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(71) Applicant (for all designated States except US): **Uni-Charm Corporation** [JP/JP]; 182, Shimobun, Kinsei-cho, Shikokuchuo-shi, Ehime, 7990111 (JP).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **TAKEUCHI, Naohito** [JP/JP]; c/o Technical Center, Uni-Charm Corporation, 1531-7, Wadahama, Toyohama-cho, Kanonji-shi, Kagawa, 7691602 (JP).

(74) Agents: **SHOBAYASHI, Masayuki** et al.; Sapia Tower, 1-7-12, Marunouchi, Chiyoda-ku, Tokyo, 1000005 (JP).

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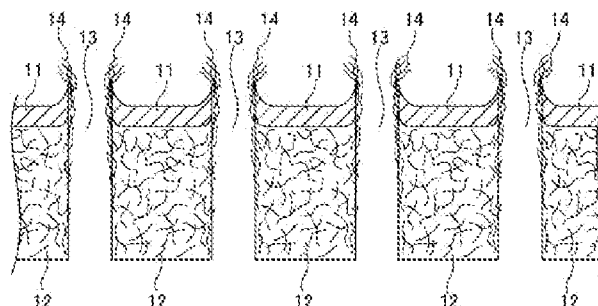
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(54) Title: LIQUID ABSORBENT SHEET AND MANUFACTURING METHOD THEREOF

[Fig. 3]



(57) Abstract: In a manufacturing method of a liquid absorbent sheet 10 having a hydrophobic layer 11 and a liquid absorbent layer 12, and pores 13 formed on the hydrophobic layer 11, the method includes: a layering step of forming a laminate of the hydrophobic layer 11 and the liquid absorbent layer 12; and a pore forming step of forming the pores 13 by thermal perforation from a side of the liquid absorbent layer 12 using perforation means. A heating temperature of the perforation means in the pore forming step is at least the melting point of a thermoplastic resin.

Description

Title of Invention: LIQUID ABSORBENT SHEET AND MANUFACTURING METHOD THEREOF

Technical Field

[0001] The present disclosure relates to a liquid absorbent sheet and its manufacturing method.

Background Art

[0002] In a food department of a supermarket or the like, a foodstuff such as fish and meat is on sale in a state of being divided into a predetermined portion, disposed in a tray and wrapped in a transparent film. In such a marketing form, if the foodstuff stays in a display shelf for a prolonged time, drip tends to accumulate in the tray. The drip accumulated in the tray not only impairs the appearance, but also accelerates spoiling of the foodstuff.

[0003] In a tray on which a foodstuff releasing drip is placed, a liquid absorbent sheet that is laid between the tray and the foodstuff and can quickly absorb drip is used (hereinafter, a liquid absorbent sheet used for such purpose is also referred to as drip absorbent sheet). For example, a drip absorbent sheet is known to the inventor(s) to include an antibacterial and water- and oil-absorbent nonwoven fabric, a plastic porous film layer with a number of pores that is layered on one face of the nonwoven fabric, and a plastic exterior film layer that is layered on another face of the nonwoven fabric to block circulation of air.

[0004] In addition, a drip absorbent sheet is proposed in which layers composed of resin films are provided on top and back faces of a liquid absorbent layer, with many pores formed at least in a top layer contacting the foodstuff.

[0005] In the above described drip absorbent sheets, each pore is formed by inserting a heated needle from the film layer side.

[0006] However, in the abovementioned manufacturing method in which the pores are formed by inserting the needles from the film layer side, the inventor(s) has noted that upon repeated insertion of the needles into the film layer, attached matter derived from fused resin accumulates at tip portions of the needles. The attached matter tends to adhere again to the film layer, in the vicinity of the pores, as foreign matter. In order to prevent the foreign matter from adhering to the film layer, sequential cleaning of the needles is required, causing the production efficiency to decline.

Summary of Invention

[0007] In one aspect of the present invention, in a manufacturing method of a liquid absorbent sheet, the liquid absorbent sheet includes: a hydrophobic layer including a

thermoplastic resin; and a liquid absorbent layer including a fibrous material and layered with the hydrophobic layer, a plurality of pores being formed in the hydrophobic layer. The method includes: a layering step of layering the hydrophobic layer and the liquid absorbent layer; and a pore forming step of forming the plurality of pores by thermal perforation from a side of the liquid absorbent layer using perforation means. A heating temperature of the perforation means in the pore forming step is equal to or higher than a melting point of the thermoplastic resin.

[0008] In another aspect of the present invention, a liquid absorbent sheet includes: a hydrophobic layer including a thermoplastic resin; a liquid absorbent layer including a fibrous material and layered with the hydrophobic layer; a plurality of pores that is formed in the hydrophobic layer; and a projecting fiber portion being a part of the nonwoven fabric constituting the liquid absorbent layer projecting from the plurality of pores to an outside of the hydrophobic layer.

Brief Description of Drawings

[0009] [fig.1]FIG. 1 is a plan view of a liquid absorbent sheet according to some embodiments of the present invention;

[fig.2]FIG. 2 is a cross-sectional view taken along the line B-B of FIG. 1, in which pores are shown to be enlarged;

[fig.3]FIG. 3 is a partially enlarged cross-sectional view taken along the line A-A of FIG. 1;

[fig.4A]FIG. 4A is a diagram schematically showing one of stages of a pore forming step, which is a step in the manufacturing method of the liquid absorbent sheet according to one or more embodiments of the present invention;

[fig.4B]FIG. 4B is a diagram schematically showing one of stages of a pore forming step, which is a step in the manufacturing method of the liquid absorbent sheet according to one or more embodiments of the present invention;

[fig.4C]FIG. 4C is a diagram schematically showing one of stages of a pore forming step, which is a step in the manufacturing method of the liquid absorbent sheet according to one or more embodiments of the present invention;

[fig.4D]FIG. 4D is a diagram schematically showing one of stages of a pore forming step, which is a step in the manufacturing method of the liquid absorbent sheet according to one or more embodiments of the present invention;

