shape. The term "softening point" means the temperature at which a thermoplastic resin, for example, is deformable by a mechanical or other force.

The steel-to-steel matched embossing is characterized in that the two embossing rollers rotate not in contact interengagement with each other but with a clearance maintained therebetween by machine setting.

[0050]

The pair of embossing rollers 41 and 42 are configured such that the roller 41 has a plurality of protrusions 411 on its peripheral surface, and the other roller 42 has, on its peripheral surface, recesses 422 at positions corresponding to the protrusions 411 of the roller 41 for receiving the protrusions 411. The pair of embossing rollers 41 and 42 are also configured such that the roller 42 has a plurality of protrusions 421 on its peripheral surface, and the other roller 41 has, on its peripheral surface, recesses 412 at positions corresponding to the protrusions 421 of the roller 42 for receiving the protrusions 421 of the roller 42. Both the embossing rollers 41 and 42 have the protrusions 411 (and 421) and the recesses 412 (and 422) arranged on their peripheral surface in a staggered pattern. The embossing rollers 41 and 42 used in the apparatus 20 of the present embodiment are the same, except for having their protrusions 411 (and 421) arranged at positions corresponding to the recesses 422 (and 412) of the respective mating rollers. Therefore, the description below will generally be confined to the protrusions 411 of the embossing roller 41 and the recesses 412 of the embossing roller 42.

[0051]

The paired rollers 41 and 42 are cylindrical members made of metal, such as an aluminum alloy or steel. As shown in Fig. 10, the steel-to-steel matched embossing unit 43 of the apparatus 20 of the present embodiment is configured such that the plurality of protrusions 411 on the peripheral surface of the roller 41 and the plurality of recesses 422 on the peripheral surface of the roller 42 are in contactless relation in their full engagement. The protrusions 411 are uniformly and regularly arranged in both the axial direction and the circumferential direction of the roller 41. The pair of rollers 41 and 42 rotate by a driving force transmitted from unshown driving means using unshown gears. From the viewpoint of avoiding collapse of the raised state, it is preferred to transmit a driving force by using gears. The rotational speed of the paired

[0054]

In the texturing part 20D, the recesses 422 of the roller 42 are arranged at positions corresponding to the protrusions 411 of the roller 41 as shown in Figs. 9 and 10. As shown in Fig. 10, the depth D of engagement between the projections 411 of the roller 41 and the projections of the roller 42 (the length of the overlap between the projection 411 and the recess 422) is preferably 0.1 mm or more, more preferably 1 mm or more, and 10 mm or less, more preferably 8 mm or less. It is preferred that there be a clearance between the top of the protrusion 411 of the roller 41 and the bottom of the recess 422 of the roller 42 so that the raised laminate 6' passing through the nip therebetween may not be pressed by the engagement and may thereby be prevented from eliminating the raised state.

[0055]

As shown in Figs. 7 and 9, the texturing part 20D further includes rollers 44 and 45 upstream and downstream, respectively, of the steel-to-steel matched embossing unit 43 for conveying the raised laminate 6' to the steel-to-steel matched embossing unit 43.

[0056]

The bonding part 20E is a part where the textured laminate 6" is seal bonded as shown in Figs. 7 and 11. As shown, the bonding part 20E of the apparatus 20 according to the present embodiment includes an ultrasonic hone 51 and a patterning roller 52. While the apparatus 20 of the present embodiment adopts an ultrasonic welding process using the ultrasonic horn 51 and the patterning roller 52, the seal-bonding may be performed by heat sealing using a heat sealing roller. As shown in Fig. 11, the patterning roller 52 is a cylindrical member made of metal, such as an aluminum alloy or steel, and having, on its peripheral surface, ridges 520 corresponding to the linear bonds 15 of the cleaning sheet 1 to be produced. The ridges 520 include first ridges 520a corresponding to the first linear bonds 15a of the cleaning sheet 1 and second ridges 520b corresponding to the second linear bonds 15b of the cleaning sheet 1. The patterning roller 52 is rotated by a driving force transmitted from unshown driving means by means of unshown gears.

The rotational speed of the patterning roller 52 is controlled by the unshown controller of the apparatus 20.

