

DESCRIPTION

Title of Invention: FIBER BUNDLE FOR ARTIFICIAL HAIR AND HAIR ACCESSORY PRODUCT

Technical Field

[0001]

The present invention relates to a fiber bundle for artificial hair and a hair accessory product.

Background Art

[0002]

In hair accessory products such as wigs, hairpieces, hair extensions, hair bands, and doll hair, the importance of artificial hair as a substitute for human hair has been increasing. As materials constituting a fiber for artificial hair, there are acrylic resins, vinyl chloride-based resins, or polyester-based resins, and fibers for artificial hair made of these resins are commercially available.

[0003]

Patent Literature 1 discloses an artificial hair characterized by containing a hollow fiber having a hollow portion with a hollow ratio of 10% to 50%.

Furthermore, Patent Literature 2 discloses a fiber for artificial hair, wherein a void is present in a central part of a fiber cross-section, a ratio of an area of the void to a total area of the fiber cross-section is 5% or more and 50% or less, a cross-sectional shape of the fiber cross-section is a flat multilobal shape, and the void has a first side and a second side with an inclination of 70 degrees or more and 110 degrees or less with respect to a major axis of the fiber cross-section.

Citation List**Patent Literature**

[0004]

Patent Literature 1 JP-A-2008-285772

Patent Literature 2 WO 2014/196642

Summary of Invention**Technical Problem**

[0005]

In recent years, weight reduction has been demanded for a fiber for artificial hair, and for example, Patent Literature 1 and Patent Literature 2 disclose a fiber for artificial hair having a hollow portion. However, in the conventional art, it was difficult to impart a natural color and glossiness with moderate variation like human hair to a fiber bundle for artificial hair containing such a hollow fiber for artificial hair having a hollow portion. In addition, depending on the

application, the fiber for artificial hair may be subjected to a hot water treatment in which it is immersed in hot water after processing such as braiding, but there were cases where shrinkage between fibers was uneven after the hot water treatment, causing a part of the braid to unravel or fiber ends to stick out from the surface of the fiber bundle.

[0006]

The present invention has been made in view of such circumstances, and provides a fiber bundle for artificial hair comprising a fiber for artificial hair having such a hollow portion, which can simultaneously achieve having a natural color and glossiness with moderate variation like human hair, and reducing unraveling and sticking out after hot water treatment.

Solution to Problem

[0007]

According to the present invention, there is provided a fiber bundle for artificial hair comprising a plurality of fibers for artificial hair, wherein the plurality of fibers for artificial hair comprises a hollow fiber for artificial hair comprising a hollow portion extending in a longitudinal direction of the fiber for artificial hair, and when an area ratio occupied by the hollow portion in a cross-section of the fiber for artificial hair perpendicular to the longitudinal direction is defined as a hollow ratio, a coefficient of variation of the hollow ratio of the fibers for artificial hair contained in the fiber bundle for artificial hair is from 0.02 to 0.30.

[0008]

The present inventors, as a result of diligent studies, found that in a fiber bundle for artificial hair comprising a hollow fiber for artificial hair, by controlling a coefficient of variation of a hollow ratio, which is an area ratio occupied by a hollow portion in a cross-section of the fiber for artificial hair perpendicular to the longitudinal direction, within a certain numerical range, it is possible to simultaneously achieve having a natural color and glossiness with moderate variation like human hair, and reducing unraveling and sticking out after hot water treatment, and have completed the present invention.

[0009]

Hereinafter, various embodiments of the present invention will be exemplified. The embodiments shown below can be combined with each other.

[1] A fiber bundle for artificial hair comprising a plurality of fibers for artificial hair, wherein: the plurality of fibers for artificial hair comprises a hollow fiber for artificial hair comprising a hollow portion extending in a longitudinal direction of the fiber for artificial hair; and when an area ratio occupied by the hollow portion in a cross-section of the fiber for artificial hair perpendicular to the longitudinal direction is defined as a hollow ratio, a coefficient of variation of the hollow ratio of the fibers for artificial hair contained in the fiber bundle for artificial hair is from 0.02 to 0.30.