[fig.5]FIG. 5 is an enlarged photograph of one pore of the liquid absorbent sheet, as taken from the side of the hydrophobic layer; and

[fig.6A]FIG. 6A is a diagram schematically showing a process of a pore forming step, which is a step in the manufacturing method of the liquid absorbent sheet according to one or more embodiments of the present invention;

[fig.6B]FIG. 6B is a diagram schematically showing a process of a pore forming step, which is a step in the manufacturing method of the liquid absorbent sheet according to one or more embodiments of the present invention;

[fig.6C]FIG. 6C is a diagram schematically showing a process of a pore forming step, which is a step in the manufacturing method of the liquid absorbent sheet according to one or more embodiments of the present invention; and

[fig.6D]FIG. 6D is a diagram schematically showing a process of a pore forming step, which is a step in the manufacturing method of the liquid absorbent sheet according to one or more embodiments of the present invention.

Description of Embodiments

[0010] Several embodiments are described hereinafter with reference to the drawings. First, the structure of a liquid absorbent sheet in accordance with some embodiments is described; thereafter, a manufacturing method of the liquid absorbent sheet in accordance with some embodiments is described. It should be noted that the liquid absorbent sheet described herein can be preferably used not only as a drip absorbent sheet that absorbs drip released from a foodstuff, but also for various other applications for absorbing and retaining liquid. FIG. 1 is a plan view of a liquid absorbent sheet 10 according to some embodiments of the present invention, and FIG. 2 is a cross-sectional view taken along the line B-B of FIG. 1, in which pores are shown to be enlarged. FIG. 3 is a partially enlarged schematic view of a cross-section taken along the line A-A of FIG. 1; FIGs. 4A to 4D are diagrams, each of which schematically showing a stage of a pore forming step, which is a step in the manufacturing method of the liquid absorbent sheet according to a first embodiment. FIG. 5 is an enlarged photograph of one pore.

[0011] Structure of Liquid Absorbent Sheet

The liquid absorbent sheet 10 in accordance with some embodiments includes, as shown in FIGS. 1 to 3, a hydrophobic layer 11 (first layer), a liquid absorbent layer 12 (second layer) that is layered with the hydrophobic layer, a plurality of pores 13 formed at least in the hydrophobic layer 11, and a projecting fiber portion 14 that is formed to project from the plurality of pores to an outside of the hydrophobic layer 11.

[0012] The size and shape of the liquid absorbent sheet 10 are not particularly limited. The liquid absorbent sheet 10 can be appropriately formed or cut into a preferred size and shape, according to intended purposes thereof.

[0013] The hydrophobic layer 11 defines an upper face of the liquid absorbent sheet 10. An upper face of the hydrophobic layer 11 is adapted to contact a bottom face of a foodstuff that is placed on the liquid absorbent sheet 10. The hydrophobic layer 11 includes a film including a thermoplastic resin or a hydrophobic nonwoven fabric

including a thermoplastic resin. In other words, the hydrophobic layer 11 includes a thermoplastic resin. Although not particularly limited, the thermoplastic resin is preferably selected from low-density polyethylene (LDPE), medium-density polyethylene (MDPE), high-density polyethylene (HDPE), linear low-density polyethylene (LLDPE), polypropylene (PP), polyethylene terephthalate (PET), ethylene-vinyl acetate copolymer (EVA), and the like. A single-layer or multilayer resin film including these resins can be preferably used as a material for the hydrophobic layer 11. In addition, as a hydrophobic nonwoven fabric including a thermoplastic resin, an spunbonded-meltblown-spunbonded (SMS) nonwoven fabric made from PP, thermal bond nonwoven fabric made from PP and the like are preferable, for example. By using the film or the nonwoven fabric including the thermoplastic resin as a material for the hydrophobic layer in this way, each of the pores 13 can be easily and reliably formed by a heated perforating needle 20, in a pore forming step (described later). Among the abovementioned materials, a polyethylene resin film such as HDPE is employed in one or more embodiments because of its excellent softness and cost-effectiveness.

- [0014] A surfactant may be blended into the materials for the hydrophobic layer 11. The surfactant may be blended in such an amount that the proportion thereof is 1 to 3% by mass. A content of the surfactant less than 1% by mass reduces the suppression of the generation of static electricity, which is inconvenient in a cutting process. On the other hand, a content of the surfactant greater than 3% increases the permeating property of a surface of the hydrophobic layer 11 and makes the water repellent function insufficient.
- [0015] As the surfactant, a non-ionic surfactant such as polyoxyethylene alkyl amine, polyoxyethylene alkyl amide, polyoxyethylene alkyl ether, polyoxyethylene alkyl phenyl ether, glycerin fatty acid ester, sorbitan fatty acid ester and the like; an anionic surfactant such as alkyl sulfonate, alkyl benzene sulfonate, alkyl sulfate, alkyl phosphate and the like; a cationic surfactant such as quaternary ammonium chloride, quaternary ammonium sulfate, quaternary ammonium nitrate and the like; or an amphoteric surfactant such as alkyl betaine type, alkyl imidazoline type, alkyl alanine and the like, can be used.
- [0016] The thickness of the hydrophobic layer 11 is 1 to 70 micrometers, and preferably 30 micrometers to 70 micrometers. A thickness less than 1 micrometer reduces the durability desired for a drip absorbent sheet and is, therefore, not preferable. A thickness in a range of 30 micrometers to 70 micrometers can provide sufficient durability for a drip absorbent sheet and superior processability in formation of the pores. A thickness greater than 70 micrometers reduces the processability and wastes material, thereby reducing the cost-effectiveness, and is, therefore, not preferable.

