconds, indicating that both wet strength and water disintegratability had been obtained.
[Reference Production Example 1]

[0205] Starting material No. 1 for a first sheet was prepared containing 45 parts by mass of beaten pulp, 32 parts by mass of non-beaten pulp, 15 parts by mass of rayon (A) and 8 parts by mass of heat-fusible fibers. In the production apparatus shown in Fig. 5, starting material No. 1 for the first sheet was supplied onto the support (OS80 by Nippon Filcon Co., Ltd.) from the starting material supply head, and dewatering was carried out from the suction boxes to form web No. 11 for the first sheet.

[0206] Next, a high-pressure water jet was sprayed onto web No. 11 for the first sheet from the high-pressure water jet nozzles, while suctioning the water with a suction from below the support, to obtain first sheet No. 11. The high-pressure water jet nozzles were situated at a distance of about 2 cm from above web No. 11 for the first sheet, and they had hole diameters of 92 μm and hole pitches of 0.5 mm. The energy received by the high-pressure water jets was 0.088 (KW/m²).

[0207] Next, first sheet No. 11 was dried for approximately 4 seconds with a yankee dryer kept at 120°C.

[0208] Second sheet No. 11 was obtained by the same production method as for first sheet No. 11.

[0209] Second sheet No. 11 was stacked onto first sheet No. 11 to form stacked sheet No. 11, and then stacked sheet No. 11 was passed through a pair of embossing rolls that had been heated to 160°C, to form multilayer sheet No. 11 having a plurality of embossed sections. The pair of embossing rolls were identical to those used in Production Example 1.

[0210] Multilayer sheet No. 1 was cut to approximately 20 cm x approximately 13 cm and impregnated with a chemical solution to produce wet tissue No. 1.

[Reference Production Example 2]

[0211] First sheet No. 12, second sheet No. 12, multilayer sheet No. 12 and wet tissue No. 12 were produced in the same manner as Reference Production Example 1, except that the upper roll of the pair of embossing rolls was changed to one having protrusions with diameters of 0.88 mm arranged in a 60° zigzag pattern with a pitch of 4.5 mm in the cross-machine direction.

[0212] Multilayer sheet No. 12 had embossed sections with diameters of 0.88 mm (area: approximately 0.6 mm²) arranged in a 60° zigzag fashion at a pitch of 4.5 mm in the cross-machine direction, the spacing of the embossed sections being approximately 3.6 mm, and the embossed sections having an area ratio of 3.4% with respect to the multilayer sheet.

[Reference Production Example 3]

[0213] First sheet No. 13, second sheet No. 13, multilayer sheet No. 13 and wet tissue No. 13 were produced in the same manner as Reference Production Example 1, except that the upper roll of the pair of embossing rolls was changed to one having on the outer peripheral surface protrusions with widths of 1.5 mm protruding in the direction perpendicular to the rotational axis line, arranged continuously at a pitch of 10 mm.

[0214] Multilayer sheet No. 13 had embossed sections with widths of 1.5 mm, extending in the machine direction, arranged in a striped fashion at a pitch of 10 mm in the cross-machine direction, the spacing between the embossed sections being 8.5 mm, and the embossed sections having an area ratio of 15% with respect to the multilayer sheet.

[Reference Examples 1 to 3]

[0215] The physical properties of the first sheets, second sheets, multilayer sheets and wet tissues produced in Reference Production Examples 1 to 3 were evaluated.

[0216] The results are shown in Table 2.

<table>
<thead>
<tr>
<th>Reference example No.</th>
<th>Reference Example 1</th>
<th>Reference Example 2</th>
<th>Reference Example 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>First sheet and second sheet</td>
<td>No.11</td>
<td>No.12</td>
<td>No.13</td>
</tr>
<tr>
<td>First sheet/second sheet</td>
<td>First</td>
<td>Second</td>
<td>First</td>
</tr>
<tr>
<td>Beaten pulp (parts)</td>
<td>45</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Non-beaten pulp (parts)</td>
<td>32</td>
<td>32</td>
<td>32</td>
</tr>
</tbody>
</table>
While not direct examples of the present invention, Table 2 suggests that the water disintegratability is excellent even when the embossing spacing is shorter than the rayon mean fiber length. Furthermore, Table 2 suggests that the water disintegratability is excellent even when the area ratio of the adhesive sections is high.

Specifically, the present disclosure relates to the following aspects J1 to J16.