[2] The fiber bundle for artificial hair of [1], wherein an average hollow ratio of the plurality of fibers for artificial hair is from 10% to 40%.

[3] The fiber bundle for artificial hair of [1] or [2], wherein a fineness of the plurality of fibers for artificial hair is from 30 to 70 denier.

[4] The fiber bundle for artificial hair of any one of [1] to [3], wherein the fiber for artificial hair comprises a vinyl chloride-based resin.

[5] A hair accessory product comprising the fiber bundle for artificial hair of any one of [1] to [4].

[6] The hair accessory product of [5], wherein the hair accessory product comprises a braid.

Advantageous Effects of Invention

[0010]

The fiber bundle for artificial hair according to the present invention is a fiber bundle for artificial hair comprising a hollow fiber for artificial hair, which can simultaneously achieve a natural color and glossiness with moderate variation like human hair, and a reduction in unraveling and sticking out after hot water treatment. In addition, the hair accessory product according to the present invention has a natural color and glossiness with moderate variation like human hair, and has less unraveling and sticking out in the product after hot water treatment.

Brief Description of Drawings

[0011]

FIG. 1 is a schematic cross-sectional view of a fiber for artificial hair according to one embodiment of the present invention. FIG. 1A shows a circular cross-section, FIG. 1B shows a circular cross-section having an inner protruding portion and an outer protruding portion, FIG. 1C shows a two-lobed cross-section in which two C-shapes are joined, FIG. 1D shows a three-lobed cross-section in which three C-shapes are joined, FIG. 1E shows a substantially triangular cross-section, and FIG. 1F shows a substantially quadrangular cross-section.

Description of Embodiments

[0012]

Hereinafter, the present invention will be described in detail by exemplifying embodiments of the present invention. The present invention is not limited in any way by these descriptions. Each feature of the embodiments of the present invention shown below can be combined with each other. In addition, an invention can be established independently for each feature.

[0013]

1. Fiber Bundle for Artificial Hair

The fiber bundle for artificial hair according to the present invention is a fiber bundle for artificial hair comprising a plurality of fibers for artificial hair, and the plurality of fibers for artificial hair comprises a hollow fiber for artificial hair comprising a hollow portion extending in a longitudinal direction of the fiber for artificial hair.

Further, when an area ratio occupied by the hollow portion in a cross-section of the fiber for artificial hair perpendicular to the longitudinal direction is defined as a hollow ratio, a coefficient of variation of the hollow ratio of the fibers for artificial hair contained in the fiber bundle for artificial hair is from 0.02 to 0.30.

[0014]

1.1 Fiber for Artificial Hair

1.1.1 Shape of Fiber for Artificial Hair

In the present invention, the plurality of fibers for artificial hair comprises a hollow fiber for artificial hair comprising a hollow portion extending in a longitudinal direction of the fiber for artificial hair. In the hollow fiber for artificial hair according to the present invention, the hollow portion may be present continuously for 10 cm or more in the longitudinal direction of the fiber for artificial hair. Since the fiber bundle for artificial hair according to the present invention comprises the hollow fiber for artificial hair because it comprises the hollow portion, it is lightweight and brings about many advantages such as being able to form a desired voluminous hairstyle with a small amount of attached hair, realizing a wide range of hairstyles including voluminous long styles, reducing damage to natural hair and the scalp, and reducing waste and environmental load.

