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

(11) Publication number: **0 237 665**
B1

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication of the patent specification: **18.07.90**

(51) Int. Cl.[5]: **D04H 1/00**, D04H 1/54, D04H 1/64

(21) Application number: **86302077.2**

(22) Date of filing: **20.03.86**

(54) **Process for producing moldable non-woven fabrics.**

(43) Date of publication of application:
23.09.87 Bulletin 87/39

(45) Publication of the grant of the patent:
18.07.90 Bulletin 90/29

(84) Designated Contracting States:
DE FR GB IT

(56) References cited:
EP-A- 0 158 156
GB-A- 2 096 195

(73) Proprietor: **Mitsubishi Yuka Badische Co., Ltd., 1000, Kawajiri-cho, Yokkaichi-shi Mie Prefecture(JP)**

(72) Inventor: **Kato, Naoyuki, Mitsubishi Yuka Badische Co. Ltd 1000 Kawajiri-cho, Yokkaichi-shi Mie(JP)**

(74) Representative: **Dixon, Donald Cossar et al, Gee & Co. Chancery House Chancery Lane, London WC2A 1QU(GB)**

EP 0 237 665 B1

Description

The present invention relates to a process for producing non-woven fabrics which have stiffness and elasticity sufficient for deep draw forming and thus are useful as, for example, interior materials for the roof lining, doors, rear package, seat backs, boot and luggage shelves of an automobile.

As interior materials, resin felts comprising a phenol-aldehyde condensation resin with fibers charged thereto, foamed articles of synthetic resins, polypropylene composites, cardboard or polypropylene, and the like, which are resistant against temperatures of 100°C or more, have been used. Of those materials, resin felt is excellent in stiffness, shape-holding properties after heat circulation (thermal resistance), and dimensional stability, but has disadvantages in that moldability, impact resistance, air permeability and lightness are poor. Cardboard or polypropylene is excellent in stiffness and lightness, but is inferior in air permeability. Moreover, when a corrugate material is used, the strength is critical in direction. Foamed articles of synthetic resin such as crosslinked polystyrene are excellent in lightness, but have disadvantages in that shape-holding stability after heat circulation and bending properties are poor. Material satisfying all the requirements as an interior material, such as stiffness, proper flexibility, lightness, dimensional stability, shape-holding properties after heat circulation (thermal resistance), and moldability has not been obtained.

A method for producing non-woven fabrics having good elasticity comprising temporarily fixing fibers of the top and bottom layers of a web by needling a fiber mat of synthetic fibers with fibers of polyethylene, polypropylene, polyester having a low melting point (e.g., 140°C), and the like, as binder fibers, and melting the above binder fibers by heating to thereby bind the other synthetic fibers is known. This non-woven fabric is good in lightness and flexibility, but is inferior in moldability and stiffness. Therefore, such non-woven fabric is useful as an interior material which is used in a flat place, but is not useful as an interior material which is used on a complex surface.

An interior material for automobiles, produced by impregnating or coating a needle punch cloth with an aqueous emulsion of a thermoplastic resin having a softening point of 100 to 130°C, heating and drying the cloth to remove water and obtain a moldable non-woven fabric, and then further heating and press molding (compression molding) the fabric is known. This interior material has an advantage in that is can be used in a place of complicated form. Mechanical bonding of fibers of the non-woven fabrics is conducted by intertwining the fibers with each other and attaching the emulsion resin to the fibers. However, since the apparent density of the non-woven fabrics which are coated or impregnated with the emulsion resin is as high as 0.08 to 0.13 g/cm^3, the effect of filling spaces between fibers with the emulsion resin is poor.

As a process for producing non-woven fabrics which are improved in the inherent disadvantages of dimensional stability and stiffness of the moldable non-woven fabric without reducing the lightness, shape-holding properties after heat circulation, and air permeability, the present inventors have proposed a process in which a fiber mat comprising 15 to 50 wt % of thermoplastic resin binder fibers and 85 to 50 wt % of synthetic fibers or natural fibers having a melting point of more than 40C° higher than that of the thermoplastic resin is needled, the mat is heated at a temperature at which the thermoplastic resin binder fibers are melted but the synthetic or natural fibers are not melted, the fiber mat is pressed while the thermoplastic resin binder fibers maintain a molten state, to thereby adjust the apparent density of the mat to 0.15 to 0.50 g/cm^3, the pressed mat is coated or impregnated with an aqueous emulsion of a thermoplastic resin having a moldable temperature range of 80 to 180°C in such an amount that the resin content of the emulsion is 15 to 300 wt% based on the weight of the fibers in the fiber mat, and then the mat is heated to 60 to 250°C and dried to remove water and obtain the desired non-woven fabrics as disclosed, for example, in Japanese Patent Application (OPI) No. 87353/83 (the term "OPI" as used herein refers to a "published unexamined Japanese patent application").

