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(54) **YARN WITH HEAT-ACTIVATED BINDER MATERIAL AND PROCESS OF MAKING**

GARN MIT EINEM DURCH HITZE AKTIVIERTEN BINDEMATERIAL UND VERFAHRENSGANG

FIL COMPRENANT UN MATERIAU DE LIAISON ACTIVE PAR LA CHALEUR ET PROCEDE DE PRODUCTION DE CE FIL

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Description

1. Field of the Invention

[0001] The invention relates to yarn suitable for tufting, especially to form carpet face fiber, and other applications. The yarn is as defined in claim 1. In a process for production of such a yarn suitable for tufting, particularly for use in a carpet, exposure of the yarn to usual process conditions for twist setting the yarn causes the heat-activated adhesive material in the inserting fiber to melt substantially completely and flow to points of intersecting base fiber filaments to create a bond upon subsequent cooling, thus altering properties and performance of the resulting product.

2. Description of Related Art

[0002] It has been known to blend non-adhesive fibers with potentially adhesive fibers to form a yarn or other textile structure or article, then to activate the potentially adhesive fibers to bond them to contacting fibers, thus modifying end-use properties of the yarn. U.S. Patent 2,252,999 to Wallach, issued August 19, 1941, provides a process wherein a yarn comprising an admixture of non-adhesive and potentially adhesive fibers is formed, the potentially adhesive fiber is activated, and the fibers compacted while in an adhesive condition so that they adhere to each other at points of contact. U.S. Patent 3,877,214 to Van der Werf, issued April 15, 1975, discloses a twist-free yarn comprising a polyamide fiber melting under a relatively low temperature as a bonding component. U.S. Patent 3,494,819 to McAlister, issued February 10, 1970, discloses a blend of fusible and non-fusible polyethylene terephthalate fibers incorporated into fabric, wherein the finished fabric is heated to fusion temperatures to provide improved pill resistance. U.S. Patent 3,978,267 to Selwood, issued August 31, 1976, discloses a substantially twistless compact yarn comprising a proportion of potentially adhesive fiber which has been activated to bond contacting fibers.

[0003] Cut-pile carpet is customarily produced from staple yarns or bulked continuous filament yarns. For example, staple fiber is conventionally carded, pinned, and spun or wrap spun into a singles yarn, which typically is twisted and plied with similar yarn to form a 2-ply or 3-ply yarn construction. This yarn is twist set by utilizing one of several commercially available twist setting processes such as the Suessen or Superba processes.

[0004] In a typical process the yarn is passed through a heated chamber, while in a relaxed condition. The temperature of this process step is crucial to the proper twist setting of the base fiber, to obtain desired properties of the final carpet product. For nylon-6 base fiber, the conditions for this step are typically 190-200°C with a residence time of about 60 seconds for the Suessen process and about 125-140°C with a residence time of about 60 seconds for the Superba process. The Superba process utilizes saturated steam and thus the yarn is subjected to a much higher level of humidity than in the Suessen process.

[0005] Similarly, bulked continuous filament yarn is produced according to various conventional methods. Twisting, entangling, or direct cabling may be utilized in various processes. For example, a 2-ply twisted yarn combining 2 ends of 1185 denier 70 filament nylon-6 yarn is prepared and subjected to conventional twist setting conditions, such as that for the staple yarn above, or in an autoclave at 132°C in saturated steam with a residence time of about 40 to 60 minutes.

[0006] It is known to wrap fiber, both staple and continuous filament, with a binder strand to physically bind the wrapped fiber to permit downstream processing. See, e.g., U.S. Patents 4,495,758 to Stahlecker et al. and 4,668,553 to Scott et al. Neither of these patents, however, uses or suggests the use of a binder strand or fiber that contains heat-activated adhesive material.

[0007] Multiple ends of the twist set yarns are tufted into cut pile carpet and conventionally finished to obtain the desired carpet product.

[0008] WO-A-94/09196 discloses a synthetic yarn made from a blend of base fibers selected from polyester, nylon 6 and nylon 6,6 and 1 to 12 weight % of a heat-activated binder fiber having a melting point within the range of 165°C to 190°C. The blended fiber may be processed in conventional ways, including spinning.