[0015]

An example of a cross-section of the hollow fiber for artificial hair according to one embodiment of the present invention perpendicular to the longitudinal direction is shown in FIG. 1. The shape of the cross-section of the hollow fiber for artificial hair according to one embodiment of the present invention perpendicular to the longitudinal direction may be any one selected from a circular shape (FIG. 1A and FIG. 1B), an elliptical shape, a two-lobed shape in which two C-shapes are joined (FIG. 1C), a three-lobed shape in which three C-shapes are joined (FIG. 1D), a four-lobed shape in which four or more C-shapes are joined, a substantially triangular shape (FIG. 1E), a substantially quadrangular shape (FIG. 1F), and a substantially polygonal shape.

[0016]

The method for producing the fiber for artificial hair according to the present invention is not particularly limited, but the fiber for artificial hair is generally obtained by melt-spinning a resin composition for a fiber for artificial hair. Further, the fiber for artificial hair having a hollow portion is formed by, for example, melt-extruding from a nozzle having one C-shaped nozzle hole as shown in FIG. 1 of Patent Literature 1, or a nozzle having a plurality of holes. Here, the resin composition is at least partially separated while passing through the nozzle, but after being discharged from the nozzle hole, the resin compositions come into contact with each other and fuse, whereby a hollow portion is formed. The hollow fiber for artificial hair according to one embodiment of the present invention can have a joint surface 14 (shown by a broken line in FIG. 1) where the resin compositions have fused in the melt extrusion process. Further, a joint portion 13, which is a region including the joint surface 14, may comprise at least one of an

inner protruding portion 16 protruding toward the hollow portion and an outer protruding portion 17 protruding toward the outside of the fiber for artificial hair (FIG. 1B). Although FIG. 1B shows a case where the fiber cross-section is circular, even when the hollow portion has another shape, at least one of an inner protruding portion protruding toward the hollow portion and an outer protruding portion protruding toward the outside of the fiber for artificial hair can be similarly provided at the joint portion. Thus, by providing the protruding portion to make the joint portion 13 thick and increasing the area of the joint surface 14 where the resin compositions have fused, the joint strength can be improved. Details of the production method will be described later.

[0017]

In the hollow fiber for artificial hair according to one embodiment of the present invention, a major axis in a cross-section perpendicular to the longitudinal direction of the fiber for artificial hair may be 30 to 300 μm . The major axis is, for example, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200, 210, 220, 230, 240, 250, 260, 270, 280, 290, or 300 μm , and may be within a range between any two of the numerical values exemplified here.

[0018]

In the hollow fiber for artificial hair according to one embodiment of the present invention, when an area ratio occupied by a hollow portion 15 in the cross-section perpendicular to the longitudinal direction of the fiber for artificial hair is defined as a hollow ratio, the hollow ratio is preferably 10 to 40%. The hollow ratio is, for example, 10, 15, 20, 25, 30, 35, or 40%, and may be within a range between any two of the numerical values exemplified here. Note that in the fiber bundle for artificial hair according to the present invention, it is sufficient if the coefficient of variation of the hollow ratio of the plurality of fibers for artificial hair contained in the fiber for artificial hair is within a specific numerical range. Therefore, if the coefficient of variation is within the specific numerical range, it may contain a hollow fiber for artificial hair having a hollow ratio of less than 10% or a hollow ratio of more than 40%.

[0019]

The hollow ratio can be determined by the following formula.

$$\text{Hollow ratio} = (\text{Area enclosed by inner surface 12}) / (\text{Area enclosed by outer surface 11}) \times 100$$

The area enclosed by the outer surface 11 means the cross-sectional area when it is assumed that the fiber for artificial hair does not have a hollow portion.

The hollow ratio can be determined by cutting the fiber for artificial hair perpendicularly to the longitudinal direction, observing the cut surface with a laser microscope or a scanning electron microscope, and performing image analysis. Specifically, it can be determined by the method described in the Examples. By setting the hollow ratio to be equal to or greater than the above lower limit, the advantages of having the hollow portion can be more reliably obtained. If the hollow ratio exceeds the above upper limit, it leads to a decrease in structure retention

rate, an increase in rigidity due to an increase in fiber diameter, and a deterioration of texture, which is not preferable.

