(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 395 142 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
10.09.2014 Bulletin 2014/37

(21) Application number: **10738551.0**

(22) Date of filing: **03.02.2010**

(51) Int Cl.:
D04H 1/42 *(2012.01)* ***D04H 1/46*** *(2012.01)*

(86) International application number:
PCT/JP2010/051512

(87) International publication number:
WO 2010/090220 (12.08.2010 Gazette 2010/32)

(54) **WATER-DISINTEGRABLE NONWOVEN FABRIC**

WASSERLÖSLICHES VLIESMATERIAL

TISSU NON-TISSÉ POUVANT SE DÉSINTÉGRER DANS L'EAU

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR

(30) Priority: **06.02.2009 JP 2009026718**

(43) Date of publication of application:
14.12.2011 Bulletin 2011/50

(73) Proprietor: **Uni-charm Corporation**
Ehime 799-0111 (JP)

(72) Inventors:
- **KONISHI, Takayoshi**
  Kanonji-shi
  Kagawa 769-1602 (JP)
- **SHIRAI, Tsutomu**
  Kanonji-shi
  Kagawa 769-1602 (JP)
- **SASAYAMA, Kenichi**
  Kanonji-shi
  Kagawa 769-1602 (JP)

(74) Representative: **Eke, Philippa Dianne**
Saunders & Dolleymore LLP
9 Rickmansworth Road
Watford Hertfordshire WD18 0JU (GB)

(56) References cited:
EP-A1- 1 302 592
JP-A- 10 008 364
JP-A- 10 280 262
JP-A- 10 280 262
JP-A- 2001 288 658
JP-A- 2002 339 218
JP-B- 2 849 218

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 2 395 142 B1

Printed by Jouve, 75001 PARIS (FR)

Description

{Technical Field}

[0001] The present invention relates to water-disintegrable nonwoven fabrics adapted to be disintegrated to fragments (small pieces) and/or individual fibers or masses of several fibers when stirred in water.

{Background}

[0002] Water-disintegrable nonwoven fabrics adapted to be disintegrated to fragments (small pieces) and/or individual fibers or masses of several fibers when stirred in water are known. For example, JP 1997-78419 A (PTL 1) discloses a nonwoven fabric of this kind as a water decaying nonwoven fabric. The nonwoven fabric disclosed therein is obtained by taking the following steps; making a web which is composed of 70 to 97% by mass regenerated cellulose fibers or synthetic fibers each having a fiber length of 5 to 20mm and 3 to 30% by mass ultrafine pulp fibers each having water retention capacity of 210 to 450%, by paper making treatment, subjecting the web to high pressure water jets treatment so that the fibers may be mechanically entangled with one another, and then drying it. The nonwoven fabric obtained in this manner is suitable for use as a material for wet tissues, sweeping wipers, diapers, sanitary napkins and the like. Such nonwoven fabric may be easily disintegrated in a large amount of water flow.

{Citation List}

{Patent Literature}

[0003] {PTL 1} JP 1997-78419 A

[0004] {Summary}

{Technical Problem}

[0005] The nonwoven fabric disclosed in PTL 1 uses ultrafine pulp fibers finely beaten in a wetted condition. While such ultrafine fibers have their surface areas enlarged and the hydrogen bonding strength between each of the ultrafine pulp fibers is significantly increased as they are drying, compared to that of pulp fibers before being beaten finely, consequently the nonwoven fabric being made of such ultrafine pulp fibers increases in strength and there is a possibility that the nonwoven fabric may become stiff and have a poor flexibility and its texture deteriorate. In addition, though this nonwoven fabric is made by following the steps of a paper making process and an injection process of high pressure water jets, in these steps, the ultrafine pulp fibers easily fall off from the web and/or it is difficult for the ultrafine pulp fibers to be entangled with other types of fibers. In these respects, manufacturing of the nonwoven fabric disclosed in the cited invention is not necessarily easy.

[0006] An object of the present invention is to provide a water-disintegrable nonwoven fabric adapted to be easily made and having a desirable degree of strength and flexibility.

{Solution to Problem}

[0007] According to the present invention, there is provided a water-disintegrable nonwoven fabric including fibers mechanically entangled with one another and being adapted to be disintegrated from one another when the nonwoven fabric is stirred in water.

[0008] The present invention is characterized as follows: 10 to 50% by mass of the above-mentioned fibers are made up of ultrafine thermoplastic synthetic fibers each having a fineness of 0.01 to 0.5dtex and a fiber length of 3 to 10mm, and 90 to 50% by mass of the above-mentioned fibers are made up of at least one of chemical fibers each having a fineness of 1 to 2dtex and a fiber length of 5 to 20mm and pulp fibers having a freeness of 600 to 770cc.

[0009] According to one embodiment of the invention, the ultrafine thermoplastic synthetic fibers are formed by splitting split fibers.

[0010] According to another embodiment of the invention, the water-disintegrable nonwoven fabric contains 3 to 10% water-soluble binder by mass.

[0011] According to still another embodiment of the invention, the water-disintegrable nonwoven fabric is obtained by taking the following steps of mixing the ultrafine thermoplastic synthetic fibers with at least one of the chemical fibers and the pulp fibers to prepare a slurry, injecting high pressure water jets to a web formed from the slurry, and thereafter drying the web.

