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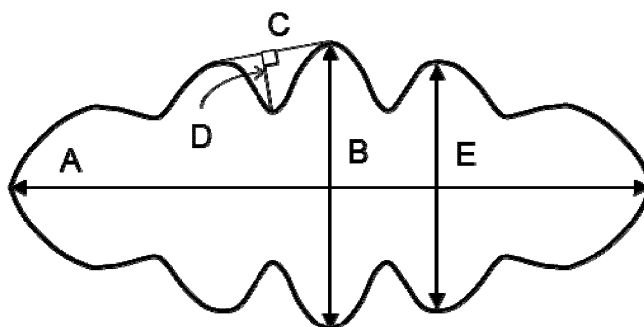
(54) **NONWOVEN FABRIC**

(57) A nonwoven fabric suitable for human cleansing and cosmetic wiper application is provided. This nonwoven fabric exhibits high absorption, retention and release of liquid such as water and chemical solution, excellent bulkiness and softness with good texture and reduced skin irritation, and high wiping ability.

The nonwoven fabric comprises 20 to 80% by weight

of a polyester fiber having an oblate multilobal cross-section and 20 to 80% by weight of a cellulose fiber, and the polyester fiber has an oblate multilobal cross-section with an oblate cross-section having at least 6 lobes on its periphery. The polyester fiber has predetermined degree of oblateness and degree of irregularity.

[Fig. 1]



Description

Technical Field

5 **[0001]** The present invention relates to a nonwoven fabric which exhibits excellent absorption together with high holding of liquid such as water and chemical solution as well as excellent bulkiness, softness, and texture, and therefore, which is particularly suitable for use as a nonwoven fabric for skin in cosmetic or cleansing purpose. More specifically, the present invention relates to a nonwoven fabric well adapted for use as a wiper which, when used for cosmetic purpose, will exhibit high holding of the cosmetic liquid with releasability of the liquid as needed, and when used for cleansing purpose, which exhibits high wiping performance without damaging the skin with the wiped smudges retained within the nonwoven fabric without re-deposition.

Background Art

15 **[0002]** Various nonwoven fabrics have been proposed as a nonwoven fabric for human cleansing applications used in wet condition. An exemplary such nonwoven fabric is the one containing 40 to 77% by weight of a polyester fiber and a polyolefin fiber in the entire fabric, and this highly soft fabric does not experience loss of bulkiness when wet (see Patent Document 1). Despite the good texture realized by the use of the polyolefin fiber, the nonwoven fabric of this proposal, however, suffered from the problems of poor liquid retention due to the lack of rigidity and insufficient bulkiness as well as insufficient cleansing ability.

20 **[0003]** A nonwoven fabric for wiper application having good bulkiness, wiping ability, and actual usability prepared by using a fiber having an irregular cross-section and a fibrillated fiber has also been proposed (see Patent Document 2). However, the situation is not such that every fiber having an irregular cross-section has improved liquid holding and cleansing ability irrespective of its cross-sectional shape, and fibrillated fibers which often have pointed fiber cross-section had the problem of the risk of damaging the skin when they are used for human cleansing purpose.

25 **[0004]** Also proposed is a nonwoven fabric containing a fiber having an irregular cross-section with hollow cross-section, and this nonwoven fabric is said to exhibit liquid holding and cleansing ability (see Patent Document 3). The nonwoven fabric of this proposal exhibited improved liquid holding due to its shape of cross-section. However, it suffered from collapse of the hollow section, and hence, insufficient shape retention, and this resulted in the insufficient liquid holding performance.

30 **[0005]** A sheet material for water-absorbing article having improved tensile strength and anti-transparency is also proposed (see Patent Document 4). The main fiber constituting this sheet is characterized by the single fiber cross-sectional shape having a degree of oblateness of up to 2.0 and at least 2 openings each having an opening angle of less than 120 degrees. The nonwoven fabric of this proposal, however, suffered from the problem of insufficient softness as a nonwoven fabric due to the low degree of oblateness despite its good anti-transparency by the diffuse reflection.

Prior Art Document

Patent Document

40 **[0006]**

Patent Document 1: Japanese Unexamined Patent Publication (Kokai) No. 2010-84297

Patent Document 2: Japanese Unexamined Patent Publication (Kokai) No. 2010-81987

45 Patent Document 3: Japanese Unexamined Patent Publication (Kokai) No. 2009-79320

Patent Document 4: Japanese Unexamined Patent Publication (Kokai) No. 2012-197546

Summary of the Invention

50 Problems to Be Solved by the Invention

[0007] Accordingly, an object of the present invention is to provide a nonwoven fabric which exhibits high absorption, retention, and release of liquids that could not be realized by the prior art as described above or sole use of the natural fiber or the cellulose fiber, suitable bulkiness and softness, and reduced irritation to the skin due to the texture together with improved wiping ability, and which is well adapted for use in human cleansing and cosmetic wiper applications.

Means for Solving the Problems

[0008] The present invention is an attempt to solve the problems as described above, and in the course of such attempt, the inventors found that combined use of the polyester fiber having an oblate multilobal cross-section with the cellulose fiber enables improvement of wiping ability with no damage to the skin, and when used by impregnating the nonwoven fabric with a liquid, such combination also enables improvement of liquid retention and liquid holding without sacrificing releasability of the liquid upon use. The present invention has been completed in view of such finding.