[0057]

The ridges 520 on the peripheral surface of the patterning roller 52 preferably have a height h1 from the peripheral surface of the patterning roller 52 to the top of the ridge 520 of 1 mm or more, more preferably 2 mm or more, and 10 mm or less, more preferably 8 mm or less from a standpoint of preventing the protrusions and depressions of the textured laminate 6" from collapsing. As stated above, since the first ridges 520a and the second ridges 520b correspond to the first linear bonds 15a and the second linear bonds 15b, respectively, the first and second ridges 520a and 520b are in an arrangement that satisfies the above discussed criteria about the angle α between the first linear bonds 15a and the second linear bonds 15b and the width W2 between the first linear bonds 15a and between the second linear bonds 15b, and the width of the top of the first and the second ridges 520a and 520b is such that satisfies the above discussed criterion about the width W1 of the first and the second linear bonds 15a and 15b.

[0058]

The cooling part 20F includes, as shown in Fig. 7, an air blower duct 28 in front of one side of a laminate 6□ as obtained after the uniting by bonding and a vacuum conveyor 29 on the other side of the laminate 6□. Cool air is blown through the air blower duct 28 to the laminate 6□. The vacuum conveyor 29 is an endless mesh belt conveying the laminate 6□. The vacuum conveyor 29 is configured such that the cool air blown from the air blower duct 28 is sucked through the mesh belt. The cooling part 20F is not limited to the structure above and may have other cooling means, such as a water-cooled roller having cooling water circulating therethrough or a vacuum roller capable of sucking air inside through its peripheral surface. Blowing air from the air blower duct is also expected to be effective in re-raising fibers that have been raised but laid down in the preceding texturing process.

[0059]

The method for making the stretch sheet 1 will then be described based on an embodiment in which the above described apparatus 20 is used. Figs. 7 through 11 are referred to.

In the joining part 20A, fiber webs 12a and 12b, each of which is a precursor of a hydrophobic fiber aggregate, are fed continuously from the cards 21A and 21B,

(2) The cleaning sheet according to clause (1), having raised fibers raised from the surface of the protrusions and the surface of the depressions.

(3) The cleaning sheet according to clause (2), wherein the raised fibers are fibers constituting the hydrophobic fiber aggregate or the raised fibers include a fiber constituting the hydrophobic fiber aggregate and a fiber constituting the hydrophilic fiber aggregate.

(4) The composite sheet according to clause (2) or (3), wherein the number of raised fibers raised in the individual depressions is larger than the number of raised fibers raised in the individual protrusions.

(5) The cleaning sheet according to one of clauses (2) to (4), wherein the fiber raised in the individual depressions has a height of preferably 0.1 mm or more, more preferably 0.5 mm or more, and 30 mm or less, more preferably 20 mm or less.

(6) The cleaning sheet according to one of clauses (2) to (5), wherein the number of the raised fibers raised in the depressions is preferably 5 or greater, more preferably 10 or greater, and 100 or fewer, more preferably 90 or fewer, per 10 mm width.

(7) The cleaning sheet according to one of clauses (2) to (6), wherein the fiber raised in the individual protrusions has a height of preferably 0.1 mm or more, more preferably 0.5 mm or more, and 30 mm or less, more preferably 20 mm or less.

(8) The cleaning sheet according to one of clauses (2) to (7), wherein the number of the raised fibers on the protrusions is preferably 5 or greater, more preferably 10 or greater, and 80 or fewer, more preferably 70 or fewer, per 10 mm width.

(9) The cleaning sheet according to one of clauses (1) to (8), wherein the linear bond intersects an imaginary line connecting the tops of two protrusions adjacent to each other at the shortest distance d.

(10) The cleaning sheet according to clause (9), wherein the linear bond intersects the imaginary line at an angle of 3° to 30°.

(11) The cleaning sheet according to one of clauses (1) to (10), wherein the individual protrusions have a plan view area of 1 mm^2 or more, more preferably 4 mm^2 or more, and 100 mm^2 or less, more preferably 25 mm^2 or less.

(12) The cleaning sheet according to one of clauses (1) to (11), wherein the individual depressions have a plan view area of 1 mm^2 or more, more preferably 4 mm^2 or more, and 100 mm^2 or less, more preferably 25 mm^2 or less.