[0012] According to yet another embodiment of the invention, the slurry contains a water-soluble binder.

{Advantageous Effects of Invention}

[0013] The water-disintegrable nonwoven fabric according to the present invention uses ultrafine thermoplastic synthetic fibers each having a fineness of 0.01 to 0.5dtex and a fiber length of 3 to 10mm and the fibers are mechanically entangled with one another in the nonwoven fabric. Such a unique arrangement allows the water-disintegrable nonwoven fabric to be easily manufactured and, in addition, improves the flexibility and tensile strength of the nonwoven fabric.

{Brief Description of Drawings}

[0014] {Fig. 1} Diagram illustrating a part of a process for making a water-disintegrable nonwoven fabric, by way of example.

{Description of Embodiments}

[0015] A water-disintegrable nonwoven fabric according to the present invention is suitable for use, for example, as a topsheet adapted to come in contact with a wearer's skin, a backsheet adapted to come in contact with a wearer's garment, dry wipes or wet wipes. This nonwoven fabric can be advantageously disintegrated into fragments (small pieces) and/or individual fibers or masses of several fibers (hereinafter referred to as "fragments") when the nonwoven fabric is placed in a large amount of water and stirred. Such water-disintegrable nonwoven fabric has a thickness of 0.15 to 0.4mm and a basis mass of 25 to 60g/m^2 and contains 10 to 50% ultrafine thermoplastic synthetic fibers by mass each having a fineness of 0.01 to 0.5dtex and a fiber length of 3 to 10mm. 90 to 50% by mass of the nonwoven fabric is made up of at least one of chemical fibers having a fineness of 1 to 2dtex and a fiber length of 5 to 20mm and pulp fibers having a freeness of 600 to 770cc. The term "thermoplastic synthetic fibers" used herein means the fibers formed from the thermoplastic synthetic resin adapted for melt spinning by means of an extruder. The term "chemical fibers" used herein includes synthetic fibers inclusive of the thermoplastic synthetic fibers, semisynthetic fibers and regenerated fibers. One example of the semisynthetic fibers is acetate fibers and one example of the regenerated fibers is rayon. These fibers included in the water-disintegrable nonwoven fabric according to the invention are entangled with one another under the effect of high-pressure water jets. The water-disintegrable nonwoven fabric may contain a water-soluble binder in order to restrain its liquid-perviousness or to enhance its tensile strength depending on the intended purposes. In contrast, the water-disintegrable nonwoven fabric may contain a hydrophilizing agent in order to improve its liquid-perviousness or liquid retention capacity.

[0016] Fig. 1 is a schematic diagram illustrating, by way of example, a process for making a water-disintegrable nonwoven fabric according to the invention wherein the water-disintegrable nonwoven fabric is denoted by reference numeral 1. The process illustrated in Fig. 1 utilizes the known process of paper making and includes a first wire part 11, a second wire part 12, a third wire part 13, a dryer drum 14 and a reeler 15. A slurry feeder 16 and a water jets injector 17 are provided so as to cooperate with the first wire part 11. The slurry feeder 16 feeds a slurry 21 containing a fibrous mixture to form the water-disintegrable nonwoven fabric and an appropriate amount of water onto the first wire part 11 so that the fibrous mixture may form a web 22 on the first wire part 11. The water jets injector 17 includes two or more nozzle rows 18 each having a plurality of nozzles arranged intermittently in a cross direction (CD) being orthogonal to a machine direction (MD). High pressure water jets are injected to the web 22 and the fibers forming the web 22 are mechanically entangled with one another under the effect of predetermined injection energy. The water jets injector 17 is provided with a suction box 19 so as to suck the high pressure water jets after working thereof. The high pressure water jets-treated web 22 is transported by the second wire part 12 and then the third wire part 13 onto a peripheral surface of the dryer drum 14. The web 22 is dried by the dryer drum 14 to become the water-disintegrable nonwoven fabric 1 and rolled up by the reeler 15.

[0017] When the water-disintegrable nonwoven fabric 1 obtained in this manner is placed into a large amount of water and stirred, the fibers being mechanically entangled with one another can be disintegrated from one another into fragments.

[0018] Referring to Fig. 1, the fibrous mixture to form the water-disintegrable nonwoven fabric and the amount of water are mixed in an appropriate proportion so that, for example, the fibrous mixture may make up 0.5 to 1.5% by mass of the quantity of the slurry 21. In the fibrous mixture, two or more types of fibers are mixed at the same ratio as that in the water-disintegrable nonwoven fabric 1. More specifically, the fibrous mixture in both the water-disintegrable nonwoven fabric 1 and the slurry 21 contain the ultrafine thermoplastic synthetic fibers having a fineness of 0.01 to 0.5dtex and a fiber length of 3 to 10mm in an amount of 10 to 50% by mass. In addition, the fibrous mixture in both the water-disintegrable nonwoven fabric 1 and the slurry 21 contain at least one of (a) the chemical fibers having a fineness of 1 to 2dtex and a fiber length of 5 to 20mm and (b) the pulp fibers having a freeness as an indication of the degree of beating, in an amount of 90 to 50% by mass.

