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(54) **Mechanically treated, continuous filament batting**

Mechanisch-behandelter Endlosfilamentvliesstoff

Non-tissé de filaments continus traité mécaniquement

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Description

Field of the Invention

This invention relates to continuous filament batting.

Background of the Invention

As illustrated by U.S. Patent Nos. 4,497,097 to Schneider et al, 4,414,961 to Luebke, 4,397,910 to Benson et al, and 3,925,993 to Roth, needle-punching of spunbonded webs and of webs made from staple fibers is known. In the case of spunbonded webs, filament production is by melt spinning, the filaments are stretched, and thereafter the filaments are randomly collected to form a web. As exemplified by U.S. Patent Nos. 4,582,750 to Lou et al and 4,814,219 to Burgess et al, non-woven webs may be crosslapped and may be heat consolidated or fused, in combination with needle-punching.

Generally speaking, in this type of prior art, needle-punching is used to produce high strength, engineering grade products, often termed geotextiles. Moreover, needle-punched structures made by the foregoing processes, typically may have a density of 0.1 g/cm^3 or more, generally in the range of about 0.1 to 0.2 g/cm^3. Accordingly, these products are not lofty.

In addition, as exemplified by U.S. Patent No. 5,081,754 to Lawton et al, tautly held tow may be treated with barbed needles to sever filaments. Lawton observes that density may be varied by increasing or decreasing needling action.

Continuous filament, polyester tow having crimped filaments is commercially available under the trade mark POLARGUARD from Hoechst Celanese Corporation of Charlotte, North Carolina. Conveniently, manufacture of the tow involves extrusion spinning, stretching, crimping, and heating to set the crimp. For insulation product applications, the tow is opened and thereafter crosslapped, and the resulting batting coated with a latex or resin. Opening and crosslapping provide orientation to filaments and a desired weight and/or thickness. The coating step provides structural integrity for further processing and handling; otherwise, the batting is difficult to handle and process. The coated batting has a harsh or stiff feel.

It would be environmentally beneficial if the batting could be provided with structural integrity without a chemical coating step. Accordingly, there is a need for an improved processing technique for providing the batting with the needed structural integrity.

In addition, there is a need for batting having a soft hand and prepared from the polyester tow. Moreover, there is a need for batting based upon the tow, that may be easily customized to a wide range of insulation values.

Summary of the Invention

In accordance with the present invention, an improved batting especially useful as an insulation material, may be advantageously based upon continuous filament tow having crimped filaments. Beneficially, in accordance with the invention, the batting is subjected to a non-chemical treatment technique to provide sufficient structural integrity for handling. Advantageously, the batting is mechanically treated using needle-punching.

As may be understood by one skilled in the art, needle-punching generally has an adverse effect upon loft. A lofty product is essential for good insulating values. Therefore, needle-punching of the batting is beneficially controlled to maintain loft. To provide the structural integrity and loft, mechanically-treated batting in accordance with this invention, should have a density in the range of about 0.005 to 0.075 g/cm^3.

Advantageously, a mechanically-treated batting in accordance with this invention, has a soft hand compared to chemically-treated batting. According to the present invention, the batting may be easily tailored to a wide range of insulation values.

Detailed Description of the Invention

As indicated above, continuous filament batting may be given the needed structural integrity for normal handling and processing, without use of a chemical coating step. Moreover, the integrity may be beneficially provided without heat consolidation or fusion.

As earlier mentioned, continuous filament, polyester tow having crimped filaments, is a commercially available product. To make batting, the tow is opened and thereafter crosslapped in accordance with conventional techniques. In this way, batting of a desired weight and/or thickness may be provided.

Generally speaking, batting useful for insulation product applications, weighs between about 67,8 - 271,3 g/m^2 (2 to 8 oz. per sq. yd). For reasons of economy, the weight may be preferably in the range of about 101,7 - 169,5 g/m^2 (3 to 5 oz. per sq. yd).

Typically, dpf will be in the range of about 0,05 - 1,7 tex (0.5 to 15), preferably about 0,13 - 0,66 tex (1.2 to 6). For the same weight product, filaments of lower dpf may provide a more uniform appearance.