- [0017] The liquid absorbent layer 12 is disposed to be layered on a bottom face of the hydrophobic layer 11. The liquid absorbent layer 12 absorbs and retains drip released from a foodstuff and the like. In some embodiments, the liquid absorbent layer 12 includes a fibrous material to absorb and retain drip released from a foodstuff. As a material for the liquid absorbent layer 12, a nonwoven fabric such as an air-laid nonwoven fabric and thermal bonded nonwoven fabric, paper (pulp) can be used. A fibrous form of urethane, or a plant-based high liquid absorbent polymer and the like also can be used as the material for the nonwoven fabric. As a fiber constituting the nonwoven fabric, a natural fiber such as pulp, kenaf, cotton and the like, a plant-based recycled fiber such as rayon and the like, or a synthetic fiber such as of polyethylene terephthalate (PET) and the like can be used. As the pulp, a wood pulp such as NBKP made from softwood and the like, or a nonwood pulp such as kenaf, abaca and the like can be used. Among these materials, a nonwoven fabric mainly including pulp is employed in one or more embodiments because of its excellent liquid absorbent property.
- [0018] The basis weight and the thickness of the nonwoven fabric and the like constituting the liquid absorbent layer 12 are set such that drip released from a foodstuff can be sufficiently absorbed. Regarding the air-laid nonwoven fabric including pulp, the basis weight is preferably in a range of 10 to 120 g/m², and the thickness is preferably in a range of approximately 0.3 to 3 mm, and more preferably in a range of approximately 0.5 to 2 mm. Here, thickness of nonwoven fabric is measured using a thickness measuring device (Thickness gauges manufactured by OZAKI MFG.CO.,LTD., diameter of an anvil 44mm, measuring pressure 3g/cm² under ordinary pressures and temperatures), by placing the sample of nonwoven fabric having area at least larger than contact point on the anvil, placing the contact point on the sample, and reading the meter of the measuring device.
- [0019] In embodiments where the nonwoven fabric constituting the liquid absorbent layer 12 contains a thermoplastic fiber, the thermoplastic fiber has a melting point higher than the melting point of the thermoplastic resin constituting the hydrophobic layer 11. In addition, in order to facilitate temperature control of the perforating needle 20, the difference in melting point between the thermoplastic fiber and the thermoplastic resin is preferably at least 50 degrees C.
- [0020] As shown in FIGS. 1 and 3, the plurality of pores 13 is formed to completely penetrate both the hydrophobic layer 11 and the liquid absorbent layer 12. The plurality of pores 13 allows the drip released from a foodstuff and remaining on the top surface of the hydrophobic layer 11 to pass therethrough to the liquid absorbent layer 12. The density of the pores 13 is preferably no less than 15 pores per 1 cm², and more preferably, no less than 200 pores per 1 cm². By uniformly disposing a large number of

pores 13, a foodstuff can be uniformly exposed to air. The pores 13 are formed in the abovementioned density over the entire surface of the hydrophobic layer 11. The pores 13 can also be provided only in a limited area in the hydrophobic layer 11 and the position at which a foodstuff releasing drip is placed can be limited to the area.

[0021] The pore diameter of the pores 13 is no greater than 5.0 mm, and more preferably approximately 0.1 to 2.0 mm. A pore diameter that is greater than the abovementioned range is not preferable since the drip absorbed by the liquid absorbent layer 12 would be visible through the pores 13. On the other hand, a pore diameter that is smaller than the abovementioned range is not preferable since the absorption property through the pores 13 to the liquid absorbent layer 12 is lowered, and it becomes difficult for the drip absorbent sheet 10 to produce sufficient absorbent property.

[0022] As shown in FIG. 3, the projecting fiber portion 14 is formed at the peripheral edges of the plurality of pores 13, on the side of the hydrophobic layer 11. The projecting fiber portion 14 is a part of the nonwoven fabric constituting the liquid absorbent layer 12 projecting through the pores 13 toward the side of the hydrophobic layer 11. The absorption of drip at the periphery of the pores 13 by the projecting fiber portion 14 causes faster drawing of the drip remaining on the surface of the hydrophobic layer 11 into the pores 13.

[0023] According to the liquid absorbent sheet 10 with the abovementioned configuration, drip is quickly absorbed by the liquid absorbent layer 12 through the pores 13 in the hydrophobic layer 11. In this case, the projecting fiber portion 14 starts the drawing of liquid and further promotes absorption of liquid. In such a case, drip does not stay on the surface of the hydrophobic layer 11 and a foodstuff placed on the liquid absorbent sheet 10 is separated from the drip, thereby preventing the progression of rot of the foodstuff due to the drip.

[0024] Manufacturing Method of Liquid Absorbent Sheet

Next, a manufacturing method of the liquid absorbent sheet according to a first embodiment of the present invention is described with reference to the drawings. FIGs. 4A to 4D are diagrams schematically showing various stages of a pore forming step, which is one of the steps in the manufacturing method of the liquid absorbent sheet according to the first embodiment.

[0025] The manufacturing method of the liquid absorbent sheet 10 in the first embodiment includes: a layering step of layering the hydrophobic layer 11 and the liquid absorbent layer 12; a pore forming step of forming the plurality of pores 13 by inserting a plurality of the heated perforating needles 20 into a laminate, which includes the hydrophobic layer 11 and the liquid absorbent layer 12, obtained in the layering step, from a side of the liquid absorbent layer 12; and a cutting step of cutting the laminate, in which the pores 13 are formed, into a product of a predetermined product

dimension.

[0026] Layering Step

The layering step is a step of forming the laminate including the hydrophobic layer 11 and the liquid absorbent layer 12 by integrating the hydrophobic layer 11 and the liquid absorbent layer 12. In the present embodiment, the hydrophobic layer 11 and the liquid absorbent layer 12 are bonded using a hot-melt adhesive at bonding portions (not illustrated) that are dotted on the entire surface of the liquid absorbent layer 12. As an alternative method of forming the laminate by integrating the hydrophobic layer 11 and the liquid absorbent layer 12, a method of melt-extruding a material resin of the hydrophobic layer 11 onto the surface of the liquid absorbent layer 12 to form a resin film can be exemplified.

