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(54) **DYED TEXTILE HOOK-AND-LOOP FASTENER AND METHOD FOR DYEING TEXTILE HOOK-AND-LOOP FASTENER**

(57) A dyed textile hook-and-loop fastener obtained through supercritical CO₂ dyeing of a textile hook-and-loop fastener, is dyed in a deep color, and exhibits a high rupture elongation due to having less thermal history in a dyeing step.

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Description

Technical Field

5 **[0001]** The present invention relates to a textile hook-and-loop fastener which has a high rupture elongation and dyed in a deep color (black), more specifically, a textile hook-and-loop fastener, which is obtained by supercritical CO₂ dyeing of the textile hook-and-loop fastener, has a high rupture elongation, and dyed in a deep color (black).

Background Art

10 **[0002]** Aqueous dyeing that is currently used for dyeing the textile hook-and-loop fastener in a dark color (black) requires a high dyeing temperature of 130 to 135 °C and a long dyeing time of 120 minutes (keeping time of 60 minutes). As a result, there is a problem that the yarns constituting the textile hook-and-loop fastener become hard (the degree of crystallization of the yarns becomes high), and the repeated peeling durability (retention rate) of the dyed textile hook-and-loop fastener is decreased. This is because the engaging element of the dyed hook-type textile fastener becomes hard, and the extent to which the loop-shaped engaging element of the dyed look-type textile fastener is more likely to be damaged or cut due to repeated engagement and peeling increases, and the number of the loop-shaped engaging element that can be engaged decreases. In order to keep the repeated peeling durability (retention rate) of the dyed textile hook-and-loop fastener high, it is necessary to lower the temperature in the dyeing process, shorten the time, and relax the heat history to reduce the degree of crystallization of the yarn, especially the loop-shaped engaging element.

15 **[0003]** Patent Literature 1 discloses a textile hook-and-loop fastener made of polyester dyed with a disperse dye. It is described that this textile hook-and-loop fastener is dyed by a "normal method" using a disperse dye or the like under dyeing conditions of a temperature of about 100 to 150 °C and a dyeing time of 10 minutes to 10 hours. In Examples, it is described that dyeing was performed at 130 °C for 1 hour. Dyeing by "normal method" which uses a disperse dye of polyester fiber products is dyeing in an aqueous medium, and the dyeing used in the above examples is dyeing in an aqueous medium, as is clear from the dyeing conditions.

20 **[0004]** Patent Literature 2 describes a method of dyeing a textile product which uses disperse dye dyeable fibers under supercritical CO₂ as a medium.

25 **[0005]** Patent Literatures 3 to 6 describe a method of dyeing a textile product using supercritical CO₂ as a medium.

Citation List

Patent Literature

35 **[0006]**

PTL 1: JP4690315B
 PTL 2: JP2002-363869A
 PTL 3: WO2018/150480
 40 PTL 4: JP2004-323982A
 PTL 5: JP2012-188664A
 PTL 6: WO2012/105011

Summary of Invention

Technical Problem

45 **[0007]** In aqueous dyeing, the diffusion rate of the dye in the fiber is rate-determining, therefore it is necessary to dye under the above-described high-temperature, long-time conditions. In order to lower the dyeing temperature and to reduce the dyeing time, it is necessary to add a large amount of a carrier agent (surfactant, solvent), and there is a negative effect of increasing the effluent load.

50 **[0008]** In the aqueous dyeing described in Patent Literature 1, when the textile hook-and-loop fastener is dyed with a disperse dye, the core component of the core-sheath composite fiber is hardly dyed, and as a result, it cannot be dyed in a dark color, and there are problems such that color loss when exposed to high temperatures becomes large. Furthermore, since the aqueous dyeing is performed under dyeing conditions of high temperature and long time, the yarns constituting the textile hook-and-loop fastener are affected. As a result, the degree of crystallization of the yarn increases, and the yarn becomes hard. A hardened yarn, particularly a hardened hook-shaped engaging element and loop-shaped engaging element, has a problem in that the loop-shaped engaging element is damaged and cut during repeated en-

gement/peeling, and the engaging strength of the textile hook-and-loop fastener decreases.

[0009] Patent Literatures 2 to 6 do not describe about dyeing the textile hook-and-loop fastener by a supercritical CO₂ dyeing. In addition, no consideration is given to the above-mentioned problems in dyeing the the textile hook-and-loop fastener by an aqueous dyeing.

Solution to Problem

[0010] The inventors have made an intensive study to solve the problems in the aqueous dyeing of the textile hook-and-loop fastener with disperse dyes, and found that the textile hook-and-loop fastener can be dyed in dark colors when supercritical CO₂ dyeing (e.g. dyeing temperature 120 °C, pressure 25 MPa, dyeing time 30 minutes) is used to dye the textile hook-and-loop fastener. Furthermore, when the textile hook-and-loop fastener is dyed using supercritical CO₂ dyeing, it is possible to prevent the degree of crystallization of the fiber for engaging element constituting the textile hook-and-loop fastener from becoming significantly high, and the rupture elongation of the fiber for engaging element after dyeing is significantly increased, and as a result, it was found that the engaging force of dyed textile hook-and-loop fastener is significantly improved compared to an aqueous dyed textile hook-and-loop fasteners. The present invention is based on these findings.

[0011] Specifically, the present invention provides the following dyed textile hook-and-loop fastener and the dyeing method of the textile hook-and-loop fastener.

[0012]

1. A dyed textile hook-and-loop fastener containing:

a textile substrate fabric composed of warp and weft; and
multiple engaging elements rising from the one surface of the substrate fabric,

in which the engaging element is a loop-shaped engaging element, a hook-shaped engaging element, or both,

in which the hook-shaped engaging element is formed of a yarn for hook-shaped engaging element which is woven into the substrate fabric parallel to the warp,

in which the loop-shaped engaging element is formed of a yarn for loop-shaped engaging element which is woven into the substrate fabric parallel to the warp,

in which the warp is made of a polyethylene terephthalate-based polyester,

in which the yarn for hook-shaped engaging element is made of the polyethylene terephthalate-based polyester or a polybutylene terephthalate-based polyester,

in which the yarn for loop-shaped engaging element is made of the polyethylene terephthalate-based polyester or a polybutylene terephthalate-based polyester,

in which the weft is made of a core-sheath type heat-fusible fiber in which a heat-fusible low-melting point polyester resin is contained as a sheath component and the polyethylene terephthalate-based polyester is contained as a core component,

in which a root of the engaging element is fused to the melted sheath component and fixed to the substrate fabric

in which the sheath component and the core component of the warp and the weft, and the engaging element are dyed with a disperse dye, and

the dyed textile hook-and loop fastener further satisfies the following conditions (1) to (3),

(1) the disperse dye is present inside the core component of the core-sheath type heat-fusible fiber;

(2) the hook-shaped engaging element has a rupture elongation of 27 to 41%;

(3) the loop-shaped engaging element has the rupture elongation of 35 to 45%.

2. The dyed textile hook-and-loop fastener according to the above item 1,
in which the rupture elongation of the hook-shaped engaging element is 27 to 38 %.

3. The dyed textile hook-and-loop fastener according to the above item 1 or 2,
in which the rupture elongation of the loop-shaped engaging element is 35 to 40 %.

4. The dyed textile hook-and-loop fastener according to any one of the above items 1 to 3,
in which the engaging element is the hook-shaped engaging element, and a degree of crystallization of the engaging element is 62 to 72 %.

5. The dyed textile hook-and-loop fastener according to any one of the above items 1 to 4,

in which the engaging element is the hook-shaped engaging element, and a breaking strength of the engaging element is 4.29 to 4.47 cN/dtex.

6. The dyed textile hook-and-loop fastener according to any one of the above items 1 to 3, in which the engaging element is the loop-shaped engaging element, and the degree of crystallization of the loop-shaped engaging element is 75 to 87 %.

7. The dyed textile hook-and-loop fastener according to any one of the items 1 to 3, and 6, in which the engaging element is the loop-shaped engaging element, and the breaking strength of the engaging element is 2.01 to 2.07 cN/dtex.

8. The dyed textile hook-and-loop fastener according to any one of the above items 1 to 7, in which a transmittance of the sheath component (heat-fused portion) of the core-sheath composite fiber is 70% or less.

9. A dyeing method of a textile hook-and-loop fastener by dyeing the textile hook-and-loop fastener under supercritical CO₂, using a disperse dye, in which the textile hook-and-loop fastener contains:

a textile substrate fabric composed of warp and weft; and
multiple engaging elements rising from the one surface of the substrate fabric,

in which the engaging element is a loop-shaped engaging element, a hook-shaped engaging element, or both,

in which the hook-shaped engaging element is formed of a yarn for hook-shaped engaging element which is woven into the substrate fabric parallel to the warp,

in which the loop-shaped engaging element is formed of a yarn for loop-shaped engaging element which is woven into the substrate fabric parallel to the warp,

in which the warp is made of a polyethylene terephthalate-based polyester,

in which the yarn for hook-shaped engaging element is made of the polyethylene terephthalate-based polyester or a polybutylene terephthalate-based polyester,

in which the yarn for loop-shaped engaging element is made of the polyethylene terephthalate-based polyester or a polybutylene terephthalate-based polyester,

in which the weft is made of a core-sheath type heat-fusible fiber in which a heat-fusible low-melting point polyester resin is contained as a sheath component and the polyethylene terephthalate-based polyester is contained as a core component,

in which a root of the engaging element is fused to the melted sheath component and fixed to the substrate fabric.

Advantageous Effects of Invention

[0013] Supercritical CO₂ dyeing is performed under conditions where the dyeing temperature is about 15 °C lower and the dyeing time is about 30 minutes shorter than aqueous dyeing. Even when dyed under such mild conditions, the dyed textile hook-and-loop fastener which is dyed by the supercritical CO₂ dyeing of the present invention, is dyed by supplying the dye to the inside of the yarn, so that the sheath component (heat fusing component), the core component, etc. are also dyed darker (black). Therefore, the dyed textile hook-and-loop fastener of the present invention has little color loss on the back side at high temperatures, compared with the dyed textile hook-and-loop fastener which is dyed by the aqueous dyeing. Since the amount of the dye dyeing inside the yarn is increased, the color loss of the surface (the surface where the engaging elements are present) is less at high temperatures, compared with the dyed textile hook-and-loop fastener which is dyed by the aqueous dyeing.

[0014] In addition, since the dyeing temperature is low and the dyeing time is short, the heat effect on the yarns constituting the textile hook-and-loop fastener is relaxed, the degree of crystallization of the yarns after dyeing is lower than in the case of being dyed by the aqueous dyeing. As a result, the hardness of the yarn is moderated, the breaking strength of the yarn is lowered, and the rupture elongation is improved. Therefore, the loop-shaped engaging elements are less damaged than the dyed textile hook-and-loop fastener which is dyed by the aqueous dyeing, and since the hook-shaped engaging elements and the loop-shaped engaging elements are softened, the hook-shaped engaging elements can easily enter between the loop-shaped engaging elements, and the loop-shaped engaging elements can also move freely, one hook-shaped engaging element can grip more filaments in the loop-shaped engaging elements, therefore the tensile shear strength, peeling strength, and repeated peeling durability (retention rate) are improved.