[0019] As the ultrafine thermoplastic synthetic fibers being contained in the water-disintegrable nonwoven fabric 1 and

the slurry 21, it is possible to use, for example, fibers which are obtained by splitting a commercially available polyester/nylon conjugate fiber having a fineness of 3.3dtex and being formed to be splittable into 11 fibers. This conjugate fiber may be mechanically treated, for example, by a grinder, to split this fiber into 11 ultrafine thermoplastic synthetic fibers having a fineness of about 0.3dtex. It is also possible to use ultrafine thermoplastic synthetic fibers which are obtained by splitting a commercially available polypropylene/polyester conjugate fiber having a fineness of 3. 3dtex and being formed to be splittable into 16 fibers having a fineness of about 0.21dtex. In addition to the above-mentioned fibers, ultrafine thermoplastic synthetic fibers which are obtained by splitting a commercially available polyester/nylon conjugate fiber having a fineness of 3.3dtex and being formed to be splittable into 16 fibers each having a fineness of about 0.21dtex, ultrafine thermoplastic synthetic fibers which are obtained by splitting a commercially available polypropylene/polyethylene conjugate fiber having a fineness of 2.0dtex and being formed to be splittable into 16 fibers each having a fineness of about 0.13dtex, ultrafine thermoplastic synthetic fibers which are obtained by splitting a commercially available polyester/polyethylene conjugate fiber having a fineness of 2.2dtex and being formed to be splittable into 8 fibers each having a fineness of about 0.28dtex are possible for use. Furthermore, it is also possible to use ultrafine thermoplastic synthetic fibers such as melt blown fibers each having a fineness of 0.01 to 0.51dtex and a fiber length of 3 to 10mm.

[0020] The ultrafine thermoplastic synthetic fibers each having a fiber length of 3 to 10mm ensure that the water-disintegrable nonwoven fabric 1 has a low stiffness, a high flexibility and a high tensile strength in a dry state as well as in a wet state. The term "stiffness" used herein is based on the value measured by Bending Resistance A Method according to JIS L 1096. It is preferable that an average bending resistance of the water-disintegrable nonwoven fabric 1 should be 80mm or less, and the average bending resistance is determined by measuring the stiffness of two or more test pieces of water-disintegrable nonwoven fabric 1 in the length direction corresponding to the machine direction as well as to the cross direction in the process of making the water-disintegrable nonwoven fabric. Assuming that the nonwoven fabric of which the stiffness exceeds 80mm is used in the bodily fluid absorbent article as a sheet to be put in contact with the wearer's skin, it will be rather difficult to put this sheet in contact with the wearer's skin with a desired fit. The tensile strength of the water-disintegrable nonwoven fabric 1 means the breaking strength value which is obtained when a test piece of 25mm in width and 150mm in length is stretched at a tension rate of 100mm/min with a chuck distance of a tensile tester set at 100mm. The test pieces with the length direction corresponding to the machine direction and the test pieces with the length direction corresponding to the cross direction were prepared and strength of the respective test pieces after they had been conditioned at a temperature of 20°C and R.H. 60% for 24 hours was measured as DRY strength. Strength after the respective test pieces had been impregnated with ion exchanged water corresponding to 200% by mass of the respective test pieces was measured as WET strength. DRY strength of the water-disintegrable nonwoven fabric 1 is 3. ON or higher per width dimension of 25mm in MD as well as in CD. WET strength thereof is 2.0N or higher per width dimension of 25mm in MD as well as in CD.

[0021] According to the invention, the water-disintegrable property is evaluated in a manner as follows. The evaluation is conducted on the basis of visual observation and measurement of dispersive power. In the visual observation, a test piece of 100 × 100mm is dried at a temperature of 100°C for 2 hours and a dry mass (W_1) is determined. Then this test piece is thrown together with 800ml of distilled water into a vertical liquid separating funnel shaker (SHKV-200 manufactured by IWKI) and shaken at a shaking speed of 240rpm for 60 minutes and then the interior of the separating funnel is visually observed. The water-disintegrable nonwoven fabric 1 according to the invention is disintegrated beyond recognition of the original shape or at least to three fractions. In the dispersive power measurement, the test piece remaining within the liquid separating funnel after having been visually observed was transferred together with distilled water into a basket made of 2-mesh woven metal wire (mesh size of 11.2mm, void of 77.8% and adapted for grain diameter of 1.5mm) and having a longitudinal dimension × transverse dimension × height dimension=100 × 100 × 120mm. Then, the quantity of the test piece remaining in the basket was dried at a temperature of 100°C for 2 hours and dry mass (W_2) was determined. From this dry mass W_2 and the dry mass W_1 having been determined in the step of visual observation, the dispersive power was obtained by a following equation:

$$\{(W_1-W_2)/W_1\}\times 100 = \text{Dispersive power (\%)}$$

[0022] The water-disintegrable nonwoven fabric 1 according to the invention has a dispersive power of 50% or higher.