[0027] As described above, for the liquid absorbent layer 12, a nonwoven fabric, paper, urethane and the like, or a plant-based high liquid absorbent polymer can be used, and in this mode, an air-laid nonwoven fabric mainly constituted of wood pulp such as NBKP made from softwood is used. The basis weight of the air-laid nonwoven fabric is preferably 10 to 120 g/m². In addition, the thickness of the air-laid nonwoven fabric is preferably in a range of approximately 0.3 to 3 mm, and more preferably in a range of approximately 0.5 to 2 mm.

[0028] In a case of using a thermoplastic resin such as HDPE as a material constituting the hydrophobic layer 11, a synthetic resin is formed into a film by the following method. First, a surfactant is blended into the synthetic resin. As described above, the surfactant is preferably blended in such an amount that a proportion thereof is 1 to 3% by mass with respect to the hydrophobic layer 11. In addition, as described above, a non-ionic surfactant, alkyl sulfonate which is an anionic surfactant, a cationic surfactant, or an amphoteric surfactant can be used.

[0029] The synthetic resin with the surfactant contained in the abovementioned ratio is formed into a film by extrusion molding or the like. The film thus formed can be used singly or in a multi-layered state in which a plurality of films is layered, as the hydrophobic layer 11. The thickness of the hydrophobic layer 11 thus manufactured is preferably 1 micrometer to 70 micrometers, and more preferably 30 micrometers to 70 micrometers.

[0030] Alternatively, a thermoplastic hydrophobic nonwoven fabric, such as an SMS nonwoven fabric made of polypropylene, can be used as a material constituting the hydrophobic layer 11. The basis weight of the thermoplastic hydrophobic nonwoven fabric used for the hydrophobic layer 11 may be 10 to 50 g/m² from the viewpoint of processability and material cost.

[0031] Pore Forming Step

As shown in FIGs. 4A to 4D, the pore forming step is a step of forming the pores 13

that penetrate from the hydrophobic layer 11 to the liquid absorbent layer 12 by piercing multiple heated perforating means in form of needles 20 (only one needle is illustrated in Figs. 4A-4D for simplicity) into the laminate obtained in the layering step.

[0032] In the present embodiment, the pores 13 are formed using a roller (not illustrated, hereinafter also referred to simply as "roller") with a number of perforating needles 20 provided on an outer periphery thereof. The roller has a function of heating the perforating needles 20 to a predetermined temperature. The laminate formed in the layering step is passed directly below the roller, while rolling up the laminate by the roller being rotated. The many perforating needles 20 being heated are successively pierced into and withdrawn from the laminate passing directly below the roller. Many of the pores 13 can thus be formed efficiently.

[0033] The process of forming the pores 13 is described further in detail with reference to FIGs. 4A to 4D. In this process, the perforating needles 20 are heated to an appropriate temperature in advance. The heating temperature of the perforating needles 20 is equal to or higher than the melting point of the thermoplastic resin constituting the hydrophobic layer 11 and equal or lower than, for example, 250 degrees C. If a thermoplastic fiber is included in the liquid absorbent layer 12, lower than the melting point of the thermoplastic fiber.

[0034] Next, as shown in FIG. 4A, the laminate formed in the layering step is passed directly below the roller, with the liquid absorbent layer 12 being directed to the perforating needles 20.

[0035] Next, as shown in FIG. 4B, the perforating needles 20 pierced into the liquid absorbent layer 12 penetrate the liquid absorbent layer 12 while pushing a part of the nonwoven fabric (fibrous materials) constituting the liquid absorbent layer 12 toward the hydrophobic layer 11. Here, since the temperature of the perforating needles 20 is lower than the melting point of the thermoplastic fiber included in the liquid absorbent layer 12, the thermoplastic fiber included in the liquid absorbent layer 12 does not melt.

[0036] Furthermore, as shown in FIG. 4C, the perforating needles 20 are heated to a temperature equal to or higher than the melting point of the thermoplastic resin constituting the hydrophobic layer 11. As a result, the perforating needles 20 easily penetrate the hydrophobic layer 11 while melting the thermoplastic resin or fiber constituting the hydrophobic layer 11, and project to the outside of the hydrophobic layer 11 so far that not only the tip of the needle but the largest diameter of the needle penetrates the layer 11 so that the diameter of the pores comply with the diameter of the needle. Here, a part of the nonwoven fabric (fibrous materials) constituting the liquid absorbent layer 12 is dragged by the perforating needles 20 and projects beyond the surface of the hydrophobic layer 11, thereby a projecting fiber portion 14 is

formed.

[0037] Thereafter, as shown in FIG. 4D, the plurality of pores 13 is formed where the perforating needles 20 are withdrawn from the hydrophobic layer 11 and the liquid absorbent layer 12. The projecting fiber portion 14 including the liquid absorbent nonwoven fabric is formed at the peripheral edges of the pores 13, on the side of the hydrophobic layer 11.

In the abovementioned pore forming step, the thermoplastic resin constituting the hydrophobic layer 11 melts and a small amount of the melted thermoplastic resin might adhere to the perforating needles 20 while penetrating the hydrophobic layer 11. However, the perforating needles 20 pass through the liquid absorbent layer 12 again when being withdrawn from the state penetrating the hydrophobic layer 11. As a result, the thermoplastic resin adhered to the perforating needles 20 is removed by the nonwoven fabric constituting the liquid absorbent layer 12 when the perforating needles 20 are withdrawn from the liquid absorbent sheet 10.

[0038] Cutting Step

This step is a step of cutting the laminate processed in the layering step and the pore forming step to obtain the liquid absorbent sheet 10. The cutting step includes a cutting preparation step of rolling out the laminate manufactured in the layering and pore forming steps while applying an appropriate tension, a first cutting step of making a slit along a longitudinal direction of the sheet using a first cutter, and a second cutting step of cutting the sheet in a width direction thereof using a second cutter.

[0039] The laminate that is cut to an appropriate size in the first cutting step and the second cutting step becomes the liquid absorbent sheet 10. The cutting step can be any cutting method that can obtain an appropriate size as a product and is not limited to a method including all the abovementioned steps.