Description of Embodiments

[0015] A dyed textile hook-and-loop fastener of the present invention can be obtained by dyeing a textile hook-and-

loop fastener with a disperse dye in supercritical CO₂ medium.

[0016] Supercritical CO₂ dyeing is performed using a known dyeing device having, for example, a pressure vessel in which three beam-type dyeing tanks (tubes) and one CO₂ storage tank are combined. Stirring is internal circulation type, and a circulation pump is set in each dyeing tank. The beam length is about 2 m, and the dyeing tank length is about 9 m.

[0017] The beam has at least one through-hole of 3 mm width × 3 mm length in a range of 200 mm width × 800 mm length. Supercritical CO₂ circulates through the through-hole of the beam.

[0018] There are two circulation methods for supercritical CO₂, which are one-way circulation from the inside to the outside of the beam, and two-way circulation from the inside to the outside and from the outside to the inside. The circulation methods are switched according to the condition of the fabric.

[0019] The beam wrapped with the textile hook-and-loop fastener is put into the dyeing tank, and supercritical CO₂ in which a disperse dye is dissolved (the concentration of the disperse dye is usually 10⁻⁶ to 0.2 mol/L) is passed through the beam. Supercritical CO₂ and disperse dye penetrate the textile hook-and-loop fastener by circulating in and out of the beam through the through-holes. As a result, the disperse dye is carried inside the fibers of the textile hook-and-loop fastener by supercritical CO₂, and the yarns of the textile hook-and-loop fastener are dyed to obtain the dyed textile hook-and-loop fastener of the present invention.

[0020] After dyeing, new liquefied CO₂ is fed into the device, and the used supercritical CO₂ in which the residual disperse dye is dissolved is transferred to the separation device. In the separation device, the pressure is lowered to evaporate the CO₂, thereby the residual disperse dye is separated and recovered. About 95% of the evaporated CO₂ is recovered, then reconverted to liquefied CO₂ and returned to the storage tank for reuse in the next batch.

[0021] After transferring the used supercritical CO₂ to the separation device, the pressure in the dyeing tank is returned to atmospheric pressure and the temperature is lowered, and the dried dyed textile hook-and-loop fastener is removed from the dyeing tank.

[0022] The supercritical CO₂ dyeing device is a device that can dye the textile hook-and-loop fasteners in a single color and evenly without spots by consuming only disperse dyes while reusing CO₂.

[0023] As the disperse dyes used for supercritical CO₂ dyeing, benzeneazo (monoazo and disazo), heterocyclic azo (thiazolazo, benzothiazolazo, pyridoneazo, pyrazoloneazo, thiophenazo, etc.), anthraquinone, condensed (quinophthalone, styryl, coumarin, etc.) and other commercially available products, can be used.

[0024] Since the critical temperature of CO₂ is 31 °C and the critical pressure is 7.38 MPa, supercritical CO₂ can be obtained by raising the temperature above the critical temperature and the pressure above the critical pressure. The dyeing temperature is preferably 110 to 130 °C, more preferably 115 to 130 °C, still more preferably 115 to 125 °C, since the sufficient dyeability can be obtained. The dyeing pressure is preferably 20 to 30 MPa. The dyeing time is preferably 10 to 50 minutes.

[0025] It is particularly preferable to keep the temperature of 120 °C and the pressure of 25 MPa for 30 minutes, since the dyeing is finished in a short time.

[0026] The properties of the dyed textile hook-and-loop fastener of the present invention obtained as described above are described below. The following properties were measured by the methods described in Examples.

Degree of Crystallization

[0027] As described above, supercritical CO₂ dyeing is performed under milder conditions (lower temperature, shorter time) than aqueous dyeing. Therefore, in the present invention, the textile hook-and-loop fastener is subjected to less heat history, and the yarn in the textile hook-and-loop fastener after dyeing exhibits a lower degree of crystallization than in the case of the aqueous dyeing.

[0028] The degree of crystallization of the hook-shaped engaging elements of the dyed hook-type textile fastener is preferably 62 to 72%, more preferably 65 to 72%, and the degree of crystallization of the loop-shaped engaging elements of the dyed loop-type textile fastener is preferably 75 to 87%, more preferably 78 to 82%. A method for measuring the degree of crystallization will be described later.

Tensile Property

[0029] As described above, the yarns in the dyed textile hook-and-loop fastener of the present invention exhibit a lower degree of crystallization than in the case of the aqueous dyeing. Therefore, the hardness of the engaging element is lowered, the breaking strength is lowered, and the rupture elongation and the rupture length are increased as compared in the case of the aqueous dyeing.

[0030] By having such tensile properties, the monofilaments in the loop-shaped engaging element are less likely to be damaged, and the hook-shaped engaging element can easily grip a plurality of monofilaments. As a result, the dyed textile hook-and-loop fastener has a high engaging strength.

[0031] The rupture elongation of the hook-shaped engaging element of the dyed hook-type textile fastener is preferably

27 to 41%. The rupture elongation of the loop-shaped engaging elements of the dyed loop-type textile fastener is preferably 35 to 45%.

[0032] The breaking strength of the hook-shaped engaging elements of the dyed hook-type textile fastener is preferably 4.29 to 4.47 cN/dtex, more preferably 4.35 to 4.47 cN/dtex, and the breaking strength of the loop-shaped engaging elements of the dyed loop-type textile fastener is preferably 2.01 to 2.07 cN/dtex, more preferably 2.03 to 2.07 cN/dtex.

[0033] The method of measuring the rupture elongation and breaking strength will be described later.

Dyeability

[0034] Compared with the aqueous dyeing, supercritical CO₂ dyeing can supply the dye to the inside of the fiber. Therefore, the dyed textile hook-and-loop fastener is dyed in a darker color, and the core and sheath components of the weft are also dyed. In particular, the disperse dye penetrates into the inside of the core component and dyes the inside of the core component.

[0035] In addition, the disperse dye penetrates into the inside of the hook-shaped engaging element and is dyed in a portion other than the range of $65.0 \pm 10.0\%$ from the center, that is, in the cross section of the hook-shaped engaging element, preferably up to 25.0% of the radius from the surface toward the center, more preferably up to 45.0% of the radius from the surface toward the center.

[0036] In the dyed textile hook-and-loop fastener of the present invention, the transmittance of the sheath component (heat-fused portion) is 70% or less, and evenly dyed. The transmittance is preferably 70% or less, more preferably 50% or less.

[0037] The method of measuring dyeability and transmittance will be described later.

Engaging strength of Dyed textile hook-and-loop fastener

[0038] As described above, since the dyed textile hook-and-loop fastener dyed with supercritical CO₂ is subjected to less heat history, the yarn constituting the textile hook-and-loop fastener has a lower degree of crystallization, a lower breaking strength, and a larger rupture elongation and rupture length, compared with the case of aqueous dyeing. When the degree of crystallization of the hook-shaped engaging element and the loop-shaped engaging element are low, the hardness of the hook-shaped engaging element and the loop-shaped engaging element are lowered, and make it easier for the hook-shaped engaging element to grip the loop-shaped engaging element. As a result, tensile shear strength (shear strength) and peeling strength (peel strength) are improved as compared with the case of aqueous dyeing.

[0039] The initial tensile shear strength of the dyed textile hook-and-loop fastener of the present invention is preferably 4.9 to 11.5 N/cm², and the initial peeling strength is preferably 0.77 to 1.31 N/cm. "Initial" means that the tensile shear strength and peeling strength were measured for the first time after manufacture.

[0040] The dyed textile hook-and-loop fastener of the present invention shows less decrease in tensile shear strength and peeling strength compared with the case of aqueous dyeing even after repeated engagement/peeling. As described above, it is considered that it is because that compared with the case of aqueous dyeing, the degree of crystallization is low, therefore, the hardness of the hook-shaped engaging element and the loop-shaped engaging element are lowered, and the filament in the loop-shaped engaging element is less damaged and cut due to repeated engagement/peeling, and one hook-shaped engaging element grips more filaments in the loop-shaped engaging element.

[0041] The tensile shear strength of the dyed textile hook-and-loop fastener of the present invention after 5,000 engagement/peeling cycles is preferably 4.0 to 11.0 N/cm², and the peeling strength after 5,000 engagement/peeling cycles is preferably 0.55 to 1.15 N/cm.

[0042] The method for measuring tensile shear strength, peeling strength, and tensile shear strength and peeling strength after 5,000 engagement/peeling cycles will be described later.

Sublimation fastness under High temperatures

[0043] Compared with the case of aqueous dyeing, supercritical CO₂ dyeing also dyes the sheath component (fused part) and core component of the warp and the weft, therefore, even when exposed to high temperatures, the backside of the dyed hook-type textile fastener and the dyed loop-type textile fastener (the side where there is no engaging element) has less color loss at high temperatures, and the backside has excellent sublimation fastness at 160 °C or higher, preferably 160 to 200 °C.

[0044] In addition, not only the sheath component (fused part) and the core component of the weft are dyed, but also the loop-shaped engaging elements are dyed, and the disperse dye dyes inside the hook-shaped engaging elements. Therefore, the surface of the dyed hook-type textile fastener and the dyed loop-type textile fastener (the surface where the engaging elements are present) have little color loss at high temperatures, and the surface has excellent sublimation fastness at 160 °C or higher, preferably 160 to 200 °C. A method for measuring the sublimation fastness will be described

later.

[0045] The textile hook-and-loop fastener (hook-type textile fastener, loop-type textile fastener, hook/loop mixed-type textile fastener) used in the present invention will be described below, but the textile hook-and-loop fastener used in the present invention is not limited to them.

Hook-type textile fastener

[0046] A large number, preferably 30 to 120/cm² of hook-shaped engaging elements made of monofilament, are present on one surface of the substrate fabric of the hook-type textile fastener used in the present invention. The hook-shaped engaging element is obtained by weaving a monofilament yarn into a substrate fabric in a loop shape, applying heat to fix the shape of the loop, and cutting one leg of the loop.

[0047] The substrate fabric is preferably a textile woven from warp, weft, and monofilament yarns for hook-shaped engaging elements. Particularly preferably,

both the warp and the weft are multifilament yarns, and the wefts have heat-fusible properties, the monofilament yarn for hook-shaped engaging element is woven into the textile parallel to the warp yarns, the hook-shaped engaging element is formed of a loop formed by a monofilament yarn for the hook-shaped engaging element straddling a plurality of warp, and the root of the hook-shaped engaging element is fixed to the substrate fabric by fusion with the weft.

[0048] In addition, in the present invention, the term "heat-fusibility" refers to the property of softening by heating. More specifically, it means that heat-fusible fibers are softened when heated to above a certain temperature and fused with fibers that are in close contact with the fibers.