[0023] Ultrafine thermoplastic synthetic fibers having a fiber length of 3 to 10mm are rarely oriented in one direction and not intricately entangled with the fibers of the web when the web 22 is formed from the slurry 21 in the process of Fig. 1. In consequence, the web 22 in which the fibers are uniformly distributed and the water-disintegrable nonwoven fabric 1 obtained from such a web are easily disintegrated in water. An ultrafine thermoplastic synthetic fiber having a fiber length exceeding 10mm will often prevent the web 22 being smoothly disintegrable in water and consequently, the water-disintegrable nonwoven fabric 1 from being obtained. An ultrafine thermoplastic synthetic fiber having a fiber length

less than 3mm will make it difficult for the fibers to be entangled with one another and will be apt to fall off from the first wire part 11.

[0024] Assuming that the content of the ultrafine thermoplastic synthetic fibers in the water-disintegrable nonwoven fabric 1 exceeds 50% by mass, it will be difficult for the web 22 to ensure a desired freeness in the process of Fig. 1. Consequently, the productivity of the water-disintegrable nonwoven fabric 1 will be diminished.

[0025] The pulp fibers being used in the invention may be used for making the water-disintegrable nonwoven fabric 1 liquid-pervious, and the pulp fibers are preferably not beaten in order to make the water-disintegrable nonwoven fabric 1 as flexible as possible or to prevent the pulp fibers from falling off from the first wire part 11 from the web 22 in the process of Fig. 1. More specifically, the freeness is preferably measured as indication of a degree of beating by Canadian Standard Freeness Tester in accordance with JIS P 2181, and pulp fibers having a freeness of 600 to 770cc are preferably used. Even when the pulp fibers meet such a requirement, there is a possibility that the water-disintegrable nonwoven fabric 1 might have a high density leading to a high stiffness. The water-disintegrable nonwoven fabric 1 containing the pulp fibers and having a relatively high density is suitable for use as wipes.

{Working Examples}

[0026] In the process illustrated in Fig. 1, the composition of the fibrous mixture contained in the slurry 21 and the injection working conditions for the injector 17 were appropriately varied to obtain water-disintegrable nonwoven fabrics as the working examples and nonwoven fabrics as the comparative examples, each having a basis mass of 35g/m^2. Compositions, evaluation items, evaluation methods and evaluation results will be indicated in TABLE 1 and described later in details.

[TABLE 1]

Composition, evaluation items.etc	Spec.unit.etc.	Working Example 1	Working Example 2	Working Example 3	Working Example 4	Working Example 5	Working Example 6	Working Example 7	Working Example 8	Working Example 9	Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4	Comparative Example 3	Comparative Example 8
NBKP	CSF 720cc		30%			50%										
NBKP	CSF 400cc													20%		
Rayon	1.1 dtex × 7mm	80%	50%	50%	90%		50%		80%	74%	100%	40%		80%	90%	80%
PET	1.45dtex × 10mm			30%				50%								
Split fiber-1	3.3dtex × 5mm	20%	20%	20%	10%	50%	50%	50%		18%		60%	100%		20%	20%
Split fiber-2	3.3dtex × 5mm								20%							
Water-soluble binder	AQ55S									8%						
injection working condition	kW/m^2	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0012	0.0131
Basis mass	g/m^2	35	35	35	35	35	35	35	35	38	35	35	35	35	35	35
Thickness	mm	0.24	0.22	0.34	0.26	0.20	0.30	0.32	0.25	0.30	0.36	0.25	0.23	0.24	0.22	0.25
Density	g/cm^2	0.146	0.159	0.103	0.135	0.175	0.117	0.109	0.140	0.127	0.097	0.140	0.152	0.146	0.159	0.140
DRY strength (N)	MD	9.39	8.42	7.85	4.35	14.01	13.56	9.86	4.14	26.24	2.15	14.16	19.52	20.33	2.74	14.23
	CD	5.66	4.35	4.01	3.27	4.85	5.06	4.32	3.11	11.53	1.68	2.55	3.66	12.29	1.20	8.58
DRY extension (%)	MD	31.02	20.85	19.54	21.34	11.34	30.15	28.15	21.60	12.27	10.40	38.37	38.35	7.30	17.57	35.11
	CD	37.51	30.32	28.64	15.98	12.10	21.39	27.55	14.27	19.97	8.30	14.95	18.89	4.30	16.03	38.93
WET strength	MD	6.75	5.46	5.04	4.26	6.47	7.99	5.52	4.73	7.72	3.00	5.72	5.52	6.57	2.55	8.24

(continued)