[0020]

Note that in the fiber bundle for artificial hair according to the present invention, if the coefficient of variation of the hollow ratio of the plurality of fibers for artificial hair contained in the fiber for artificial hair is within the specific numerical range, the plurality of fibers for artificial hair may contain a solid fiber for artificial hair which does not have a hollow portion extending in the longitudinal direction of the fiber for artificial hair.

The shape of the solid fiber for artificial hair is not particularly limited, and examples include a circular shape, an elliptical shape, a polygonal shape such as a substantially triangular shape or a substantially quadrangular shape, a multilobal shape such as a two-lobed shape or a three-lobed shape, and a Y-shape. Further, the major axis in the cross-section perpendicular to the longitudinal direction of the fiber for artificial hair may be similar to that of the hollow fiber for artificial hair, and may be 30 to 300 μm .

[0021]

1.1.2 Composition of Fiber for Artificial Hair

The resin composition constituting the fiber for artificial hair according to one embodiment of the present invention is not particularly limited, and can include at least one of a polyamide-based resin, a polyester-based resin, a vinyl chloride-based resin, an AS-based resin (acrylonitrile-styrene-based resin), a PP resin, a PET resin, a PE resin, a PAN-based resin, and a PLA-based resin (polylactic acid-based resin). The fiber for artificial hair according to one embodiment of the present invention preferably contains a vinyl chloride-based resin from the viewpoint that a die swell effect is easily obtained, a structure having a protruding portion with an increased area of the joint surface where resin compositions have fused can be obtained, and a fiber for artificial hair having a structure with improved joint strength is easily obtained. Further, it is preferable that the fiber for artificial hair according to one embodiment of the present invention contains a vinyl chloride-based resin and an AS-based resin (acrylonitrile-styrene-based resin).

[0022]

The polyvinyl chloride-based resin according to one embodiment of the present invention can include a vinyl chloride-based polymer containing a monomer unit derived from a vinyl chloride monomer (a vinyl chloride monomer unit). The polyvinyl chloride-based resin according to the present invention can include a homopolymer obtained by homopolymerizing a vinyl chloride monomer, and/or a copolymer containing a monomer unit derived from a vinyl chloride monomer and another monomer copolymerizable with the vinyl chloride monomer. Examples of the copolymer include copolymers of vinyl chloride and vinyl esters such as a vinyl chloride-vinyl acetate copolymer and a vinyl chloride-vinyl propionate copolymer; copolymers of vinyl chloride and olefins such as a vinyl chloride-ethylene copolymer and a vinyl chloride-propylene copolymer; and a vinyl chloride-acrylonitrile copolymer. Further, the polyvinyl

chloride-based resin according to the present invention may be composed of one type of vinyl chloride-based polymer, or may include two or more types of vinyl chloride-based polymers.

[0023]

The resin composition for a fiber for artificial hair constituting the fiber for artificial hair according to one embodiment of the present invention contains 50 to 99% by mass of a vinyl chloride-based resin in 100% by mass of the resin composition, preferably 65 to 95% by mass, and more preferably 65 to 90% by mass. Specifically, it is, for example, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, or 99% by mass, and may be within a range between any two of the numerical values exemplified here.

[0024]

The AS-based resin (acrylonitrile-styrene-based resin) is a copolymer having a styrene-based monomer unit and an acrylonitrile-based monomer unit, and may contain another monomer unit copolymerizable therewith as necessary. The AS-based resin, with respect to 100% by mass of the AS resin, contains the styrene-based monomer unit, for example, in an amount of 60, 65, 70, 75, 80, 85, or 90% by mass, and may be within a range between any two of the numerical values exemplified here. The AS-based resin, with respect to 100% by mass of the AS resin, contains the acrylonitrile-based monomer unit, for example, in an amount of 10, 15, 20, 25, 30, 35, or 40% by mass, and may be within a range between any two of the numerical values exemplified here.