This method has great attraction in that the stiffness of the non-woven fabrics is increased by using the fiber binder made of a thermoplastic resin in combination with the resin emulsion, the dimensional stability is increased by bonding the fibers to each other, and the stiffness of the non-woven fabrics is increased by removing a part of air by compressing the fiber mat before coating or impregnating with the emulsion resin to thereby increase the filling efficiency of the emulsion resin into the mat (i.e., the amount of the emulsion resin which fills spaces between the fibers of the web).

This process for producing moldable non-woven fabrics requires a preceding heating step to melt the binder fibers and a subsequent heating step to dry the resin emulsion, and this is disadvantageous from a standpoint of heat energy.

An object of the present invention is to provide a process for producing moldable non-woven fabrics having good elasticity, which can omit one heating step by controlling the resin content of an emulsion coated on the non-woven fabrics and the compression ratio of the mat.

The process for producing moldable non-woven fabrics according to the present invention comprises coating or impregnating a mat made of non-woven fabric with an aqueous emulsion of a thermoplastic resin having a glass transition point which lies in the range of 80 to 180°C in such an amount that the solids content of the emulsion is 15 to 300 wt% based on the weight of the fiber in the non-woven fabric mat, heating and drying the mat to remove water, and then compressing the non-woven fabric mat to control the apparent density of the mat to 0.15 to 0.5 g/cm^3.

The non-woven fabric mat which can be used in the present invention may be produced by feeding synthetic fibers and/or natural fibers having a size of 1.2 to 300 denier and a fiber length of 2.5 to 150 mm which are fully mixed and split in a web-producing unit, and super posing cards made of the fibers on each other in such an amount that the desired web weight per unit area is attained.

As the starting material for synthetic fibers, thermoplastic resin such as polyethylene terephthalate, polyamide and polypropylene are used. In addition, as natural fibers, cotton, flax, wool and the like are used. These may all be waste (reused).

In controlling the apparent density during compression, it is convenient that a fiber mixture of 15 to 50 wt% of thermoplastic resin binder fibers and 85 to 50 wt% of synthetic or natural fibers having a melting point of more than 40C° higher than that of the thermoplastic resin is used as the material for the non-woven fabric mat.

A web (fiber mat) comprising superposed cards of the above fibers is pierced with a needle in a vertical direction and the fibers are crossed in the vertical direction so that all the cards are temporarily combined together (so-called needling).

This fiber mat is coated or impregnated with an aqueous emulsion of a thermoplastic resin in such an amount that the solids content in the emulsion is 15 to 300 wt%, preferably 30 to 150 wt%, based on the weight of the fiber mat, and then heated and dried at a tempera ture higher than the melting point of the emulsion resin to remove the water,whereupon the desired moldable non-woven fabrics are produced. Particularly when the mat uses the binder fibers, controlling the apparent density can be facilitated by heating to a temperature at which not only the emulsion resin but also the binder fibers are melted.

The thermoplastic resin for the emulsion used for impregnation of the fiber mat has a moldable temperature range (glass transition point) of 80°C or more, preferably 120 to 180°C, and a particle diameter of 0.01 to 5 microns. More specifically, styrene/lower ester of acrylic acid (having 2 to 6 carbon atoms in the ester moiety) copolymers, methacrylate/lower ester of acrylic acid copolymers, vinylidene chloride copolymers (vinylidene chloride content is 85 wt% or more), styrene/diene copolymers and other thermoplastic resins can be used. Some of them are sold under the Trade Marks Acronal YJ-1100D, 8393D and 7082D, and Diofan 192D, or Mitsubishi Yuka Badische Co., Ltd.

Means to coat or impregnate the fiber mat with the emulsion include licker roll, squeeze roll, spray gun, and dipping. In general, to ensure the impregnation of the fiber mat with the emulsion, the emulsion coating is squeezed under pressure by passing through squeeze rolls.

Coating of the emulsion can be carried out from only one side or both sides of the fiber mat. The impregnation can be applied onto the entire surface of the fiber mat, or in such a manner that the central portion of the mat remains uncoated, or in such a manner that one side of the mat remains partially uncoated. By designing such that the fiber mat is only partially impregnated, the cushioning properties of the non-woven fabrics can be prevented from being extremely decreased.