Tow having crimped filaments is beneficially used because crimp aids in opening and may yield a loftier structure. In other words, generally speaking, filaments that have not been crimped, may lay on top of one another, and loft may therefore not be provided for. By comparison, crimp leads to spacing between filaments and thus loft. Crimped tow useful in the present invention may have, for purposes of illustration, conventional crimp or omega type crimp (rounded off on ends).

The tow filaments may be solid or hollow. Advantageously, hollow filaments may be used to provide a less dense product than solid filaments and accordingly rel-

atively greater insulation. Hollow fil, polyester tow is commercially available from Hoechst Celanese of Charlotte, North Carolina under the trade mark POLARGUARD HV.

As indicated, it is an object of the invention to provide batting prepared from continuous filament tow, with sufficient structural integrity for handling and subsequent processing. In accordance with the present invention, the batting is beneficially subjected to mechanical treatment to provide the needed integrity, and hence may be free of latex or other chemical coating. To this end, a needle-punching step in accordance with the invention, may be advantageously used that entangles filaments so as to provide the structural integrity. For use as an insulation material, enough structural integrity is needed to allow the batting to be normally handled and placed into, for instance, a garment or sleeping bag.

Beneficially, a mechanical treatment step of this type may provide a product of generally uniform structural integrity. However, needle-punching typically destroys loft and is thus used to produce a relatively flat product of increased strength. Accordingly, carefully controlled needle-punching is necessary to produce a lofty batting of the needed structural integrity.

A lofty batting in accordance with the present invention, should have a density in the range of about 0.005 to 0.075 g/cm^3, preferably about 0.0075 to 0.05 g/cm^3, and even more preferably about 0.01 to 0.035 g/cm^3. ASTM method D-1777 may be used to measure sample thickness, and density may be calculated using thickness and fabric weight. Generally speaking, relatively lower density yields a relatively higher insulation value. However, the density to be selected from the foregoing range, will depend upon factors including the particular end use.

Factors affecting density of a needle-punched product include penetrations per square inch (ppsi). Beneficially, a low number of penetrations per square inch may be used to maintain relatively greater loft. Relatively more penetrations per square inch typically yield a relatively denser product, whereas relatively fewer penetrations per square inch produce a relatively loftier product. Generally, about 50 to 800 penetrations per square inch may be used to provide a batting in accordance with the present invention. Preferably, about 75 to 400 penetrations per square inch are used.

Another factor affecting loft is needle penetration depth. Relatively deeper penetration into the batting generally results in relatively less loft, whereas relatively shallower penetration yields a relatively loftier product. Typically, a penetration depth of about 4 to 9 mm may be used. Preferably, the needle penetration depth is in the range of about 5 to 7 mm, with a depth of about 6 to 7 being especially preferred in combination with about 150 to 250 penetrations per square inch for a typical batting in accordance with the present invention.

Another factor affecting loftiness of the needle-punched product, is aggressiveness of the needles. Relatively more aggressiveness typically produces relatively greater density of the needled structure, whereas relatively less aggressiveness results in a relatively loftier structure. Aggressiveness is determined by needle design parameters such as needle size, presence or absence of barbs, barb location, and barb configuration and size. Conveniently, conventional barbed needles of 38 or 40 gauge with close point to first barb spacing, may be used. Other needle types may also be used; however, needles so aggressive as to destroy loft should be avoided.

In accordance with the invention, penetrations per square inch, needle penetration depth and needle aggressiveness are balanced to give a lofty product. Accordingly, if relatively more penetrations per square inch within the foregoing range are utilized, then needle penetration depth and/or needle aggressiveness may be reduced to maintain loftiness. On the other hand, if relatively fewer penetrations per square inch are used, then penetration depth and/or needle aggressiveness may be increased to obtain a selected density within the foregoing range.

Also affecting loftiness of the needle-punched product is the needle density. Beneficially, in accordance with the invention, relatively low needle density may be used in combination with a relatively low number of strokes, to maintain loft. Typically, a density of about 11,8 - 59 needles/linear cm (30 to 150 needles/linear inch), preferably 13,8 - 31,5 needles/linear cm (35 to 80 needles/linear inch), may be used.

In the needling step, conventional needle looms equipped with barbed needles are typically suitable for treating the opened and crosslapped batting. The barbs of descending needles hook filaments and pull the hooked filaments downwardly, thereby mechanically entangling the batting. The needles are drawn out of the batting on ascent.