[0040] The abovementioned manufacturing method of a liquid absorbent sheet, and the abovementioned liquid absorbent sheet provide the following effects.

[0041] (1) In the manufacturing method of the liquid absorbent sheet according to the first embodiment, the pores 13 are formed by perforating needles 20 at a heating temperature equal to or higher than the melting point of the thermoplastic resin of the hydrophobic layer 11 from the side of the liquid absorbent layer 12 including nonwoven fabric. As a result, when the perforating needles 20 are withdrawn, the tip portions thereof pass through the liquid absorbent layer 12 while contacting the fiber constituting the liquid absorbent layer 12, which removes the fused resin adhered to the perforating needles and prevents the accumulation of attached matter. Therefore, the workload of cleaning the perforating needles 20 can be reduced, thereby improving production efficiency.

[0042] (2) In addition, in a case in which the liquid absorbent layer 12 is a nonwoven fabric

including non-thermoplastic fiber, fused resin is not easily adhered to the perforating needles 20 in an initial run of the perforating needles 20 through the laminate of the hydrophobic layer 11 and liquid absorbent layer 12 for formation of the pores 13 therein. Even if a minute amount of the fused resin is adhered to the perforating needles 20 in a subsequent run, as in (1), the tip portions of the perforating needles 20 pass through the liquid absorbent layer 12 while contacting the fiber constituting the liquid absorbent layer 12, which removes the fused resin adhered to the perforating needles 20 and prevents the accumulation of attached matter. Therefore, the workload of cleaning the perforating needles 20 can be further reduced, thereby improving production efficiency.

[0043] (3) Furthermore, in a case in which the liquid absorbent layer 12 includes a thermoplastic fiber, the pores 13 are formed by the perforating needles 20 at a heating temperature lower than the melting point of the thermoplastic fiber constituting the liquid absorbent layer. As a result, fused resin is not easily adhered to the perforating needles 20 in an initial run of the perforating needles 20 through the laminate of the hydrophobic layer 11 and liquid absorbent layer 12 for formation of the pores 13 therein. Even if a minute amount of the fused resin is adhered to the perforating needles 20 in a subsequent run, as in (1), the tip portions of the perforating needles 20 pass through the liquid absorbent layer 12 while contacting the fiber constituting the liquid absorbent layer 12, which removes the fused resin adhered to the perforating needles 20 and prevents the accumulation of attached matter. Therefore, the workload of cleaning the perforating needles 20 can be reduced, thereby improving production efficiency.

[0044] (4) In the manufacturing method of the liquid absorbent sheet of the first embodiment, in the pore forming step, a part of the nonwoven fabric constituting the liquid absorbent layer 12 is made to project by the perforating needles 20 from the plurality of pores 13 to the outside of the hydrophobic layer 11, thereby forming the projecting fiber portion 14. The projecting fiber portion 14 starts the absorption of drip by the liquid absorbent layer 12 through the pores 13. As a result, the liquid absorbent sheet 10 having superior absorption performance can be manufactured by a manufacturing method of high production efficiency.

[0045] (5) Moreover, the liquid absorbent sheet 10 is a bilayer liquid absorbent sheet in which the hydrophobic layer 11 including a film or a hydrophobic nonwoven fabric including a thermoplastic resin and the liquid absorbent layer 12 including a liquid absorbent nonwoven fabric and layered with the hydrophobic layer, are layered. The liquid absorbent sheet 10 further includes: the plurality of pores 13 that is formed in the hydrophobic layer 11; and

the projecting fiber portion 14 formed by a part of the nonwoven fabric constituting the liquid absorbent layer 12 projecting from the plurality of pores 13 to the outside of

the hydrophobic layer 11. The projecting fiber portion 14 starts the absorption of drip by the liquid absorbent layer 12 through the pores 13. As a result, the liquid absorbent sheet 10 can absorb drip more quickly.

- [0046] (6) The pores 13 are formed by thermal perforation from the side of the liquid absorbent layer 12, and the heating temperature in the formation of the pores is equal to or higher than the melting point of the thermoplastic resin. As a result, the perforating needles 20 punch the fiber constituting the liquid absorbent layer 12 and form the projecting fiber portion 14, thereby increasing absorption performance. In addition, fused resin can be prevented from adhering to the perforating needles 20 in the pore forming step, thereby increasing production efficiency.
- [0047] (7) The liquid absorbent layer 12 is a nonwoven fabric including non-thermoplastic fiber. As a result, fused resin can be prevented from adhering to the perforating needles 20 in the pore forming step, thereby increasing production efficiency.
- [0048] (8) The liquid absorbent layer 12 is configured to include thermoplastic fiber, the thermoplastic fiber having a melting point higher than the melting point of the thermoplastic resin, and the heating temperature for forming the pores is lower than the melting point of the thermoplastic fiber. As a result, fused resin can be prevented from adhering to the perforating needles 20 in the pore forming step, thereby increasing production efficiency.
- [0049] Next, a the manufacturing method of the liquid absorbent sheet in accordance with a second embodiment. The manufacturing method of the liquid absorbent sheet according to the second embodiment is different from the first embodiment in the method of integrating the hydrophobic layer 11 and the liquid absorbent layer 12. In the following description of the second embodiment, other points which are not specifically referred to is the same as in the first embodiment. In the layering step of the second embodiment, the laminate is formed by simply placing the hydrophobic layer 11 on the liquid absorbent layer 12, without bonding the hydrophobic layer 11 to the liquid absorbent layer 12 with hot-melt adhesive and/or without melt-extruding the material resin of the hydrophobic layer 11 onto the surface of the liquid absorbent layer 12. Then, the hydrophobic layer 11 and the liquid absorbent layer 12 are bonded in the pore forming step by the adhesive force of the thermoplastic resin constituting the hydrophobic layer 11 that is fused by the heat of the perforating needles 20. The manufacturing method of the liquid absorbent sheet according to the second embodiment provides the following effects.
- [0050] (9) In the pore forming step, the hydrophobic layer 11 and the liquid absorbent layer 12 are bonded by means of the thermoplastic resin fused by the thermal perforation. As a result, formation of the pores 13 and bonding of two layers can be realized in a single step, thereby increasing production efficiency of the liquid absorbent sheet 10.