[0009] Accordingly, the nonwoven fabric of the present invention is a nonwoven fabric comprising 20 to 80% by weight of a polyester fiber having an oblate multilobal cross-section and 20 to 80% by weight of a cellulose fiber wherein the polyester fiber having an oblate multilobal cross-section has an oblate cross-section with at least 6 lobes on its periphery, and

when the cross-section of the polyester fiber having a multilobal oblate cross-section has maximum length A, maximum width B, length C of line connecting adjacent lobe apexes in the section with largest lobes, and length D of perpendicular between the line C connecting the adjacent lobe apexes and the bottom of recess between the adjacent lobes,

degree of oblateness (A/B) and degree of irregularity (C/D) simultaneously satisfy the following relations (1) and (2) :

$$\text{Degree of oblateness } (A/B) = 2.0 \text{ to } 3.0 \quad (1),$$

and

$$\text{Degree of irregularity } (C/D) = 1.0 \text{ to } 5.0 \quad (2).$$

[0010] According to a preferable embodiment of the present invention, when maximum length A of the polyester fiber having an oblate multilobal cross-section is regarded as axis of symmetry, and line segments are depicted between opposing lobe apexes on opposite sides of the maximum length A, and second longest line segment next to the maximum width B of the line segments has length E, lobe ratio (E/B) satisfies the following relation (3):

$$\text{Lobe ratio } (E/B) = 0.6 \text{ to } 0.9 \quad (3).$$

[0011] According to a preferable embodiment of the present invention, the polyester fiber having a multilobal oblate cross-section has a single-fiber fineness of up to 2.0 dtex.

[0012] The nonwoven fabric of the present invention is particularly adapted for use as a nonwoven fabric for a wiper.

Advantageous Effect of the Invention

[0013] The present invention is capable of producing a nonwoven fabric which exhibits high absorption, retention, and release of liquids such as water and chemical solution, suitable bulkiness and softness, and reduced irritation to the skin together with improved wiping ability, and which is well adapted for use in human cleansing and cosmetic applications.

Brief Description of the Drawings

[0014] [FIG. 1] FIG. 1 is a cross-sectional view for illustrating the cross-section of the polyester fiber having an oblate multilobal cross-section with a plurality of lobes (8 lobes) on its periphery used in the nonwoven fabric of the present invention.

Description of Preferred Embodiments

[0015] Next, the nonwoven fabric of the present invention is described in detail.

[0016] The cellulose fiber used in the present invention is at least one cellulose fiber selected from natural fibers such as linen, silk, and cotton, regenerated fibers such as viscose rayon, cuprammonium rayon, and solvent spun cellulose, and semi-synthetic fibers such as acetate. Of these, the preferred is use of viscose rayon and solvent spun cellulose in view of handling convenience and versatility.

[0017] The cellulose fiber used in the present invention may have any cross-section, while the cross-section is preferably oblate shape having lobes and recesses on its periphery. Larger number of the lobes and recesses on the periphery

corresponds to higher liquid absorption, and in addition, reduced water spot due to uniform liquid dispersion to the entire nonwoven fabric by the capillary action.

[0018] The number of lobes on the periphery is preferably at least 5, and more preferably at least 8. Preferably, the shape of the lobe and the recess is curved in view of the texture.

[0019] The cellulose fiber may preferably have a single fiber fineness of 1.0 to 5 dtex. The single fiber fineness is more preferably 1.2 to 2.2 dtex. When the single fiber fineness is less than 1.0 dtex, the fiber is easily wound around the card cylinder, and this may invite drastic loss of processability. As a result, the nonwoven fabric is likely to suffer from texture unevenness. On the other hand, when the single fiber fineness is in excess of 5 dtex, the nonwoven fabric will have a hard feel and this tends to be particularly unfavorable for use with human. Increased size of the single fiber also results in the excessive increase in the size of the gap between the fibers, and this tends to result in the drastic loss of the liquid holding.

[0020] The cellulose fiber preferably has a fiber length of 30 to 80 mm in view of efficiently producing a nonwoven fabric exhibiting a high interlace with other constituent fibers such as polyester fiber, high liquid absorption, sufficient liquid holding and release, and uniform texture. The fiber length is more preferably 35 to 64 mm. Exemplary commercially available cellulose fibers include rayon manufactured by Daiwabo Rayon Co., Ltd. of Japan.

[0021] In the nonwoven fabric of the present invention, content of the cellulose fiber is 20 to 80% by weight. When the blend ratio (content) of the cellulose fiber is less than 20% by weight, water absorption for the liquid impregnation will be reduced, and function of holding the water in the nonwoven fabric will be insufficient and the liquid will unnecessarily flow out of the nonwoven fabric during its use. The flexibility inherent to the cellulose fiber will also be lost from the nonwoven fabric of the present invention, and the texture in its use will be unfavorable. On the other hand, the blend ratio of the cellulose fiber in excess of 80% by weight will invite holding of the impregnated liquid in the fiber, and the fiber will not be able to release a sufficient amount of liquid when needed. The nonwoven fabric will also lose its bulkiness, and this will invite reduced liquid retention as well as bulky touch. Accordingly, preferable content of the cellulose fiber is 40 to 60% by weight.

