EUROPEAN PATENT SPECIFICATION

PROCESS FOR WINDING ELASTOMERIC FIBER PACKAGE

VERFAHREN ZUM WICKELN EINES WICKELS AUS ELASTOMEREN FASERN

PROCEDE DE BOBINAGE D'UNE BOBINE DE FIBRES ELASTOMERES

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References cited:
US-A- 2 753 125
US-A- 3 672 583

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FIELD OF THE INVENTION

[0001] The present invention relates to a winding process for an elastomeric fiber package and, more particularly, to a process for winding a package utilizing a contact roll exerting variable pressure during the winding.

DESCRIPTION OF BACKGROUND ART

[0002] Products based on elastomeric fibers have been used in many areas such as industrial materials, clothing, and disposable personal care products (for example diapers). The elastomeric fibers have been woven and knit into fabrics, stitch-bonded into nonwovens, and directly adhered onto sheet materials such as nonwovens and films. The elastomeric fiber is ordinarily provided wound onto tubecores. The wound fiber and associated tubecore are referred to as a "package". In use, the elastomeric fiber is unwound from the package sequentially or in parallel, either passively (for example, by "over-end take-off") or actively (for example by "rolling take-off"), and fed to a downstream process.

[0003] US-A-3 672 583 discloses an apparatus and a method for winding a package positioned on a spindle assembly and held against a roller bail with substantially continually decreasing winding pressure as winding progresses and the spindle assembly moves across dead center with gravity first urging the package towards the roller bail and then away from the roller bail.

[0004] However, there have been problems in that elastomeric fiber packages have heretofore sometimes had poor package shape. Such packages have been wound with rising force of the contact roll on the tubecore and package. This poor package shape can cause the elastomeric fiber to slough off the package readily (for example as a result of rubbing against shipping materials or other elastomeric fiber packages) so that the unwinding elastomeric fiber becomes entangled with the sloughed-off elastomeric fiber, leading to breaks in the fiber. Such breaks also occur as a direct result of the rubbing. As a result, the economics of unwinding fibers from such packages were poor, and an improved process for winding elastomeric fiber packages is needed.

SUMMARY OF THE INVENTION

[0005] A process for winding an elastomeric fiber (2) producing an inflected force profile, comprising the steps of:

(A) rotating a tubecore in contact with a contact roll (3);

(B) winding the fiber onto the tubecore so that the contact roll exerts an initial force no greater than about 10 kg against the fiber on the tubecore and a package (1) begins to be formed; and

(C) reducing the force to a final force that is no less than about 1 kg; which corresponds to the process disclosed in US-A-3 672 583 is characterised in that:

said process produces an inflected force profile by gradually reducing the force in step (C) a first time to about 25-60% of the initial force during the first 30% of winding time;

holding the force substantially constant until the final 30% of winding time; and

reducing the force a second time to about a final force that is 10-35% of the initial force, and the package size is at least 3 kg.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Figure 1 is a schematic side view illustrating an elastomeric fiber package obtained by the process of the invention. Figure 2 is a plot of the force that the contact roll exerts against the tubecore and package vs package diameter from the beginning of winding to the end of winding in the process of the present invention. This is an example of an inflected force profile.

Figure 3 shows a cross-section of an elastomeric fiber package made by conventional winding.

Figure 4 illustrates an example of an uninflected force profile as used in a conventional winding process.

Figure 5 schematically illustrates an example of a means that can be used in the present process to vary the force that the contact roll exerts against the elastomeric fiber package.
DETAILED DESCRIPTION OF THE INVENTION

[0007] It has now been found that an elastomeric fiber package, especially a large package which has good unwinding characteristics and excellent package shape, can be made by winding the package with an inflected force profile.

[0008] "Elastomeric fiber" means a filament which has a break elongation in excess of 100% independent of any crimp and which when stretched and released, retracts quickly and forcibly to substantially its original length. Such fibers include rubber fiber, spandex or elastane, polyetherester fiber, polyetheramide fiber, certain polypropylenes, and elastoster. "Spandex" and "elastane" mean a manufactured fiber in which the fiber-forming substance is a long chain synthetic elastomer comprised of at least 85% by weight of a segmented polyurethane. "Inflected force profile" means a plot of the package diameter vs the force of the contact roll against the tubecore and winding package, the plot having a change of curvature, with respect to a fixed line, from concave to convex, or conversely, depending on the point from which the plot is viewed.