[0051] Furthermore, with reference to FIGs. 6A to 6D, a manufacturing method of the liquid absorbent sheet in accordance with a third embodiment. The manufacturing method of the liquid absorbent sheet according to the third embodiment is different from the first and second embodiments in that a second layering step is included.

[0052] The second layering step is performed after the pore forming step shown in Figs 6A and 6B. In the second layering step, as shown in Fig. 6C, a liquid impermeable third layer 16 is laminated on the laminate of the liquid absorbent layer 12 and the hydrophobic layer 11 in which the plurality of pores 13 was formed in the pore forming step. More specifically, as shown in Fig. 6D, in the second layering step, the liquid impermeable third layer 16 is laminated on the liquid absorbent layer 12 of the laminate, i.e., on a side on which the hydrophobic layer 11 is not disposed. The manufacturing method of the liquid absorbent sheet according to the third embodiment provides the following effects.

[0053] (10) After the pore forming step, the liquid impermeable third layer 16 is laminated on one face of the liquid absorbent layer 12 on which the hydrophobic layer 11 is not layered. As a result, fused resin can be prevented from adhering to the perforating needles 20, as in the pore forming step of the abovementioned manufacturing methods, and an absorbent sheet of trilaminar structure, which can avoid leakage of drip to a back surface thereof, can be manufactured.

[0054] EXAMPLES

Several Examples in accordance with some embodiments of the present invention are described in more detail hereinafter; however, the present invention is not limited to these Examples.

[0055] Examples 1 to 5, Comparative Examples 1 and 2

The liquid absorbent sheets of Examples 1 to 5 and Comparative Examples 1 and 2 were manufactured with the materials described later, in the configurations shown in Table 1. For the liquid absorbent sheets of Examples 1 to 5 and Comparative Examples 1 and 2, the hydrophobic layers and the liquid absorbent layers including the materials described later were sequentially layered and bonded, thereby manufacturing laminates for the liquid absorbent sheets. For Comparative Example 2, a third layer was further laminated and bonded to the liquid absorbent layer, on a side that is opposite to the hydrophobic layer, thereby manufacturing a laminate for the liquid absorbent sheet. The bonding of these layers was realized with a hot-melt adhesive at 2 g/m². The laminates for the liquid absorbent sheets were 1000 mm in width and 1000 m in length.

[0056] Hydrophobic Layer

The hydrophobic layer and the third layer were formed of the materials described below (Material name: Thickness or basis weight).

High-density polyethylene film: 30 micrometers (hereinafter referred to as HDPE)

SMS nonwoven fabric: 20 g/m² basis weight (hereinafter referred to as SMS)

Spun-bonded nonwoven fabric: 20 g/m² basis weight (hereinafter referred to as SB)

It should be noted that the melting point of HDPE is approximately 130 to 137 degrees C, and the melting point of the polypropylene constituting SMS and SB is approximately 170 degrees C.

[0057] Liquid Absorbent Layer

The liquid absorbent layer was formed of the materials described below (Material name: Composition: Basis weight).

Air-laid nonwoven fabric: NBKP 100% pulp: 50 g/m² basis weight (hereinafter referred to as nonwoven fabric 1)

Air-laid nonwoven fabric: NBKP 50%, PET 50% pulp: 50 g/m² basis weight (hereinafter referred to as nonwoven fabric 2)

Wet crepe paper: NBKP 100% pulp: 50 g/m² basis weight (hereinafter referred to as paper 1)

It should be noted that NBKP is a non-thermoplastic fiber and the melting point of PET is approximately 260 to 264 degrees C.

[0058] Pore Formation Test

In the laminates for the liquid absorbent sheets of Examples 1 to 5 and Comparative Examples 1 and 2, pores were formed using a roller with many perforating needles provided on the outer circumference thereof. During the pore formation process, the perforating needles were maintained at 200 degrees C. The pores of 0.5 mm in pore diameter were formed over the entire surface of the laminates in a density of 15 pores/cm². The pores were formed by piercing the perforating needles from the liquid absorbent layer for Examples 1 to 5; from the hydrophobic layer for Comparative Example 1; and from the third layer for Comparative Example 2. After the step of forming pores covering 1000 m, the existence of fused resin adhered to the vicinity of the perforation needles was observed. In the meantime, the existence of the fused resin adhered to the vicinity of the pores was also observed. In addition, it was observed whether a projecting fiber portion was formed on a face of the laminate on the side of the hydrophobic layer. The results are shown in Table 1 and FIG. 5.

[0059] Liquid Absorbency Measurement Test

The laminates for the liquid absorbent sheets of Examples 1 to 5 and Comparative Examples 1 and 2 were cut to a size of 65 mm x 80 mm to make the liquid absorbent sheets of Examples 1 to 5 and Comparative Examples 1 and 2. Red-colored saline of the following composition was dripped onto these liquid absorbent sheets at a rate of 1.0 ml/3 seconds from 10 mm above the surface of the hydrophobic layer, and the amount of time required to absorb the saline from the surface of the samples, thereby evaluating liquid absorbency. The test was conducted under the condition of JIS Z

8703-1983, in which the condition of temperature was 23 degrees C plus or minus 5 degrees C, and humidity was 65% RH plus or minus 20% RH. The results are shown in Table 1. Red-colored saline: 1 L of NaCl solution (0.9% concentration); 1.63 g of Sunset Yellow FCF(Yellow No.5) ; 8.5 g of New Coccine; 2 g of Amaranth(Food Red No.2)

[0060] [Table 1]