[0022] The polyester constituting the polyester fiber used in the present invention is, for example, high molecular weight polymer produced by condensation between terephthalic acid and ethylene glycol or butylene glycol, condensation product of sebacic acid, adipic acid, trimellitic acid, isophthalic acid, paraoxybenzoic acid or the like with ethylene glycol or butylene glycol, or a polyester polymer containing other polyesters.

[0023] The polyester fiber having an oblate multilobal cross-section used in the present invention is an oblate fiber wherein the cross-section has at least 6 lobes on the periphery.

[0024] The polyester fiber having an oblate multilobal cross-section used in the present invention is a polyester fiber having an oblate cross section having at least 6 lobes. When the number of lobes on the periphery is less than 6, the gap formed by the adjacent fibers will be insufficient and the water absorption and water retention will be insufficient. The oblate cross section realizes gaps between the fibers, and this gap formed between the fibers results in the excellent bulkiness. In addition, use of such polyester fiber results in the higher likeliness of bending or flattening of the single fibers constituting the nonwoven fabric, and hence, in soft feel.

[0025] FIG. 1 shows an embodiment of the cross-sectional shape of the single fiber of the polyester fiber having an oblate multilobal cross-section used in the present invention. FIG. 1 illustrates the cross-sectional shape of the polyester fiber having an oblate multilobal cross-section according to the nonwoven fabric of the present invention having a plurality of lobes (8 lobes) on its periphery.

[0026] In the present invention, the polyester fiber used has an oblate cross-section with at least 6, preferably at least 8, and more preferably at least 10 lobes. Upper limit for the number of lobes is preferably 12, and the lobes preferably have a curved shape in view of the texture.

[0027] The polyester fiber having an oblate multilobal cross-section used in the present invention has an oblate multilobal cross-section of the single fiber which simultaneously has the degree of oblateness (A/B) and the degree of irregularity (C/D) satisfying the following relations (1) and (2):

$$\text{Degree of oblateness (A/B)} = 2.0 \text{ to } 3.0 \quad (1),$$

and

$$\text{Degree of irregularity (C/D)} = 1.0 \text{ to } 5.0 \quad (2).$$

[0028] In the relations as described above, "A" is length of the longest line segment of the oblate multilobal cross-section; "B" is length of the line segment which is the maximum width between the lobe apexes perpendicular to the line

segment length A. "C" is length of the line segment connecting adjacent lobe apexes which are the largest lobes of the oblate multilobal cross-section. "D" is length of the perpendicular between the line C connecting the adjacent lobe apexes and the bottom of recess between the adjacent lobes.

[0029] In other words, according to preferred embodiment of the nonwoven fabric of the present invention, the polyester fiber having an oblate multilobal cross-section which is used by blending with another fiber has the degree of oblateness and the degree of irregularity simultaneously satisfying the relations (1) and (2) when the cross-section of the polyester fiber having a multilobal oblate cross-section has maximum length A, maximum width B, length C of line connecting adjacent lobe apexes in the section with largest lobes, and length D of perpendicular between the line C connecting the adjacent lobe apexes and the bottom of recess between the adjacent lobes.

[0030] When the degree of oblateness (A/B) is less than 2.0 in the present invention, fiber flattening will be difficult, and soft feel will not be realized. On the other hand, the degree of oblateness (A/B) in excess of 3.0 will result in the insufficient tension and loss of resilience, and also, loss of spinnability and poor degree of irregularity. The degree of oblateness (A/B) is preferably 2.0 to 2.7, and more preferably 2.0 to 2.5.

[0031] The degree of irregularity (C/D) shows size of the recess between adjacent lobes in the oblate multilobal cross-section, and the larger degree of irregularity means the smaller recess while the smaller degree of irregularity means the larger recess. Since larger degree of irregularity (C/D) results in the shallow recess, namely, in the smaller space between the fibers, and this results in the lower water absorption and retention, and also, in the lower wiping ability of the smudges. Accordingly, the degree of irregularity (C/D) is up to 5.0. In the meanwhile, an excessively small degree of irregularity (C/D) invites easy bending of the cross section at the recess, and retention the oblate shape tends to be difficult. In addition, the fiber is easily damaged by abrasion, and this results in the risk of skin damage upon frictional contact with the skin. In view of the situation as described above, the degree of irregularity (C/D) is at least 1.0. Accordingly, the degree of irregularity (C/D) is in the range of 1.0 to 5.0, and in view of absorption and retention of the liquid as well as wiping ability, the degree of irregularity (C/D) is 2.0 to 4.0 in the more preferable embodiment.

[0032] In the present invention, content of the polyester fiber having an oblate multilobal cross-section in the nonwoven fabric is 20 to 80% by weight. When the blend ratio (content) of the polyester fiber having an oblate multilobal cross-section is less than 20% by weight, the nonwoven fabric will lose its bulkiness and this results in the poor liquid holding. The feel of the nonwoven fabric will also be hard detracting from the texture. On the other hand, when the blend ratio (content) of the polyester fiber having an oblate multilobal cross-section is in excess of 80% by weight, the space between the fibers will be excessive and there will be a problem that the liquid will flow out of the nonwoven fabric during its use despite the good bulkiness of the nonwoven fabric. The content of the polyester fiber having an oblate multilobal cross-section in the nonwoven fabric is preferably 40 to 60% by weight.