[0009] Synthetic elastomeric fibers such as elastane, polyetheramide fibers, and polyetherester fibers can be prepared from polymeric glycols; copolymeric glycols can also be used. In the case of elastane, the polymeric glycol can be a (co)polyether glycol, (co)polyester glycol, and/or (co)polycarbonate glycol. The polymeric glycol is typically reacted with a diisocyanate and at least one diamine, alkanolamine, or diol to form the polymer. In the case of polyetheresters, a polyether glycol can be reacted with a diacid and at least one low-molecular weight diol to form the polymer. Polyether diamines, diacids, and low-molecular weight diamines can be used to make polyetheramides. Monofunctional chain terminators such as alcohols and amines can be used to control the molecular weight of the polymers.

[0010] Depending on the type of polymer to be made, solution- or melt-polymerization can be used. Correspondingly, dry-, wet-, or melt-spinning can be used to prepare the fiber, depending on the type of polymer. Additives and stabilizers can be added to the fiber, provided they do not adversely affect the process of the invention.

[0011] After the fiber has been spun, it is typically reciprocated transversely to the direction of its travel by a traverse means and wound up on a tubecore. The tubecore is customarily mounted on a spindle assembly, and the fiber is wound onto the tubecore with the aid of a contact roll. The spindle assembly can be driven and the contact roll can be undriven (freely rotating). Alternatively, the spindle assembly can be undriven, and the contact roll can be driven, thus providing the rotatable drive needed to rotate the spindle assembly.

[0012] In the process of the present invention, the force exerted by the contact roll on the tube core (and after winding begins, on the growing package) is reduced during winding according to a specific profile. The force reductions are described herein by reference to the force used at the beginning of winding (the "initial force"). The maximum initial force can be 10Kg, and the minimum force can be 1 Kg. During the first 30%, preferably 10%, of winding time, the force is gradually reduced a first time, to about 25-60% of the initial force. The contact roll force is then held substantially constant until the final 30%, preferably about 20%, of the winding time, at which point the force is reduced a second time to no less than about 10%, preferably about 10-35%, of the initial force. Winding time corresponds approximately to package diameter, and plotting the contact roll force against the diameter of the winding package gives an inflected force profile as illustrated in Figure 2.

[0013] The method of this invention provides an elastomeric fiber package which has a substantially uniform wound width, thereby providing excellent unwinding and shape retention properties. That is, the present invention produces a package as illustrated in Figure 1, which has a small difference δω between the maximum value δmax and the minimum value δmin of the wound package width. A small δω indicates sidewalls that are desirably substantially flat and perpendicular to the axis of the tubecore; such packages have good unwinding characteristics.

[0014] The process of the invention is especially useful for elastomeric fiber packages weighing 3Kg or more and even exceeding 4Kg.

[0015] Any suitable method can be used in this invention as a means to control and vary the force that the contact roll exerts against the package. For example, an apparatus as illustrated in Figure 5 can be used in which compressed air cylinder 5 operates on signals from a control device (not shown) to adjust the weight of arm 4 that supports contact roll 3 which rotates in contact with tubecore and package 1 as elastomeric fiber 2 is wound up. Thus when the cylinder is extended, the contact roll force is reduced, and when it is contracted, the force is increased. A hydraulic cylinder can be used in place of the air cylinder. Other geometries can also be used to obtain the inflected force profile of the invention.

Example 1

[0016] A 560 denier (622 dtex) Lycra® spandex (Type 127; a registered trademark of E. I. du Pont de Nemours and Company) was dry-spun by conventional means and wound up on a 175-mm long tubecore to reach a wound package weight of 4.5Kg. No finish was applied to the fiber. The force that the contact roll exerted against the package during winding followed the inflected force profile shown in Figure 2, in which package diameter (in mm) is plotted on the abscissa and the force that the contact roll exerts against the package (in Kg) is plotted on the ordinate. As shown in
Figure 2, the total winding diameter was about 282 mm. The beginning of winding, during which the contact roll force was reduced a first time, was about 9 mm (5% of the total diameter and about 5% of the total winding time), and the end of winding during which the force was reduced a second time was about 46 mm (24% of the total diameter and about 24% of the total winding time). The force declined from about 5.7Kg at the beginning of winding to about 2.9Kg during the middle of winding, or to about 50% of the initial force. The contact roll force was held substantially constant until the end of winding, at which point it was reduced further to about 31% of the initial force, in other words to about 1.8Kg. As shown in Table 1, the difference in wound width was small and the product had excellent sidewall shape and unwinding characteristics.