A wet tissue with water disintegratability, including a multilayer sheet comprising a first sheet and a second sheet, wherein the first sheet includes a first hydrophilic fiber-containing layer including hydrophilic fibers at 95 to 100 mass% and a first hydrophobic fiber-containing layer including hydrophobic fibers at 5 to 30 mass%, and the second sheet includes a second hydrophilic fiber-containing layer including hydrophilic fiber at 95 to 100 mass% and a second hydrophobic fiber-containing layer including hydrophobic fiber at 5 to 30 mass%,
the multilayer sheet having a plurality of connected sections, disposed across spacings, where the first hydrophobic fiber-containing layer and the second hydrophobic fiber-containing layer are connected, the spacings between the plurality of connected sections being 0.6 times or above the mean fiber length of the hydrophobic fibers of the first hydrophobic fiber-containing layer and 0.6 times or above the mean fiber length of the hydrophobic fibers of the second hydrophobic fiber-containing layer, the plurality of connected sections having an area ratio of 0.5 to 12.0% with respect to the multilayer sheet, each of the first sheet and second sheet, which is separated from the multilayer sheet, having a disintegratability of 100 seconds or less in a disintegration test, the multilayer sheet having a bending resistance of 150 mm or less, and the wet tissue having a tensile strength of 1.0N or greater per 25 mm width.

[J2]

[0220] The wet tissue according to J1, wherein a fiber density of the first hydrophobic fiber-containing layer is higher than a fiber density of the first hydrophilic fiber-containing layer, and/or a fiber density of the second hydrophobic fiber-containing layer is higher than a fiber density of the second hydrophilic fiber-containing layer.

[J3]

[0221] The wet tissue according to J1 or J2, wherein the first hydrophilic fiber-containing layer and the second hydrophilic fiber-containing layer are disposed on the surface layer of the multilayer sheet, the multilayer sheet having a ridge-furrow structure formed by spraying a high-pressure water jet on one or both surfaces of the multilayer sheet.

[J4]

[0222] The wet tissue according to any one of J1 to J3, wherein each of the first hydrophobic fiber-containing layer and second hydrophobic fiber-containing layer includes, as the hydrophobic fibers, heat-fusible fibers consisting of composite fibers that include a low-melting-point component and a high-melting-point component having a higher melting point than the low-melting-point component.

[J5]

[0223] The wet tissue according to J4, wherein each of the plurality of the connected sections is an embossed section, and in the embossed section, at least some of the low-melting-point component of the hydrophobic fibers of the first hydrophobic fiber-containing layer are fused with the fibers in the second hydrophobic fiber-containing layer, and/or at least some of the low-melting-point component of the hydrophobic fibers of the second hydrophobic fiber-containing layer are fused with the fibers in the first hydrophobic fiber-containing layer.

[J6]

[0224] The wet tissue according to any one of J1 to J5, wherein the hydrophobic fibers of the first hydrophobic fiber-containing layer and/or the hydrophobic fibers of the second hydrophobic fiber-containing layer have a mean fiber length of 6.5 mm or less.

[J7]

[0225] The wet tissue according to any one of J1 to J6, wherein each of the plurality of connected sections has an area of 0.4 to 9 mm².

[J8]

[0226] The wet tissue according to any one of J1 to J7, wherein each of the first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer includes hydrophilic fibers at 100 mass%, and each of the first hydrophobic fiber-containing layer and second hydrophobic fiber-containing layer includes hydrophobic fibers at 5 to 30 mass% and hydrophilic fibers at 70 to 95 mass%.
The wet tissue according to any one of J1 to J8, wherein the hydrophilic fibers of the first hydrophilic fiber-containing layer and/or the hydrophilic fibers of the second hydrophilic fiber-containing layer include pulp and regenerated cellulose.

The wet tissue according to any one of J1 to J9, wherein the wet tissue has a fold structure formed by crepe treatment of the first sheet and/or second sheet.

A method of producing the wet tissue according to any one of J1 to J10, the method including the steps of:

1. forming the first sheet;
2. forming the second sheet; and
3. stacking the second sheet onto the first sheet with the first hydrophobic fiber-containing layer and the second hydrophobic fiber-containing layer facing each other, to form a stacked sheet, and connecting the stacked sheet to form a multilayer sheet having a plurality of connected sections.