[0033] The polyester fiber having an oblate multilobal cross-section used in the present invention comprises the polyester fibers satisfying the lobe ratio as defined by the following relation (3) when maximum length A of the polyester fiber having an oblate multilobal cross-section is regarded as axis of symmetry, and line segments are depicted between opposing lobe apexes on opposite sides of the maximum length A, and second longest line segment next to the maximum width B of the line segments has length E.

$$\text{Lobe ratio } (E/B) = 0.6 \text{ to } 0.9 \quad (3).$$

[0034] The lobe ratio (E/B) has the meaning of an index for evaluating the degree of deformation of the substantially oblong shape depicted by connecting the lobe apexes at opposite ends of the maximum width B, the E, and the maximum length A. When the lobe ratio is too small, the depth of the recess will be insufficient and the cross-section will resemble an oblate cross shape to the extremity. As a consequence, the space ratio between the fibers will be reduced, and this results in reduced water absorption and retention. In addition, when the nonwoven fabric is brought in contact with the skin, the number of lobes that becomes in contact with the skin will be reduced due to the resemblance of the cross-section with the oblate cross shape, and this results in the poor texture and softness. Accordingly, the lobe ratio is preferably at least 0.6.

[0035] On the other hand, when the lobe ratio is excessively high, more recesses will be completely blocked when the lobes and recesses of the fiber are brought to fit with each other, and the space ratio will be reduced with reduced water absorption and retention. In addition, when the nonwoven fabric is brought in contact with the skin, the number of lobes that become in contact with the skin will be reduced due to the resemblance with the cross-section to oblate hexagonal shape, and this results in the poor texture and softness. In view of the situation as described above, the lobe ratio (E/B) is preferably up to 0.9. Accordingly, the lobe ratio (E/B) is more preferably 0.6 to 0.9, and in view of the balance, the lobe ratio (E/B) is preferably 0.6 to 0.8, and more preferably 0.7 to 0.8.

[0036] The polyester fiber having an oblate multilobal cross-section used in the present invention preferably has a single fiber fineness of up to 2.0 dtex. The single fiber fineness is more preferably 1.0 to 2.0 dtex, and still more preferably

1.2 to 1.8 dtex. When the single fiber fineness is in excess of 2 dtex, rigidity inherent to the polyester fiber will be high, and the texture will be poor with higher irritation to the skin, and the soft feel will be impaired. In addition, the gap between the fibers will be excessive, and liquid holding will be poor despite the high liquid retention, and liquid tends to flow out of the nonwoven fabric in the use of the nonwoven fabric. On the other hand, the single fiber fineness of less than 1.0

dtex is likely invite insufficient processability in the carding step as well as reduced productivity.

[0037] The polyester fiber having an oblate multilobal cross-section preferably has a fiber length of 30 to 64 mm in view of preventing the fiber falling off the nonwoven fabric. The fiber length is more preferably 35 to 51 mm.

[0038] The nonwoven fabric of the present invention may additionally include a heat fusion fiber. Inclusion of a heat fusion fiber in the nonwoven fabric enables improvement of the morphological stability which is an important function for use in wiping operation by the heat fusion of the heat fusion fiber. While the heat fusion fiber may be a single component-heat fusion fiber, preferable embodiment is use of a composite-type heat fusion fiber such as side-by-side or core-sheath type heat fusion fiber comprising two or more resin components and including the parts not fused by the heat treatment since the fiber strength is retained by the parts not fused by the heat treatment.

[0039] Exemplary components constituting the heat fusion fiber include combinations such as 6-nylon and a polyethylene, a polypropylene and a polyethylene, a polypropylene and an ethylene-vinyl acetate copolymer, a polyester and a polypropylene, a polyester and a polyethylene, 6-nylon and 66-nylon, and a high density polyester and a low density polyester. Preferable blend ratio of the heat fusion fiber is 5 to 20% by weight in relation to the weight of the nonwoven fabric.

[0040] Next, the production method of the nonwoven fabric of the present invention is described.

[0041] The polyester fiber having an oblate multilobal cross-section and the cellulose fiber are carded to form a fiber web. As described above, mixing ratio (weight ratio) of the polyester fiber having an oblate multilobal cross-section to the cellulose fiber is such that the polyester fiber having an oblate multilobal cross-section/cellulose fiber is 20/80 to 80/20, and preferably 30/70 to 70/30.

[0042] Next, the fiber web formed by the carding is sent to the spunlacing step by a feed lattice, where the web is processed into a sheet by interlacing using a high pressure water jet. The nonwoven fabric after the spunlacing is sent to drying step by a conveyer. When the nonwoven fabric includes the heat treatment fiber as described above, the nonwoven fabric may also be subjected to a heat treatment simultaneously with the drying at a temperature solely allowing the melting of the heat fusion fiber.