	Example 1	Example 2	Example 3	Example 4	Example 5	Comparative Example 1	Comparative Example 2
Hydrophobic Layer	HDPE	HDPE	HDPE	SMS	SB	HDPE	HDPE
Liquid Absorbent Layer	Nonwoven Fabric 1	Nonwoven Fabric 2	Paper 1	Nonwoven Fabric 1	Nonwoven Fabric 1	Nonwoven Fabric 1	Nonwoven Fabric 1
Third Layer	-	-	-	-	-	-	HDPE
Piercing Direction of Perforating Needles	From Liquid Absorbent Layer	From Liquid Absorbent Layer	From Liquid Absorbent Layer	From Liquid Absorbent Layer	From Liquid Absorbent Layer	From Hydrophobic Layer	From Third Layer
Projecting Fiber Portion	Yes	Yes	Yes	Yes	Yes	No	Yes
Attached Matter	No	No	No	No	No	Yes	Yes
Absorption Rate (Seconds)	11.2	12	12.5	5.2	3.8	15.1	11.6

[0061] FIG. 5 is an enlarged photograph of the pore of Example 1, taken from the side of the hydrophobic layer. According to FIG. 5, it is found that the projecting fiber portion is formed at the periphery of the pore on the side of the hydrophobic layer by the manufacturing method of the first to third embodiments.

[0062] According to Table 1, it is found that the fused matter can be prevented from adhering to the perforating needles in cases in which the perforating needles are pierced from the liquid absorbent layer including nonwoven fabric or paper. In addition, it is found that liquid absorbency is increased by the projecting fiber portions formed in association with formation of pores.

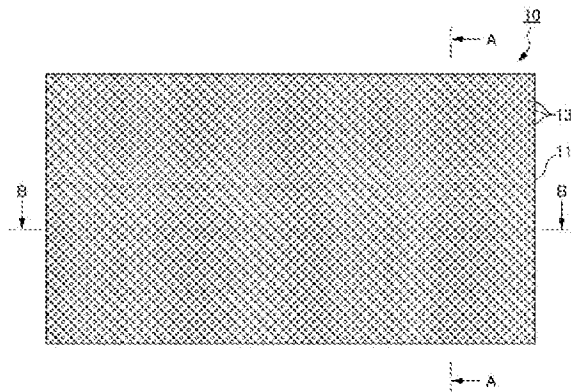
This application claims the benefit of Japanese Application No. 2011-053593 the entire disclosure of which is incorporated by reference herein.

Claims

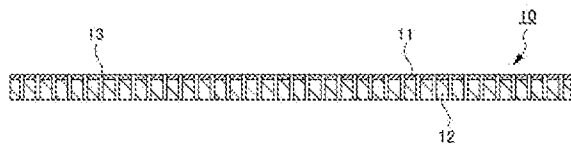
- [Claim 1] A manufacturing method of a liquid absorbent sheet, the liquid absorbent sheet including: a hydrophobic layer including a thermoplastic resin; and a liquid absorbent layer including a fibrous material and layered with the hydrophobic layer, a plurality of pores being formed in the hydrophobic layer, the method comprising: a layering step of layering the hydrophobic layer and the liquid absorbent layer; and
a pore forming step of forming the plurality of pores by thermal perforation from a side of the liquid absorbent layer using perforation means,
wherein a heating temperature of the perforation means in the pore forming step is equal to or higher than a melting point of the thermoplastic resin.
- [Claim 2] The manufacturing method according to claim 1,
wherein the liquid absorbent layer is a nonwoven fabric including non-thermoplastic fiber.
- [Claim 3] The manufacturing method according to claim 1,
wherein the liquid absorbent layer includes a thermoplastic fiber, the thermoplastic fiber having a melting point higher than the melting point of the thermoplastic resin constituting the hydrophobic layer; and
the heating temperature is equal to or higher than the melting point of the thermoplastic resin and lower than the melting point of the thermoplastic fiber.
- [Claim 4] The manufacturing method according to any one of claims 1 to 3,
the pore forming step further comprises:
pushing a part of the fibrous materials constituting the liquid absorbent layer toward the hydrophobic layer while the perforation means penetrates through the liquid absorbent layer and the hydrophobic layer; and
projecting the part of the fibrous materials that constitutes the liquid absorbent layer and being dragged by the perforating needles, beyond a surface of the hydrophobic layer to form a projecting fiber portion.
- [Claim 5] The manufacturing method according to any one of claims 1 to 4,
wherein, in the pore forming step, the hydrophobic layer and the liquid absorbent layer are bonded by means of the thermoplastic resin fused by thermal perforation.

- [Claim 6] The manufacturing method according to any one of claims 1 to 5, further comprising, after the pore forming step, a second layering step of layering a liquid impermeable layer on a face of the liquid absorbent layer on which the hydrophobic layer is not disposed.
- [Claim 7] The manufacturing method according to any one of claims 3 to 6, wherein a difference in melting point between the thermoplastic fiber and the thermoplastic resin is at least 50 degrees C.
- [Claim 8] The manufacturing method according to any one of claims 1 to 7, further comprises a blending step of blending a surfactant into a material constituting a hydrophobic layer in an amount of 1 to 3 % of mass of hydrophobic layer.
- [Claim 9] A liquid absorbent sheet, comprising:
a hydrophobic layer including a thermoplastic resin;
a liquid absorbent layer including a fibrous material and layered with the hydrophobic layer;
a plurality of pores that is formed in the hydrophobic layer; and
a projecting fiber portion being a part of the nonwoven fabric constituting the liquid absorbent layer projecting from the plurality of pores to an outside of the hydrophobic layer.
- [Claim 10] The liquid absorbent sheet according to claim 9, wherein the plurality of pores is formed by thermal perforation using perforation means from a side of the liquid absorbent layer; and
a heating temperature of the perforation means when forming the pores is equal to or higher than a melting point of the thermoplastic resin.
- [Claim 11] The liquid absorbent sheet according to claim 10, wherein the liquid absorbent layer is a nonwoven fabric including non-thermoplastic fiber.
- [Claim 12] The liquid absorbent sheet according to claim 10, wherein the liquid absorbent layer includes a thermoplastic fiber, the thermoplastic fiber having a melting point higher than the melting point of the thermoplastic resin; and
the heating temperature is lower than the melting point of the thermoplastic fiber.
- [Claim 13] The liquid absorbent sheet according to any one of claims 9 to 12, where in a thickness of hydrophobic layer is 30 micrometers to 70 micrometers.