The method according to J11, wherein step (1) further includes the steps of:

1.a. supplying an aqueous dispersion of a starting material for the first hydrophilic fiber-containing layer onto a support, and forming a web of the first hydrophilic fiber-containing layer on the support;
1.b. spraying the web of the first hydrophilic fiber-containing layer on the support with a high-pressure water jet from a high-pressure water jet nozzle to tangle the fibers, and form a first hydrophilic fiber-containing layer;
1.c. supplying an aqueous dispersion of a starting material for the first hydrophobic fiber-containing layer onto a support, and forming a web of the first hydrophobic fiber-containing layer on the support;
1.d. stacking the web of the first hydrophobic fiber-containing layer onto a surface of the first hydrophilic fiber-containing layer that has not been sprayed with the high-pressure water jet, and forming a water-including first sheet; and
1.e. drying the water-including first sheet.

The method according to J11 or J12, wherein step (2) further includes the steps of:

2.a. supplying an aqueous dispersion of a starting material for the second hydrophilic fiber-containing layer onto a support, and forming a web of the second hydrophilic fiber-containing layer on the support;
2.b. spraying the web of the second hydrophilic fiber-containing layer on the support with a high-pressure water jet from a high-pressure water jet nozzle to tangle the fibers, and form a second hydrophilic fiber-containing layer;
2.c. supplying an aqueous dispersion of a starting material for the second hydrophobic fiber-containing layer onto a support, and forming a web of the second hydrophobic fiber-containing layer on the support;
2.d. stacking the web of the second hydrophobic fiber-containing layer onto a surface of the second hydrophilic fiber-containing layer that has not been sprayed with the high-pressure water jet, and forming a water-including second sheet; and
2.e. drying the water-including second sheet.

The method according to any one of J11 to J13, wherein each of the first hydrophobic fiber-containing layer and the second hydrophobic fiber-containing layer include, as hydrophobic fibers, heat-fusible fibers consisting of composite fibers including a low-melting-point component and a high-melting-point component having a higher melting point than the low-melting-point component, in step (1), the water-including first sheet is dried at a temperature lower than the melting point of the low-melting-point component of the hydrophobic fibers in the first hydrophobic fiber-containing
layer, and in step (2), the water-including second sheet is dried at a temperature lower than the melting point of the low-melting-point component of the hydrophobic fibers in the second hydrophobic fiber-containing layer.

[J15]

[0233] The method according to J14, wherein in step (3), the stacked sheet is embossed at a temperature at or above the melting point of the low-melting-point component of the hydrophobic fibers in the first hydrophobic fiber-containing layer and the low-melting-point component of the hydrophobic fibers in the second hydrophobic fiber-containing layer, and below the melting point of the high-melting-point component of the hydrophobic fibers in the first hydrophobic fiber-containing layer and the high-melting-point component of the hydrophobic fibers in the second hydrophobic fiber-containing layer, to form a multilayer sheet having a plurality of connected sections.

[J16]

[0234] The method according to J12, wherein in step (1e), the water-including first sheet is dried while contacting the first hydrophilic fiber-containing layer with a roll of a roll-type dryer.

[J17]

[0235] The method according to J13, wherein in step (2e), the water-including second sheet is dried while contacting the second hydrophilic fiber-containing layer with a roll of a roll-type dryer.

[J18]

[0236] The method according to any one of J11 to J17, wherein step (1) further includes a step of crepe treatment of the first sheet, and/or step (2) further includes a step of crepe treatment of the second sheet.

Explanation of Symbols

[0237]