[0043] The thus produced nonwoven fabric exhibits excellent water absorption and water retention as well as soft texture, and therefore, the sheet is well adapted for use as a nonwoven fabric for human wiping and cosmetic use intended in the present invention.

[0044] More specifically, the sheet obtained from the nonwoven fabric produced as described above exhibits excellent water absorption together with high holding of liquid such as water and chemical solution as well as excellent bulkiness, softness, and texture, and therefore, such sheet is particularly suitable for use as a nonwoven fabric used for skin in cosmetic or cleansing purpose. When used for cosmetic purpose, the sheet will exhibit high holding of the cosmetic liquid with releasability of the liquid as needed. When used for cleansing purpose, it exhibits high wiping performance without damaging the skin, and the wiped smudges are retained in the recesses on the fiber surface, namely, within the nonwoven fabric. A sheet with high cleansing performance without re-deposition is thereby realized.

[0045] Examples of the final application include baby wipes, wet tissues, cleansing sheets, and facial sheets.

Examples

[0046] Next, the present invention is described in further detail by referring to the following Examples which by no means limit the scope of the invention. The physical property values in the Examples are the values measured by the following procedures, and the values are average of 3 measurements.

[Evaluation method of the thickness of the nonwoven fabric]

[0047] 5 nonwoven fabrics each having a unit weight of 50 g/m² were laminated and the thickness of the laminate was measured with a vernier calliper.

[Evaluation method of liquid retention]

[0048] The evaluation was conducted according to water absorbency defined in JIS L 1907 7.2 (2010). A square test piece of 10 cm x 10 cm was cut out of the nonwoven fabric having a unit weight of 50 g/m², and its mass (A) was measured. The test piece was immersed in ion exchanged water for 30 seconds. The test piece was collected from the water by pinching a corner of the test piece with forceps, and weight (B) after 1 minute was measured.

[0049] The liquid retention (C) is calculated by the following equation:

$$\text{Liquid retention C (\%)} = \{(B - A) / A\} \times 100$$

[Evaluation method of remaining liquid (liquid holding)]

[0050] The evaluation was conducted according to water absorbency defined in JIS L 1907 7.2 (2010). A square test piece of 10 cm x 10 cm was cut out of the nonwoven fabric having a unit weight of 50 g/m², and its mass (A) was measured. The test piece was immersed in ion exchanged water for 30 seconds. The test piece was collected from the water by pinching a corner of the test piece with forceps, and weight (D) after 5 minutes was measured. The liquid holding (E) is calculated by the following equation:

$$E (\%) = \{(D - A) / A\} \times 100$$

[Wiping ability]

[0051] A square test piece of 10 cm x 10 cm was cut out of the nonwoven fabric having a unit weight of 50 g/m², and the test piece was folded into quarters before the use. The test piece was impregnated with 3 times its weight of water. The wiping ability was evaluated by 5 test participants according to the following criteria by wiping the lipstick applied to their arm with the test piece. "A" was evaluated pass.

- A: successfully wiped off
- B: slight remaining of the lipstick
- C: the lipstick barely wiped off

[Texture]

[0052] A square test piece of 10 cm x 10 cm was cut out of the nonwoven fabric having a unit weight of 50 g/m², and the test piece was folded into quarters before the use. The test piece was impregnated with 3 times its weight of water. The texture was evaluated by 5 test participants according to the following criteria by wiping their arm with the test piece. "A" was evaluated pass.

- A: good texture
- B: slight discomfort after the wiping
- C: irritation after the wiping

[Touch (feel)]

[0053] A square test piece of 10 cm x 10 cm was cut out of the nonwoven fabric having a unit weight of 50 g/m², and the test piece was folded into quarters before the use. The test piece was impregnated with 3 times its weight of water. The touch was evaluated by 5 test participants according to the following criteria by gripping the test piece. "A" was evaluated pass.

- A: soft feel
- B: slightly hard feel
- C: hard feel

[Example 1]

[0054] 20% by weight of a polyester fiber having oblate multilobal cross-section with 8 lobes (single-fiber fineness, 1.7 dtex; fiber length, 51mm) with degree of oblateness of 2.1, degree of irregularity of 2.7, and lobe ratio of 0.8 and 80% by weight of a rayon fiber (single-fiber fineness, 1.7 dtex; fiber length, 51 mm) were uniformly mixed, and a carded fiber web having a unit weight of 60 g/cm² was produced by a method commonly used in the art. A sheet was then prepared by duplex treatment with water jet (water pressure, 50 kg/cm²; speed, 1 m/min; nozzle diameter, 0.1 mm; pitch, 0.6 mm; 834 holes; effective width, 500 mm), and the sheet was dried at a temperature of 120°C to obtain a nonwoven fabric having a unit weight of 50 g/m². Fiber constitution of the nonwoven fabric is shown in Table 1, and the results of the evaluation are shown in Table 2.