(13) The cleaning sheet according to one of clauses (1) to (12), wherein the linear bond has a bonding width preferably of 0.3 mm or more, more preferably 0.5 mm or

[0089]

Example 1

A cleaning sheet of Fig. 1 was made by the method shown in Fig. 7. A fiber web having a basis weight of 30 g/m^2 was prepared by carding polyester fiber (1.45 dtex; fiber length: 38mm; 100%) in a usual manner. Hydroentangled nonwoven fabric having a basis weight of 40 g/m^2 and containing 100 mass% hydrophilic rayon fiber was used as a hydrophilic fiber aggregate (backbone material). The fiber web was superposed on the upper and lower side of the hydroentangled nonwoven fabric. The resulting stack was united by entanglement with water jets jetted from a plurality of nozzles, followed by drying to obtain a laminate having hydrophobic fiber aggregates. The laminate was raised on both sides thereof using the engraved rollers 31 and 34. The engraved rollers 31 and 34 rotated in a direction reverse to the moving direction of the laminate. The wrap angle β of the laminate around each engraved roller was 130°. The projections 310 and 340 of the engraved rollers 31 and 34 had a height of about 0.07 mm. The distance between adjacent projections (the pitch of the projections) in the circumferential direction and that in the axial direction were each about 0.22 mm. The number of the projections per unit area was 2000/cm^2. The laminate was then passed through the steel-to-steel matched embossing unit 43 to be textured with protrusions and depressions. The surface temperature of the rollers 41 and 42 was 105°C. The protrusions 411 of the roller 41 had a height of 2.0 mm, and the depth of engagement between the protrusions 411 of the roller 41 and the recesses 422 of the roller 42 was 1.6 mm. The distance (pitch) between the protrusions 411 adjacent in the axial direction was 7 mm, and that in the circumferential direction was 7 mm. The textured laminate was introduced between the ultrasonic horn 51 and the patterning roller 52 to form linear bonds at which the hydroentangled nonwoven fabric and the fiber web on both sides of the nonwoven fabric were bonded and united together. The angle α of intersection between the first linear bonds 15a and the second linear bonds 15b was 67° (each linear bond made an angle of 67/2° with the MD (direction X)). The width W1 of the first and second linear bonds was 1 mm. The distance W2 between adjacent first linear bonds 15a and between adjacent second linear bonds 15b was 22mm. The cleaning sheet of Example 1 was produced under these conditions. In the resulting cleaning sheet, the intersecting angle γ between a first imaginary line ILa connecting the tops of adjacent protrusions 2 and the first linear bond 15a was 10°, and the intersecting angle δ between a 12th imaginary line ILb connecting the tops of

shown in Table 1.

[0098]

(a) Sprinkled water absorptivity

Each of the cleaning sheets of Examples 1 to 4 and Comparative Examples 1 to 5 was attached to the head of a cleaning implement, Quickle Wiper® from Kao Corp. On a 30 cm by 90 cm piece of wood flooring (Woody F from Matsushita Electric Works Co., Ltd.) was dropped 0.3 ml of ion exchanged water and wiped up by the cleaning sheet attached to the head in a single, one-way mopping motion of over a given distance (60 cm) of the flooring. The mass of the ion exchanged water absorbed by the cleaning sheet was obtained by subtracting the mass of the cleaning sheet before mopping from the total mass of the cleaning sheet after mopping. The above test was repeated sequentially using five cleaning sheets of a kind to determine the total mass of absorbed ion-exchanged water out of 1.5 ml (total mass of sprinkled ion-exchanged water). The total mass of absorbed water was divided by 1.5, and the quotient was multiplied by 100 to give a water absorbency (%).

Absorptivity for sprinkled water was rated as follows.

A: Good absorptivity with an absorbency of 70% or more.

B: Practically sufficient absorptivity with an absorbency of 50% or more and less than 70%.

C: A slightly low and yet practical level of absorptivity with an absorbency of 40% or more and less than 50%.

D: A practically unacceptable level of absorptivity with an absorbency less than 40%.