1 Wet tissue
2 First sheet
  2a First hydrophilic fiber-containing layer
  2b First hydrophobic fiber-containing layer
3 Second sheet
  3a Second hydrophilic fiber-containing layer
  3b Second hydrophobic fiber-containing layer
4 Multilayer sheet
5 Connected section
6 Hydrophobic fiber
7 Tangled point
8 Ridge
9 Furrow
10 Surface
101 Production apparatus
102, 112 Starting material supply head
103, 113 Support
104, 114 Webs
105 High-pressure water jet nozzle
106 First hydrophilic fiber-containing layer
107 Suction box
121, 123 Transport conveyor
122 First sheet
125, 126 Wind-up roll
127 Second sheet
128 Stacked sheet
129 Embossing roll
Claim 1. A wet tissue with water disintegratability, including a multilayer sheet comprising a first sheet and a second sheet, wherein the first sheet includes a first hydrophilic fiber-containing layer including hydrophilic fibers at 95 to 100 mass% and a first hydrophobic fiber-containing layer including hydrophobic fiber at 5 to 30 mass%, and the second sheet includes a second hydrophilic fiber-containing layer including hydrophilic fibers at 95 to 100 mass% and a second hydrophobic fiber-containing layer including hydrophobic fiber at 5 to 30 mass%, the first hydrophobic fiber-containing layer being disposed adjacent to the second hydrophobic fiber-containing layer, the multilayer sheet having a plurality of connected sections, disposed across spacings, where the first hydrophobic fiber-containing layer and the second hydrophobic fiber-containing layer are connected, the spacings between the plurality of connected sections being 0.6 times or above the mean fiber length of the hydrophobic fibers of the first hydrophobic fiber-containing layer and 0.6 times or above the mean fiber length of the hydrophobic fibers of the second hydrophobic fiber-containing layer, the plurality of connected sections having an area ratio of 0.5 to 12.0% with respect to the multilayer sheet, each of the first sheet and second sheet, which is separated from the multilayer sheet, having a disintegratability of 100 seconds or less in a disintegration test, the multilayer sheet having a bending resistance of 150 mm or less, and the wet tissue having a tensile strength of 1.0N or greater per 25 mm width.

Claim 2. The wet tissue according to claim 1, wherein a fiber density of the first hydrophobic fiber-containing layer is higher than a fiber density of the first hydrophilic fiber-containing layer, and/or a fiber density of the second hydrophobic fiber-containing layer is higher than a fiber density of the second hydrophilic fiber-containing layer.

Claim 3. The wet tissue according to claim 1 or 2, wherein the first hydrophilic fiber-containing layer and the second hydrophilic fiber-containing layer are disposed on the surface layer of the multilayer sheet, the multilayer sheet having a ridge-furrow structure formed by spraying a high-pressure water jet on one or both surfaces of the multilayer sheet.

Claim 4. The wet tissue according to any one of claims 1 to 3, wherein each of the first hydrophobic fiber-containing layer and second hydrophobic fiber-containing layer includes, as the hydrophobic fibers, heat-fusible fibers consisting of composite fibers that include a low-melting-point component and a high-melting-point component having a higher melting point than the low-melting-point component.

Claim 5. The wet tissue according to claim 4, wherein each of the plurality of connected sections is an embossed section, and in the embossed section, at least some of the low-melting-point component of the hydrophobic fibers of the first hydrophobic fiber-containing layer are fused with the fibers in the second hydrophobic fiber-containing layer, and/or at least some of the low-melting-point component of the hydrophobic fibers of the second hydrophobic fiber-containing layer are fused with the fibers in the first hydrophobic fiber-containing layer.

Claim 6. The wet tissue according to any one of claims 1 to 5, wherein the hydrophobic fibers of the first hydrophobic fiber-containing layer and/or the hydrophobic fibers of the second hydrophobic fiber-containing layer have a mean fiber length of 6.5 mm or less.

Claim 7. The wet tissue according to any one of claims 1 to 6, wherein each of the plurality of connected sections has an area of 0.4 to 9 mm².

Claim 8. The wet tissue according to any one of claims 1 to 7, wherein each of the first hydrophilic fiber-containing layer and second hydrophilic fiber-containing layer includes hydrophilic fibers at 100 mass%, and each of the first hydrophobic fiber-containing layer and second hydrophobic fiber-containing layer includes hydrophobic fibers at 5 to 30 mass% and hydrophilic fibers at 70 to 95 mass%.

Claim 9. The wet tissue according to any one of claims 1 to 8, wherein the hydrophilic fibers of the first hydrophilic fiber-containing layer and/or the hydrophilic fibers of the second hydrophilic fiber-containing layer include pulp and regenerated cellulose.
10. The wet tissue according to any one of claims 1 to 9, wherein the wet tissue has a fold structure formed by crepe treatment of the first sheet and/or second sheet.

11. A method of producing the wet tissue according to any one of claims 1 to 10, including the steps of:

(1) forming the first sheet;
(2) forming the second sheet; and
(3) stacking the second sheet onto the first sheet with the first hydrophobic fiber-containing layer and the second hydrophobic fiber-containing layer facing each other, to form a stacked sheet, and connecting the stacked sheet to form a multilayer sheet having a plurality of connected sections.