Comparative Example 1

[0017] Elastomeric fiber was spun and wound up exactly as in Example 1 except that the force that the contact roll exerted against the package was increased as during conventional winding and as shown in Figure 4. As reported in Table 1, the resulting package had a wound width greater than that of the package of Example 1, showed inferior unwinding characteristics, and had an S-shape (substantial bulge) in the sidewall as illustrated in Figure 3.

| TABLE 1 |
|------------------------|------------------------|
| The curve shape of the force that contact roll exerts against package | Example 1 | Comp. Example 1 |
| Difference in wound width $\delta_w$ (mm) | 16 | 30 |
| Sidewall shape | Gentle curve | S-shaped, with large bulge |
| Unwinding characteristics | Good | Poor |

Claims

1. A process for winding an elastomeric fiber (2) producing an inflected force profile, comprising the steps of:
   (A) rotating a tubecore in contact with a contact roll (3);
   (B) winding the fiber onto the tubecore so that the contact roll exerts an initial force no greater than about 10 kg against the fiber on the tubecore and a package (1) begins to be formed; and
   (C) reducing the force to a final force that is no less than about 1 kg; characterised in that:
   said process produces an inflected force profile by gradually reducing the force in step (C) a first time to about 25-60% of the initial force during the first 30% of winding time; holding the force substantially constant until the final 30% of winding time; and reducing the force a second time to about a final force that is 10-35% of the initial force, and the package size is at least 3 kg.

2. The process of claim 1 wherein the force is reduced a first time during about the first 10% of winding time and the force is reduced a second time during about the final 20% of winding time.

3. The process of claim 1 wherein the fiber is selected from the group consisting of spandex and polyetherester.

4. The process of claim 1 or claim 3 wherein the package size is at least 4 kg.

Patentansprüche

1. Verfahren zum Aufwickeln einer Elastomerfaser (2), erzeugend ein gekrümmtes Kraftprofil, umfassend die Schritte:
   (A) Rotieren eines Spulenkerns in Kontakt mit einer Kontaktrolle (3);
   (B) Aufwickeln der Faser auf den Spulen kern, so dass die Kontaktrolle eine Anfangskraft von nicht größer als etwa 10 kgf auf die Faser auf dem Spulenkern ausübt und sich ein Wickelkörper (1) zu bilden beginnt; sowie
(C) Verringern der Kraft bis zu einer Endkraft von nicht weniger als etwa 1 kgf, dadurch gekennzeichnet, dass:

mit dem Verfahren ein gekrümmtes Kraftprofil erzeugt wird, indem die Kraft in Schritt (C) ein erstes mal bis etwa 25 bis 60% der Anfangskraft während der ersten 30% der Wickelzeit verringert wird; die Kraft bis zu den letzten 30% der Wickelzeit weitgehend konstant gehalten wird; und die Kraft ein zweites mal bis etwa zu einer Endkraft verringert wird, die 10 bis 35% der Anfangskraft beträgt und die Größe des Wickelkörpers etwa 3 kg beträgt.

2. Verfahren nach Anspruch 1, bei welchem die Kraft ein erstes mal während der ersten etwa 10% der Wickelzeit verringert wird und die Kraft ein zweites mal während der letzten etwa 20% der Wickelzeit verringert wird

3. Verfahren nach Anspruch 1, bei welchem die Faser ausgewählt ist aus der Gruppe, bestehend aus Spandex und Polyetherester.

4. Verfahren nach Anspruch 1 oder 3, bei welchem die Größe des Wickelkörpers mindestens 4 kg beträgt.

Revendications

1. Procédé de bobinage d'une fibre élastomère (2) produisant un profil de force infléchie, comprenant les étapes ci-dessous:

   (A) rotation d'un noyau tubulaire en contact avec un rouleau de contact (3);
   (B) bobinage de la fibre sur le noyau tubulaire, de sorte que le rouleau de contact exerce une force initiale non supérieure à environ 10 kg contre la fibre sur le noyau tubulaire, une bobine (1) commençant à être formée; et
   (C) réduction de la force à une force finale non inférieure à environ 1 kg;

   caractérisé en ce que

ledit procédé produit un profil de force infléchie par une première réduction progressive de la force lors de l'étape (C) de sorte qu'elle représente environ 25 à 60% de la force initiale au cours des premiers 30% du temps de bobinage; maintien d'une force pratiquement constante jusqu'à l'écoulement des 30% finaux du temps de bobinage; et deuxième réduction de la force à une force finale représentant 10 à 35% de la force initiale, le poids de la bobine correspondant au moins à 3 kg.

2. Procédé selon la revendication 1, dans lequel la force est réduite une première fois au cours d'environ les premiers 10% du temps de bobinage, la force étant réduite une deuxième fois au cours d'environ les 20% finaux du temps de bobinage.

3. Procédé selon la revendication 1, dans lequel la fibre est sélectionnée dans le groupe constitué de spandex et de polyétherester.

4. Procédé selon les revendications 1 ou 3, dans lequel le poids de la bobine correspond au moins à 4 kg.
FIG. 1

FIG. 2