[0099]

(b) Hair trapping performance

(b-1) Hair trapping performance on dry floor

Each of the cleaning sheets of Examples 1 to 4 and Comparative Examples 1 to 4 was attached to the head of a cleaning implement, Quickle Wiper® from Kao Corp. On a 30 cm by 90 cm piece of wood flooring (Woody F from Matsushita Electric Works Co., Ltd.) were scattered ten human hairs of about 10 cm in length. The hairs were

[0105]

(f-2) Resistance to mopping motion on wet floor

Each of the cleaning sheets of Examples 1 to 4 and Comparative Examples 1 to 4 was cut to prepare five circular specimens of 25 mm in diameter. Under the raised surface of each specimen was dripped 0.1 ml of ion exchanged water. After the specimen was allowed to stand for 10 seconds, a coefficient μ of static friction of the specimens on its raised surface was determined using Heidon Tribogear Muse Type:94i available from Shinto Scientific Co., Ltd. An average of μ values of five specimens was taken as a measure for resistance to mopping motion. The resistance to mopping motion of the cleaning sheet was rated based on the average μ value as follows.

A: An average μ value of smaller than 0.40. Convenient to use with little resistance to mopping operation.

B: An average μ value of 0.40 or greater and smaller than 0.60. Slightly less convenient to use due to high resistance to mopping operation but still practical to use.

C: An average μ value of 0.60 or greater. Poor in convenience of use and impractical for use due to large resistance to mopping operation.

CLAIMS

1. A cleaning sheet comprising a hydrophilic fiber aggregate composed mainly of hydrophilic fibers, and a hydrophobic fiber aggregate composed mainly of hydrophobic fibers and arranged on both sides of the hydrophilic fiber aggregate, the hydrophobic fiber aggregate having its constituent fibers entangled with one another, entering the hydrophilic fiber aggregate, and entangled with fibers constituting the hydrophilic fiber aggregate in a way that the hydrophilic fiber aggregate and the hydrophilic fiber aggregate are united together,

the cleaning sheet being three-dimensionally textured with a plurality of protrusions and a plurality of depressions on both sides thereof in a pattern such that protrusions on one side correspond to depressions on the other side and that depressions on one side correspond to protrusions on the other side, and

the cleaning sheet having a linear bond where the hydrophilic fiber aggregate and the hydrophobic fiber aggregate are bonded to each other.

2. The cleaning sheet according to claim 1, having raised fibers raised from the surface of the protrusions and the surface of the depressions.

3. The composite sheet according to claim 2, wherein the number of raised fibers raised in the individual depressions is larger than the number of raised fibers raised in the individual protrusions.

4. The cleaning sheet according to claim 2 or 3, wherein the raised fiber raised in the individual depressions has a height of 0.1 to 30 mm, and the number of the raised fibers raised in the depressions is 5 to 100 per 10 mm width.

5. The cleaning sheet according to any one of claims 1 to 4, wherein the linear bond intersects an imaginary line connecting the tops of two protrusions adjacent to each other at the shortest distance.

6. The cleaning sheet according to any one of claims 1 to 5, wherein the individual protrusions have a plan view area of 1 to 100 mm^2, and the linear bond has a

bonding width of 0.3 to 5 mm.

7. The cleaning sheet according to any one of claims 1 to 6, wherein the hydrophilic fiber aggregate has a larger basis weight than the hydrophobic fiber aggregate per side.

8. A method for making the cleaning sheet according to claim 2, comprising the steps of superposing the hydrophobic fiber aggregate on each side of the hydrophilic fiber aggregate to make a stack, entangling the fibers of the hydrophilic fiber aggregate and the fibers of the hydrophobic fiber aggregate by applying high-pressure water jets to each side of the stack to unite the stack into a laminate, subjecting the laminate to raising on both sides thereof, texturing a plurality of regions of the raised laminate with protrusions and depressions, and seal bonding the textured laminate to form a linear bond at which the hydrophilic fiber aggregate and the hydrophobic fiber aggregates are bonded together.

shape. The term "softening point" means the temperature at which a thermoplastic resin, for example, is deformable by a mechanical or other force.

The steel-to-steel matched embossing is characterized in that the two embossing rollers rotate not in contact interengagement with each other but with a clearance maintained therebetween by machine setting.