[0009] WO-A-94/20657 discloses ply-twisted yarns comprising blends of 70 to 90 weight % base fiber which is preferably nylon 6,6 or nylon 6, and 10 to 30 weight % of a non-melt compatible polyolefin fiber having a melting point of 130°C to 170°C.

SUMMARY OF THE INVENTION

[0010] According to the present invention, yarn, preferably synthetic, comprises at least one bundle of fiber, the fibre being selected from polyamides, nylon-6, nylon-6,6, polyesters, polyolefins, cotton and wool, the fiber bundle being ring spun with a second fiber (an insert fiber) comprising a heat-activated binder material, preferably a fiber, having a melting point range of about 105 to 190°C, preferably 165 to 190°C, under ambient humidity conditions, such that the yarn comprises a total of 0.1 to 12, preferably 0.25 to 10, more preferably 0.5 to 8, weight percent binder material. The preferred fiber bundle comprise staple fibers, preferably in the form of a sliver. Alternatively the bundle of fibers may be continuous filaments. The preferred second, binder fiber is a copolyamide, more preferably a copolyamide of the nylon 6/nylon 6,6 type. The preferred bundle of fiber is nylon 6. The present invention is also an article, preferably tufted, more preferably a carpet, made from this yarn. The present invention is also a process of producing a yarn suitable for tufting, the process comprising the steps of:

a. forming a bundle of fiber, the fibre being selected

from polyamides, nylon-6, nylon-6,6, polyesters, polyolefins, cotton and wool, preferably by spinning staple fiber;

b. ring spinning the bundle of fiber with a second fiber comprising a heat-activated binder material having a melting point range of about 105 to 190°C, preferably 165 to 190°C, under ambient humidity conditions to form a yarn comprising 0.1 to 12, preferably 0.25 to 10, more preferably 0.5 to 8, weight percent of the binder material;

c. heating the yarn sufficiently to melt the binder material; followed by

d. cooling the yarn, preferably during twist setting, to solidify the binder material.

[0011] With ring spinning, the insert fiber is inserted before the front delivery roll into a continuous bundle of base fibers, preferably staple fibers in a sliver. This invention also relates to yarn made in accordance with the aforesaid process,

[0012] When the yarn is twisted, plied and twist set by conventional processes, for example 190-200°C Suessen twistsetting with a residence time of about 60 seconds, and the treated yarn tufted into cut-pile carpet, the resulting carpet displays enhanced carpet tuft appearance, improved resilience, and reduced change of appearance with use.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0013] Applicant has discovered that by incorporation of a minor proportion of heat-activated binder fiber having substantially lower melting point than the base fiber into the yarn construction, the standard heat conditions for twist setting the yarn will cause the binder fiber to melt, substantially losing its identity as a fiber. It will flow to intersecting points of base fiber and upon subsequent cooling will encapsulate and bind fibers and yarn together, thereby retaining the twist in cut-pile carpets. Carpets made with the yarn of this invention can be improved in surface, aesthetics, hand, durability and wear performance. By careful selection of the binder fiber desired improvement is "built-in" to the yarn, with no additional process steps required by the yarn spinner, the carpet manufacturer, or in dyeing and finishing.

[0014] The binder fiber is selected to provide good adhesion to the base fiber. It is important that the melting point of the binder fiber be in the range of 105-190°C, preferably 165-190°C, under ambient humidity conditions. This range ensures that the binder fiber will melt during the conventional twist setting process yet will provide adequate adhesive properties during any subsequent dyeing steps and final use. A saturated steam environment, such as in an autoclave, reduces the fiber melting point of polyamide binder fibers dramatically.

[0015] A preferred class of binder fiber for use with polyamide base fibers are copolyamides within the specified melting point ranges. Suitable copolyamides of the 6/66/12 type and a process for their production are disclosed in U.K. Patent 1,168,404, issued October 22,1969 to Inventa A. G. A melt bonding copolyamide adhesive fiber is commercially available from EMS as GRILON® type K 140 (melting range 130-140°C) and type K 115 (melting range 110-117°C) copolyamides of the 6/66 Type as in U.S. Patent 5,478,624 to Lofquist.

