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(54) CUT RESISTANT YARN, FABRIC AND GLOVES

SCHNITTFESTES GARN ODER GEWEBE SOWIE SCHNITTFESTER HANDSCHUH

FILS, TISSU ET GANTS DIFFICILES A COUPER

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Description

This invention relates to the use of cut resistant yarns in protective garments. There are many applications for such protective garments. Meat processing employees exposed to sharp knives require such garments. Metal and glass handlers who must be protected from sharp edges during the handling of materials may use such protective garments. Medical personnel who are exposed to scalpels and other sharp insturments may obtain protection through the use of such garments.

It is known to make cut resistant fabric for gloves used for safety in the meat cutting industry. For example see US-A-4470251, -438449 and -4044295. It is also known to make a composite line containing two different filamentary materials in the form of a core and a jacket of different tensile strengths and elongations as in US-A-4321854. It is also known to make composite strand, cables, yarns, ropes, textiles, filaments and the like in other prior U.S. patents not cited herein.

In the prior art, US-A-3883898 suggests that an aramid fiber, such as "Kevlar", be used in cut resistant gloves that are worn by meat processors. US-A-3953893 teaches using an aramid fiber in cut resistant aprons.

US-A-4004295 suggests the use of a glove composed of yarn of metal wire and a nonmettalic fiber such as an aramid fiber as protection from knife cuts, especially in meat processing plants. US-A-4384449 and -4470251 also suggest the use of metal wire in combination with aramid fibers.

US-A-4651514 suggests the use of a yarn composed of a monofilament nylon core that is wrapped with at least one strand of aramid fiber and a strand of nylon fiber. The stated advantage of this yarn over that suggested in, for example, US-A-4004295 is that this yarn is electrically nonconductive.

US-A-4304811 describes a woven fabric, resistant to temperatures above 538°C, formed from a plied yarn, one ply being aramid and the other glass fibre. The fabric is especially intended for use in the manufacture of glass products.

By ultrahigh molecular weight is meant 300,000 to 7,000,000. Normal molecular weight is then below 300,000.

By fiber herein is meant any thread, filament or the like, alone or in groups of multifilaments, continuous running lengths or short lengths such as staple.

By yarn herein is meant any continuous running length of fibers, which may be wrapped with similar or dissimilar fiber, suitable for further processing into fabric by braiding, weaving, fusion bonding, tufting, knitting or the like, of less than 1111 tex (10,000 denier).

By strand herein is meant either a running length of multifilament end or a monofilament end of continuous fiber or spun staple fibers, preferably untwisted, of less than 222 tex (2,000, denier).

For many applications, cut resistant garments made using the prior art have undesirable disadvantages or limitations. Garments made using only high strength polyethylene or other fibers offer improved levels of cut protection. However, very sharp edges, such as newly sharpened knives, can cut even very cut resistant fibers with only moderate cutting forces. The addition of metal wire to a yarn containing one of the above high strength fibers can improve yarn cut resistance. Even very sharp edges can have difficulty cutting through a yarn made of aramid and metal fiber. However, such yarns are much less flexible due to the stiffness of the metal. If a garment is too stiff the wearer may become fatigued by using it, or in an extreme case may remove the garment and lose the intended protection. Repeated use and flexing of the garment may cause the relatively stiff metal wire to break. In this case it is likely that the broken wire ends will protrude from the yarn. These sharp wires protruding from the garment may scratch the wearer or any objects being handled.

The use of metal wire in a cut resistant yarn makes the yarn electrically conductive. This means that a garment made with such a yarn cannot be used in contact with high-voltage electrical equipment. The use of a nylon monofilament, instead of metal wire, in a cut resistant yarn removes the problem of electrical conductivity. However, the use of nylon monofilament results in a less cut resistant yarn. The nylon is much more easily cut by very sharp edges than is metal wire. Therefore, the yarn as a whole is more easily cut.