[0025]

The fiber for artificial hair according to one embodiment of the present invention may also contain other components as necessary. Examples of other components include an antistatic agent, a heat stabilizer, a lubricant, a colorant, a processing aid, a plasticizer, a reinforcing agent, an ultraviolet absorber, an antioxidant, a filler, a flame retardant, a pigment, an initial coloration improving agent, a conductivity-imparting agent, a fragrance, and the like.

[0026]

1.2 Properties of Fiber Bundle for Artificial Hair

The fiber bundle for artificial hair according to the present invention includes a plurality of fibers for artificial hair, and the plurality of fibers for artificial hair includes a hollow fiber for artificial hair. In one embodiment of the present invention, the plurality of fibers for artificial hair may include a solid fiber for artificial hair.

In the fiber bundle for artificial hair according to the present invention, when the plurality of fibers for artificial hair contained in the fiber bundle for artificial hair is taken as 100% by mass, a content of the hollow fiber for artificial hair may be 50% by mass or more. The content of the hollow fiber for artificial hair is, for example, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, or 100% by mass, and may be within a range between any two of the numerical values exemplified here.

The fiber bundle for artificial hair according to one embodiment of the present invention is preferably composed of a plurality of fibers for artificial hair, and it is preferable that the

plurality of fibers for artificial hair consists of only the hollow fiber for artificial hair.

[0027]

In the fiber bundle for artificial hair according to the present invention, a coefficient of variation of the hollow ratio of the fibers for artificial hair contained in the fiber bundle for artificial hair is from 0.02 to 0.30. Here, the coefficient of variation is represented by the following formula.

Coefficient of variation = Standard deviation/Average hollow ratio

Hereinafter, the average hollow ratio, the standard deviation, and the coefficient of variation will be described in order.

[0028]

The hollow ratio of the fiber for artificial hair is as described above, and the method of determining each hollow ratio of each fiber for artificial hair is as described above. The hollow ratio can be determined by the following formula by cutting the fiber for artificial hair perpendicularly to the longitudinal direction, observing the cut surface with a laser microscope or a scanning electron microscope, and performing image analysis.

Hollow ratio = (Area enclosed by inner surface 12)/(Area enclosed by outer surface 11) × 100

The average hollow ratio is an average value of the hollow ratios of the plurality of fibers for artificial hair contained in the fiber bundle for artificial hair, and can be, for example, an average value with N=50.

[0029]

The average hollow ratio is preferably 10 to 40%, and is, for example, 10, 15, 20, 25, 30, 35, or 40%, and may be within a range between any two of the numerical values exemplified here. By setting the average hollow ratio to be equal to or greater than the above lower limit, the advantages of having the hollow portion can be more reliably obtained. If the average hollow ratio exceeds the above upper limit, it leads to a decrease in structure retention rate, an increase in rigidity due to an increase in fiber diameter, and a deterioration of texture, which is not preferable.

[0030]

The standard deviation of the hollow ratio can be determined by the following formula.

$$S = \sqrt{\frac{1}{N} \sum_{i=1}^N (X_i - X_{average})^2}$$

[0031]

Here, S indicates the standard deviation, N indicates the number of fibers for artificial hair for which the hollow ratio was measured, X_i indicates the hollow ratio of each fiber for artificial hair, and $X_{average}$ indicates the average hollow ratio.

The standard deviation may be from 1 to 7, and is, for example, 1, 2, 3, 4, 5, 6, or 7, and may be within a range between any two of the numerical values exemplified here.

[0032]

The coefficient of variation can be calculated by the following formula using the above average hollow ratio and standard deviation.

Coefficient of variation = Standard deviation/Average hollow ratio

The coefficient of variation is from 0.02 to 0.30, and is, for example, 0.02, 0.04, 0.06, 0.08, 0.10, 0.12, 0.14, 0.16, 0.18, 0.20, 0.22, 0.24, 0.26, 0.28, or 0.30, and may be within a range between any two of the numerical values exemplified here.