[0050]

The pair of embossing rollers 41 and 42 are configured such that the roller 41 has a plurality of protrusions 411 on its peripheral surface, and the other roller 42 has, on its peripheral surface, recesses 422 at positions corresponding to the protrusions 411 of the roller 41 for receiving the protrusions 411. The pair of embossing rollers 41 and 42 are also configured such that the roller 42 has a plurality of protrusions 421 on its peripheral surface, and the other roller 41 has, on its peripheral surface, recesses 412 at positions corresponding to the protrusions 421 of the roller 42 for receiving the protrusions 421 of the roller 42. Both the embossing rollers 41 and 42 have the protrusions 411 (and 421) and the recesses 412 (and 422) arranged on their peripheral surface in a staggered pattern. The embossing rollers 41 and 42 used in the apparatus 20 of the present embodiment are the same, except for having their protrusions 411 (and 421) arranged at positions corresponding to the recesses 422 (and 412) of the respective mating rollers. Therefore, the description below will generally be confined to the protrusions 411 of the embossing roller 41 and the recesses 422 of the embossing roller 42.

[0051]

The paired rollers 41 and 42 are cylindrical members made of metal, such as an aluminum alloy or steel. As shown in Fig. 10, the steel-to-steel matched embossing unit 43 of the apparatus 20 of the present embodiment is configured such that the plurality of protrusions 411 on the peripheral surface of the roller 41 and the plurality of recesses 422 on the peripheral surface of the roller 42 are in contactless relation in their full engagement. The protrusions 411 are uniformly and regularly arranged in both the axial direction and the circumferential direction of the roller 41. The pair of rollers 41 and 42 rotate by a driving force transmitted from unshown driving means using unshown gears. From the viewpoint of avoiding collapse of the raised state, it is preferred to transmit a driving force by using gears. The rotational speed of the paired

[0054]

In the texturing part 20D, the recesses 422 of the roller 42 are arranged at positions corresponding to the protrusions 411 of the roller 41 as shown in Figs. 9 and 10. As shown in Fig. 10, the depth D of engagement between the projections 411 of the roller 41 and the recesses of the roller 42 (the length of the overlap between the projection 411 and the recess 422) is preferably 0.1 mm or more, more preferably 1 mm or more, and 10 mm or less, more preferably 8 mm or less. It is preferred that there be a clearance between the top of the protrusion 411 of the roller 41 and the bottom of the recess 422 of the roller 42 so that the raised laminate 6' passing through the nip therebetween may not be pressed by the engagement and may thereby be prevented from eliminating the raised state.

[0055]

As shown in Figs. 7 and 9, the texturing part 20D further includes rollers 44 and 45 upstream and downstream, respectively, of the steel-to-steel matched embossing unit 43 for conveying the raised laminate 6' to the steel-to-steel matched embossing unit 43.

[0056]

The bonding part 20E is a part where the textured laminate 6" is seal bonded as shown in Figs. 7 and 11. As shown, the bonding part 20E of the apparatus 20 according to the present embodiment includes an ultrasonic hone 51 and a patterning roller 52. While the apparatus 20 of the present embodiment adopts an ultrasonic welding process using the ultrasonic horn 51 and the patterning roller 52, the seal-bonding may be performed by heat sealing using a heat sealing roller. As shown in Fig. 11, the patterning roller 52 is a cylindrical member made of metal, such as an aluminum alloy or steel, and having, on its peripheral surface, ridges 520 corresponding to the linear bonds 15 of the cleaning sheet 1 to be produced. The ridges 520 include first ridges 520a corresponding to the first linear bonds 15a of the cleaning sheet 1 and second ridges 520b corresponding to the second linear bonds 15b of the cleaning sheet 1. The patterning roller 52 is rotated by a driving force transmitted from unshown driving means by means of unshown gears.

The rotational speed of the patterning roller 52 is controlled by the unshown controller of the apparatus 20.