The present invention overcomes many of the limitations of cut resistant yarns made using the prior art. The present invention can have a cut resistance equal to or beter than that obtained by using yarn containing metal wire, however, it does not have the stiffness or electrical conductivity associated with a yarn containing metal wire.

The present invention provides a process for protecting the body from cuts, comprising making a cut resistant fabric from a yarn comprising a plurality of nonmetallic fibers, at least one of said nonmetallic fiber being flexible and inherently cut resistant and at least one other of said nonmetallic fiber having a level of hardness at above 3 on the Mohs hardness scale, and forming said fabric into a cut resistant garment, and applying the garment to a portion of the body to protect it from cuts.

Preferably, the inherently cut resistant fiber is selected from high strength polyethylene, high strength polypropylene, high strength polyvinyl alcohol, aramids, high strength liquid crystal polyesters and mixtures thereof. The fiber having a high level of hardness is preferably selected from glass, ceramic, carbon and mixtures thereof.

In one embodiment, the fiber having a high level of hardness is a multiple component fiber comprised of a softer core material that is coated with a hard material selected from glass, ceramic, carbon and mixtures thereof.

The fiber having a hard level of hardness can also be a composite fiber comprised of softer material that is impregnated with a hard material selected from glass, ceramic, carbon and mixtures thereof.

If desired, the fiber having a hard level of hardness is coated with an elastomeric coating.

The present invention employs a highly cut resistant composite yarn. The yarn is comprised of at least two fibrous materials. All materials in the yarn are nonmetallic. At least one of the materials is required to be highly flexible and inherently cut resistant. At least one of the materials is required to have a high level of hardness. An example of such a yarn results from the combination of glass fiber, which is a hard fibrous material, and high strength, extended-chain polyethylene fiber, which is a flexible and inherently cut resistant fibrous material.

Garments, such as gloves, made from yarn of the present invention are highly cut resistant. They are also very flexible and nonconductive.

The present invention differs from the prior art in that a nonmetallic, hard fibrous material is used as a component of the yarn used to form protective garments. The only hard fibrous material suggested in the prior art is metal wire. Other materials suggested for this purpose by the prior art, such as nylon, are not considred hard materials.

It is somewhat surprising that brittle, hard materials, such as glass fibers, can add such a significant level of cut resistance to the composite yarns used according to the present invention. It would normally be assumed that such brittle materials would easily break and provide little protection when the yarn is impacted with a cutting edge. However, it has been found that when very small diameter glass is used in the core of the yarn, and optionally is protected by an outer wrapping of flexible fiber or elastomeric coating, the composite yarn is very resistant to breakage during cutting.

The a cut resistant yarn comprises at least two nonmetallic fibers with at least one being flexible and inherently cut resistant and at least another having a high level of hardness. The level of hardness is above 3 on the Mohs hardness scale. It is preferred that the cut resistant fiber would be resistant to being cut for at least 10 cycles on the cutting apparatus described in U.S. Serial No. 223,596 (now US-A-4864852) with cutting weight of 135 g., mandrel speed of 50 rpm, steel mandrel diameter of 19 mm, blade drop height of 9mm, using a single-edge industrial razor blade for cutting, said fiber being tested as a knitted fabric comprised of 267 tex (2400 denier) fiber, with less than 2 turns per inch of twist, and being knitted on a 10 gauge knitting machine to a fabric of 373 g/m^2 (11 oz. per sq. yd). The preferred cut resistant fiber is selected from the group consisting of high strength polyethylene, high strenth polypropylene, high strength polyvinyl alcohol, aramids, high strength liquid crystal polyesters and mixtures thereof. The preferred fiber having the high level of hardness is selected from the group consisting of glass, ceramic, carbon and mixtures thereof. It is preferred that the fiber having a high level of hardness have a diameter of at most 12 µm, most preferrably the diameter is between 2 and 10 µm. Another preferred fiber having a high level of hardness can be a multiple component fiber of any diameter or thickness which can have a softer core material and an outer coating of the hard material, such as glass, ceramic or carbon. Likewise, this hard fiber could be a composite fiber of any thickness wherein the matrix is a softer material impregnated with the hard material such as carbon, glass or ceramic. Mixtures of any of the hard fibers mentioned above would also be useful. The fiber having a high level of hardness can be coated with an elastomeric coating.