[0049] The warp is substantially preferably a multifilament yarn composed of polyethylene terephthalate-based polyester (including recycled polyethylene terephthalate-based polyester) from the viewpoint of not undulating of the surface of the substrate fabric due to heat, water absorption, or moisture absorption, further from the viewpoint of improving the heat-fusibility of the weft. More preferred are multifilament yarns formed from polyethylene terephthalate homopolymer (including recycled polyethylene terephthalate homopolymer). The melting point of polyethylene terephthalate-based polyester and polyethylene terephthalate homopolymer is preferably 250 to 260 °C.

[0050] The polyethylene terephthalate-based polyester described above and below is a polyester mainly composed of ethylene terephthalate units, and is a polyester obtained mainly by a condensation reaction from terephthalic acid and ethylene glycol, and if necessary, a small amount of polymerized units other than terephthalic acid and ethylene glycol may be added. Examples of such polymerized units include aromatic dicarboxylic acids such as isophthalic acid, sodium sulfoisophthalate, phthalic acid and naphthalenedicarboxylic acid; aliphatic dicarboxylic acids such as adipic acid and sebacic acid; diols such as propylene glycol and 1,4-butanediol; oxycarboxylic acids such as hydroxybenzoic acid and lactic acid; monocarboxylic acids such as benzoic acid. Furthermore, a small amount of other polymers may be added to the polyethylene terephthalate-based polyester. The polyethylene terephthalate-based polyester is preferably a polyethylene terephthalate homopolymer. The monofilaments forming the warp (multifilament) must be made of polyethylene terephthalate-based polyester that does not melt at the heat treatment temperature described below. The melting point of the polyethylene terephthalate-based polyester forming the warp is preferably 250 to 260 °C.

[0051] Multifilament yarns used as warp are composed of 20 to 54 monofilaments and preferably have a total decitex of 100 to 300 decitex. A multifilament yarn having a total decitex of 150 to 250 decitex which is composed of 24 to 48 filaments, is particularly preferred.

[0052] The weft is preferably a heat-fusible multifilament yarn. A suitable example of the heat-fusible multifilament yarn is a multifilament yarn in which core-sheath type heat-fusible monofilaments having a sheath component as a heat-fusible component are bundled.

[0053] When the weft is a heat-fusible multifilament yarn, it becomes possible to firmly fix the monofilament yarn for hook-shaped engaging element to the substrate fabric. Unlike the conventional hook-type textile fastener, it is not necessary to apply a polyurethane or acrylic back coat resin to the back side of the hook-type textile fastener substrate fabric in order to prevent the monofilament yarn for the engaging element from being pulled out of the substrate fabric, and the process can be simplified. Furthermore, since the back side of the substrate fabric is not hardened with a back coat resin, the flexibility and air permeability of the hook-type textile fastener are not impaired. Furthermore, the problem of deterioration of the dyeability of the hook-type textile fastener due to the presence of the back coat resin layer, does not occur.

[0054] A suitable example of the above-described core-sheath type heat-fusible multifilament yarn is a multifilament yarn, which is composed of heat-fusible polyester resin whose sheath component (heat-fused portion) melts at the heat treatment temperature so that the root of the monofilament yarn for the hook-shaped engaging element can be firmly fixed to the substrate fabric, and in which a plurality of core-sheath-type monofilaments, which are made of a polyester

resin whose core component does not melt at the heat treatment temperature, are bundled.

[0055] A specific example of the core-sheath type multifilament is a core-sheath type monofilament yarn having a core component of polyethylene terephthalate (including recycled polyethylene terephthalate) and a sheath component of copolymerized polyethylene terephthalate (including recycled copolymerized polyethylene terephthalate) whose melting point or softening point is greatly lowered by copolymerizing a large amount (for example, 20 to 30 mol%) of a copolymer component such as isophthalic acid or adipic acid. The melting point or softening point of the sheath component is preferably 100 to 200 °C, and it is preferably 20 to 150 °C lower than the melting points of the warp, the core component, and the monofilaments for the hook-shaped engaging elements. The cross-sectional shape of the core-sheath type heat-fusible fiber may be a concentric core-sheath, an eccentric core-sheath, a single-core core-sheath, or a multi-core core-sheath.

[0056] It is preferable that all of the multifilament yarns constituting the weft are the above heat-fusible multifilament yarns, because the monofilament yarns for the hook-shaped engaging elements are firmly fixed to the substrate fabric. In the case where the multifilament yarn constituting the weft does not have a core-sheath cross-sectional shape but is a filament yarn in which the entire cross section is formed of a heat-fusible polymer, the melted and re-hardened heat-fusible polymer becomes brittle and easily broken, and when sewn, the substrate fabric is easily torn from the sewing yarn portion. Therefore, the heat-fusible multifilament yarn preferably contains a core component that is not heat-fusible, and preferably has a core-sheath cross-sectional shape. The weight ratio of the core component and the sheath component is preferably 50:50 to 80:20, more preferably 55:45 to 75:25.

[0057] The weft is preferably a multifilament yarn composed of 10 to 72 heat-fusible monofilament yarns having a total decitex of 80 to 300 decitex, and more preferably a multifilament yarn composed of 18 to 36 heat-fusible monofilament yarns having a total decitex of 90 to 200 decitex.

[0058] The resin forming the monofilament yarn for the hook-shaped engaging element is preferably polyethylene terephthalate-based polyester (including recycled polyethylene terephthalate-based polyester) or polybutylene terephthalate-based polyester, more preferably polyethylene terephthalate-based polyester (including recycled polyethylene terephthalate-based polyester), and still more preferably polyethylene terephthalate homopolymer (including recycled polyethylene terephthalate homopolymer).

[0059] The details of the polyethylene terephthalate-based polyester are as described above.

[0060] The polybutylene terephthalate-based polyester is a polyester mainly composed of butylene terephthalate units, and is a polyester mainly obtained by a condensation reaction of terephthalic acid and 1,4-butanediol. If necessary, a small amount of polymerized units other than terephthalic acid and 1,4-butanediol may be added. Examples of such polymerized units include aromatic dicarboxylic acids such as isophthalic acid, sodium sulfoisophthalate, phthalic acid, and naphthalenedicarboxylic acid; aliphatic dicarboxylic acids such as adipic acid and sebacic acid; diols such as ethylene glycol and propylene glycol; oxycarboxylic acids such as hydroxybenzoic acid and lactic acid; monocarboxylic acids such as benzoic acid. Further, a small amount of a polymer such as a polyester-based elastomer or polytrimethylene terephthalate, for example, 0.2 to 8% by mass may be added to the above polyethylene terephthalate-based polyester and the polybutylene terephthalate-based polyester.

[0061] The melting point of polyethylene terephthalate-based polyester is preferably 250 to 260 °C, and the melting point of polybutylene terephthalate-based polyester is preferably 220 to 230 °C.

[0062] The thickness of the monofilament yarn for the hook-shaped engaging element is preferably 0.10 to 0.23 mm in diameter from the viewpoint of achieving both engaging strength and soft touch feeling, more preferably 0.14 to 0.20 mm in diameter.

[0063] A textile for a hook-type textile fastener is woven from the warp, weft, and monofilament yarns for hook-shaped engaging elements, which are described above. The weave structure of the textile is preferably a plain weave in which the monofilament yarn for the hook-shaped engaging element is used as a part of the warp. It is preferable that the monofilament yarn for the hook-shaped engaging element is present parallel to the warp, and rises from the substrate fabric surface in the middle of the structure to form a loop for the hook-shaped engaging element across several warps.

[0064] The weave density of the warp is preferably 50 to 90 yarns/cm as a weave density of after heat treatment, and the weave density of the weft is preferably 15 to 25 yarns/cm as a weave density of after heat treatment. The weight ratio of the weft is preferably 10 to 45% with respect to the total weight of the yarn for the hook-shaped engaging element constituting the hook-type textile fastener, the warp, and the weft.

[0065] The number of the monofilament yarn for the hook-shaped engaging element to be driven is preferably 3 to 6 per 20 warps (including monofilament yarn for hook-shaped engaging element). More preferred is the ratio of one monofilament for the hook-shaped engaging element to five warps (including the monofilament yarn for the hook-shaped engaging element). It is preferable that the monofilament yarns for the hook-shaped engaging elements are driven evenly with respect to the warp. Therefore, it is preferred that the monofilament yarns for the hook-shaped engaging element are present on both sides of the four warps.

[0066] It is preferable that the monofilament yarn for the hook-shaped engaging element is woven into the textile substrate fabric every four warps in parallel with the warp, and after floating and sinking five wefts, it floats on the weft

and straddles three warps and one weft to form a loop for the hook-shaped engaging element, which satisfies both engaging strength and peeling durability. A weaving method that the looped monofilament then floats and sinks on five wefts, floats on the weft, forms a loop straddling three warps and one weft, and sinks under the warp and weft, repeatedly, is preferred.

[0067] The textile for the hook-type textile fastener obtained in such way is then heat treated to melt the sheath component of the core-sheath type heat-fusible multifilament yarn constituting the weft. As a result of this, the backcoat treatment which was used in conventional hook-type textile fastener becomes not necessary, and it can prevent problems such as the deterioration of the working environment due to evaporation of the organic solvent used in the backcoat resin solution and the backcoat resin solution adhering to manufacturing equipment, the problem that the backcoat resin impairs the flexibility and air permeability of the hook-type textile fastener, and the problem that the presence of the backcoat resin impairs the dyeability of the hook-type textile fastener.

[0068] The heat treatment temperature is preferably 150 to 220 °C, at which the sheath component of the heat-fusible multifilament yarn is melted or softened, but the loop for the hook-shaped engaging element, warp, and core component are not melted, and more preferably 185 to 210 °C. Furthermore, since the shape of the loop for the hook-shaped engaging element is fixed by this heat treatment, the hook shape can be maintained even when one leg of the loop is cut off.

[0069] On the surface of the hook-type textile fastener obtained as above, 30 to 120 loops/cm² of the loop for the hook-shaped engaging elements having a fixed shape are preferably present. Then, one leg of the loop for the hook-shaped engaging element is cut to obtain the hook-shaped engaging element. Cutting of one leg is usually performed with clippers or the like.

[0070] When cutting one leg, it is preferable to cut the loop at a point slightly displaced from the top of the loop toward one leg, that is, when the height from the substrate fabric surface to the top of the loop is 1, it is preferable to cut the loop at a position close to the top that is 2/3 or more from the substrate fabric surface and slightly displaced from the top, in order to prevent fibrillation to a higher level due to the frequent engagement and peeling of the hook-shaped engaging element.

[0071] The density of the hook-shaped engaging elements on the surface of the hook-type textile fastener obtained as above, is preferably 25 to 125/cm² based on the portion of the substrate fabric where the hook-shaped engaging elements are present. In addition, the height of the hook-shaped engaging element is preferably 1.0 to 2.5 mm from the surface of the substrate fabric.

Loop-type textile fastener

[0072] A plurality of loop-shaped engaging elements, preferably 30 to 120/cm², are present on one surface of the substrate fabric of the loop-type textile fastener used in the present invention.