12. The method according to claim 11, wherein step (1) further includes the steps of:

(1 a) supplying an aqueous dispersion of a starting material for the first hydrophilic fiber-containing layer onto a support, and forming a web of the first hydrophilic fiber-containing layer on the support;
(1 b) spraying the web of the first hydrophilic fiber-containing layer on the support with a high-pressure water jet from a high-pressure water jet nozzle to tangle the fibers, and form a first hydrophilic fiber-containing layer;
(1 c) supplying an aqueous dispersion of a starting material for the first hydrophobic fiber-containing layer onto a support, and forming a web of the first hydrophobic fiber-containing layer on the support;
(1 d) stacking the web of the first hydrophobic fiber-containing layer onto a surface of the first hydrophilic fiber-containing layer that has not been sprayed with the high-pressure water jet, and forming a water-including first sheet; and
(1 e) drying the water-including first sheet.

13. The method according to claim 11 or 12, wherein step (2) further includes the steps of:

(2a) supplying an aqueous dispersion of a starting material for the second hydrophilic fiber-containing layer onto a support, and forming a web of the second hydrophilic fiber-containing layer on the support;
(2b) spraying the web of the second hydrophilic fiber-containing layer on the support with a high-pressure water jet from a high-pressure water jet nozzle to tangle the fibers, and form a second hydrophilic fiber-containing layer;
(2c) supplying an aqueous dispersion of a starting material for the second hydrophobic fiber-containing layer onto a support, and forming a web of the second hydrophobic fiber-containing layer on the support;
(2d) stacking the web of the second hydrophobic fiber-containing layer onto a surface of the second hydrophilic fiber-containing layer that has not been sprayed with the high-pressure water jet, and forming a water-including second sheet; and
(2e) drying the water-including second sheet.

14. The method according to any one of claims 11 to 13, wherein each of the first hydrophobic fiber-containing layer and the second hydrophobic fiber-containing layer include, as hydrophobic fibers, heat-fusible fibers consisting of composite fibers including a low-melting-point component and a high-melting-point component having a higher melting point than the low-melting-point component, in step (1), the water-including first sheet is dried at a temperature lower than the melting point of the low-melting-point component of the hydrophobic fibers in the first hydrophobic fiber-containing layer, and in step (2), the water-including second sheet is dried at a temperature lower than the melting point of the low-melting-point component of the hydrophobic fibers in the second hydrophobic fiber-containing layer.

15. The method according to claim 14, wherein in step (3), the stacked sheet is embossed at a temperature at or above the melting point of the low-melting-point component of the hydrophobic fibers in the first hydrophobic fiber-containing layer and the low-melting-point component of the hydrophobic fibers in the second hydrophobic fiber-containing layer, and below the melting point of the high-melting-point component of the hydrophobic fibers in the first hydrophobic fiber-containing layer and the high-melting-point component of the hydrophobic fibers in the second hydrophobic fiber-containing layer, to form a multilayer sheet having a plurality of connected sections.

16. The method according to claim 12, wherein in step (1 e), the water-including first sheet is dried while contacting the first hydrophilic fiber-containing layer with a roll of a roll-type dryer.

17. The method according to claim 13, wherein in step (2e), the water-including second sheet is dried while contacting the second hydrophilic fiber-containing layer with a roll of a roll-type dryer.
18. The method according to any one of claims 11 to 17, wherein step (1) further includes a step of crepe treatment of the first sheet, and/or step (2) further includes a step of crepe treatment of the second sheet.
### INTERNATIONAL SEARCH REPORT

**A. CLASSIFICATION OF SUBJECT MATTER**

A47K7/00(2006.01)i, D21H27/00(2006.01)i, D21H27/30(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)

A47K7/00, D21H27/00, D21H27/30

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

Jitsuyu Shinan Koho 1922-1996
Jitsuyu Shinan Toroku Koho 1996-2015
Kokai Jitsuyu Shinan Koho 1971-2015
Toroku Jitsuyu Shinan Koho 1994-2015

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

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>JP 2006-180983 A (Kao Corp.), 13 July 2006 (13.07.2006), paragraphs [0010], [0014], [0022] to [0026], [0038], [0040]; fig. 1 (Family: none)</td>
<td>1-18</td>
</tr>
<tr>
<td>A</td>
<td>JP 2008-190073 A (Daio Paper Corp.), 21 August 2008 (21.08.2008), paragraphs [0001], [0015], [0017], [0019], [0022], [0029], [0032] (Family: none)</td>
<td>1-18</td>
</tr>
</tbody>
</table>

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
  *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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Name and mailing address of the ISA/

Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

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<table>
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<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
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