The yarn used according to the present invention is comprised of at least two fibrous materials, with at least one being flexible and cut resistant and at least another which must have a high level of hardness. The desirability of using this particular combination of materials has been made apparent through careful observation of the cutting action of sharp edges against various fibrous materials.

It is known that certain fibrous materials have an inherently high level of cut resistance. For example, aramid fibers, such as "Kevlar", are difficult to cut compared to most other synthetic fibers. As an example, more force is required to cut through an aramid fiber than through an equivalent amount of polyester fiber, assuming the cutting edge sharpness is the same in both cases.

It has been observed that extended-chain polyethylene (ECPE) fibers, such as "Spectra" (TM), are also inherently cut resistant. ECPE fibers, in addition to being highly cut resistant, are very abrasion resistant and flexible, providing a superior cut-resistant yarn.

The present invention requires that at least one of the fibrous materials in the yarn be a flexible, inherently cut resistant material such as, but not limited to, an aramid fiber or ECPE fiber.

While materials such as aramid fibers and ECPE fibers are cut resistant, even they can be cut through with relatively moderate force if an extremely sharp edge is used during cutting and if the edge is pulled across the material while the cutting force is being applied. In the course of developing the present invention it was discovered that adding a hard fibrous material to the flexible, inherently cut resistant material dramatically increased the cut resistance of the yarn. It was discovered that the hard material dulled the cutting edge during the cutting process, and as a result made it more difficult for the edge to cut through.

The assumption that the hard material was responsible for dulling the sharp edge and making it more difficult to cut the yarn was verified by the following simple test. A sample of knitted ECPE fabric was cut with a previously unused scalpel blade. Enough force was applied, by hand, as the scalpel was pulled across the fabric to cut through the fabric. Next, a similar unused scalpel blade was brought in contact 2.8 tex (25 denier) glass fiber. The cutting edge of the scalpel was pulled over the glass fiber under moderate hand pressure, the pressure being not so great as to break the glass fiber, such that the entire cutting edge made contact with the glass fiber. This scalpel was then used to cut the ECPE fabric mentioned before. It was found that the force required to cut through the fabric was greatly increased for this case. It was obvious that pulling the scalpel edge over the glass fiber had reduced the sharpness of the edge. It was found that if the scalpel edge was repeatedly made to contact the glass fiber, the edge could be dulled to the extent that the ECPE fabric could not be cut through at any level of hand pressure. In contrast, if a previously unused scalpel was used to repeatedly cut the ECPE fabric, the force required to cut did not increase with the number of cuts. It was obvious that the ECPE was not noticeably dulling the scalpel edge.

For the purposes of this invention, any nonmetallic, hard fibrous material may be used. Glass fibers and ceramic fibers are common examples of such materials. For the purposes of this invention, "hard" material is any material that has a hardness level such that it is capable of significantly reducing the sharpness of a cutting edge.

The form that the hard fibrous material takes can be quite varied. The hard fibrous material can be of uniform composition and continuous in length, such as a continuous filament glass fiber. It may be of noncontinuous length, such as chopped glass fiber. It may be nonuniform in composition. For example, the fibrous material may be composed of an organic fiber coated with layer of ceramic material. Another example would be that of an organic fiber which is impregnated with ceramic particles or fibrils. The foregoing examples are for illustration only in that numerous modifications can readily be imagined by one skilled in the art.