[0057]

The ridges 520 on the peripheral surface of the patterning roller 52 preferably have a height h1 from the peripheral surface of the patterning roller 52 to the top of the ridge 520 of 1 mm or more, more preferably 2 mm or more, and 10 mm or less, more preferably 8 mm or less from a standpoint of preventing the protrusions and depressions of the textured laminate 6" from collapsing. As stated above, since the first ridges 520a and the second ridges 520b correspond to the first linear bonds 15a and the second linear bonds 15b, respectively, the first and second ridges 520a and 520b are in an arrangement that satisfies the above discussed criteria about the angle α between the first linear bonds 15a and the second linear bonds 15b and the width W2 between the first linear bonds 15a and between the second linear bonds 15b, and the width of the top of the first and the second ridges 520a and 520b is such that satisfies the above discussed criterion about the width W1 of the first and the second linear bonds 15a and 15b.

[0058]

The cooling part 20F includes, as shown in Fig. 7, an air blower duct 28 in front of one side of a laminate 6□ as obtained after the uniting by bonding and a vacuum conveyor 29 on the other side of the laminate 6□. Cool air is blown through the air blower duct 28 to the laminate 6□. The vacuum conveyor 29 is an endless mesh belt conveying the laminate 6□. The vacuum conveyor 29 is configured such that the cool air blown from the air blower duct 28 is sucked through the mesh belt. The cooling part 20F is not limited to the structure above and may have other cooling means, such as a water-cooled roller having cooling water circulating therethrough or a vacuum roller capable of sucking air inside through its peripheral surface. Blowing air from the air blower duct is also expected to be effective in re-raising fibers that have been raised but laid down in the preceding texturing process.

[0059]

The method for making the cleaning sheet 1 will then be described based on an embodiment in which the above described apparatus 20 is used. Figs. 7 through 11 are referred to.

In the joining part 20A, fiber webs 12a and 12b, each of which is a precursor of a hydrophobic fiber aggregate, are fed continuously from the cards 21A and 21B,

(2) The cleaning sheet according to clause (1), having raised fibers raised from the surface of the protrusions and the surface of the depressions.

(3) The cleaning sheet according to clause (2), wherein the raised fibers are fibers constituting the hydrophobic fiber aggregate or the raised fibers include a fiber constituting the hydrophobic fiber aggregate and a fiber constituting the hydrophilic fiber aggregate.

(4) The cleaning sheet according to clause (2) or (3), wherein the number of raised fibers raised in the individual depressions is larger than the number of raised fibers raised in the individual protrusions.

(5) The cleaning sheet according to one of clauses (2) to (4), wherein the fiber raised in the individual depressions has a height of preferably 0.1 mm or more, more preferably 0.5 mm or more, and 30 mm or less, more preferably 20 mm or less.

(6) The cleaning sheet according to one of clauses (2) to (5), wherein the number of the raised fibers raised in the depressions is preferably 5 or greater, more preferably 10 or greater, and 100 or fewer, more preferably 90 or fewer, per 10 mm width.

(7) The cleaning sheet according to one of clauses (2) to (6), wherein the fiber raised in the individual protrusions has a height of preferably 0.1 mm or more, more preferably 0.5 mm or more, and 30 mm or less, more preferably 20 mm or less.

(8) The cleaning sheet according to one of clauses (2) to (7), wherein the number of the raised fibers on the protrusions is preferably 5 or greater, more preferably 10 or greater, and 80 or fewer, more preferably 70 or fewer, per 10 mm width.

(9) The cleaning sheet according to one of clauses (1) to (8), wherein the linear bond intersects an imaginary line connecting the tops of two protrusions adjacent to each other at the shortest distance d.

(10) The cleaning sheet according to clause (9), wherein the linear bond intersects the imaginary line at an angle of 3° to 30°.

(11) The cleaning sheet according to one of clauses (1) to (10), wherein the individual protrusions have a plan view area of 1 mm^2 or more, more preferably 4 mm^2 or more, and 100 mm^2 or less, more preferably 25 mm^2 or less.

(12) The cleaning sheet according to one of clauses (1) to (11), wherein the individual depressions have a plan view area of 1 mm^2 or more, more preferably 4 mm^2 or more, and 100 mm^2 or less, more preferably 25 mm^2 or less.