[0073] The substrate fabric is preferably a fabric woven from warp, weft, and yarns for the loop-shaped engaging elements.

[0074] Further, it is particularly preferable that the warp, the weft, and the yarn for the loop-shaped engaging element are all multifilament yarns, the weft has heat-fusibility, the yarn for the loop-shaped engaging element is woven into the fabric in parallel with the warp, the loop-shaped engaging element is formed by the yarn for the loop-shaped engaging element straddling one weft without straddling the warp, and the root of the loop engaging element is fixed to the substrate fabric by fused with the weft.

[0075] The warp is preferably a multifilament yarn substantially composed of polyethylene terephthalate-based polyester (including recycled polyethylene terephthalate-based polyester) for the viewpoint of not undulating the surface of the substrate fabric due to heat, water absorption or moisture absorption, and also from the viewpoint of improving the heat fusibility of the weft. More preferred is a multifilament yarn formed from polyethylene terephthalate homopolymer (including recycled polyethylene terephthalate homopolymer). The details of the polyethylene terephthalate-based polyester are as described above.

[0076] Multifilament yarns used as warp preferably are composed of 20 to 54 monofilaments and preferably have a total decitex of 100 to 300 decitex. A multifilament yarn having a total decitex of 150 to 250 decitex, which are composed of 24 to 48 filaments, is particularly preferred.

[0077] The weft is preferably heat-fusible multifilament yarn. A suitable example of the heat-fusible multifilament yarn is a multifilament yarn in which core-sheath type heat-fusible monofilaments having a sheath component as a heat-fusible component are bundled.

[0078] When the weft is a heat-fusible multifilament yarn, it becomes possible to firmly fix the yarn for the loop-shaped engaging element to the substrate fabric. Unlike the conventional loop-type textile fastener, it is not necessary to apply a polyurethane or acrylic back coat resin to the back side of the loop-type textile fastener substrate fabric in order to prevent the yarn for the loop-shaped engaging element from being pulled out of the substrate fabric, and the process can be simplified. Furthermore, since the back side of the substrate fabric is not hardened with a back coat resin, the flexibility and air permeability of the loop-type textile fastener are not impaired. Furthermore, it is possible to prevent the

problem of deterioration of the dyeability of the loop-type textile fastener due to the presence of the back coat resin layer.

[0079] A suitable example of the above-described core-sheath type heat-fusible multifilament yarn is a multifilament yarn, which is composed of heat-fusible polyester resin whose sheath component (heat-fused portion) melts at the heat treatment temperature so that the root of the multifilament yarn for the loop-shaped engaging element can be firmly fixed to the substrate fabric, and in which a plurality of core-sheath-type monofilaments, which are made of a polyester resin whose core component does not melt under heat treatment conditions, are bundled.

[0080] A suitable example of the above-described core-sheath type heat-fusible multifilament yarn is a multifilament yarn, which is composed of heat-fusible polyester resin whose sheath component melts at the heat treatment temperature so that the root of the monofilament yarn for the hook-shaped engaging element can be firmly fixed to the substrate fabric, and in which a plurality of core-sheath-type monofilaments, which are made of a polyester resin whose core component does not melt at the heat treatment temperature, are bundled.

[0081] A specific example of the core-sheath type multifilament is a core-sheath type polyester-based monofilament yarn having a core component of polyethylene terephthalate (including recycled polyethylene terephthalate) and a sheath component of copolymerized polyethylene terephthalate (including recycled copolymerized polyethylene terephthalate) whose melting point or softening point is greatly lowered by copolymerizing a large amount (for example, 20 to 30 mol%) of a copolymer component such as isophthalic acid or adipic acid. The melting point or softening point of the sheath component is preferably 100 to 200 °C, and it is preferably 20 to 150 °C lower than the melting points of the warp, the core component, the monofilaments for the hook-shaped engaging elements, and the multifilament yarn for the loop-shaped engaging elements. The cross-sectional shape of the core-sheath type heat-fusible fiber may be a concentric core-sheath, an eccentric core-sheath, a single-core core-sheath, or a multi-core core-sheath.

[0082] It is preferable that all of the multifilament yarns constituting the weft are the above-described core-sheath type heat-fusible monofilament yarns, because the yarn for the loop-shaped engaging elements are firmly fixed to the substrate fabric. In the case where the multifilament yarn constituting the weft is formed with only heat-fusible polymers, the melted and re-hardened heat-fusible polymer becomes brittle and easily broken, and when sewn, the substrate fabric is easily torn from the sewing yarn portion. Therefore, the heat-fusible monofilament yarn preferably contains a component that is not heat-fusible, and more preferably has a core-sheath cross-sectional shape. The weight ratio of the core component and the sheath component is preferably 20:80 to 80:20, more preferably 75:25 to 55:45.

[0083] The weft is preferably a multifilament yarn composed of 10 to 72 heat-fusible monofilament yarns having a total decitex of 80 to 300 decitex, and particularly preferably a multifilament yarn composed of 18 to 36 heat-fusible monofilament yarns having a total decitex of 100 to 240 decitex.

[0084] A multifilament yarn in which 6 to 12, preferably 6 to 9 monofilaments of 32 to 45 decitex are bundled, is preferable as the yarn for the loop-shaped engaging element.

[0085] The resin forming the multifilament yarn for the loop-shaped engaging element is preferably polyethylene terephthalate-based polyester or polybutylene terephthalate-based polyester, more preferably polyethylene terephthalate-based polyester (including recycled polyethylene terephthalate-based polyester). The details of the polyethylene terephthalate-based polyester and the polybutylene terephthalate-based polyester are as described above.

[0086] A textile for the loop-type textile fastener is woven from the warp, weft, and multifilament yarn for the loop-shaped engaging elements described above. The weave structure of the textile fabric is preferably a plain weave using the multifilament yarn for the loop-shaped engaging element as part of the warp. It is preferable that the multifilament yarn for the loop-shaped engaging element, while existing in parallel with the warp, rises from the surface of the substrate fabric in the middle, straddles one to several wefts without straddling the warp, and then sinks under the weft to form the loop.

[0087] The weave density of the warp is preferably 50 to 90 yarns/cm, as the weave density of after heat treatment, and the weave density of the weft is preferably 15 to 25 yarns/cm, as the weave density of after heat treatment. The weight ratio of the weft is preferably 10 to 45% with respect to the total weight of the yarn for the loop-shaped engaging element constituting the loop-type textile fastener, the warp, and the weft.

[0088] The number of the multifilament yarn for the loop-shaped engaging element to be driven is preferably 3 to 6 per 20 warps (including multifilament yarn for loop-shaped engaging element). More preferred is the ratio of one multifilament yarn for the loop-shaped engaging element to five warps (including the multifilament yarn for the loop-shaped engaging element). It is preferable that the yarn for the loop-shaped engaging elements are driven evenly with respect to the warp. Therefore, it is preferred that the multifilament yarns for the loop-shaped engaging element are present on both sides of the four warps.

[0089] In the loop-type textile fastener, the loop-shaped engaging elements are arranged in rows in the warp direction (MD direction), and a plurality of such rows exist in parallel in the weft direction (CD direction). It is preferable since the weft straddled by the loop-shaped engaging element in one row is different from the weft straddled by the loop-shaped engaging element in the adjacent row, it is possible to prevent concentration of peeling force on a specific weft, and as a result, the peeling durability is improved.

[0090] In particular, in the present invention, it is preferable that the yarn for the loop-shaped engaging element is

woven every four warps in parallel with the warp, and after floating and sinking five wefts, it floats on the weft and straddles one weft to form a loop for the engaging element, which satisfies both engaging strength and peeling durability.

[0091] The textile for the loop-type textile fastener obtained in such way is then heat treated to melt the sheath component of the core-sheath type heat-fusible multifilament yarn constituting the weft. As a result of this, the backcoat treatment which was used in conventional loop-type textile fastener, becomes not necessary, and it can prevent problems such as the deterioration of the working environment due to evaporation of the organic solvent used in the backcoat resin solution and the backcoat resin solution adhering to manufacturing equipment, the problem that the backcoat resin layer impairs the flexibility and air permeability of the loop-type textile fastener, and the problem that the presence of the backcoat resin impairs the dyeability of the loop-type textile fastener. The heat treatment temperature is preferably 150 to 220 °C, at which the sheath component of the heat-fusible multifilament yarn is melted or softened, but the loop for the loop-shaped engaging element, warp, and core component are not melted, and more preferably 185 to 210 °C.

[0092] The loops are naturally twisted by the heat during the heat treatment, and the loop surfaces cross the warp direction. In particular, in the case of a multifilament yarn in which a small number of thick monofilaments are bundled as described above, and the loops are formed without straddling the warp, it is twisted and easy to make the loop surface cross the warp direction. In particular, when the yarn for the loop-shaped engaging element forms a loop by straddling one weft without straddling the warp, it is easy to be twisted and easy to make the loop surface cross the warp direction.

[0093] When the loop surface crosses the warp direction, uniform engagement with the hook-shaped engaging elements is likely to occur. Furthermore, by rubbing the surface of the loop-shaped engaging element with a cloth or the like, the loop-shaped engaging element can be easily divided into individual monofilaments without being cut (easily separated).

[0094] The density of the loop-shaped engaging elements in the loop-type textile fastener is preferably 25 to 125 /cm² based on the portion of the substrate fabric where the loop engaging elements are present. Moreover, the height of the loop-shaped engaging element is preferably 1.5 to 3.5 mm from the surface of the substrate fabric.

[0095] It is more preferable to rub the surface of the loop-shaped engaging element with a cloth or the like to divide (separate) the multifilament yarn forming the loop-shaped engaging element into individual monofilaments in order to increase the peeling durability.

Hook/Loop mixed type textile fastener

[0096] A hook/loop mixed type textile hook-and-loop fastener (hereinafter sometimes simply referred to as a "mixed-type textile fastener") is a textile hook-and-loop fastener in which hook-shaped engaging element and loop-shaped engaging element are present on the same surface of the substrate fabric.

[0097] The hook-shaped engaging elements of the hook/loop mixed type textile fastener (hereinafter sometimes simply referred to as "mixed-type textile fastener") are required to have rigidity and so-called hook shape retention properties, in which the hook shape does not stretch under light force, and thick synthetic fiber monofilaments are used for this purpose. As such a monofilament, a monofilament formed from polybutylene terephthalate-based polyester which is particularly excellent in hook shape retention properties, or polyethylene terephthalate-based polyester (including recycled polyethylene terephthalate-based polyester), is used.

[0098] The details of polyethylene terephthalate-based polyester and polybutylene terephthalate-based polyester are as described above.

[0099] The thickness of the monofilament yarn for the hook-shaped engaging element is preferably 0.10 to 0.25 mm in diameter because the hook-shaped engaging element is easily formed, and more preferably 0.12 to 0.22 mm in diameter. This thickness is slightly smaller than the thickness of the hook-shaped engaging elements of conventional general textile hook-and-loop fasteners, but this thinness provides the hook and loop mixed type textile fastener with flexibility.