As may be appreciated, needle-punching provides a facile technique for tailoring the density of the needle-punched structure to the desired application. As a consequence, batting in accordance with the present invention, may have a wide range of insulation values. However, treatment conditions that result in too much densification are to be avoided.

The batting may be needled onto scrim to provide added support for later processing. A light weight, nonwoven scrim having a weight of for example, about 0.25 to 1.5 oz. per square yard, may be used. The scrim may be incorporated into the final product if desired.

EXAMPLE 1

0,33 tex (3 dpf), continuous filament, polyester tow having crimped, solid round filaments and commercially available under the trademark POLARGUARD, is opened and crosslapped prior to being passed through a needling machine. The batting has a weight of 118,7 g/m^2 (3.5 oz. per sq. yd).

A set of barbed needles is mounted in a vertically reciprocable needle board, and the needles are arranged in a plurality of rows each extending across the effective width of the needling machine. The needles are 38 gauge, regular barbed needles with close point to first barb spacing, and the needle density is 15 needles per linear cm (38 needles per linear inch).

The needle loom has a conventional bed plate and stripper plate both of which are perforated to allow passage of the needles when the needle head descends, and the path of the batting is between these plates. The number of strokes is set at 220 rpm at a line speed of 1.1 m/minute.

The barbs of descending needles hook filaments and pull the hooked filaments downwardly, thereby mechanically entangling the batting. The needles are drawn out of the batting on ascent. Needle penetration depth is 6 mm, and 192 penetrations per square inch are used. A lofty, needle-punched product having improved integrity is obtained. The product has a density of about 0.015 to 0.025 g/cm^3. The product is free of conventional latex coating and has a very soft hand.

EXAMPLE 2

0,33 tex (3 dpf) tow, needled with scrim, similarly processed as in the foregoing example, is used as an insulating material in jackets, 135,6 g/m^2 (4 oz./sq.yd). sleeves, and 203,5 g/m^2 (6 oz./sq.yd). body. The lofty, needle-punched batting has sufficient integrity for handling and a very soft hand. Three jackets containing the batting and having an average weight of 0.946 kg, are found to have an average thermal insulation value of 2.3.

EXAMPLE 3

3 dpf tow, needled with scrim, 108,5 g/m^2 (3.2 oz./sq. yd)., similarly processed as in Example 1, is used as an insulating material in vests. The lofty, needle-punched batting has sufficient integrity for handling and a very soft hand. Three vests containing the batting and having an average weight of 0.438 kg, are found to have an average thermal insulation value of 1.8; however, the thermal insulation value may have been affected by the vests being sized too small.

EXAMPLE 4

0,33 tex (3 dpf) tow, 108,5 g/m^2 (3.2 oz./sq. yd)., similarly processed as in Example 1, is used as an insulating material in sleeping bags. The lofty, needle-punched batting has sufficient integrity for handling and a very soft hand. Four sleeping bags containing the batting and having a mean weight of 1.91 kg and a mean batting weight of 1.41 kg, are found to have a mean thermal insulation value of 5.1.

EXAMPLE 5

0,33 tex (3 dpf) tow, needled with scrim, 108,5 g/m^2 (3.2 oz./sq. yd.), similarly processed as in Example 1, is used as an insulating material in sleeping bags. The lofty, needle-punched batting has sufficient integrity for handling and a very soft hand. Four sleeping bags containing the lofty batting and having a mean bag weight of 2.13 kg and a mean batting weight of 1.63 kg, are found to have a mean thermal insulation value of 5.2.

The needle-punched batting may be used in a variety of ways including as an insulation material in sleeping bags. The mechanically-treated batting has a softer, more appealing hand than that of resinated products.

Claims

1. A needle-punched, continuous filament batting having crimped filaments, said needle-punched batting having a density in the range of about 0.005 to 0.075 g/cm^3.

2. The needle-punched batting of claim 1, wherein said density is in the range of about 0.0075 to 0.05 g/cm^3.

3. The needle-punched batting of claim 1, wherein said density is in the range of about 0.01 to 0.035 g/cm^3.

4. The needle-punched batting of claim 1, wherein said batting is polyester.

5. The needle-punched batting of claim 1 in combination with a scrim support.

6. An insulation material comprising the batting of claim 1.

7. A process for making a lofty batting having sufficient structural integrity for handling, said process comprising opening and crosslapping, continuous filament tow having crimped filaments to produce a batting, and needle-punching said batting to provide a density in the range of about 0.005 to 0.075 g/cm^3.