Composition, evaluation items.etc	Spec.unit.etc.	Working Example 1	Working Example 2	Working Example 3	Working Example 4	Working Example 5	Working Example 6	Working Example 7	Working Example 8	Working Example 9	Comperative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4	Comparative Example 3	Comparative Example 8
(N)	CD	4.09	2.26	2.11	2.42	2.69	3.32	2.07	2.94	4.43	1.92	2.76	2.16	3.66	1.59	5.10
WET extension	MD	39.45	38.26	38.41	41.68	34.51	34.01	42.59	31.40	29.55	29.60	33.91	30.17	27.90	29.82	42.77
(%)	CD	40.89	46.03	44.25	29.60	40.34	32.22	27.90	27.70	51.56	18.40	34.65	30.22	25.80	39.08	44.29
Cantilever bending resistance	mm	34	48	40	30	46	50	54	35	78	38	52	33	86		
Water disintegrable property	Visual Observation	○	○	○	○	○	Δ	Δ	○	Δ	○	×	×	○	○	×
	Dispersive power(%)	78	79	74	87	72	58	63	76	53	97	14	3	99	91	34
Liquid retention	%	24.7%	27.0%	19.1%	26.9%	22.3%	16.1%	7.0%	10.7%	8.1%	30.8%	18.6%	10.0%	31.3%		
Liquid absorbing time	sec	1sec	1sec	1sec	1sec	1sec	1sec	3sec	1sec	7sec	1sec	1sec	12sec	1sec		
Dispersion area	mm^2	2256	2585	1974	2500	2116	1680	1260	1520	306	2736	1764	304	3021		

(Composition in TABLE 1)

[0027]

1. NBKP is the abbreviated name of Nadelholz Bleached Kraft Pulp (bleached softwood kraft pulp). This type of pulp having a freeness of 720cc as measured by Canadian Freeness Standard Filter was used in the working examples and the same type of pulp having a freeness of 400cc was used in the comparative examples.
2. PET is the abbreviated name of polyethylene terephthalate fiber.
3. An ultrafine fiber, which has a fineness of about 0.3dtex and is obtained by splitting a PET/nylon conjugate fiber having a fineness of 3.3dtex and a fiber length of 5mm and being formed to be splittable into 11 fibers, was used as a split fiber-1.
4. An ultrafine fiber, which has a fineness of about 0.21dtex and is obtained by splitting a polypropylene/PET conjugate fiber having a fineness of 3.3dtex and a fiber length of 5mm and being formed to be splittable into 16 fibers, was used as a split fiber-2.
5. Sulfopolyester resin (AQ5SS of Eastman Chemical Company) was used as a water-soluble binder.

(Conditions for injection working shown in Fig.1 and TABLE 1)

[0028]

1. The injector 17 shown in Fig. 1 includes four nozzle rows 18 which have injection nozzles each having an orifice diameter of 95μ and lining up in the cross direction at a pitch of 0.5mm are arranged in the machine direction.
2. The conditions for injection working being set on the respective nozzle rows 18 were adjusted by varying a working energy quantity in accordance with an equation below:

$$\text{Working energy quantity } (kW/m^2) = 1.63 \times \text{injection pressure } (kg/cm^2) \times \text{injection flow rate } (m^3/min) / \text{working speed } (m/min)/60$$

$$\text{Injection flow rate } (m^3/min) = 750 \times \text{total orifice area } (m^2) \times \text{injection pressure } (kg/cm^2)^{0.495}$$

Injection nozzles: having an orifice diameter of 95μ and arranged at a pitch of 0.5mm

[0029] First, second and third wire parts: LL-70E manufactured by Nippon Filcon Co., Ltd.

(Evaluated Items in TABLE 1)

1. Basis mass

[0030] A basis mass indicates an average value of each basis mass of three test pieces each dimensioned in 100 x 100mm.

2. Thickness

[0031] A thickness indicates an average value of each thickness of three test pieces under measuring pressure of 3g/cm^2 by a dial thickness gauge.

3. Density

[0032] A density was calculated from the basis mass and the thickness.

4. DRY strength

[0033] After leaving each test piece having a width dimension of 25mm and a length dimension of 150mm in a humidity controlled condition for 24 hours at a temperature of 20°C and R.H. of 60%, a tensile test was conducted at an inter-chuck distance of 100mm and a tension rate of 100m/min to determine a tensile strength at break. Three test pieces being dimensioned to be coincident with one another in the machine direction (MD) and in the cross direction (CD) were prepared, and the tensile strength was determined on these test pieces, respectively, in both directions. Then an average value thereof was calculated as the DRY strength. The water-disintegrable nonwoven fabric according to the present invention preferably has DRY strength of 3kg or higher in both directions MD, CD.

5. DRY extension percentage

[0034] A DRY extension percentage is an average value of each extension percentage of the test pieces of when DRY strength at break is measured. The water-disintegrable nonwoven fabric according to the present invention preferably has DRY extension percentage of 10% or higher in both directions MD, CD.

6. WET strength

[0035] A WET strength was determined under the same conditions as those of DRY strength except that an amount of ion-exchanged water corresponding to 200% of the mass of the test piece was sprayed onto the test piece and thereby the test piece was impregnated with the ion-exchanged water. The water-disintegrable nonwoven fabric according to the present invention preferably has WET strength of 2kg or higher in both directions MD, CD.

7. WET extension percentage

[0036] A WET extension percentage is an average value of each extension percentage of the test pieces of when WET tensile strength at break is measured. The water-disintegrable nonwoven fabric according to the present invention preferably has WET extension percentage of 20% or higher in both directions MD, CD.

8. Stiffness

[0037] A stiffness was measured in accordance with Bending Resistance A Method (45° cantilever method) specified by Section 8. 19. 1 of JIS L 1096. Test results are indicated by average values of measured values which are obtained from three test pieces each having the longitudinal direction thereof aligned in the MD and other three test pieces each having the longitudinal direction thereof aligned in the CD.

