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(54) High loft rebulkable non-woven fabric: tacker fiber approach.

(57) A method for making compressible webs of high loft nonwoven material containing bicomponent synthetic fibers having a thermoplastic component with a lower softening point component, such as a sheath-core bicomponent fiber, and converting the webs into a densified sheet of reduced thickness, and including compiling a plurality of the webs and exposing the fibers to a bonding temperature sufficiently high to soften the lower softening point component of the bicomponent fibers and to obtain a high-loft nonwoven material through inter-fiber contact points without compression of the webs, which method is characterized in that a thermoplastic tacking fiber having a softening point lower than that of all other components of the webs is incorporated within the webs before exposing the fibers to the said bonding temperature, the bonding temperature being sufficiently high to provide a low-density bonding pattern, and then heating the high-loft nonwoven material under compression at a temperature below the softening point of the lower softening point component and at or above the softening point of the tacking fiber to obtain a more densely bonded interim sheet product suitable for storage and/or transportation that can be rebulked by softening the tacking fibers without melting the lower softening point component.

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This invention relates to a method for making compressible webs of high loft nonwoven material containing synthetic fibers and converting the webs into a densified sheet of reduced thickness, for instance, for storage or transportation.

For many uses of nonwoven materials containing synthetic fiber, as in coverstock for absorbent personal care articles such as disposable diapers, sanitary napkins, and incontinence pads, substantial advantages in use can be gained by increasing the thickness of the nonwoven material to maintain a satisfactory separation between the wearer's skin and the fluid-retaining core. However, bulky nonwoven coverstock occupies expensive space for storage and transport.

A number of approaches have been offered in the art for making bulky coverstock. For example, U. S. Patent 4,391,869 discloses nonwoven air-laid fabric with low density and high loft made of synthetic staple fibers bonded with an aqueous resin binder, the excess of impregnating binder being removed by suction.

U.S. Patent 4,883,707 discloses through-air bonding of carded layers of flat-crimped thermoplastic bicomponent fibers, including sheath-core bicomponent fiber bonded by melting the sheaths to bond the layers together, to obtain a high-loft fabric having a basis weight of 15 to 40 grams per square yard. The bicomponent fibers may comprise combinations of polyolefin and polyester and polyethylene/polypropylene. The disclosure includes adding up to 30% of a single component fiber.

Once the desired high-loft of the fabric has been achieved by known methods, however, it occupies more space than is convenient for storage and transport, and may inadvertently be compressed by further handling, such as by storage in rolled form. This problem is mentioned in an article entitled "Multilayer Nonwovens for Coverstock, Medical, and Other End Uses" by J. Pirkkanen in the November 1987 issue of "Nonwovens World" and is solved by compressing the fabric with weights, which are removed to rebulk the fabric. None of the above prior disclosures suggests a method for making compressible webs of high loft nonwoven material containing synthetic fibers and converting the webs into a stable densified sheet of reduced thickness, for instance, for storage or transportation without maintaining physical loading, and then rebulking the sheet for its intended use. There is clearly a need for such a method.

According to the invention, a method for making high loft nonwoven material comprising one or more compressible webs containing bicomponent synthetic fibers having a thermoplastic component with a lower softening point component, such as a sheath-core bicomponent fiber, and converting the webs or webs into a densified sheet of reduced thickness, including exposing the fibers of the nonwoven material to a bonding temperature sufficiently high to soften the lower softening point component of the bicomponent fibers and to obtain a high-loft nonwoven material through inter-fiber contact points, is characterized in that a thermoplastic tacking fiber having a softening point lower than that of all other components of the webs is incorporated within the webs before exposing the fibers to the said bonding temperature, the bonding temperature being sufficiently high to provide low-density bonding, and then heating the high-loft nonwoven material under compression at a temperature below the softening point of the lower softening point component and at or above the softening point of the tacking fiber to obtain a more densely bonded interim sheet product suitable for storage and/or transportation that can be rebulked by softening the tacking fibers without melting the lower softening point component.

The expression "low density bonding", preferably means a level of bonding that provides a high-loft fabric having a basis weight of 15 to 40 grams per square yard, as indicated to be desirable in the above-mentioned U.S. Patent 4,883,707.

The temperature of air jets or mandrels used to carry out the bonding step is preferably within the range of 50°C to 180°C, more preferably 100°C to 180°C, depending on the relative softening points of the fibers, the low point on the range being at or above the softening point of the tacking fiber and, as already indicated, below the softening point of the lower softening point component, and the high point being below the softening point of the higher softening point component of the bicomponent fibers.