In order to impart a heavy feeling to the non-woven fabrics, a filler such as calcium carbonate, iron oxide, ferrite, and barium sulfate can be compounded to the emulsion, or in order to provide the non-woven fabrics with moldability, a powder of a low melting point resin such as low density polyethylene or polystyrene, and an ethylene/vinyl acetate copolymer can be compounded to the emulsion.

The fiber mat with the emulsion coated or impregnated is then heated to a temperature higher than the melting point of the emulsion resin to remove the moisture, whereupon the moldable non-woven fabrics having an apparent density of 0.15 to 0.5 g/cm^3, preferably 0.17 to 0.3 g/cm^3, can be obtained. In this heat drying step, some of the resin particles in the emulsion are present in the fiber mat in the form of particles and some of them form a film, to thereby increase the binding between the fibers and provide the fiber mat with moldability and stiffness.

The reason why the apparent density of the moldable non-woven fabrics is controlled to 0.15 to 0.5 g/cm^3 is as follows. If the apparent density is less than 0.15 g/cm^3, the effect of the binder such as the emulsion resin and binder fibers filling the space in the mat to bind the fibers each other is low, and also the binding force between the fibers is low and the fibers are easily taken out. On the other hand, if the apparent density is more than 0.5 g/cm^3, the fiber layer becomes dense, and its elasticity is poor like the resin felt. Moreover, the air permeability is lowered.

The non-woven fabrics thus provided with moldability are then heated to a temperature higher than the melting point of the emulsion resin and compression molded into the desired form, whereupon a molding well balanced in stiffness and elasticity is obtained. In this case, when the non-woven fabrics are superposed on a decorating paper, a propylene sheet, an ABS leather sheet, a polyvinyl chloride leather sheet, or a tuffted carpet, a molding the surface of which is decorated can be obtained. When a reinforcing material such as a plywood, a resin felt, or cardboard, is used in place of the above sheet, a composite molding in which the reinforcing material and the non-woven fabrics are integrally bonded can be obtained.

The moldable non-woven fabrics obtained by the process of the present invention can be used, in addition to an interior material of an automobile, as a flooring material in the house, and a slip-resistant material bonded to the surface of a deck board of a pallet.

The present invention is described in greater detail by reference to the following non-limiting Examples. Unless otherwise indicated, all parts and percents are by weight.

EXAMPLE 1

A fiber mat (870 g/m^2) prepared by superposing random layers of mixed fibers comprising 20% of a recovered polypropylene (m.p.: 164°C) binder fibers having a fiber length of about 100 m (15 denier) and recovered polyethylene terephthalate (m.p.: 264°C) fibers having a fiber length of 75 to 125 mm (15 denier), was subjected to needling at a ratio of 50 per square inch using 15-18-32-3RB needle (thickness: about 7.5 mm).

The apparent density of the web subjected to the above needling was 0.12 g/cm^3, and its bending strength, tensile strength and tensile elongation were as follows:

Physical Properties	Longitudinal Direction
Bending Strength (g/3 cm width)	0
Tensile Strength (kg/3 cm width)	75
Tensile Elongation (%)	18

Bending Strength:

A test piece (120 mm length and 30 mm width) was fixed at one end, and at a position 100 mm apart from the fixed point, a load is applied in a vertical direction at a rate of 50 cm/min using Instron tester, and the bending resistance value was measured.

The web subjected to the above needling was coated with an aqueous emulsion of an acrylate/styrene copolymer ("Acronal YJ-7082D", produced by Mitsubishi Yuka Badische Co., Ltd.; resin softening point: about 120°C; resin particle diameter: 0.1 to 0.3 micron; solids content: 50%) in such an amount that the resin content was 350 g/m^2, and then the emulsion was allowed to impregnate into the web using a nip roll.

The water in the emulsion was then removed using a cylinder drier (190°C) while at the same time melting the emulsion resin, and the web was formed into a 5.0 mm thickness using a cooling roll to ensure the binding of fibers of cooled fiber binder made of a thermoplastic resin.

The moldable non-woven fabrics thus prepared had a bending strength of 254 g/3 cm width and an apparent density of 0.17 g/cm^3.

The moldable non-woven fabrics were good in air permeability.

The air permeability was measured as follows:

The non-woven fabrics were heated to 190°C and compression molded at 0.35 kg/cm^{3}G to produce a tray-form container having a length of 200 mm, a width of 200 mm and a depth of 20 mm. Water was placed in the container. Its air permeability was rated as follows:

o : Water leaks immediately and continuously from the container.