[Example 2]

[0055] 50% by weight of a polyester fiber having oblate multilobal cross-section with 8 lobes (single-fiber fineness, 1.7 dtex; fiber length, 51mm) with degree of oblateness of 2.1, degree of irregularity of 2.7, and lobe ratio of 0.8 and 50% by weight of a rayon fiber (single-fiber fineness, 1.7 dtex; fiber length, 51 mm) were uniformly mixed, and a carded fiber web having a unit weight of 60 g/cm² was produced by a method commonly used in the art. A sheet was then prepared by duplex treatment with water jet (water pressure, 50 kg/cm²; speed, 1 m/min; nozzle diameter, 0.1 mm; pitch, 0.6 mm; 834 holes; effective width, 500 mm), and the sheet was dried at a temperature of 120°C to obtain a nonwoven fabric having a unit weight of 50 g/m². Fiber constitution of the nonwoven fabric is shown in Table 1, and the results of the evaluation are shown in Table 2.

[Example 3]

[0056] 80% by weight of a polyester fiber having oblate multilobal cross-section with 8 lobes (single-fiber fineness, 1.7 dtex; fiber length, 51mm) with degree of oblateness of 2.1, degree of irregularity of 2.7, and lobe ratio of 0.8 and 20% by weight of a rayon fiber (single-fiber fineness, 1.7 dtex; fiber length, 51 mm) were uniformly mixed, and a carded fiber web having a unit weight of 60 g/cm² was produced by a method commonly used in the art. A sheet was then prepared by duplex treatment with water jet (water pressure, 50 kg/cm²; speed, 1 m/min; nozzle diameter, 0.1 mm; pitch, 0.6 mm; 834 holes; effective width, 500 mm), and the sheet was dried at a temperature of 120°C to obtain a nonwoven fabric having a unit weight of 50 g/m². Fiber constitution of the nonwoven fabric is shown in Table 1, and the results of the evaluation are shown in Table 2.

[Table 1]

	Example 1	Example 2	Example 3
Polyester with oblate octalobal cross-section	20	50	80
Polyester with hexalobal cross-section (degree of oblateness, 1)			
Polyester with trilobal (Y-shaped) cross-section			
Polyester with substantially C-shaped cross-section			
Polyester with circular cross-section			
Rayon	80	50	20

[Table 2]

	Example 1	Example 2	Example 3
Thickness (mm)	3.0	3.3	3.5
Liquid retention (%)	850	930	1110
Liquid holding (%)	44	32	25
Wiping ability	A	A	A
Texture	A	A	A
Touch (feel)	A	A	A

[Comparative Example 1]

[0057] 15% by weight of a polyester fiber having oblate multilobal cross-section with 8 lobes (single-fiber fineness, 1.7 dtex; fiber length, 51mm) with degree of oblateness of 2.1, degree of irregularity of 2.7, and lobe ratio of 0.8 and 85% by weight of a rayon fiber (single-fiber fineness, 1.7 dtex; fiber length, 51 mm) were uniformly mixed, and a carded fiber web having a unit weight of 60 g/cm² was produced by a method commonly used in the art. A sheet was then prepared by duplex treatment with water jet (water pressure, 50 kg/cm²; speed, 1 m/min; nozzle diameter, 0.1 mm; pitch, 0.6 mm; 834 holes; effective width, 500 mm), and the sheet was dried at a temperature of 120°C to obtain a nonwoven fabric having a unit weight of 50 g/m². Fiber constitution of the nonwoven fabric is shown in Table 3, and the results of

the evaluation are shown in Table 4.

[Comparative Example 2]

5 **[0058]** 85% by weight of a polyester fiber having oblate multilobal cross-section with 8 lobes (single-fiber fineness, 1.7 dtex; fiber length, 51mm) with degree of oblateness of 2.1, degree of irregularity of 2.7, and lobe ratio of 0.8 and 15% by weight of a rayon fiber (single-fiber fineness, 1.7 dtex; fiber length, 51 mm) were uniformly mixed, and a carded fiber web having a unit weight of 60 g/cm² was produced by a method commonly used in the art. A sheet was then prepared by duplex treatment with water jet (water pressure, 50 kg/cm²; speed, 1 m/min; nozzle diameter, 0.1 mm; pitch, 0.6 mm; 834 holes; effective width, 500 mm), and the sheet was dried at a temperature of 120°C to obtain a nonwoven fabric having a unit weight of 50 g/m². Fiber constitution of the nonwoven fabric is shown in Table 3, and the results of the evaluation are shown in Table 4.

[Comparative Example 3]

15 **[0059]** A carded fiber web having a unit weight of 60 g/cm² was produced from 100% by weight of a rayon fiber (single-fiber fineness, 1.7 dtex; fiber length, 51 mm) by a method commonly used in the art. A sheet was then prepared by duplex treatment with water jet (water pressure, 50 kg/cm²; speed, 1 m/min; nozzle diameter, 0.1 mm; pitch, 0.6 mm; 834 holes; effective width, 500 mm), and the sheet was dried at a temperature of 120°C to obtain a nonwoven fabric having a unit weight of 50 g/m². Fiber constitution of the nonwoven fabric is shown in Table 3, and the results of the evaluation are shown in Table 4.