9. Water-disintegrable properties

(Visual observation method)

[0038] A single test piece of 100 × 100mm was dried at a temperature of 100°C for 2 hours to measure a dry mass (W_1). The dried test piece was introduced together with 800ml of distilled water into a vertical separating funnel shaking apparatus (SHKV-200 manufactured by IWKI) and shaken at a shaking speed of 240rpm for 60 minutes. Thereafter the inside of the separating funnel was visually observed. The water-disintegrable property was ranked as highly disintegrable (circle-mark) if the test piece was observed to be disintegrated beyond recognition, ranked as moderately disintegrable (triangle-mark) if the test piece was observed to be disintegrated to at least three fractions or to visually countable number of fibers, and ranked as poorly disintegrable (×-mark) if disintegration of the test piece was observed to come short of the moderately disintegrable property. The water-disintegrable nonwoven fabric according to the present invention has the highly or moderately water-disintegrable properties.

(Measuring method of dispersive power)

[0039] The test piece remaining within the liquid separating funnel after having been visually observed was transferred together with distilled water into a basket made of 2-mesh woven metal wire (mesh size of 11.2mm, void of 77.8% and

adapted for grain diameter of 1.5mm) and having longitudinal dimension × transverse dimension × height dimension=100 × 100 × 120mm. Then, the quantity of the test piece remaining in the basket was dried at a temperature of 100°C for 2 hours and dry mass (W_2) was determined. With this dry mass W_2 and the dry mass W_1 having been determined in the step of visual observation, the dispersive power was obtained by a following equation:

$$\text{Dispersive power (\%)} = \{(W_1-W_2)/W_1\}\times 100$$

10. Liquid retention percentage

[0040] Five 100×100mm dimensioned paper filters in accordance with JIS P 3801 were layered one on another and a 100×100mm dimensioned test piece (having a mass W_0) was placed on the layer. A burette was used to drop 1cc of physiologic saline water from a height of 10mm onto the test piece at a rate of 1cc/2sec. After 30 seconds had elapsed from dropping, the mass of the test piece (W_1) was determined and the liquid retention percentage was calculated according to a following equation:

$$\text{Liquid retention (\%)} = \{(W_1-W_0)/W_0\} \times 100$$

[0041] The water-disintegrable nonwoven fabric 1 according to the present invention tends to have a high liquid retention percentage by containing pulp fibers and/or rayon fibers. The disintegrable nonwoven fabric 1 having a liquid retention percentage of 20% or higher is suitable for use as dry wipes or wet wipes.

11. Liquid absorption time length

[0042] In the step of measuring the liquid retention percentage, a time length from completion of dropping of physiologic saline water to a moment at which all drops of physiologic saline water disappeared from the surface of the test piece was measured. In TABLE 1, a record "measuring time length: 1 sec" means that the time length until all drops of physiologic saline water disappear was 1 second or shorter.

[0043] The water-disintegrable nonwoven fabric 1 according to the present invention may be used in a bodily fluid-absorbent article as a liquid-pervious water-disintegrable nonwoven fabric if the liquid absorption time length is 3 seconds or shorter. If the liquid absorption time length is a range of 6 to 8 seconds due to water-soluble binder contained therein, the water-disintegrable nonwoven fabric 1 according to the present invention may be used in the bodily fluid-absorbent article as a poorly liquid-pervious water-disintegrable nonwoven fabric.

12. Dispersion area

[0044] In the step of measuring the liquid retention percentage, a dimension ML (mm) over which the physiologic saline water dispersed on the surface of the test piece in MD direction and a dimension CL (mm) over which the physiologic saline water dispersed on the surface of the test piece in CD direction were measured and the dispersion area was determined according to a following equation:

$$\text{Dispersion area} = ML \times CL$$

[0045] The water-disintegrable nonwoven fabric 1 according to the present invention contains rayon and/or pulp fibers both of which are hydrophilic and apt to enlarge the dispersion area. The water-disintegrable nonwoven fabric 1 ensuring a dispersion area larger than 2000mm^2 is suitable for use as dry wipes or wet wipes. In contrast, the water-disintegrable nonwoven fabric 1 in which the dispersion area is smaller than 1800mm^2 is suitable to enhance a spot absorption property of the bodily fluid-absorbent article.

<Working example 1>

[0046] In the process illustrated in Fig. 1, a fibrous mixture including the split fibers-1 of ultrafine thermoplastic synthetic fibers in 20% by mass and chemical fibers in 80% by mass, specifically, rayon fibers each having a fineness of 1.1dtex, was used in a slurry. The injection working was carried out under the conditions that four rows of nozzles each having an injection energy of 0.0063kW/m^2 may be used to obtain a water-disintegrable nonwoven fabric having the same

composition as that of the fibrous mixture, a basis mass of 35g/m^2 and a thickness of 0.24mm. Evaluation results of the water-disintegrable nonwoven fabric are indicated in TABLE 1.