[0100] The height of the hook-shaped engaging element is preferably 1.5 to 3.0 mm, more preferably 1.8 to 2.5 mm.

[0101] The density of the hook-shaped engaging elements is preferably 15 to 50/cm², more preferably 20 to 40/cm².

[0102] The loop-shaped engaging element is a multifilament which are composed of monofilaments formed of polyethylene terephthalate-based polyester or polybutylene terephthalate-based polyester. The details of the polyethylene terephthalate-based polyester and the polybutylene terephthalate-based polyester are as described above.

[0103] The multifilament yarn for the loop-shaped engaging element is preferably a multifilament yarn composed of 5 to 9 monofilaments and having a total decitex of 150 to 350 decitex. In order to firmly fix the loop-shaped engaging element to the substrate fabric by heat fusion, which will be described later, it is preferable that the number of monofilaments is small, so the number of monofilaments of the multifilament for the loop-shaped engaging element forming the mixed type textile fastener is slightly smaller than the number of 10 to 24 monofilaments of the commonly used multifilament forming the loop-shaped engaging element. A multifilament composed of 6 to 8 monofilaments and having a total decitex of 230 to 330 decitex, is more preferred.

[0104] The height of the loop-shaped engaging element is preferably 1.6 to 4.0 mm, more preferably 2.0 to 3.3 mm.

It is preferable that the height of the hook-shaped engaging element is 1.5 to 3.0 mm, the height of the loop-shaped engaging element is 1.6 to 4.0 mm, and that the loop-shaped engaging element is 0.1 to 1.0 mm higher than the hook-shaped engaging element, so that a soft feel can be obtained; and it is more preferable that the height of the hook-shaped engaging element is 1.8 to 2.5 mm, the height of the loop engaging element is 2.0 to 3.3 mm, and the height of the loop-shaped engaging element is 0.2 to 0.8 mm higher than the hook-shaped engaging element.

[0105] The density of the loop-shaped engaging elements (multifilament) is preferably 15 to 50/cm², more preferably 20 to 40/cm². Further, $100 \times (\text{number of loop-shaped engaging elements}) / (\text{number of loop-shaped engaging elements} + \text{number of hook-shaped engaging elements})$ is preferably 30 to 70, more preferably 45 to 55.

[0106] Both the monofilament yarn for the hook-shaped engaging element and the multifilament yarn for the loop-shaped engaging element are inserted into the substrate fabric parallel to the warp. The monofilament yarn for the hook-shaped engaging element floats on the substrate fabric after floating and sinking several wefts, for example, five wefts, and straddles several, for example, 3 to 4 warps and several, for example, 1 to 2 wefts, to form a loop in which the loop surface crosses the warp direction. In the case of the loop-shaped engaging element, it is preferable to form the loop so that the loop surface is substantially parallel to the warp direction without straddling the warp, since the hook-shaped engaging element is easily caught by the loop-shaped engaging element.

[0107] The formed loop for the hook-shaped engaging element and the loop for the loop-shaped engaging elements are heat treated to fix the shape of the respective loops. During this heat treatment, the heat-fusible fibers (weft) are fused to the roots of the loop-shaped engaging elements and the loop for the hook-shaped engaging element, and the loop-shaped engaging element and the loop for the hook-shaped engaging element are fixed to the base fabric.

[0108] The heat treatment temperature is a temperature at which the sheath component of the heat-fusible fiber melts, but the warp, the loop-shaped engaging element, the loop for the hook-shaped engaging element, and the core component of the heat-fusible fiber do not melt, and is preferably 150 to 250 °C, more preferably 185 to 220 °C.

[0109] After heat fixing, the hook-shaped engaging element is obtained by cutting one loop leg of the loop for the hook-shaped engaging element. For cutting, it is preferable to use a cutting device having one movable cutting blade that reciprocates between two fixed blades. However, the portion through which the loop-shaped engaging element passes is not provided with a movable cutting blade. Since the loop for the hook-shaped engaging element is formed across the warp as described above, only one leg of the loop can be easily cut. In order not to cut the adjacent loop-shaped engaging elements, it is preferable to provide at least two rows of the loop for the hook-shaped engaging element in the warp direction.

[0110] As the warp forming the substrate fabric, multifilament yarns of polyethylene terephthalate-based polyester (including recycled polyethylene terephthalate-based polyester), which have excellent heat resistance, are preferable, and multifilament yarns of polyethylene terephthalate homopolymer (including recycled polyethylene terephthalate homopolymer) are more preferable, because the shape change due to melting, shrinkage, etc. is small, under heat treatment conditions.

[0111] The multifilament for the warp is preferably a multifilament composed of 12 to 96 monofilaments and having a total decitex of 75 to 250 decitex, more preferably a multifilament composed of 24 to 48 monofilaments having a total decitex of 100 to 170 decitex. The multifilament yarn for the warp is preferably woven into the substrate fabric so that the warp weave density after heat treatment is 60 to 90 yarns/cm.

[0112] The monofilament yarns for the hook-shaped engaging elements and the multifilament yarns for the loop-shaped engaging elements are woven into the substrate fabric parallel to the warp as described above. The total number of the monofilament yarn for the hook-shaped engaging element and multifilament yarns for the loop-shaped engaging element, to be driven, is preferably 3 to 6 per 20 warps (including monofilament yarns for the hook engaging element and multifilament yarns for the loop engaging element).

[0113] The weft forming the substrate fabric is preferably a heat-fusible multifilament yarn since it can be heat-fused under the heat treatment conditions to firmly fix the roots of the monofilament yarn for the hook-shaped engaging element and the multifilament yarn for the loop-shaped engaging element to the substrate fabric. For example, a multifilament in which core-sheath type monofilaments, at which the sheath component is melted, but the core component is not melted under the heat treatment conditions, are bundled, is given.

[0114] A specific example of the core-sheath type monofilament is a core-sheath type polyester-based monofilament yarn having a core component of polyethylene terephthalate (including recycled polyethylene terephthalate) and a sheath component of copolymerized polyethylene terephthalate (including recycled copolymerized polyethylene terephthalate) whose melting point or softening point is greatly lowered by copolymerizing a large amount (for example, 20 to 30 mol%) of a copolymer component such as isophthalic acid or adipic acid.

[0115] The melting point or softening point of the sheath component is preferably 100 to 200 °C, and it is preferably 20 to 150 °C lower than the melting points of the core component, the warp, the monofilament yarn for the hook-shaped engaging element, and the multifilament yarn for the loop-shaped engaging element.

[0116] It is preferable that all of the multifilament yarns constituting the weft are the above heat-fusible multifilament yarns, because the hook-shaped engaging element and the yarn for the loop-shaped engaging element are firmly fixed

to the substrate fabric. In the case where the multifilament constituting the weft is formed with only heat-fusible polymers, the melted and re-hardened heat-fusible polymer becomes brittle and easily broken, and when sewn, the substrate fabric is easily torn from the sewing yarn portion. Therefore, the heat-fusible monofilament yarn preferably contains a resin component that is not heat-fusible, and more preferably has a core-sheath cross-sectional shape. The weight ratio of the core component and the sheath component is preferably 20:80 to 80:20.

[0117] In order to more firmly fix both the hook-shaped engaging element and the loop-shaped engaging element to the substrate fabric, it is preferable that the heat-fusible filament is heat-fused and the heat-fusible filament itself shrinks to tighten the roots of the hook-shaped engaging element and the loop-shaped engaging element from both sides. For this purpose, it is preferable that the heat-fusible filament undergoes large heat shrinkage under heat treatment conditions. For example, the dry heat shrinkage of the heat-fusible filament when heated at 200 °C for 1 minute is preferably 8 to 20%, more preferably 11 to 18%.

[0118] The multifilament for the weft is preferably a multifilament composed of 12 to 72 monofilaments and having a total decitex of 100 to 300 decitex, and more preferably a multifilament composed of 24 to 48 monofilaments and having a total decitex of 150 to 250 decitex. The multifilament yarn for the weft is preferably woven into the substrate fabric so that the weave density after heat treatment is 15 to 25 yarns/cm. The weight ratio of the weft is preferably 15 to 40% with respect to the total weight of the monofilament for the hook-shaped engaging element, the multifilament for the loop-shaped engaging element, the warp, and the weft.

[0119] The weave structure of the substrate fabric is preferably a plain weave in which the monofilament yarn for the hook-shaped engaging element and the multifilament yarn for the loop-shaped engaging element are used as part of the warp. The yarn for the hook-shaped engaging element is woven in parallel with the warp, then stand up from the surface of the substrate fabric, jump over one to four warp yarns while forming loops, and enter between the warps. The yarns for the loop-shaped engaging elements are woven in parallel with the warp, then stand up from the surface of the substrate fabric, enter between the warps without straddling the warps, and form loops parallel to the warp direction. Such a weave structure is preferred because one leg of the hook-shaped engaging element loop can be cut without damaging the loop-shaped engaging element loop.

[0120] The dyed textile hook-and-loop fastener of the present invention can be used in applications where conventional textile hook-and-loop fasteners are used. For example, It can be used in a wide range of fields such as shoes, bags, hats, gloves, clothes, blood pressure gauges, supporters, binding bands for packing, binding tapes, various toys, fixing materials for civil engineering and construction sheets, fixing materials for various panels and wall materials, fixing materials for roofs of solar cells, fixing materials for electric parts, storage boxes and packing cases that can be freely assembled and disassembled, small items, curtains.

Examples

[0121] The present invention will be described below with reference to Examples, but the present invention is not limited to these Examples.

Production Example 1: Hook-type textile fastener

[0122] The following yarns were used as the yarns for forming the hook-type textile fastener.

Warp

[0123]

Multifilament yarn composed of polyethylene terephthalate with a melting point of 260 °C
 Number of filaments: 30
 Total decitex: 167 dtex
 Number of twists: 602 turns/m

Weft: Multifilament yarn composed of core-sheath type composite filament

[0124]

Core component: Polyethylene terephthalate with a melting point of 260 °C
 Sheath component: 25 mol% isophthalic acid copolymer polyethylene terephthalate with a softening point of 190 °C
 Core component: Sheath component = 70:30 (mass ratio)
 Number of filaments: 24

Total decitex: 99dtex

Yarns for the hook-shaped engaging element

5 **[0125]**

Monofilament yarn composed of polyethylene terephthalate with a melting point of 260 °C

Diameter: 0.18 mm

10 Manufacture of Hook-type textile fasteners

[0126] Using the warp, weft, and monofilament yarn for the hook-shaped engaging element, a textile of plain weave for the hook-type textile fastener was obtained.

15 **[0127]** The fabric was woven so that the weave density of the warp after heat treatment was 52 yarns/cm (including monofilament yarns for the hook-shaped engaging elements) and the weave density of the weft was 18 yarns/cm.

[0128] A monofilament yarn for the hook-shaped engaging element was driven in parallel to the warps at a rate of one per four warps. The monofilament yarn for hook-shaped engaging element floats and sinks on five wefts, floats on the wefts, and straddles one weft and three warps to form a loop. The loop-formed monofilament yarn for hook-shaped engaging element was woven so that it floated on five wefts, floated on the wefts, straddled one weft and three warps to form a loop, and then returned between the warps.