(13) The cleaning sheet according to one of clauses (1) to (12), wherein the linear bond has a bonding width preferably of 0.3 mm or more, more preferably 0.5 mm or

[0089]

Example 1

A cleaning sheet of Fig. 1 was made by the method shown in Fig. 7. A fiber web having a basis weight of 30 g/m^2 was prepared by carding polyester fiber (1.45 dtex; fiber length: 38mm; 100%) in a usual manner. Hydroentangled nonwoven fabric having a basis weight of 40 g/m^2 and containing 100 mass% hydrophilic rayon fiber was used as a hydrophilic fiber aggregate (backbone material). The fiber web was superposed on the upper and lower side of the hydroentangled nonwoven fabric. The resulting stack was united by entanglement with water jets jetted from a plurality of nozzles, followed by drying to obtain a laminate having hydrophobic fiber aggregates. The laminate was raised on both sides thereof using the engraved rollers 31 and 34. The engraved rollers 31 and 34 rotated in a direction reverse to the moving direction of the laminate. The wrap angle β of the laminate around each engraved roller was 130°. The projections 310 and 340 of the engraved rollers 31 and 34 had a height of about 0.07 mm. The distance between adjacent projections (the pitch of the projections) in the circumferential direction and that in the axial direction were each about 0.22 mm. The number of the projections per unit area was 2000/cm^2. The laminate was then passed through the steel-to-steel matched embossing unit 43 to be textured with protrusions and depressions. The surface temperature of the rollers 41 and 42 was 105°C. The protrusions 411 of the roller 41 had a height of 2.0 mm, and the depth of engagement between the protrusions 411 of the roller 41 and the recesses 422 of the roller 42 was 1.6 mm. The distance (pitch) between the protrusions 411 adjacent in the axial direction was 7 mm, and that in the circumferential direction was 7 mm. The textured laminate was introduced between the ultrasonic horn 51 and the patterning roller 52 to form linear bonds at which the hydroentangled nonwoven fabric and the fiber web on both sides of the nonwoven fabric were bonded and united together. The angle α of intersection between the first linear bonds 15a and the second linear bonds 15b was 67° (each linear bond made an angle of 67/2° with the MD (direction X)). The width W1 of the first and second linear bonds was 1 mm. The distance W2 between adjacent first linear bonds 15a and between adjacent second linear bonds 15b was 22mm. The cleaning sheet of Example 1 was produced under these conditions. In the resulting cleaning sheet, the intersecting angle γ between a first imaginary line ILa connecting the tops of adjacent protrusions 2 and the first linear bond 15a was 10°, and the intersecting angle δ between a second imaginary line ILb connecting the tops of

shown in Table 1.

[0098]

(a) Sprinkled water absorptivity

Each of the cleaning sheets of Examples 1 to 4 and Comparative Examples 1 to 4 was attached to the head of a cleaning implement, Quickle Wiper® from Kao Corp. On a 30 cm by 90 cm piece of wood flooring (Woody F from Matsushita Electric Works Co., Ltd.) was dropped 0.3 ml of ion exchanged water and wiped up by the cleaning sheet attached to the head in a single, one-way mopping motion of over a given distance (60 cm) of the flooring. The mass of the ion exchanged water absorbed by the cleaning sheet was obtained by subtracting the mass of the cleaning sheet before mopping from the total mass of the cleaning sheet after mopping. The above test was repeated sequentially using five cleaning sheets of a kind to determine the total mass of absorbed ion-exchanged water out of 1.5 ml (total mass of sprinkled ion-exchanged water). The total mass of absorbed water was divided by 1.5, and the quotient was multiplied by 100 to give a water absorbency (%).

Absorptivity for sprinkled water was rated as follows.

A: Good absorptivity with an absorbency of 70% or more.

B: Practically sufficient absorptivity with an absorbency of 50% or more and less than 70%.

C: A slightly low and yet practical level of absorptivity with an absorbency of 40% or more and less than 50%.

D: A practically unacceptable level of absorptivity with an absorbency less than 40%.