<Working example 2> through <Working example 8>

[0047] In the working examples 2 through 8, water-disintegrable nonwoven fabrics were obtained by the same process as in the working example 1 except that the composition of the fibrous mixture in a slurry and the composition of the fibrous mixture in the water-disintegrable nonwoven fabrics were differentiated from those in the working example 1 as indicated in TABLE 1. Evaluation results of these water-disintegrable nonwoven fabrics according to the working examples 2 through 8 are indicated in TABLE 1. The water-disintegrable nonwoven fabrics according to the working examples 2 and 5 have a relatively high density and stiffness and are suitable for use particularly as liquid-absorbent wipes.

<Working example 9>

[0048] In the working example 9, a water-disintegrable nonwoven fabric having a composition similar to that of the water-disintegrable nonwoven fabric according to the working example 1 except that the slurry being used in the working example 1 contains a water-soluble binder so that the water-disintegrable nonwoven fabric contains the water-soluble binder in 8% by mass is obtained. Evaluation results of the water-disintegrable nonwoven fabric are indicated in TABLE 1. Specifically, being high in DRY strength as well as in WET strength and assuring significant long liquid-absorption time, the water-disintegrable nonwoven fabric according to this working example is suitable for use as a water-disintegrable backsheet material for bodily fluid-absorbent articles.

<Comparative example 1> through <Comparative example 4>

[0049] The nonwoven fabrics according to these comparative examples were made under the same working conditions as those for the working example 1 except that the composition of the fibrous mixture in the slurry used in the process of Fig. 1 was different from the composition of the fibrous mixture in the working example 1. Evaluation results of the nonwoven fabrics according to these comparative examples are indicated in TABLE 1.

<Comparative example 5> and <Comparative example 6>

[0050] The nonwoven fabrics according to these comparative examples were made under the same working conditions as those for the working example 1 except the injection working condition. Evaluation results of the nonwoven fabrics according to the comparative examples 5, 6 are indicated in TABLE 1.

{Reference Signs List}

[0051]

1 water-disintegrable nonwoven fabric
21 slurry
22 web

Claims

1. A water-disintegrable nonwoven fabric comprising fibers mechanically entangled with one another and adapted to be disintegrated from one another when the water-disintegrable nonwoven fabric is stirred in water, the water-disintegrable nonwoven fabric being **characterized in that**:

   10 to 50% by mass of the above-mentioned fibers is made up of ultrafine thermoplastic synthetic fibers each having a fineness of 0.01 to 0.5dtex and a fiber length of 3 to 10mm; and
   90 to 50% by mass of the above-mentioned fibers is made up of at least one of chemical fibers each having a fineness of 1 to 2dtex and a fiber length of 5 to 20mm and pulp fibers having a freeness of 600 to 770cc.

2. The water-disintegrable nonwoven fabric defined by claim 1, wherein the ultrafine thermoplastic synthetic fibers are formed by splitting split fibers.

3. The water-disintegrable nonwoven fabric defined by claim 1 or 2, wherein the water-disintegrable nonwoven fabric contains a water-soluble binder in 3 to 10% by mass.

4. The water-disintegrable nonwoven fabric defined by claim 1 or 2, wherein the water-disintegrable nonwoven fabric is obtained by taking the following steps of mixing the ultrafine thermoplastic synthetic fibers with at least one of the chemical fibers and the pulp fibers to prepare a slurry, injecting high pressure water jets to a web formed from a slurry and thereafter drying the web.

5. The water-disintegrable nonwoven fabric defined by claim 4, wherein the slurry contains therein a water-soluble binder.

Patentansprüche

1. Wasserlöslicher Vliesstoff, der Fasern umfasst, die mechanisch miteinander verwickelt und so adaptiert sind, das sie voneinander aufgelöst werden, wenn der wasserlösliche Vliesstoff in Wasser eingerührt wird, wobei der wasserlösliche Vliesstoff **dadurch gekennzeichnet** wird, dass

   10 bis 50 % nach Masse der oben genannnten Fasern besteht aus verfeinerten thermoplatischen synthetischen Fasern hergestellt wurde, von denen jede eine Feinheit von 0,01 bis 0,5 dtex und eine Faserlänge von 3 bis 10 mm hat, und
   90 bis 50 % nach Masse der oben genannten Fasern besteht aus wenigstens einer von chemischen Fasern, von denen jede eine Feinheit von 1 bis 2 dtex, und eine Faserlänge von 5 bis 20 mm und Zellstoffen mit einer Feinheit von 600 bis 770 cm^3 hat.

2. Wasserlöslicher Vliesstoff nach Anspruch 1, wobei die ultrafeinsten thermoplastischen synthetischen Fasern durch Teilung der gespaltenen Fasern geformt werden.

3. Wasserlöslicher Vliesstoff nach Anspruch 1 oder 2, wobei der wasserlösliche Vliesstoff ein wasserlösliches Bindemittel in 3 bis 10 % Masse enthält.

4. Wasserlöslicher Vliesstoff nach Anspruch 1 oder 2, wobei der wasserlösliche Vliesstoff durch Einhaltung der folgenden Schritte beim Mischen der ultrafeinen thermopoastichen synthetischen Fasern mit wenigsten einem der chemischen Fasern enthält und die Zellstofffasern einen Schlamm vorbereiten, wobei ein Wasserstrahl mit Hochdruck auf ein Gewebe eingespritzt wird, das aus einem Schlamm geformt ist, und anschließendem Trocknen des Gewebes erhalten wird.