For the formation of the more densely bonded compressed interim product, the temperature is between the softening point of the tacking fiber and the softening point of the lower softening point component of the bicomponent fibers.

Preferably, the bicomponent fibers are crimped and the lower softening point component is the sheath component of a sheath/core bicomponent fiber.

The said high-loft nonwoven material preferably comprises 2 to 6 compiled webs obtained by carding staple fiber, of which at least half, and preferably all, contains sheath/core type bicomponent staple fiber in an amount of about 10 % to 80 % of each web, by weight, mixed with about 10 % to 40 %, by weight, and preferably 18-20 weight %, of a low melting point monocomponent thermoplastic tacking fiber, the balance, if any, being crimped or uncrimped monocomponent staple fiber and/or fibrillated film preferably arranged in machine or cross direction. In each case, such balance of web components preferably should not exceed 30 % by weight of the fabric and it must have a minimum softening point higher than that of the tacking fiber component and at least equal to or higher than that of the higher softening point component of the bicomponent staple fiber.

Suitable examples of sheath/core components, can be for instance, a polyolefin (including polyethylene, polypropylene, and copolymers) with a polyester (preferably polyethylene terephthalate) core, linear low-density or high density polyethylene with a polypropylene core, polypropylene with a polyester core, an aliphatic polyester or copolyester with a polyester core, and a polyolefin with a nylon core.

The tacking fiber component preferably comprises a low density polyolefin fiber or filament such as a polyethylene or similar low melting thermoplastic polymer or copolymer, including a low-melting polyester, that is capable of wetting at least one of the components of the bicomponent fiber, which in the preferred sheath/core structure will, of course, be the sheath.

The above-described heating and compressing step normally precedes storage, usually by rolling the compressed interim sheet product, and transporting it to another processing location. The method according to the invention therefore also may include the step of rebulking the interim sheet product for its intended use, characterized in that the said interim product is heated to a temperature below the melting point, and preferably below the softening point, of the lower softening point component of the bicomponent fiber and above the softening point of the tacking fiber to weaken or destroy bonding points created in the heating and compressing step and thereby to allow the webs to expand to a high-loft nonwoven material.

Preferably, the interim product is heated by passing hot air through the compressed material. Other methods of heating, such as by infra-red radiation or steam, may be used.

Preferably, the bicomponent staple fibers are from 0.75″ to 3″ long and 1.5 to 30 denier per filament (dpf), the tacking fibers are about the same length or shorter (0.2″ to 3″) and from 1 to 30 dpf, and the crimped or uncrimped monocomponent staple fiber or fibrillated film are from 2 to 30 dpf. The fibers and filaments used in the present invention can possess various conventional cross-sectional configurations such as round, diamond, delta, and dogbone configurations or mixtures thereof.

Example I

A. A test nonwoven material is prepared by air bonding two compiled fiber webs obtained by carding (2 cards) a blend of crimped staple, consisting of 27.0 1b high density polyethylene/polyethylene terephthalate sheath/core bicomponent material (3.0 d x 1.5″) obtained from BASF, and 6.0 1b of uncrimped linear low density polyethylene fiber (MI = 25 dg/min, density = .917 g/cc 3.5 d x 1.5″). After bonding, the nonwoven material is cut into 5″ x 5″ test squares having an average bulked thickness of 33 mils as determined with a 0.3 psi-loaded thickness gauge. Duplicate squares, identified as 1S-A, 2S-A, 3S-A, 4S-A, and 5S-A are compressed on a Carver press at 120°C/300 psi/0.5 seconds to obtain average compressed thicknesses of 8.0, 7.3, 7.5, 8.5, and 6.5 mils, respectively. Rebulking characteristics are determined by cutting the compressed sample into 1″ strips and pulling the strips through a plurality of air jet (110°C) at a pull through speed of 1 second. The rebulk height (mils) is compared against original bulked height and test results reported in Table 1 below.

B. Additional test nonwoven material is prepared as in Ex. 1A using an identical fiber blend to obtain squares identified as 1S-B, 25-B, 35-B, 45-B, and 5S-B. The squares are compressed as before on a Carver Press and the rebulk process is carried out using 1″ strips in a 2 second passage through air jets (115°C). Test results are again reported in Table 1 below.

C. Test nonwoven material is prepared as in Ex. 1A using the same fiber blend. Test squares identified as 6S-A and 6S-B are compressed as before and the compressed squares cut into 1″ strips for rebulking in air jets at 110°C and 115°C, respectively, and at 1 second and 2 second passes, respectively. Test results are reported in Table I.