An assumption that might be made, even by one skilled in the art, is that hard fibrous materials used as part of this invention would be very brittle and, therefore, of limited use in garments. In practice, the brittleness of the hard materials used is not a major concern. The glass or ceramic fibers that would normally be used in this invention are extremely small in diameter. If larger diameter is required, a coated or impregnated fiber, described above, can be used. As a result, these hard materials are still very flexible and can be bent around a very small radius without breaking. It is preferred that the hard fibrous material be placed in the core of the composite yarn. In this manner, the hard material is exposed to the least stress during bending of the yarn. In addition, by placing the hard material in the core of the yarn, the outer layers of flexible, inherently cut resistant material help protect the more brittle core material.

In many cases, it will be preferred that the hard fibrous material be coated with a continuous layer of elastic material. This coating has several important functions. If the hard material is a multifilament fiber, the coating holds the fiber bundle together and helps protect it from stresses that develop during handling of this fiber before it is placed in the composite yarn. The coating may provide a physical barrier to provide chemical protection for the hard material. Additionally, if the hard material is broken during use, the coating will trap the material so that it will not leave the yarn structure.

A cut testing apparatus useful to measure the cut resistance of fibers and yarns used according to this invention is described in copending U.S. Serial No. 223,596 (now US-A-4864852). For purposes of this invention "the cut testing apparatus" shall mean the above-described apparatus.

Example

Tests of Cut Resistant Fabrics

Sample A was a knitted glove made from a ECPE fiber, Spectra 1000. The glove was knitted on a 7 gauge Shima Seiki glove knitting machine. The yarn used to produce the glove was composed of 2 ends of 133 tex (1200 denier) fiber, with 39 turns per metre (1 turn per inch) twist in each fiber end, resulting in a yarn of 267 tex (2400 denier). The glove fabric was approximately 1.14 mm (0.045 inches) thick, with a weight of approximately 467.9 g/m^2 (13.8 oz. per sq. yd).

Sample B was a woven fabric made using glass fiber (E-glass). The fabric was a satin weave 57x54, using 66 tex (595 denier) untwisted glass fiber, with a thickness of 0.23 mm (0.009 inches) and a weight of 301.8 g/m^2 (8.9 oz. per sq. yd).

Sample C was a knitted glove made from the combination of ECPE fibers (Spectra 1000) and a glass fiber (E-glass). The yarn used in the glove was constructed by placing a 66 tex (595 denier) glass fiber and a 72 tex (650 denier) ECPE fiber in the yarn core, with no twist, and wrapping the core in one direction with 72 tex (650 denier) ECPE fiber and then wrapping in the other direction with another 72 tex (650 denier) ECPE fiber. The composite yarn was 322 tex (2900 denier). The glove was knitted on a 7 gauge Shima Seiki glove knitting machine. The glove fabric was approximately 1.40 mm (0.055 inches) thick, with a weight of approximately 610.3 g/m^2 (18 oz. per sq. yd).

The test used to measure the cut resistance of the mentioned samples is described in copending U.S. Serial No. 223,596 (now US-A-4864852). The test involves repeatedly contacting a sample with a sharp edge until the sample is penetrated by the cutting edge. The higher the number of cutting cycles (contacts) required to penetrate the sample, the higher the reported cut resistance of the sample. During testing, the following conditions were used: 135 grams cutting weight, mandrel speed of 52 rpm, rotating steel mandrel diameter of 19 mm, cutting blade drop height of 9 mm, use of a single-edged industrial razor blade (Red Devil brand) for cutting, cutting arm distance from pivot point to center of blade being 15.24 cm (6 inches). The two glove fabrics (sample A and C) were tested by cutting fingers from the gloves and mounting the finger on the tester mandrel. The fingers were held on the mandrel with a band clamp placed over the cut end of the fingers. The woven fabric sample (sample B) was tested by cutting a 5.1 x 5.1 cm (2 by 2 inch) piece from the fabric, wrapping the sample around the tester mandrel and holding it on the mandrel with adhesive tape. The woven fabric was mounted so that the cutting blade did not contact the sample where the mounted fabric edges overlapped. The cutting cycles reported are an average of multiple tests. For each test a new, unused razor blade was used so that the sharpness of the cutting edge was the same for each test.