[0016] By selection of the thermally activated binder fiber within the weight percent ranges and melting point ranges specified it is possible to modify end-use properties of the finished carpet to improve wear resistance, resilience, reduced change of appearance over time and with use, and to increase hand, lustre and apparent value. Denier per filament, cut length, fiber cross-section, crimp type and frequency, surface finish, melt viscosity, softening point, melting point, dye affinity, and other properties are crucial to achieving ideal properties in the final product. A proper selection of the binder fiber must be made to obtain the desired, or optimum results from the finished carpet product. This will depend on numerous factors including the denier, length, crimp, finish, and other properties of the base fiber product.

[0017] With the utilization of this invention, twist setting conditions normally used are sufficient to activate the binder fiber, to create bind points which strengthen the final product, thereby imparting other characteristics which are desirable. For the Suessen process, under relatively low humidity conditions, the twisted yarn is subjected to a temperature of 190-205°C for a residence time of 50-60 seconds. In the Suessen process motion of the fiber while in the relaxed state, caused by vibration or air currents, sufficiently motivates the molten binder fiber to flow to the intersecting "touch points" of the base fiber, as a function of the melt flow properties of the binder fiber and surface characteristics. As the fiber emerges from the elevated temperature condition, the binder solidifies and encapsulates or bonds two or more base fibers together at intersecting points in a durable bond. Subsequent processing including dyeing, finishing, and backcoating using commercial processing methods does not soften the bond points sufficiently to weaken them, but rather will strengthen them. The resultant carpet can be of many forms, but a typical style would be cut-pile carpet with about 1.4 kg/m^2 (40 ounces per square yard) of face yarn including the binder, with an attached backing. Carpet construction would be typically 0.06cm (5/32") gauge, 1.9cm (3/4") pile height, and the carpet would be dyed, dryed, backcoated, and sheared using normal processing techniques. The yarn of the invention would also provide important property improvements in the production of loop-pile carpet.

EXAMPLE

[0018] Carpets also may be produced by introducing a binder yarn at ring spinning before the front delivery roll into a continuous bundle of base staple fibers being drafted to produce a ring spun yarn. The binder yarn can

consist of 100% heat-activated adhesive fibers or consist of a blend of heat-activated adhesive fibers and non-adhesive fibers. Binder yarns as such can be either continuous filament yarn or spun staple yarn produced by conventional manufacturing methods. This ring spun yarn has greater strength due to the added strength of the inserted yarn in the total spun yarn structure, which results in improved operating performance at spinning by reducing single end breakouts.

[0019] The resulting ring spun yarn when later twisted into a plied yarn and twist set by conventional processes results in a treated yarn with altered, unique performance properties. The unique properties are produced by the heat activated adhesive fibers in the inserted binder yarn being intermingled within the continuous bundle (sliver) of non-adhesive base staple fibers during the ring spinning process, melting during conventional twist setting processes, and then solidifying when emerging from the elevated temperature forming a durable crossbonding with the non-adhesive base staple fibers within the individual ends of the plied yarn and between the individual ends of the plied yarn.

[0020] The treated plied twist set yarn has a more resilient, stiffer hand, significantly improved ply twist retention, and a less hairy surface. When tufted into cut-pile carpet, the hand of the pile is significantly firmer, the individual tufts are tighter and more defined, and the pile surface is cleaner with less hairiness. These carpet improvements can be further enhanced by the continuous bundle of base staple fibers being a blend with a low weight percent of heat-activated adhesive fibers and a high weight percent of non-adhesive fibers in which the binder yarn is inserted as described above.