TABLE 1

TRIAL	ORIGINAL BULKED[1] THICKNESS (mils)	STORAGE COMPRESSED THICKNESS (mils)[2]	WT. % TACKER FIBER (±0.5%)	REBULKED THICKNESS (Mils)[2]	HOT AIR REBULK HEATING (Seconds)	ESTIMATED REBULK TEMP (°C)	%[3] RECOVERY (AV)
1 S-A	33	8	18	14	1	110	42.4
1 S-B	33	8	18	20	2	115	60.6
2 S-A	33	7.3	18	12	1	110	36.4
2 S-B	33	7.3	18	12	2	115	36.4
3 S-A	33	7.5	18	11	1	110	33.3
3 S-B	33	7.5	18	15	2	115	45.5
4 S-A	33	8.5	18	15	1	110	45.5
4 S-B	33	8.5	18	21	2	115	63.6
5 S-A	33	6.5	18	17.5	1	110	53.0
5 S-B	33	6.5	18	17.5	2	115	53.0
6 S-A	33	7.8	18	23.5	2	110	71.2
6 S-B[4]	34	10	18	33	2	115	97.1

[1] 0.3 psi on thickness gauge.
[2] Average of 4 readings on fabric squares.
[3] % Recovery (after 10 seconds) = $\frac{\text{Rebulk (mil)}}{\text{Orig. Bulk (mil)}} \times 100\%$.
[4] No load on thickness gauge.

Claims

1. A method for making of high loft nonwoven material comprising one or more compressible webs containing bicomponent synthetic fibers having a thermoplastic component with a lower softening point component, such as a sheath-core bicomponent fiber, and converting the webs or webs into a densified sheet of reduced thickness, including exposing the fibers of the nonwoven material to a bonding temperature sufficiently high to soften the lower softening point component of the bicomponent fibers and to obtain a high-loft nonwoven material through inter-fiber contact points, characterized in that a thermoplastic tacking fiber having a softening point lower than that of all other components of the webs is incorporated within the webs before exposing the fibers to the said bonding temperature, the bonding temperature being sufficiently high to provide low-density bonding, and then heating the high-loft nonwoven material under compression at a temperature below the softening point of the lower softening point component and at or above the softening point of the tacking fiber to obtain a more densely bonded interim sheet product suitable for storage and/or transportation that can be rebulked by softening the tacking fibers without melting the lower softening point component.

2. A method for making high loft nonwoven material as claimed in claim 1, further characterized in that the low density bonding is a level of bonding that provides a high-loft fabric having a basis weight of 15 to 40 grams per square yard.

3. A method for making high loft nonwoven material as claimed in claim 1 or 2, further characterized in that the temperature used to carry out the bonding step is within the range of 100°C to 180°C.

4. A method for making high loft nonwoven material as claimed in Claims, 1, 2 or 3, further characterized in that the bicomponent staple fiber is a sheath/core bicomponent in which the sheath is the lower-softening component.

5. A method for making high loft nonwoven material as claimed in any of the preceding claims, further characterized in that the tacking fiber is staple fiber having a dpf range of 1.0 to 30 dpf.

6. A method for making high loft nonwoven material as claimed in any of the preceding claims, further characterized in that it includes the step of rebulking the interim sheet product for its intended use by heating the said interim sheet product to a temperature below the melting point of the lower softening point component of the bicomponent fiber and above the softening point of the tacking fiber to weaken or destroy bonding points created in the heating and compressing step and thereby to allow the webs to expand to a high-loft nonwoven material.

7. A method for making high loft nonwoven material as claimed in claim 6, further characterized in that the said interim sheet product is heated to a temperature below the softening point of the lower softening point component of the bicomponent fiber.

8. A method for making high loft nonwoven material as claimed in claim 6 or 7, further characterized in that the interim sheet product is heated by exposing it to a hot gas.

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EUROPEAN SEARCH REPORT

Application Number

EP 92 30 9439

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	EP-A-0 404 032 (JAPAN VILENE COMPANY)	1,3,4, 6-8	D04H1/54
A	* claims 1,3,4,5; examples 3,4 *	2	
A	WO-A-8 800 258 (WM.T.BURNETT & CO.) * page 10, line 12 - page 12, line 31 *	1,5	
P,A	EP-A-0 483 386 (TEIJIN LTD.) * page 8, line 39 - page 9, line 22; example 1 *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

D04H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	03 DECEMBER 1992	VAN BEURDEN-HOPKINS

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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