Δ: Water permeates through the container and drops intermittently.

x: Water does not permeate through the container at all.

The non-woven fabrics were heated to 200°C and press molded. As a result, a molding completely conforming to the shape of the mold can be obtained.

EXAMPLES 2 TO 5 AND COMPARATIVE EXAMPLES 1 TO 3

The procedure of Example 1 was repeated except that the resin solids content of the emulsion compounded to the fiber mat was 250 g/m^2, and the pressure of the cooling roll was changed so as to provide thicknesses as shown in Table 1.

The moldable non-woven fabrics and moldings having physical properties shown in Table 1 were obtained.

TABLE 1

Example No.	Non-woven Fabrics: Thickness (mm)	Apparent Density (g/cm3)	Air Permeability	Stiffness *1)	Bending Strength (g/3 cm width)	Molding: Mold Conformity *2)
Comparative Example 1	1.5	0.58	×	◎	300 or more	o
Example 2	2.0	0.44	Δ	◎	286	o
Example 3	3.0	0.29	o	◎	220	o
Example 4	4.0	0.22	o	o	194	o
Example 5	5.0	0.17	o	o∿Δ	162	o
Comparative Example 2	6.0	0.145	o	×	73	Δ
Comparative Example 3	7.5	0.12	o	×	0	×

*1) ◎: Very good
o: Good
Δ: Ordinary
×: Bad

*2) o: Good
Δ: Ordinary
×: Bad

EP 0 237 665 B1

Claims

1. A process for producing a moldable non-woven fabric, which comprises coating or impregnating a mat made of non-woven fabric with an aqueous emulsion of a thermoplastic resin having a glass transition point which lies in the range of from 80 to 180°C in such an amount that the resin solids content in the emulsion is 15 to 300 wt% based on the weight of the non-woven fabric mat and removing the water from the mat by heating, characterised in that the non-woven fabric mat is pressed after the coating or impregnating and heat-treating step so as to control the apparent density of the mat to 0.15 to 0.5 g/cm³.

2. A process as claimed in Claim 1, wherein the non-woven fabric mat is obtained by subjecting a fiber mat comprising 15 to 50 wt% of thermoplastic resin binder fibers and 85 to 50 wt% of synthetic or natural fibers having a melting point of more than 40°C higher than that of the thermoplastic resin to needling.

3. A process as claimed in Claim 1 or Claim 2, wherein said mat is produced by forming cards of synthetic and/or natural fibers and superposing a plurality of said cards on one another.

4. A process as claimed in Claim 3, wherein said cards are temporarily combined by needling (as hereinbefore defined) and the thus-formed mat is then coated or impregnated with said aqueous emulsion and pressed.

5. A process as claimed in any preceding Claim, wherein said aqueous emulsion includes a filler to impart a heavy feeling to the fabric produced.

6. A process as claimed in any preceding Claim, wherein said aqueous emulsion includes a powder of low melting point resin to impart moldability to the fabric produced.

7. A process as claimed in any preceding Claim, wherein said emulsion is coated or impregnated over the complete surface of both sides of said mat.

8. A process as claimed in any of Claims 1 to 6, wherein at least one side of said mat is coated or impregnated with said emulsion over only part of its complete surface.

9. A process for manufacturing a fabric-faced material, comprising producing a moldable non-woven fabric as claimed in any preceding Claim, and superposing said fabric on a backing sheet.

Patentansprüche

1. Verfahren zur Herstellung eines formbaren nichtgewebten Stoffes bzw. Faservlieses, bei dem eine Stoffbahn, hergestellt aus Faservlies, mit einer wäßrigen Emulsion eines thermoplastischen Harzes mit einem Glasübergangspunkt, der innerhalb des Bereichs von 80–180°C liegt, in solch einer Menge, daß der Harzfeststoffgehalt in der Emulsion 15–300 Gew.-%, bezogen auf das Gewicht der Faservliesbahn liegt, beschichtet oder imprägniert wird und das Wasser aus der Stoffbahn durch Erwärmen entfernt wird, dadurch gekennzeichnet, daß die Faservliesbahn nach der Beschichtungs- oder Imprägnier- und Wärmebehandlungsstufe gepreßt wird, um die scheinbare Dichte der Stoffbahn bei 0,15–0,5 g/cm³ zu kontrollieren.

2. Verfahren nach Anspruch 1, worin die Faservliesbahn erhalten wird, indem eine Faserstoffbahn, umfassend 15–50 Gew.-% thermoplastische Harzbindemittelfasern und 85–50 Gew.-% synthetische oder natürliche Fasern mit einem Schmelzpunkt, der um mehr als 40°C höher ist als der des thermoplastischen Harzes liegt, einem Nadeln (needling) ausgesetzt wird.