	Sample A	Sample B	Sample C
Cutting Cycles to Penetrate Sample	45	1	114
Fabric Thickness (mils)/mm	45/1.14	9/0.23	55/1.40
Fabric Weight (oz/sq. yd.)/g/m^2	13.8/467.9	8.9/301.8	18/610.3
Cycles per Thickness (cycles/mils/cycles/μm	1.0/25.4	0.1/2.5	2.1/53.4
Cycles per Weight (cycles/oz/sq.yd.)/cycles per gram per square metre)	3.3/0.096	0.1/0.003	6.3/0.187

It is surprising that adding glass fiber to ECPE fibers (sample C) can result in such a large increase in the cut resistance of the fibers. It is clear that the glass fiber by itself offers very little cut resistance. The glass fibers are easily broken during the impact of the cutting process, when used alone. A synergistic effect is observed when ECPE fibers and glass fiber are combined to produce a cut resistant yarn.

For this comparative testing, a woven glass fabric was used because of its availability. It would have been desireable to test a knitted glass fabric as well. However, glass fibers are difficult to knit due to their brittleness and such fabrics were not readily available. It is not expected that a knitted glass fabric would have a significantly different level of cut resistance as compared to a woven glass fabric.

Claims

1. A process for protecting the body from cuts, comprising making a cut resistant fabric, forming said fabric into a cut resistant garment, and applying the garment to a portion of the body to protect it from cuts, characterized in that the fabric is made with a yarn comprising a plurality of nonmetallic fibers, at least one of said nonmetallic fibers being flexible and inherently cut resistant and at least one other of said nonmetallic fibers having a level of hardness at above 3 on the Mohs hardness scale,

2. The process of Claim 1 wherein the inherently cut resistant fiber is resistant to being cut through for at least 10 cycles on the cut testing apparatus with a cutting weight of 135 grams, mandrel speed of 50 rpm, steel mandrel diameter of 19 mm, blade drop height of 9 mm, using a single-edged industrial razor blade for cutting, said fabric being tested as a knitted fabric comprised of 267 tex (2400 denier) fiber, with less than 79 turns per metre (two turns per inch) twist, and being knitted on a 10-gauge knitting machine to produce a fabric weight of about 373 g/m^2 (11 ounce per square yard).

3. The process of Claim 1 wherein the inherently cut resistant fiber is selected from the group consisting of high strength polyethylene, high strength polypropylene, high strength polyvinyl alcohol, aramids, high strength liquid crystal polyesters and mixtures thereof, and wherein the fiber having a high level of hardness is selected from the group consisting of glass, ceramic, carbon and mixtures thereof, to form a cut resistant fabric network.

4. The process of Claim 1 wherein the inherently cut resistant fiber is selected from the group consisting of high strength polyethylene, high strength polypropylene, high strength polyvinyl alcohol, high strength liquid crystal polyesters, and mixtures thereof, and wherein the fiber having a high level of hardness is selected from the group consisting of glass, ceramic, carbon, and mixtures thereof, to form a cut resistant fabric network.

5. The process of Claim 1 wherein the fiber having a high level of hardness is a multiple component fiber comprised of a softer core material that is coated with a hard material selected from a group consisting of glass, ceramic, carbon, and mixtures thereof.

6. The process of Claim 1 wherein the fiber having a high level of hardness is a composite fiber comprised of a softer material that is impregnated with a hard material selected from the group of glass, ceramic, carbon, and mixtures thereof.