[0129] The obtained textile for the hook-type textile fastener was heat-treated at 205 °C for 1 minute, which is a temperature at which only the sheath component of the weft is heat-melted and the warp, the core component of the monofilament yarn for hook-shaped engaging element and the weft yarn are not heat-melted. As a result, the sheath component was melted, and the neighboring yarn was fused to the core component of the weft.

25 **[0130]** One leg of the loop for hook-shaped engaging element was then cut at a position 4/5 from below the height of the loop for the hook-shaped engaging element to form the hook-shaped engaging element. The density of the hook-shaped engaging elements of the obtained hook-type textile fastener was 48 pieces/cm², and the height of the hook-shaped engaging elements from the surface of the substrate fabric was 1.85 mm.

30 Production Example 2: Loop-type textile fastener

[0131] The following yarns were used as the yarns for forming the loop-type textile fastener.

Warp

35

Multifilament yarn composed of polyethylene terephthalate with a melting point of 260 °C

[0132]

40 Number of filaments: 36
Total decitex: 167 dtex
Number of twists: 602 turns/m

Weft: Multifilament yarn composed of core-sheath type composite filament

45

[0133]

Core component: Polyethylene terephthalate with a melting point of 260 °C

Sheath component: 25 mol% isophthalic acid copolymer polyethylene terephthalate with a softening point of 190 °C

50 Core component: Sheath component = 70:30 (mass ratio)

Number of filaments: 24

Total decitex: 120dtex

Multifilament yarn for loop-shaped engaging elements

55

[0134] Multifilament yarn composed of polybutylene terephthalate blended with 5% by mass of polytrimethylene terephthalate

Melting point: 220 °C
 Number of filaments: 7
 Total decitex: 265dtex

5 Manufacture of Loop-type textile fasteners

[0135] Using the warp, weft, and multifilament yarn for loop-shaped engaging element, a textile of plain weave for the loop-type textile fastener was obtained.

10 **[0136]** The fabric was woven so that the weave density of the warp after heat treatment was 55 yarns/cm and the weave density of the warp was 22 yarns/cm.

[0137] A multifilament yarn for loop-shaped engaging element was driven in parallel to the warp without straddling the warp at a rate of one per four warps. After that, the multifilament yarn for the loop-shaped engaging element floats and sinks on the five wefts, floats on the substrate fabric, and forms a loop by straddling one weft without straddling the warp.

15 **[0138]** On the surface of the obtained textile for the loop-type textile fastener, loops were arranged in rows in the warp direction, and a plurality of such rows existed in parallel in the weft direction. Also, the weft straddled by the loop existing in one row was the weft positioned midway in the warp direction of the two wefts straddled by the two loops in the adjacent row. Also, the loop surfaces of most of the loop engaging elements were twisted in the warp direction.

[0139] The obtained textile for the loop-type textile fastener was heat-treated at 200 °C for 1 minute at a temperature at which only the sheath component of the weft heat-melted, and the warp, the multifilament yarn for the loop-shaped engaging element, and the core component of the weft did not heat-melt. As a result, the sheath component was melted, and the neighboring yarn was fused to the core component of the weft.

[0140] The density of the loop-shaped engaging element was 44 pieces/cm², and the height of the loop-shaped engaging elements from the substrate fabric surface was 2.40 mm.

25 Production Example 3: Hook-type textile fastener and Loop-type textile fastener using recycled materials

[0141] A hook-type textile fastener and a loop-type textile fastener were manufactured in the same manner as in Production Examples 1 and 2, except that the yarns made of the following recycled materials were used.

30 Hook-type textile fastener

Warp

35 **[0142]** Multifilament yarn composed of recycled polyethylene terephthalate with a melting point of 260 °C

Number of filaments: 30
 Total decitex: 167 dtex
 Number of twists: 602 turns/m

40 Weft: Multifilament yarn composed of core-sheath type composite filament

[0143]

45 Core component: recycled polyethylene terephthalate with a melting point of 260 °C
 Sheath component: 25 mol% isophthalic acid copolymer polyethylene terephthalate with a softening point of 190 °C
 Core component: Sheath component = 70:30 (mass ratio)
 Number of filaments: 24
 Total decitex: 99dtex

50 Yarn for hook-shaped engaging element

[0144] Monofilament yarn composed of recycled polyethylene terephthalate with a melting point of 260 °C

Loop-type textile fastener

55 Warp

[0145] Multifilament yarn made of recycled polyethylene terephthalate with a melting point of 260 °C

Number of filaments: 36
Total decitex: 167dtex
Number of twists: 602 turns/m

5 Weft: Multifilament yarn composed of core-sheath type composite filament

[0146]

10 Core component: recycled polyethylene terephthalate with a melting point of 260 °C
Sheath component: 25 mol% isophthalic acid copolymer polyethylene terephthalate with a softening point of 190 °C
Core component: Sheath component = 70:30 (mass ratio)
Number of filaments: 24
Total decitex: 120dtex

15 Multifilament yarn for loop engaging elements

[0147] Multifilament yarn composed of polybutylene terephthalate blended with 5% by mass of polytrimethylene terephthalate

20 Melting point: 220 °C
Number of filaments: 7
Total decitex: 265dtex

Example 1

25 **[0148]** The hook-type textile fastener and the loop-type textile fastener obtained in Production Examples 1 and 2 were each dyed in a dark color (black) with a disperse dye using the beam-type supercritical CO₂ dyeing device described above.

[0149] As the disperse dye, a black dye obtained by mixing the plastic dye "KP PLAST (trade name)" series manufactured by Kiwa Kagaku Kogyo Co., Ltd. at the following ratio was used.

KP Plast Orange HG (C.I. Solvent Orange 60): 45 parts by weight
KP Plast Violet R (C.I. Solvent Violet 31): 25 parts by weight
KP Plast Blue G (C.I. Solvent Blue 78): 30 parts by weight

35 **[0150]** The outline of the dyeing method is shown below.

1. A beam wrapped with a textile hook-and-loop fastener was put into a dyeing tank (tube).
2. The temperature of liquefied CO₂ was raised to 120 °C and the pressure was raised to 25 MPa to make supercritical CO₂, and the supercritical CO₂ was circulated.
3. The circulation method was one-way circulation from the inside of the beam to the outside of the beam through the through holes.
4. Supercritical CO₂ was circulated in the dye tank provided in the circulation path, the dye was dissolved in the supercritical CO₂, and the dye was supplied to the dyeing tank.
- 45 5. After reaching a temperature of 120 °C and a pressure of 25 MPa, the pressure and the temperature was maintained for 30 minutes.
6. After the 30 minutes hold, fresh liquefied CO₂ was fed into the device and the used supercritical CO₂ with residual dye dissolved was transferred to the separator.
- 50 7. After transferring the used supercritical CO₂, it is cooled to below 100 °C, the pressure is returned to atmospheric pressure, and the dried dyed textile hook-and-loop fastener is removed from the dyeing tank.

Example 2

[0151] The hook-type textile fastener and the loop-type textile fastener using the recycled material obtained in Production Example 3 were each dyed in the same manner as in Example 1 to obtain a dyed hook-type textile fastener and a dyed loop-type textile fastener.

Example 3

[0152] In "2." and " 5." in the outline of the dyeing method, the same operation as in Example 1 was performed except that the temperature was changed from 120 °C to 110 °C., and a dyed hook-type textile fastener and a dyed loop-type textile fastener were obtained.

Example 4

[0153] In "2." and " 5." in the outline of the dyeing method, the same operation as in Example 1 was performed except that the temperature was changed from 120 °C to 130 °C, and a dyed hook-type textile fastener and a dyed loop-type textile fastener were obtained.

Comparative Example 2

[0154] In "2." and " 5." of the outline of the dyeing method, the temperature was changed from 120 °C to 100 °C, and "7." was changed to 7-1. of below. A dyed hook-type textile fastener and a dyed loop-type textile fastener were obtained by performing the same operation as in Example 1 except as follows.

[0155] 7-1. After transferring the used supercritical CO₂, the pressure is returned to atmospheric pressure and the dried dyed textile hook-and-loop fastener is removed from the dyeing tank.

Comparative Example 3

[0156] In "2." and " 5." in the outline of the dyeing method, the same operation as in Example 1 was performed except that the temperature was changed from 120 °C to 140 °C, and a dyed hook-type textile fastener and a dyed loop-type textile fastener were obtained.

Comparative Example 1

[0157] A dyed hook-type textile fastener and a dyed loop-type textile fastener, which were dyed black in the same manner as in Example 1 except that the hook-type textile fastener and the loop-type textile faster obtained in Production Examples 1 and 2, were dyed in aqueous dyeing (high temperature and high pressure cheese dyeing), were obtained.

[0158] A conventional cheese dyeing device was used. A cheese dyeing device has a cylindrical dyeing tank and a cylindrical carrier that is loaded into it. The carrier has several levels of partition plates in the height direction. Innumerable holes are drilled in the partition plate so that the dyeing solution can circulate sufficiently. A roll of textile hook-and-loop fastener is placed on this partition plate. A carrier laminated with a number of partition plates on which rolls of the textile hook-and-loop fasteners are placed, is placed in a dyeing tank, and the dyeing solution is circulated from the top to the bottom or from the bottom to the top of the partition plate via a heater and a circulation pump, dyeing the textile hook-and-loop fasteners.

[0159] The outline of cheese dyeing is shown below.

1. The water of room temperature was stored in a dyeing tank, and dyeing aids (dispersant, leveling agent, etc.) were added and circulated for 10 minutes.
2. Several rolls of the textile hook-and-loop fastener were laminated onto the partition plate of the carrier.
3. The carrier was introduced into the dyeing tank.
4. After raising the temperature of the water in the dyeing tank to 60 °C, the carrier was removed from the dyeing tank.
5. A disperse dye (tuxedo black) was put into the dyeing tank, and the carrier was put again.
6. The temperature was raised to 135 °C and kept for 60 minutes after reaching 135 °C.
7. After keeping for 60 minutes, it was cooled to 80 °C or less.
8. All the residual liquid in the dyeing tank was discharged.
9. Fresh water was added to the dyeing tank until it overflowed.
10. The carrier was introduced into the dyeing tank while allowing it to overflow.
11. The above 8 to 10 were repeated three times to obtain an aqueous dyed textile hook-and-loop fastener.

[0160] Each characteristic of the dyed hook-type textile fastener and the dyed loop-type textile fastener obtained in Examples 1 to 4 and Comparative Examples 1 to 3, was measured.

Degree of Crystallization

[0161] About 3 mg of the warp, the weft, the hook-shaped engaging element, and the loop-shaped engaging element were collected from each of the dyed hook-type textile fastener and the dyed loop-type textile fastener, and a DSC curve was obtained with a differential scanning calorimeter (DSC). By analyzing this DSC curve, analytical data such as heat quantity, melting point, crystallization temperature, glass transition temperature, etc. when endothermic or exothermic heat was generated in the sample were obtained. The degree of crystallization was calculated based on the obtained analytical data.