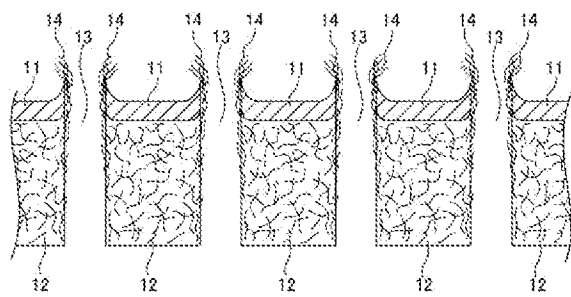
[Fig. 1]



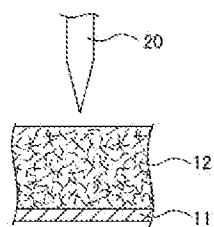
[Fig. 2]



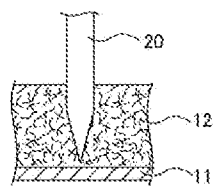
[Fig. 3]



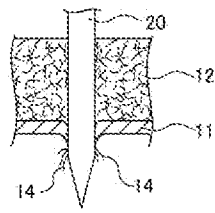
[Fig. 4A]



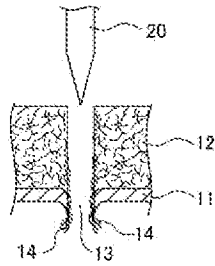
[Fig. 4B]



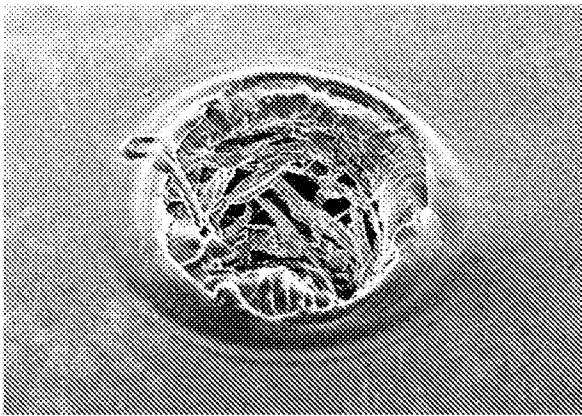
[Fig. 4C]



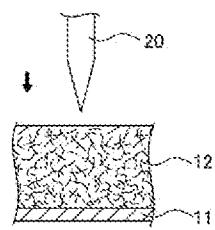
[Fig. 4D]



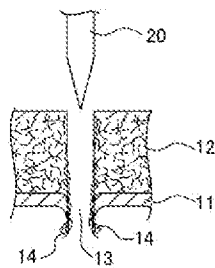
[Fig. 5]



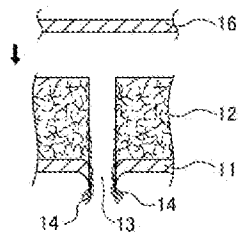
[Fig. 6A]



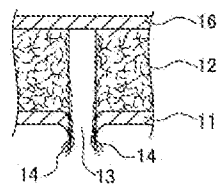
[Fig. 6B]



[Fig. 6C]



[Fig. 6D]



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/001604

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. B32B5/24 (2006.01) i, B32B27/00 (2006.01) i, B65D65/40 (2006.01) i,
B65D85/50 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl. B32B1/00-43/00, D04H1/00-18/04, B65D65/00-65/46, B65D85/50-85/52, B65D85/60,
B65D85/72-85/80, B65D85/82-85/84

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

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2012
Registered utility model specifications of Japan 1996-2012
Published registered utility model applications of Japan 1994-2012

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

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 06-305027 A (YOSHIKAWA Akira) 1994.11.01, Claim 1, 【0001】 , 【0011】 , Figs 3, 4 (Family: none)	1, 5, 8-10, 13 2-4, 6, 7, 11, 12
Y A	US 2002/0160085 A1 (TOKITA Norihiro, SHIBATA Akira, SHIKATANI Masahiko) 2002.10.31, Claim 1, [0002], [0011], [0012], [0039] & JP 2002-240179 A, Claim 1, 【0001】 , 【0009】 , 【0010】 , 【0028】	1, 5, 8-10, 13 2-4, 6, 7, 11, 12

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

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“P” document published prior to the international filing date but later than the priority date claimed

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Date of the actual completion of the international search

28.05.2012

Date of mailing of the international search report

12.06.2012

Name and mailing address of the ISA/JP

Japan Patent Office

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

Authorized officer

SAITO, Katsuya

Telephone No. +81-3-3581-1101 Ext. 3474

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/001604

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 06-280150 A (MITSUI PETROCHEMICAL INDUSTRIES LTD) 1994.10.04, Claims 1, 2, 3, 9, 【0013】 , 【0017】 , 【0029】 , 【0034】 , Figs 1-3 (Family: none)	1-13
A	JP 04-070983 B2 (FUJI PACK CORPORATION LTD) 1992.11.12, Claim 1 (Family: none)	1-13
A	EP 1632597 A1 (UNICHARM CORPORATION) 2006.03.08, Claim 1 & JP 2006-077332 A, Claim 1 & US 2006/0052024 A1	1-13
A	JP 2001-009954 A (SHINWA CORPORATION) 2001.01.16, Claims 1, 2, 【0012】 , 【0014】 , Fig 2 (Family: none)	1-13
A	JP 2005-335393 A (UNICHARM CORPORATION) 2005.12.08, Claim 1, 【0027】 (Family: none)	1-13
A	JP 2002-300848 A (UNICHARM CORPORATION) 2002.10.15, Claims 1, 2, 【0017】 , 【0048】 , 【0056】 (Family: none)	1-13