7. The process of Claim 1 wherein the fiber having a high level of hardness is coated with an elastomeric coating.

8. A glove comprising a fabric made from a yarn comprising a plurality of nonmetallic fibers, at least one of said nonmetallic fibers being flexible and inherently cut resistant, and at least one other of said nonmetallic fibers having a level of hardness of above 3 on the Mohs hardness scale.

Patentansprüche

1. Verfahren zum Schützen des Körpers vor Schnitten, welches das Herstellen eines schnittfesten Stoffes, das Formen dieses Stoffes zu einem schnittfesten Kleidungsstück sowie das Anlegen des Kleidungsstückes an einen Teil des Körpers, um ihn vor Schnitten zu schützen umfaßt, dadurch gekennzeichnet, daß der Stoff mit einem Faden aus einer Mehrzahl nicht-metallischer Fasern hergestellt ist, wovon zumindest eine der nicht-metallischen Fasern biegsam und inhärent schnittfest ist, wobei zumindest eine weitere der nicht-metallischen Fasern einen Härtegrad oberhalb von 3 auf der Mohs'schen Härteskala besitzt.

2. Verfahren nach Anspruch 1, bei dem die inhärent schnittfeste Faser gegen Durchschneiden während mindestens 10 Zyklen am Schnittestgerät mit einem Schneidgewicht von 135 Gramm, einer Spindelgeschwindigkeit von 50 U/min, einem Stahlspindeldurchmesser von 19 mm und einer Klingenfallhöhe von 9 mm unter Verwendung einer Industrierasierklinge mit einer einzigen Kante zum Schneiden widerstandsfähig ist, wobei der Stoff als gestrickter Stoff mit einer Faser von 267 tex (2400 Denier), einer Drehung von weniger als 79 Drehungen pro Meter (zwei Drehungen pro Zoll) getestet wird, der an einer 10-maschigen Strickmaschine zur Erzeugung eines Stoffgewichtes von etwa 373 g/m^2 (11 Unzen pro Quadratyard) gestrickt wurde.

3. Verfahren nach Anspruch 1, bei dem die inhärent schnittfeste Faser aus der aus hochfestem Polyäthylen, hochfestem Polypropylen, hochfestem Polyvinylalkohol, Aramiden, hochfesten Flüssigkristall-Polyestern und Gemischen davon bestehenden Gruppe ausgewählt ist, und bei dem die Faser mit einem hohen Härtegrad aus der aus Glas, Keramik, Kohle und Gemischen davon bestehenden Gruppe ausgewählt ist, um ein Netzwerk eines schnittfesten Stoffes zu bilden.

4. Verfahren nach Anspruch 1, bei dem die inhärent schnittfeste Faser aus der aus hochfestem Polyäthylen, hochfestem Polypropylen, hochfestem Polyvinylalkohol, hochfesten Flüssigkristall-Polyestern und Gemischen davon bestehenden Gruppe ausgewählt ist, und bei dem die Faser mit einem hohen Härtegrad aus der aus Glas, Keramik, Kohle und Mischungen davon bestehenden Gruppe ausgewählt ist, um ein Netzwerk eines schnittfesten Stoffes zu bilden.

5. Verfahren nach Anspruch 1, bei dem die Faser mit einem hohen Härtegrad eine Faser aus mehreren Komponenten ist, die ein weicheres Seelenmaterial aufweist, welches mit einem aus einer aus Glas, Keramik, Kohle und Gemischen davon bestehenden Gruppe ausgewählten harten Material beschichtet ist.

6. Verfahren nach Anspruch 1, bei dem die Faser mit einem hohen Härtegrad eine zusammengesetzte Faser ist, die ein weicheres Material aufweist, welches mit einem aus der aus Glas, Keramik, Kohle und Gemischen davon bestehenden Gruppe ausgewählten harten Material imprägniert ist.

7. Verfahren nach Anspruch 1, bei dem die Faser mit einem hohen Härtegrad mit einer elastomeren Beschichtung überdeckt ist.