5. Wasserlöslicher Vliesstoff nach Anspruch 4, wobei der Schlamm ein wasserlösliches Bindemittel enthält.

Revendications

1. Tissu non tissé pouvant se désintégrer dans l'eau comprenant des fibres enchevêtrées mécaniquement les unes avec les autres et adaptées pour se désintégrer les unes des autres lorsque le tissu non tissé pouvant se désintégrer dans l'eau est agité dans de l'eau, le tissu non tissé pouvant se désintégrer dans l'eau étant **caractérisé en ce que** :

   de 10 à 50 % en masse des fibres susmentionnées sont constituées de fibres synthétiques thermoplastiques ultrafines ayant chacune une finesse de 0,01 à 0,5 dtex et une longueur de fibre de 3 à 10 mm;
   et
   de 90 à 50 % en masse des fibres susmentionnées sont constituées d'au moins l'une d'entre des fibres chimiques ayant chacune une finesse de 1 à 2 dtex et une longueur de fibre de 5 à 20 mm et des fibres de pulpe ayant un égouttage de 600 à 770 cc.

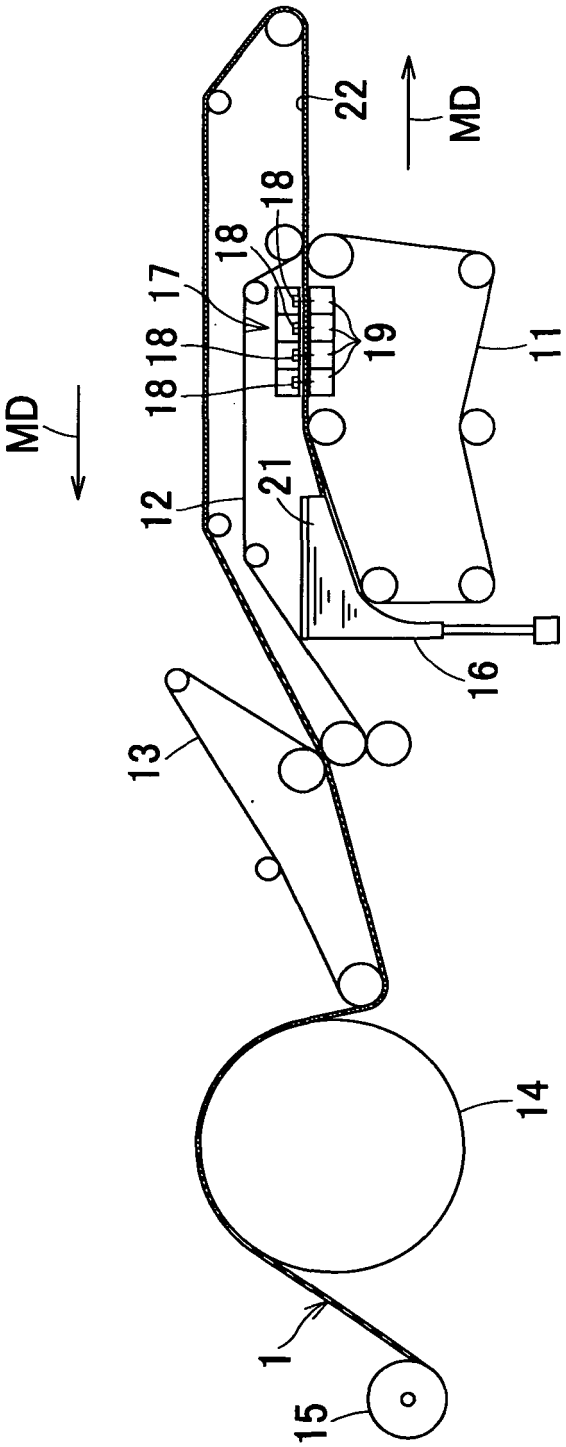
2. Tissu non tissé pouvant se désintégrer dans l'eau selon la revendication 1, dans lequel les fibres synthétiques thermoplastiques ultrafines sont formées en divisant des fibres fendues.

3. Tissu non tissé pouvant se désintégrer dans l'eau selon la revendication 1 ou 2, dans lequel le tissu non tissé pouvant se désintégrer dans l'eau contient un liant soluble dans l'eau de 3 à 10 % en masse.

4. Tissu non tissé pouvant se désintégrer dans l'eau selon la revendication 1 ou 2, dans lequel le tissu non tissé pouvant se désintégrer dans l'eau est obtenu en exécutant les étapes suivantes consistant à mélanger les fibres synthétiques thermoplastiques ultrafines avec au moins l'une d'entre des fibres chimiques et des fibres de pulpe pour préparer une boue, à injecter des jets d'eau à haute pression dans un voile formé avec une boue et à sécher ensuite le voile.

5. Tissu non tissé pouvant se désintégrer dans l'eau selon la revendication 4, dans lequel la boue contient dedans un liant soluble dans l'eau.

FIG.1



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 9078419 A **[0002] [0003]**