[0021] In this example, a 3.3 tex (30 denier) 12 filament yarn is inserted before the front delivery roll into the continuous bundle of base staple fibers (sliver) being drafted at ring spinning. The sliver is 100% 1.9 tex (17 denier) per filament AlliedSignal T317 nylon-6 staple fibers, which is spun into a (3.0/1 cotton count) yarn containing 1.9 "z" twists per cm (4.8 "Z" twists per inch). This singles yarn is then plied with another singles end of the same yarn to produce 5.2/2 mm/kg (3.0/2 cotton count)1.9 Z twists per cm x 1.6 twists per cm (4.8 Z twists per inch x 4.1 S twists per inch) final yarn. This final yarn contains a binder yarn, which is the 3.3 tex (30 denier) 12 filament yarn inserted in each end of the 2 plies. This 3.3 tex (30 denier yarn) is a copolyamide nylon having a melt point range of 105-180°C. The remainder of the 5.2/2 mm/kg (3.0/2 cotton count) yarn is AlliedSignal T317 nylon-6 staple fibers having a melt point range of 215-225°C, which results in a blend of about 1.7 percent binder. This ratio can be increased by inserting a larger denier binder yarn at the front delivery roll, or by a low weight percent of heat activated adhesive fibers and a high weight percent of non-adhesive AlliedSignal T317 nylon-6 staple fibers blend being in the continuous bundle (sliver) of base staple fibers, before ring spinning, in which the 3.3 tex (30 denier) 12 filament binder yarn is inserted at the front delivery roll of ring spinning.

[0022] This final 5.2/2 mm/kg (3.0/2 cotton count) yarn was twist set by a conventional Suessen twist setting process. The yarn was passed through a heated chamber at 190°C, while in a relaxed condition, with a residence time of 60 seconds. Multiple ends of this yarn were tufted into cut-pile carpet and conventionally finished to obtain the improved product.

[0023] The resulting carpet was compared to a control carpet prepared in the same manner from 100 percent non-adhesive AlliedSignal T317 nylon-6 base staple fibers. The carpet containing the 1.7 percent inserted binder yarn displayed more defined individual pile tufts, a more resilient, stiffer hand, and a cleaner, enhanced carpet surface appearance which is more like a BCF cut pile carpet.

Claims

1. A yarn comprising

a. at least one bundle of fiber, the fibre being selected from polyamides, nylon-6, nylon-6,6, polyesters, polyolefins, cotton and wool, and
b. a second fiber comprising a heat-activated binder material having a melting point range of about 105°C to 190°C under ambient humidity conditions, said yarn comprising a total of 0.1 to 12 weight percent binder material, **characterised in that** said bundle is ring spun with said second fiber.

2. The yarn of claim 1 comprising 0.25 to 10 weight percent binder material and more preferably, 0.5 to 8 weight percent binder material.

3. The yarn of claim 1 or claim 2 wherein the bundle of fiber is selected from the group consisting of staple fibers; a sliver; and continuous filaments.

4. The yarn of any preceding claim wherein the second fiber comprising a heat-activated binder fiber.

5. The yarn of claim 4 wherein said binder fiber is selected from the group consisting of nylon 6 and a copolyamide of the nylon 6/nylon 6,6 type.

6. A process for producing a yarn suitable for tufting, said process comprising the steps of:

a. forming a bundle of fiber the fibre being selected from polyamides, nylon-6, nylon-6,6, polyesters, polyolefins, cotton and wool ;
b. ring spinning the bundle of fiber with a second fiber comprising a heat-activated binder material having a melting point range of about 105°C to 190°C under ambient humidity conditions to

form a yarn comprising 0.1 to 12 weight percent of the binder material;
c. heating the yarn sufficiently to melt the binder material; followed by
d. cooling the yarn to solidify the binder material.

7. The process of claim 6, wherein the bundle of fiber is formed by spinning staple fiber.

Patentansprüche

1. Garn aus

a. mindestens einem Faserbündel, ausgewählt unter Polyamiden, Nylon 6, Nylon 66, Polyestern, Polyolefinen, Baumwolle und Wolle, und
b. einer zweiten Faser, welche zumindest zum Teil aus einem hitzeaktivierbaren Bindematerial mit einem Schmelzpunktbereich von etwa 105°C bis 190°C under normalen Feuchtigkeitsverhältnissen besteht, wobei das Garn insgesamt zu 0,1 bis 12 Gew.-% aus Bindematerial besteht, **dadurch gekennzeichnet, daß** das Faserbündel mit der zweiten Faser ringgesponnen ist.