8. Handschuh mit einem aus einem Faden mit einer Mehrzahl nicht-metallischer Fasern hergestelltem Stoff, wovon zumindest eine der nicht-metallischen Fasern biegsam und inhärent schnittfest ist und wovon zumindest eine weitere der nicht-metallischen Fasern einen Härtegrad oberhalb von 3 auf der Mohs'schen Härteskala besitzt.

Revendications

1. Procédé pour protéger le corps contre les coupures, comprenant la fabrication d'un étoffe résistant aux coupures,

la formation de ladite étoffe en un vêtement résistant aux coupures et l'application du vêtement à une partie du corps pour le protéger contre les coupures, caractérisé en ce l'étoffe est constituée d'un filé comprenant une multitude de fibres non métalliques, au moins l'une desdites fibres non métalliques étant flexible et résistant aux coupures par inhérence et au moins une autre desdites fibres non métalliques ayant un degré de dureté supérieur à 3 sur l'échelle de dureté Mohs.

2. Procédé selon la revendication 1, dans lequel la fibre résistant aux coupures par inhérence résiste aux coupures pendant au moins 10 cycles sur l'appareil d'essai des coupures avec un poids de coupe de 135 grammes, une vitesse du mandrin de 50 trm, un diamètre du mandrin en acier de 19 mm, une hauteur de chute de la lame de 9 mm, avec l'utilisation d'une lame de rasoir industrielle à une seule arête de coupe, ladite étoffe étant testée comme une étoffe tricotée comprenant une fibre de 267 tex (2400 deniers), avec une torsion inférieure à 79 tours par mètre (deux tours par pouce), et étant tricotée sur une machine à tricoter de calibre 10 afin d'obtenir un poids de l'étoffe d'environ 373 g/m^2 (11 onces par yard carré).

3. Procédé selon la revendication 1, dans lequel la fibre résistant aux coupures par inhérence est choisie dans le groupe constitué d'un polyéthylène de haute résistance, d'un polypropylène de haute résistance, d'un alcool polyvinyle de haute résistance, des aramides, des polyesters à cristaux liquides de haute résistance et leurs mélanges, et dans lequel la fibre ayant un degré élevé de dureté est choisie dans le groupe constitué du verre, d'une céramique, du carbone et de leurs mélanges, afin de former un filet en étoffe résistant aux coupures.

4. Procédé selon la revendication 1, dans lequel la fibre résistant aux coupures par inhérence est choisie dans le groupe constitué d'un polyéthylène de haute résistance, d'un polypropylène de haute résistance, d'un alcool polyvinyle de haute résistance, de polyesters à cristaux liquides de haute résistance, et de leurs mélanges et dans lequel la fibre ayant un degré élevé de dureté est choisie dans le groupe constitué du verre, d'une céramique, du carbone, et de leurs mélanges, afin de former un filet d'une étoffe résistant aux coupures.

5. Procédé selon la revendication 1, dans lequel la fibre ayant un degré élevé de dureté est une fibre à multiples composants constituée d'un matériau de coeur tendre qui est revêtu d'un matériau dur choisi dans le groupe constitué du verre, d'une céramique, du carbone, et de leurs mélanges.

6. Procédé selon la revendication 1, dans lequel la fibre ayant un degré élevé de dureté est une fibre composite qui est constituée d'un matériau tendre imprégné avec un matériau dur choisi dans le groupe du verre, d'une céramique, du carbone, et de leurs mélanges.

7. Procédé selon la revendication 1, dans lequel la fibre ayant un degré élevé de dureté est recouverte d'un revêtement élastomère.

8. Gant comprenant une étoffe constituée d'un filé comportant une multitude de fibres non métalliques, au moins l'une desdites fibres non métalliques étant flexible et résistant aux coupures par inhérence, et au moins une autre desdites fibres non métalliques ayant un degré de dureté supérieur à 3 sur l'échelle de dureté Mohs.