[Comparative Example 4]

25 **[0060]** 80% by weight of a polyester fiber having irregular cross-section with 6 lobes on its periphery (single-fiber fineness, 1.7 dtex; fiber length, 51mm) with degree of oblateness of 1.0 and 20% by weight of a rayon fiber (single-fiber fineness, 1.7 dtex; fiber length, 51 mm) were uniformly mixed, and a carded fiber web having a unit weight of 60 g/cm² was produced by a method commonly used in the art. A sheet was then prepared by duplex treatment with water jet (water pressure, 50 kg/cm²; speed, 1 m/min; nozzle diameter, 0.1 mm; pitch, 0.6 mm; 834 holes; effective width, 500 mm), and the sheet was dried at a temperature of 120°C to obtain a nonwoven fabric having a unit weight of 50 g/m². Fiber constitution of the nonwoven fabric is shown in Table 3, and the results of the evaluation are shown in Table 4.

[Comparative Example 5]

35 **[0061]** 80% by weight of a polyester fiber having irregular (Y-shaped) cross-section with 3 lobes on its periphery (single-fiber fineness, 1.7 dtex; fiber length, 51mm) and 20% by weight of a rayon fiber (single-fiber fineness, 1.7 dtex; fiber length, 51 mm) were uniformly mixed, and a carded fiber web having a unit weight of 60 g/cm² was produced by a method commonly used in the art. A sheet was then prepared by duplex treatment with water jet (water pressure, 50 kg/cm²; speed, 1 m/min; nozzle diameter, 0.1 mm; pitch, 0.6 mm; 834 holes; effective width, 500 mm), and the sheet was dried at a temperature of 120°C to obtain a nonwoven fabric having a unit weight of 50 g/m². Fiber constitution of the nonwoven fabric is shown in Table 3, and the results of the evaluation are shown in Table 4.

[Comparative Example 6]

45 **[0062]** 80% by weight of a polyester fiber having irregular C-shaped cross-section (single-fiber fineness, 1.7 dtex; fiber length, 51mm) and 20% by weight of a rayon fiber (single-fiber fineness, 1.7 dtex; fiber length, 51 mm) were uniformly mixed, and a carded fiber web having a unit weight of 60 g/cm² was produced by a method commonly used in the art. A sheet was then prepared by duplex treatment with water jet (water pressure, 50 kg/cm²; speed, 1 m/min; nozzle diameter, 0.1 mm; pitch, 0.6 mm; 834 holes; effective width, 500 mm), and the sheet was dried at a temperature of 120°C to obtain a nonwoven fabric having a unit weight of 50 g/m². Fiber constitution of the nonwoven fabric is shown in Table 3, and the results of the evaluation are shown in Table 4.

[Comparative Example 7]

55 **[0063]** 80% by weight of a polyester fiber with circular cross-section (single-fiber fineness, 1.7 dtex; fiber length, 51mm) and 20% by weight of a rayon fiber (single-fiber fineness, 1.7 dtex; fiber length, 51 mm) were uniformly mixed, and a carded fiber web having a unit weight of 60 g/cm² was produced by a method commonly used in the art. A sheet was then prepared by duplex treatment with water jet (water pressure, 50 kg/cm²; speed, 1 m/min; nozzle diameter, 0.1 mm;

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pitch, 0.6 mm; 834 holes; effective width, 500 mm), and the sheet was dried at a temperature of 120°C to obtain a nonwoven fabric having a unit weight of 50 g/m². Fiber constitution of the nonwoven fabric is shown in Table 3, and the results of the evaluation are shown in Table 4.

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[Table 3]

	Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4	Comparative Example 5	Comparative Example 6	Comparative Example 7
Polyester with oblate octalobal cross-section	15	85					
Polyester with hexalobal cross-section (degree of oblateness, 1)			80				
Polyester with trilobal (Y-shaped) cross-section				80			
Polyester with substantially C-shaped cross-section					80		
Polyester with circular cross-section						80	
Rayon	85	15	100	20	20	20	20

[Table 4]

	Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4	Comparative Example 5	Comparative Example 6	Comparative Example 7
Thickness (mm)	2.7	3.8	1.8	4.0	4.2	2.8	2.4
Liquid retention (%)	790	1140	700	1160	1200	810	780
Liquid holding (%)	48	22	55	21	19	27	29
Wiping ability	B	A	B	A	B	B	C
Texture	A	B	A	C	C	B	B
Touch (feel)	B	A	B	C	C	B	B

[0064] As shown in Examples 1 to 3, the nonwoven fabric prepared from 20 to 80% by weight of a polyester fiber having an oblate multilobal cross-section with 8 lobes on its periphery and 20 to 80% by weight of rayon was confirmed to exhibit a high liquid retention, namely, high capability of retaining liquid such as water and chemical solution as well as low liquid holding, namely, capability of releasing the retained liquid to enable efficient use of the liquid. High wiping ability as well as good touch (feel) and texture were also confirmed.

[0065] On the other hand, as shown in Comparative Example 1, content of the cellulose fiber in excess of 80% by weight results in the loss of bulkiness of the nonwoven fabric despite the good texture, and this results in the reduced liquid retention. The liquid holding is also high due to the retention of the chemical solution in the cellulose fiber, and this may become the cause of poor release of the chemical solution.

[0066] In addition, as shown in Comparative Example 2, content of the polyester fiber having an oblate multilobal cross-section in excess of 80% by weight invites loss of flexibility realized by the cellulose fiber, and this results in the poor texture.