3. Verfahren nach Anspruch 1 oder 2, worin die Stoffbahn durch Bilden von Karden (cards) aus synthetischen und/oder natürlichen Fasern und Aufeinanderlegen einer Mehrzahl dieser Karden hergestellt wird.

4. Verfahren nach Anspruch 3, worin die Karden vorübergehend durch Nadeln (wie vorstehend definiert) kombiniert werden und die so gebildete Stoffbahn dann mit der wäßrigen Emulsion beschichtet oder imprägniert und gepreßt wird.

5. Verfahren nach einem der vorhergehenden Ansprüche, worin die wäßrige Emulsion ein Füllmittel einschließt, um dem hergestellten Stoff ein Schweregefühl zu verleihen.

6. Verfahren nach einem der vorhergehenden Ansprüche, worin die wäßrige Emulsion ein Pulver aus einem Harz mit niedrigem Schmelzpunkt einschließt, um dem hergestellten Stoff Formbarkeit zu verleihen.

7. Verfahren nach einem der vorhergehenden Ansprüche, worin die Emulsion über die ganze Oberfläche beider Seiten der Stoffbahn beschichtet oder imprägniert wird.

8. Verfahren nach einem der Ansprüche 1 bis 6, worin wenigstens eine Seite der Stoffbahn mit der Emulsion nur über einem Teil ihrer ganzen Oberfläche beschichtet oder imprägniert wird.

9. Verfahren zur Herstellung eines Materials mit einer Stoffseite, bei dem ein formbarer nichtgewebter Stoff bzw. ein Faservlies nach einem der vorhergehenden Ansprüche gebildet wird und das Vlies auf eine Rückseite aufgebracht wird.

Revendications

1. Procédé de production d'étoffes non-tissées moulables qui consiste à revêtir ou imprégner une natte faite en étoffe nontissée avec une émulsion aqueuse d'une résine thermoplastique ayant un point de transition vitreuse qui se situe dans la plage de 80°C à 180°C, en quantité telle que le contenu solide de

résine dans l'émulsion soit de 15 à 300% en poids rapporté au poids de la natte en étoffe non-tissée et à extraire l'eau de la natte par chauffage, caractérisé en ce que la natte en étoffe non tissée est pressée après l'étape de revêtement ou d'imprégnation et de chauffage afin de régler la densité apparente de la natte de 0,15 à 0,50 g/cm^3.

2. Procédé tel que revendiqué dans la revendication 1, dans lequel la natte d'étoffe non-tissée est obtenue en soumettant à un aiguilletage une natte de fibres comportant 15 à 50% en poids de fibres à liant en résine thermoplastique et 85 à 50% en poids de fibres naturelles ou synthétiques ayant un point de fusion supérieur de plus de 40°C à celui de la résine thermoplastique.

3. Procédé tel que revendiqué dans l'une des revendications 1 ou 2, dans lequel la natte est produite par formation de cartes de fibres synthétiques et/ou naturelles et par superposition d'une pluralité de ces cartes les unes sur les autres.

4. Procédé tel que revendiqué dans la revendication 3, dans lequel les cartes sont combinées momentanément par aiguilletage (tel que défini ci-dessus) et la natte ainsi formée est ensuite revêtue ou imprégnée de l'émulsion aqueuse et pressée.

5. Procédé tel que revendiqué dans l'une quelconque des revendications précédentes, dans lequel ladite émulsion aqueuse comporte une charge, pour communiquer à l'étoffe produite du poids au toucher.

6. Procédé tel que revendiqué dans l'une quelconque des revendications précédentes, dans lequel ladite émulsion aqueuse comporte une poudre à base de résine à bas point de fusion, pour communiquer de l'aptitude au moulage à l'étoffe produite.

7. Procédé tel que revendiqué dans l'une des revendications précédentes, dans lequel ladite émulsion aqueuse est déposée ou soumise à imprégnation sur toute la surface de la natte, sur ses deux faces.

8. Procédé tel que revendiqué dans l'une des revendications 1 à 6, dans lequel au moins une face de la natte est revêtue ou imprégnée de ladite émulsion sur une partie seulement de toute sa surface.

9. Procédé de fabrication d'une matière doublée d'étoffe, consistant à produire une étoffe non-tissée moulable telle que revendiquée dans l'une quelconque des revendications précédentes, et à superposer ladite étoffe sur une feuille de base.