[0099]

(b) Hair trapping performance

(b-1) Hair trapping performance on dry floor

Each of the cleaning sheets of Examples 1 to 4 and Comparative Examples 1 to 4 was attached to the head of a cleaning implement, Quickle Wiper® from Kao Corp. On a 30 cm by 90 cm piece of wood flooring (Woody F from Matsushita Electric Works Co., Ltd.) were scattered ten human hairs of about 10 cm in length. The hairs were

[0105]

(f-2) Resistance to mopping motion on wet floor

Each of the cleaning sheets of Examples 1 to 4 and Comparative Examples 1 to 4 was cut to prepare five circular specimens of 25 mm in diameter. To the raised surface of each specimen was dripped 0.1 ml of ion exchanged water. After the specimen was allowed to stand for 10 seconds, a coefficient μ of static friction of the specimens on its raised surface was determined using Heidon Tribogear Muse Type:94i available from Shinto Scientific Co., Ltd. An average of μ values of five specimens was taken as a measure for resistance to mopping motion. The resistance to mopping motion of the cleaning sheet was rated based on the average μ value as follows.

A: An average μ value of smaller than 0.40. Convenient to use with little resistance to mopping operation.

B: An average μ value of 0.40 or greater and smaller than 0.60. Slightly less convenient to use due to high resistance to mopping operation but still practical to use.

C: An average μ value of 0.60 or greater. Poor in convenience of use and impractical for use due to large resistance to mopping operation.

CLAIMS

1. A cleaning sheet comprising a hydrophilic fiber aggregate composed mainly of hydrophilic fibers, and a hydrophobic fiber aggregate composed mainly of hydrophobic fibers and arranged on both sides of the hydrophilic fiber aggregate, the hydrophobic fiber aggregate having its constituent fibers entangled with one another, entering the hydrophilic fiber aggregate, and entangled with fibers constituting the hydrophilic fiber aggregate in a way that the hydrophilic fiber aggregate and the hydrophilic fiber aggregate are united together,

the cleaning sheet being three-dimensionally textured with a plurality of protrusions and a plurality of depressions on both sides thereof in a pattern such that protrusions on one side correspond to depressions on the other side and that depressions on one side correspond to protrusions on the other side,

the cleaning sheet having raised fibers raised from the surface of the protrusions and the surface of the depressions,

the raised fiber raised in the individual depressions having a height of 0.1 to 30 mm, and the number of the raised fibers raised in the depressions being 5 to 100 per 10 mm width, and

the cleaning sheet having a linear bond where the hydrophilic fiber aggregate and the hydrophobic fiber aggregate are bonded to each other.

2. The cleaning sheet according to claim 1, wherein the linear bond intersects an imaginary line connecting the tops of two protrusions adjacent to each other at the shortest distance.

3. The cleaning sheet according to claim 1 or 2, wherein the individual protrusions have a plan view area of 1 to 100 mm^2, and the linear bond has a bonding width of 0.3 to 5 mm.

4. The cleaning sheet according to any one of claims 1 to 3, wherein the hydrophilic fiber aggregate has a larger basis weight than the hydrophobic fiber aggregate per side.

5. The cleaning sheet according to any one of claims 1 to 4, wherein the fiber raised in the individual protrusions has a height of 0.5 mm or more and 30 mm or less.

6. The cleaning sheet according to any one of claims 1 to 5, wherein the number of the raised fibers on the protrusions is 5 or greater per 10 mm width and 80 or fewer per 10 mm width.

7. The cleaning sheet according to claim 2, wherein the linear bond intersects the imaginary line at an angle of 3° to 30°.

8. A method for making the cleaning sheet according to claim 1, comprising the steps of superposing the hydrophobic fiber aggregate on each side of the hydrophilic fiber aggregate to make a stack, entangling the fibers of the hydrophilic fiber aggregate and the fibers of the hydrophobic fiber aggregate by applying high-pressure water jets to each side of the stack to unite the stack into a laminate, subjecting the laminate to raising on both sides thereof, texturing a plurality of regions of the raised laminate with protrusions and depressions, and seal bonding the textured laminate to form a linear bond at which the hydrophilic fiber aggregate and the hydrophobic fiber aggregates are bonded together.

9. The method for making the cleaning sheet according to claim 8, wherein the raising is carried out using a rotating engraved roller having a plurality of projections on its peripheral surface.

10. The method for making the cleaning sheet according to claim 9, wherein the engraved roller rotates in a direction reverse to the moving direction of the laminate.

11. The method for making the cleaning sheet according to claim 9 or 10, wherein the peripheral velocity V3 of the engraved roller and the transport rate V2 of the laminate satisfy a relationship of V3>V2.