8. The process of claim 7, wherein a needle penetration depth of about 5 to 7 mm, and penetrations per square inch of from about 75 to 400 are used.

9. The process of claim 7, wherein a needle penetration depth of about 6 to 7 mm, and penetrations per square inch of from about 150 to 250 are used.

10. The process of claim 7, wherein said tow is polyester tow.

Patentansprüche

1. Vernadelte Endlosfaden-Wattierung mit gekräuselten Fäden, wobei die vernadelte Wattierung eine Dichte im Bereich von etwa 0,005 bis 0,075 g/cm^3 aufweist.

2. Vernadelte Wattierung nach Anspruch 1, wobei die Dichte im Bereich von etwa 0,0075 bis 0,05 g/cm^3 liegt.

3. Vernadelte Wattierung nach Anspruch 1, wobei die Dichte im Bereich von etwa 0,01 bis 0,035 g/cm^3 liegt.

4. Vernadelte Wattierung nach Anspruch 1, wobei die Wattierung Polyester ist.

5. Vernadelte Wattierung nach Anspruch 1 in Kombination mit einem Trägergewebe.

6. Isoliermaterial, umfassend die Wattierung nach Anspruch 1.

7. Verfahren zur Herstellung einer locker-elastischen Wattierung mit einer strukturellen Festigkeit, die zur Handhabung ausreichend ist, wobei das Verfahren das Öffnen und Kreuzlegen eines Kabels aus Endlosfaden mit gekräuselten Fäden zur Herstellung einer Wattierung und das Vernadeln der Wattierung umfaßt, wodurch eine Dichte im Bereich von etwa 0,005 bis 0,075 g/cm^3 erzeugt wird.

8. Verfahren nach Anspruch 7, wobei eine Nadeleindringtiefe von etwa 5 bis 7 mm und etwa 75 bis 400 Eindringungen/inch^2 verwendet werden.

9. Verfahren nach Anspruch 7, wobei eine Nadeleindringtiefe von etwa 6 bis 7 mm und etwa 150 bis 250 Eindringungen/inch^2 verwendet werden.

10. Verfahren nach Anspruch 7, wobei das Kabel ein Polyesterkabel ist.

Revendications

1. Ouate en feuille aiguilletée, à filaments continus, comprenant des filaments crépés, ladite ouate en feuille aiguilletée ayant une densité de l'ordre d'environ 0,005 à 0,075 g/cm^3.

2. Ouate en feuille aiguilletée selon la revendication 1, dans laquelle ladite densité est de l'ordre d'environ 0,0075 à 0,05 g/cm^3.

3. Ouate en feuille aiguilletée selon la revendication 1, dont ladite densité est de l'ordre d'environ 0,01 à 0,035 g/cm^3.

4. Ouate en feuille aiguilletée selon la revendication 1, dans laquelle ladite ouate en feuille est en polyester.

5. Ouate en feuille aiguilletée selon la revendication 1, en combinaison avec un support en canevas léger.

6. Matière d'isolation consistant en la ouate en feuille de la revendication 1.

7. Procédé de production d'une ouate en feuille volumineuse ayant une cohésion structurelle suffisante pour la manipulation, ledit procédé comprenant l'ouverture et l'entrechevêtrement d'une étoupe à filaments continus ayant des filaments crêpés pour produire une ouate en feuille et l'aiguilletage de ladite ouate en feuille pour produire une densité de l'ordre de 0,005 à 0,075 g/cm^3.

8. Procédé selon la revendication 7, suivant lequel une profondeur de pénétration des aiguilles d'environ 5 à 7 mm et des pénétrations par pouce carré d'environ 75 à 400 sont utilisées.

9. Procédé selon la revendication 7, suivant lequel une profondeur de pénétration des aiguilles d'environ 6 à 7 mm et des pénétrations par pouce carré d'environ 150 à 250 sont utilisées.

10. Procédé selon la revendication 7, dans lequel ladite étoupe est une étoupe de polyester.