[0067] In contrast, as shown in Comparative Examples 3 to 7, use of other polyester fiber having a non-flat irregular cross-section results in the drastically reduced liquid holding despite increase in the liquid retention, and this will be the cause for liquid flow during use of the nonwoven fabric due to the insufficient liquid holding in the nonwoven fabric. In addition, non-oblate cross-section results in the hard feeling and poor texture.

Claims

1. A nonwoven fabric comprising 20 to 80% by weight of a polyester fiber having an oblate multilobal cross-section and 20 to 80% by weight of a cellulose fiber wherein the polyester fiber having an oblate multilobal cross-section has an oblate cross-section with at least 6 lobes on its periphery, and when the cross-section of the polyester fiber having a multilobal oblate cross-section has maximum length A, maximum width B, length C of line connecting adjacent lobe apexes in the section with largest lobes, and length D of perpendicular between the line C connecting the adjacent lobe apexes and the bottom of recess between the adjacent lobes, degree of oblateness (A/B) and degree of irregularity (C/D) simultaneously satisfy the following relations (1) and (2) :

$$\text{Degree of oblateness (A/B)} = 2.0 \text{ to } 3.0 \quad (1),$$

and

$$\text{Degree of irregularity (C/D)} = 2.0 \text{ to } 5.0 \quad (2).$$

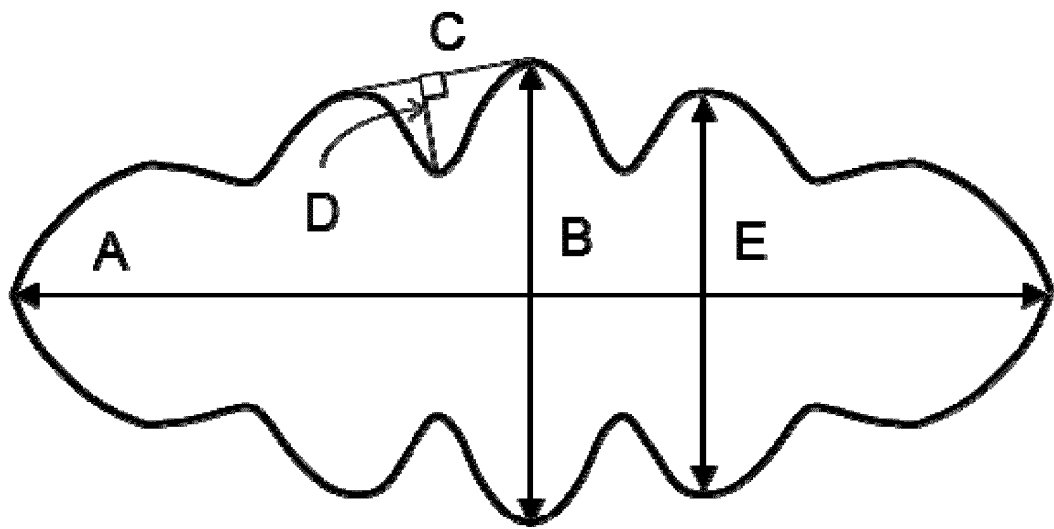
2. A nonwoven fabric according to claim 1 wherein, when maximum length A of the polyester fiber having an oblate multilobal cross-section is regarded as axis of symmetry, and line segments are depicted between opposing lobe apexes on opposite sides of the maximum length A, and second longest line segment next to the maximum width B of the line segments has length E, lobe ratio (E/B) satisfies the following relation (3) :

$$\text{Lobe ratio (E/B)} = 0.6 \text{ to } 0.9 \quad (3).$$

3. A nonwoven fabric according to claim 1 or 2 wherein the polyester fiber having a multilobal oblate cross-section has a single-fiber fineness of up to 2.0 dtex.

4. A nonwoven fabric for a wiper comprising the nonwoven fabric according to any one of claims 1 to 3.

【 Fig. 1】



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/050632

A. CLASSIFICATION OF SUBJECT MATTER

D04H1/4391(2012.01)i, A45D34/04(2006.01)i, D04H1/425(2012.01)i, D04H1/435(2012.01)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)

D04H1/00-18/04, A45D33/00-40/30

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2014
Kokai Jitsuyo Shinan Koho	1971-2014	Toroku Jitsuyo Shinan Koho	1994-2014

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

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2005-350777 A (Toray Industries, Inc.), 22 December 2005 (22.12.2005), claims 1, 5; paragraph [0001]; fig. 1 (Family: none)	1-4
A	JP 2007-277739 A (Toray Industries, Inc.), 25 October 2007 (25.10.2007), paragraphs [0076], [0077]; fig. 9 (Family: none)	1-4
A	JP 2009-079320 A (Toray Industries, Inc.), 16 April 2009 (16.04.2009), claim 1; paragraphs [0001], [0035] (Family: none)	1-4

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

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

"&" document member of the same patent family

Date of the actual completion of the international search
03 April, 2014 (03.04.14)Date of mailing of the international search report
22 April, 2014 (22.04.14)Name and mailing address of the ISA/
Japanese Patent Office

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2010084297 A [0006]
- JP 2010081987 A [0006]
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