[0162] In the table below, the measurement value is the average of three measurements.

[Table 1]

[0163]

Table 1: Degree of Crystallization (%)

	Comparative Example 2	Example 3	Example 1	Example 2	Example 4	Comparative Example 3	Comparative Example 1
	Measurement value	Measurement value	Measurement value	Measurement value	Measurement value	Measurement value	Measurement value
Dyed hook-type textile fastener	Warp	59.0	64.8	63.1	67.2	70.2	70.6
	Weft	66.5	73.8	67.3	77.9	82.8	84.4
	Engaging element	62.1	69.7	66.5	71.5	75.7	74.2
Dyed loop-type textile fastener	Warp	60.2	66.2	62.9	69.7	74.0	71.1
	Weft	67.5	75.0	73.2	79.2	84.1	85.1
	Engaging element	75.3	80.2	77.3	86.7	88.2	91.0
Production Condition (temperature × time)		110°C × 30min	120°C × 30min	120°C × 30min	130°C × 30min	140°C × 30min	135°C × 60min

[0164] As is clear from Table 1, the degree of crystallization was lower in all of the warps, the wefts, and the engaging elements in the case of supercritical CO₂ dyeing, compared with the case of aqueous dyeing.

Tensile properties

[0165] Measurements were made using a desktop precision universal testing machine (autograph) in accordance with the tensile testing machine specified in 7.4.1a)1 of JIS L3416:2000 and in accordance with the elongation modulus test specified in 8.9 of JIS L1013:2010. The engagement measurement jig was replaced with a test yarn measurement jig. Test yarns (hook-shaped engaging element or loop-shaped engaging element) taken from dyed hook-type textile faster and dyed loop-type textile fastener were fixed to the upper and lower zippers (zipper spacing: 10 cm), measurements were started and the breaking strength, rupture elongation, elastic modulus and breaking length of the test yarn were determined. The measurement value in Table 2 is the average of 10 measurements.

[Table 2]

[0166]

Table 2

	Unit	Comparative Example 2	Example 3	Example 1	Example 2	Example 4	Comparative Example 3	Comparative Example 1
		Measurement value	Measurement value	Measurement value	Measurement value	Measurement value	Measurement value	Measurement value
Engaging element of Dyed hook-type textile fastener	Breaking strength	3.86	4.29	4.38	4.31	4.47	4.57	4.63
	Rupture elongation	45.8	39.9	34.1	33.9	27.3	20.8	18.3
	Modulus	39.4	48.5	57.6	64.0	75.1	92.1	88.5
	Breaking length	99.2	86.7	74.2	68.1	68.7	63.2	57.8
Engaging element of Dyed loop-type textile fastener	Breaking strength	1.58	2.01	2.04	2.03	2.07	2.09	2.06
	Rupture elongation	51.1	43.9	36.8	35.8	35.2	32.3	32.5
	Modulus	7.6	8.5	9.4	10.3	10.0	10.8	10.6
	Breaking length	124.7	97.1	93.5	91.1	90.2	86.7	86.2
Production condition (temperature × time)		100 °C × 30min	110 °C × 30min	120 °C × 30min	120 °C × 30min	130 °C × 30min	140 °C × 30min	135 °C × 60min

[0167] As is clear from Table 2, the breaking strength of the hook-shaped engaging elements and the loop-shaped engaging elements obtained from the dyed textile hook-and-loop fastener of the present invention was lower than in the case of aqueous dyeing. In addition, the rupture elongation and the breaking length were larger than those in the case of aqueous dyeing.

Dyeability

[0168] The cross-section of each yarn of the dyed textile hook-and-loop fastener after supercritical CO₂ dyeing was observed with a micro-ultraviolet-visible-near-infrared spectrophotometer to measure the degree of dyeing.

[0169] For the sheath portion of the core-sheath type composite fiber, the spectral transmittance was measured over a wide wavelength range from the ultraviolet region to the near-infrared region by UV-visible spectroscopy based on JIS K 0115:2020.

[0170] "MSV-5200 DGK" by JASCO Corporation (measurement method: transmission measurement, wavelength range 200 to 2700 nm) was used as the spectral transmittance measurement device. In the measurement, the focus was focused on the darkest portion of the heat-fused portion of the weft, and the measurement was performed at a size of 10 μm. The spectral transmittance was measured for 10 different wefts, and the average value was taken as the value of the spectral transmittance.

[Table 3]

[0171]

Table 3

	Comparative Example 2	Example 3	Example 1	Example 2	Example 4	Comparative Example 3	Comparative Example 1
Hook-shaped engaging element	Dyed up to $16 \pm 5 \mu\text{m}$ from the yarn outer diameter	Dyed up to $17.0 \pm 8.0 \mu\text{m}$ from the yarn outer diameter	Dyed up to $18.0 \pm 9.0 \mu\text{m}$ from the yarn outer diameter (The range of diameter (The range of $65.0 \pm 10.0\%$ from the center is not dyed)	Dyed up to $18.0 \pm 9.0 \mu\text{m}$ from the yarn outer diameter (The range of diameter (The range of $65.0 \pm 10.0\%$ from the center is not dyed)	Dyed up to $18.0 \pm 9.0 \mu\text{m}$ from the yarn outer diameter	Dyed up to $18.0 \pm 9.0 \mu\text{m}$ from the yarn outer diameter	Dyed up to $12.0 \pm 0.5 \mu\text{m}$ from the yarn outer diameter (The range of diameter (The range of $86.5 \pm 5.0\%$ from the center is not dyed)
Loop-shaped engaging element	Dyed	Dyed	Dyed	Dyed	Dyed	Dyed	Dyed
Weft (Heat-fused portion)	70% or less of transmittance	70% or less of transmittance	50% or less of transmittance	70% or less of transmittance	70% or less of transmittance	70% or less of transmittance	71% or more of transmittance
Weft (core component)	Disperse dye exist inside	Disperse dye exist inside	Disperse dye exist inside	Disperse dye exist inside	Disperse dye exist inside	Disperse dye exist inside	Disperse dye does not exist inside
Warp	Dyed	Dyed	Dyed	Dyed	Dyed	Dyed	Dyed
Production condition (temperature $\times$ time)	$100^\circ\text{C} \times 30\text{min}$	$110^\circ\text{C} \times 30\text{min}$	$120^\circ\text{C} \times 30\text{min}$	$120^\circ\text{C} \times 30\text{min}$	$130^\circ\text{C} \times 30\text{min}$	$140^\circ\text{C} \times 30\text{min}$	$135^\circ\text{C} \times 60\text{min}$

[0172] From Table 3, it can be seen that the hook-shaped engaging elements of Examples 1 and 2 were dyed with the dye not only on the outside but also on the inside (parts excluding the range of $65.0 \pm 10.0\%$ from the center). On the other hand, in Comparative Example 1, a small portion of the inside of the hook-shaped engaging element was dyed with the dye.

[0173] In addition, the sheath component (heat-fused portion) is also dyed, and it can be seen that it was dyed evenly compared with the case of aqueous dyeing (Comparative Example 1).

[0174] In addition, the dye penetrated (existed) in the entire cross section of the core component. That is, the entire cross section was dyed with the dye. On the other hand, in the case of aqueous dyeing (Comparative Example 1), no penetration (existence) of the dye into the core component was observed.

Engaging strength of dyed textile hook-and-loop fasteners

a. Tensile shear strength (shear strength)

[0175] It was measured according to the tensile shear strength specified in 7.4.1 of JIS L3416:2000. A dyed hook-type textile fastener and a dyed loop-type textile fastener were each cut to 25 mm wide $\times$ 100 mm long. The hook-type textile fastener was placed on the bottom and the loop-type textile fastener was placed on the top, and the portion 50 mm from the edge of each hook and loop fastener was placed so that the grip part (non-engaging part) remained on each hook and loop fastener. Then, a sample was prepared by two reciprocating rolling compactions with a 2 kg roller. One grip portion (within 30 mm in length) of the sample was set in the upper chuck of a desktop precision universal testing machine, and the other grip portion (within 30 mm in length) was set in the lower chuck, and the strength was measured.

b. Peeling strength (peel strength)

[0176] It was measured according to the peeling strength specified in 7.4.2 of JIS L3416:2000. The dyed hook-type textile fastener and the dyed loop-type textile fastener were cut to 25 mm wide by 150 mm long. The dyed hook-type textile fastener was placed on the top and the dyed loop-type textile fastener was placed on the bottom so that both ends were aligned. Then, a sample was prepared by two reciprocating rolling compactions with a 2 kg roller. A portion within 30 mm from the edge of the sample was peeled off, and the peeled portion was set in a chuck of a desktop precision universal testing machine to measure the peeling strength.

c. Repeated peeling durability

[0177] A peeling tester conforming to the durability tester specified in JIS L3416:2000 7.5.1c was used. The dyed hook-type textile fastener and the dyed loop-type textile fastener were set in the peeling tester, and the specified 5,000 times of engagement and peeling were repeated. After the peeling was completed, the strength was measured according to the above-described tensile shear strength (shear strength) measurement, and peeling strength (peel strength) measurement methods. The measurement value in Table 4 are the average of three measurements.

[Table 4]

[0178]

Table 4

	Comparative Example 2		Example 3		Example 1		Example 2		Example 4		Comparative Example 3		Comparative Example 1	
	Measurement value	Retention rate	Measurement value	Retention rate	Measurement value	Retention rate	Measurement value	Retention rate	Measurement value	Retention rate	Measurement value	Retention rate	Measurement value	Retention rate
Tensile shear strength (shear strength) N/cm ²	Initial	-	7.8	7.9	-	-	8.2	11.4	-	-	7.8	6.9	-	-
	After 5000 times peeling	86	6.7	6.9	87	89	100	88	7.3	88	6.3	5.6	82	82
Peeling strength (peel strength) N/cm	Initial	-	0.98	1.01	-	-	1.04	1.27	-	-	0.97	0.88	-	-
	After 5000 times peeling	81	0.79	0.81	80	81	1.03	81	0.86	81	0.72	0.63	72	72
Production condition (temperature × time)	100°C × 30min		110°C × 30min		120°C × 30min		120°C × 30min		130°C × 30min		140°C × 30min		135°C × 60min	

[0179] It can be seen that the supercritical CO₂ dyeing is superior to the aqueous dyeing in terms of tensile shear strength and peeling strength of the initial and after repeated of 5,000 times of engagement/peeling.

d. Number of engagement

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[0180] Measurements were taken on the sample before peeling strength (peel strength) measurement and the sample after repeated peeling durability measurement. Using a magnifying glass, the number of engaged loop-shaped engaging elements present in a 25 mm wide $\times$ 20 mm long portion of the sample (450 loop engaging elements exist) was visually counted while being peeled off. Furthermore, the number of filaments engaged among the filaments ($450 \times 8 = 3,600$ filaments) in the loop-shaped engaging element was determined. The engagement number in Table 5 is the average of three measurements.