2. Garn nach Anspruch 1, enthaltend 0,25 bis 10 Gew.-% Bindematerial und besonders bevorzugt 0,5 bis 8 Gew.-% Bindematerial.

3. Garn nach Anspruch 1 oder 2, bei dem das Faserbündel unter Stapelfasern, einem Faserband und Endlosfilamenten ausgewählt ist.

4. Garn nach einem der vorhergehenden Ansprüche, bei dem die zweite Faser zumindest zum Teil aus einer hitzeaktivierbaren Bindefaser besteht.

5. Garn nach Anspruch 4, bei dem die Bindefaser unter Nylon 6 und einem Copolyamid des Typs Nylon 6/Nylon 66 ausgewählt ist.

6. Verfahren zur Herstellung eines tufttauglichen Garns, bei dem man

a. ein Faserbündel, ausgewählt unter Polyamiden, Nylon 6, Nylon 66, Polyestern, Polyolefinen, Baumwolle und Wolle, herstellt,
b. das Faserbündel mit einer zweiten Faser, welche zumindest zum Teil aus einem hitzeaktivierbaren Bindematerial mit einem Schmelzpunktbereich von etwa 105°C bis 190°C unter normalen Feuchtigkeitsverhältnissen besteht, zu einem 0,1 bis 12 Gew.-% des Bindematerials enthaltenden Garn ringspinnt,
c. das Garn so erhitzt, daß das Bindematerial aufschmilzt, und anschließend
d. das Garn wieder abkühlt und so das Bindematerial zum Erstarren bringt.

7. Verfahren nach Anspruch 6, bei dem man das Faserbündel durch Verspinnen aus Stapelfaser herstellt.

Revendications

1. Fil comprenant :

a. au moins un faisceau de fibres, la fibre étant sélectionnée parmi les polyamides, le Nylon 6, le Nylon 6,6, les polyesters, les polyolefines, le coton et la laine, et
b. une seconde fibre comprenant une matière liante activée par la chaleur ayant un intervalle de point de fusion d'environ 105°C à 190°C dans des conditions d'humidité ambiante, ledit fil comprenant un total de 0,1 à 12% en poids de matière liante, **caractérisé en ce que** ledit faisceau est filé en continu avec un anneau avec ladite seconde fibre.

2. Fil selon la revendication 1 comprenant 0,25 à 10% en poids de matière liante et de préférence 0,5 à 8% en poids de matière liante.

3. Fil selon la revendication 1 ou la revendication 2 dans lequel le faisceau de fibres est sélectionné parmi le groupe constitué de fibres discontinues ; un ruban ; et des filaments continus.

4. Fil selon l'une quelconque des revendications précédentes dans lequel la seconde fibre comprend une fibre de liaison activée par la chaleur.

5. Fil selon la revendication 4 dans lequel ladite fibre de liaison est sélectionnée parmi le groupe constitué de Nylon 6 et d'un copolyamide du type Nylon 6/Nylon 6,6.

6. Procédé de production d'un fil adéquat pour le tuftage, ledit procédé comprenant les étapes de :

a. formation d'un faisceau de fibres, la fibre étant sélectionnée parmi les polyamides, le Nylon 6, le Nylon 6,6, les polyesters, les polyolefines, le coton et la laine ;
b. filage continu avec un anneau du faisceau de fibres avec une seconde fibre comprenant une matière liante activée par la chaleur ayant un intervalle de point de fusion d'environ 105°C à 190°C dans des conditions d'humidité ambiante, pour former un fil comprenant 0,1 à 12% en poids de matière liante ;
c. chauffage du fil suffisamment pour faire fon-

dre la matière liante, et enfin
d. refroidissement du fil pour solidifier la matière liante.

7. Procédé selon la revendication 6, dans lequel le faisceau de fibres est formé par filage de fibres discontinues.

REFERENCES CITED IN THE DESCRIPTION

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