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[Table 5]

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[0181]

Table 5

		Comparative Example 2		Example 3		Example 1		Example 2		Example 4		Comparative Example 3		Comparative Example 1	
		Engagement number	Ratio	Engagement number	Ratio	Engagement number	Ratio	Engagement number	Ratio	Engagement number	Ratio	Engagement number	Ratio	Engagement number	Ratio
Number of engaged elements (in 450 engaging elements)	Initial	179	40%	177	39%	173	38%	174	39%	169	38%	163	36%	181	40%
	After 5000 times of peeling	143	32%	141	31%	137	30%	138	31%	134	30%	110	24%	115	26%
Number of engaged filaments	Initial	678	19%	664	18%	688	19%	699	19%	657	18%	672	19%	605	17%
	After 5000 times of peeling	530	15%	545	15%	529	15%	564	16%	539	15%	475	13%	406	11%
Production condition (temperature × time)		100°C × 30min		110°C × 30min		120°C × 30min		120°C × 30min		130°C × 30min		140°C × 30min		130°C × 60min	

[0182] The number of the engagement of the loop-shaped engaging elements in the initial is larger in the case of aqueous dyeing, but the results in Table 4 show that the case of supercritical CO₂ dyeing is superior in tensile shear strength and peeling strength.

[0183] From the results in Table 5, it can be seen that the supercritical CO₂ dyed textile hook-and-loop fastener has more engaged filaments in the loop-shaped engaging element compared with the aqueous dyed textile hook-and-loop fastener, that is, it can be seen that the hook-shaped engaging elements is gripping more filaments.

[0184] The results in Tables 4 and 5 show that even with a large number of engaged loop-shaped engaging elements, when the number of engaged filaments in the loop-shaped engaging elements is low, the tensile shear strength and peel strength decrease.

Sublimation fastness under high temperature

[0185] A ventilation/circulation thermostat was used. The constant temperature chamber was set to a predetermined temperature (160 to 200 °C), and 30 minutes after reaching the set temperature, the sample was placed in the constant temperature chamber and left for 24 hours. After standing, the surface and back of the sample are measured with a spectrophotometer using the sample before heat treatment as a reference, and the density of the surface of the dyed textile hook-and-loop fastener (Table 6) and the color difference ΔE between the surface and back sides (Table 7) are obtained. The measured density in Table 6 and the measured ΔE in Table 7 are each an average of three measurements.

[Table 6]

[0186]

Table 6

	Curing temperature	Comparative Example 2	Example 3	Example 1	Example 2	Example 4	Comparative Example 3	Comparative Example 1
		Measured density (%)	Measured density (%)	Measured density (%)	Measured density (%)	Measured density (%)	Measured density (%)	Measured density (%)
Dyed hook-type textile fastener (Surface)	160°C	90.2	92.2	96.2	97.1	97.0	97.8	89.0
	170°C	85.1	87.9	91.7	93.5	92.5	93.2	85.9
	180°C	82.9	84.6	88.3	91.2	89.0	89.8	80.8
	190°C	77.7	80.2	83.7	87.3	84.4	85.1	73.8
	200°C	72.6	75.9	79.2	82.2	79.9	80.5	68.8
Dyed loop-type textile fastener (Surface)	160°C	87.0	88.8	92.7	93.0	93.5	94.2	90.1
	170°C	83.6	85.3	89.0	90.3	89.7	90.5	87.1
	180°C	75.3	78.7	82.1	84.1	82.8	83.5	72.2
	190°C	73.4	75.7	79.0	81.1	79.7	80.3	71.8
	200°C	70.6	72.7	75.9	77.9	76.5	77.2	71.0
Production condition (temperature × time)		100°C × 30min	110°C × 30min	120°C × 30min	120°C × 30min	130°C × 30min	140°C × 30min	135°C × 60min

[Table 7]

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[0187]

Table 7

	Curing temperature	Comparative Example 2	Example 3	Example 1	Example 2	Example 4	Comparative Example 3	Comparative Example 1
		Measured ΔE	Measured ΔE	Measured ΔE	Measured ΔE	Measured ΔE	Measured ΔE	Measured ΔE
Dyed hook-type textile fastener (Back)	160°C	0.80	0.53	0.17	0.10	0.08	0.06	1.00
	170°C	1.35	0.91	0.67	0.66	0.60	0.68	1.83
	180°C	1.40	1.27	0.75	0.73	0.79	0.76	2.52
	190°C	2.22	1.73	1.61	1.51	1.52	1.63	2.94
	200°C	2.40	2.01	1.83	1.73	1.80	1.86	3.36
Dyed loop-type textile fastener (Back)	160°C	1.38	0.94	0.60	0.59	0.61	0.60	1.49
	170°C	1.87	1.54	1.21	1.19	1.15	1.23	1.71
	180°C	2.15	1.80	1.55	1.43	1.56	1.58	2.46
	190°C	2.68	2.57	2.29	2.15	2.36	2.33	2.98
	200°C	3.02	2.89	2.67	2.33	2.64	2.71	3.63
Production condition (temperature × time)		100°C × 30min	110°C × 30min	120°C × 30min	120°C × 30min	130°C × 30min	140°C × 30min	135°C × 60min

[0188] Tables 6 and 7 show that the surface and back sides of the dyed textile hook-and-loop fasteners of the present invention have excellent sublimation fastness at high temperatures.

Claims

1. A dyed textile hook-and-loop fastener comprising:

a textile substrate fabric composed of warp and weft; and
multiple engaging elements rising from the one surface of the substrate fabric,

wherein the engaging element is a loop-shaped engaging element, a hook-shaped engaging element, or both,

wherein the hook-shaped engaging element is formed of a yarn for hook-shaped engaging element which is woven into the substrate fabric parallel to the warp,

wherein the loop-shaped engaging element is formed of a yarn for loop-shaped engaging element which is woven into the substrate fabric parallel to the warp,

wherein the warp is made of a polyethylene terephthalate-based polyester,

wherein the yarn for hook-shaped engaging element is made of the polyethylene terephthalate-based polyester or a polybutylene terephthalate-based polyester,

wherein the yarn for loop-shaped engaging element is made of the polyethylene terephthalate-based polyester or a polybutylene terephthalate-based polyester,

wherein the weft is made of a core-sheath type heat-fusible fiber in which a heat-fusible low-melting point polyester resin is contained as a sheath component and the polyethylene terephthalate-based polyester is contained as a core component,

wherein a root of the engaging element is fused to the melted sheath component and fixed to the substrate fabric,

wherein the sheath component and the core component of the warp and the weft, and the engaging element are dyed with a disperse dye, and

the dyed textile hook-and-loop fastener further satisfies the following conditions (1) to (3),

(1) the disperse dye is present inside the core component of the core-sheath type heat-fusible fiber;

(2) a rupture elongation of the hook-shaped engaging element is 27 to 41%;

(3) a rupture elongation of the loop-shaped engaging element is 35 to 45%.

2. The dyed textile hook-and-loop fastener according to claim 1,

wherein the rupture elongation of the hook-shaped engaging element is 27 to 38 %.

3. The dyed textile hook-and-loop fastener according to claim 1 or 2,

wherein the rupture elongation of the loop-shaped engaging element is 35 to 40 %.

4. The dyed textile hook-and-loop fastener according to any one of claims 1 to 3,

wherein the engaging element is the hook-shaped engaging element, and a degree of crystallization of the engaging element is 62 to 72 %.

5. The dyed textile hook-and-loop fastener according to any one of claims 1 to 4,

wherein the engaging element is the hook-shaped engaging element, and a breaking strength of the engaging element is 4.29 to 4.47 cN/dtex.

6. The dyed textile hook-and-loop fastener according to any one of claims 1 to 3,

wherein the engaging element is the loop-shaped engaging element, and the degree of crystallization of the engaging element is 75 to 87 %.

7. The dyed textile hook-and-loop fastener according to any one of claims 1 to 3 and 6, wherein the engaging element is the loop-shaped engaging element, and the breaking strength of the engaging element is 2.01 to 2.07 cN/dtex.

8. The dyed textile hook-and-loop fastener according to any one of claims 1 to 7,

wherein a transmittance of the sheath component (heat-fused portion) of the core-sheath composite fiber is 70% or less.

- 5 9. A dyeing method of a textile hook-and-loop fastener, comprising dyeing the textile hook-and-loop fastener under supercritical CO₂ using a disperse dye, in which the textile hook-and-loop fastener contains:

a textile substrate fabric composed of warp and weft; and
multiple engaging elements rising from the one surface of the substrate fabric,

10 wherein the engaging element is a loop-shaped engaging element, a hook-shaped engaging element, or both,

wherein the hook-shaped engaging element is formed of a yarn for hook-shaped engaging element which is woven into the substrate fabric parallel to the warp,

15 wherein the loop-shaped engaging element is formed of a yarn for loop-shaped engaging element which is woven into the substrate fabric parallel to the warp,

wherein the warp is made of a polyethylene terephthalate-based polyester,

wherein the yarn for hook-shaped engaging element is made of the polyethylene terephthalate-based polyester or a polybutylene terephthalate-based polyester,

20 wherein the yarn for loop-shaped engaging element is made of the polyethylene terephthalate-based polyester or a polybutylene terephthalate-based polyester,

wherein the weft is made of a core-sheath type heat-fusible fiber in which a heat-fusible low-melting point polyester resin is contained as a sheath component and the polyethylene terephthalate-based polyester is contained as a core component,

25 wherein a root of the engaging element is fused to the melted sheath component and fixed to the substrate fabric.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2022/030236

A. CLASSIFICATION OF SUBJECT MATTER

A44B 18/00(2006.01)i; D06P 5/00(2006.01)i; D06P 5/20(2006.01)i
 FI: A44B18/00; D06P5/00 Z; D06P5/20 Z

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A44B18/00; D06P1/00-7/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
 Published unexamined utility model applications of Japan 1971-2022
 Registered utility model specifications of Japan 1996-2022
 Published registered utility model applications of Japan 1994-2022

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2014-27989 A (KURARAY FASTENING CO., LTD.) 13 February 2014 (2014-02-13) paragraphs [0031]-[0065]	1-9
Y	JP 2002-363869 A (ASAHI KASEI CORP.) 18 December 2002 (2002-12-18) paragraphs [0004], [0007], [0011]	1-9
A	WO 2020/153160 A1 (KURARAY FASTENING CO., LTD.) 30 July 2020 (2020-07-30)	1-9

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

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“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

13 October 2022

Date of mailing of the international search report

25 October 2022

Name and mailing address of the ISA/JP

Japan Patent Office (ISA/JP)
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Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/JP2022/030236

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2014-27989 A	13 February 2014	(Family: none)	
JP 2002-363869 A	18 December 2002	(Family: none)	
WO 2020/153160 A1	30 July 2020	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 4690315 B [0006]
- JP 2002363869 A [0006]
- WO 2018150480 A [0006]
- JP 2004323982 A [0006]
- JP 2012188664 A [0006]
- WO 2012105011 A [0006]