[0033]

According to the present invention, by setting the coefficient of variation to be equal to or greater than the above lower limit, a fiber bundle for artificial hair having a natural color and glossiness with moderate variation like human hair is obtained. Further, by setting the coefficient of variation to be equal to or less than the above upper limit, variation in shrinkage rate of the fibers for artificial hair contained in the fiber bundle for artificial hair can be moderately suppressed, and it is presumed that unraveling and sticking out after hot water treatment can be further reduced.

[0034]

The average hollow ratio, the standard deviation, and the coefficient of variation can be controlled by adjusting the production conditions of the fiber for artificial hair, and in particular, can be adjusted by changing the nozzle shape in the melt spinning step. As one example, a method using a nozzle having a plurality of nozzle holes capable of simultaneously discharging a plurality of fibers, wherein the plurality of nozzle holes have a distribution in shape and size capable of adjusting the average hollow ratio, standard deviation, and coefficient of variation of the obtained fibers within the above numerical ranges, can be mentioned.

[0035]

The fiber bundle for artificial hair according to one embodiment of the present invention preferably has a fineness of 30 to 70 denier. The fineness is, for example, 30, 35, 40, 45, 50, 55, 60, 65, or 70 denier, and may be within a range between any two of the numerical values exemplified here.

By setting the fineness within the above numerical range, the obtained fiber bundle for artificial hair has a natural color and glossiness with moderate variation like human hair, has less unraveling and sticking out after hot water treatment, and is further excellent in texture.

The fineness of the fiber bundle for artificial hair can be determined by the method described in the Examples. Further, the fineness can be controlled by adjusting the conditions of the spinning step, the drawing step, and the heat treatment.

[0036]

<Structure Retention Rate>

The fiber bundle for artificial hair according to one embodiment of the present invention preferably has a structure retention rate of the cross-section of the fiber for artificial hair of 90% or more. The structure retention rate is, for example, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, or 100%, and may be within a range between any two of the numerical values exemplified here.

The structure retention rate indicates a proportion of fibers for artificial hair having a cross-section in which the joint portions are not separated and the hollow portion is not collapsed, and specifically, can be calculated by the method described in the Examples, for example, based on the observation results of fiber cross-sections with N=300, based on the following formula.

$$\text{Structure retention rate} = (300 - i - j)/300$$

i: number of fibers having one or more separated joint portions

j: number of fibers in which the hollow portion has collapsed and the inner surfaces are in contact

The fiber having a separated portion indicates a state where, for example, when the fiber originally has a circular cross-section, the cross-section is not donut-shaped but C-shaped, and a part is separated.

[0037]

The fiber bundle for artificial hair according to one embodiment of the present invention has a high structure retention rate, and for example, the structure having a hollow portion is maintained with high reliability without being destroyed even after undergoing steps such as a drawing step and a heat treatment step, so that the advantages of having the hollow portion can be sufficiently and reliably obtained. The structure retention rate can be increased by adjusting the average hollow ratio, standard deviation, coefficient of variation, and cross-sectional structure of the fiber bundle for artificial hair.

[0038]

The fiber bundle for artificial hair according to the present invention is a fiber bundle for artificial hair comprising a hollow fiber for artificial hair, which can simultaneously achieve a natural color and glossiness with moderate variation like human hair, and a reduction in unraveling and sticking out after hot water treatment. In addition, the fiber bundle for artificial hair according to the present invention is excellent in texture. Furthermore, in the fiber bundle for artificial hair according to one embodiment of the present invention, the hollow structure of each fiber is maintained with high reliability, and the fiber bundle is lightweight. This brings about many advantages such as being able to form a desired voluminous hairstyle with a small amount of attached hair, realizing a wide range of hairstyles including voluminous long styles, reducing damage to natural hair and the scalp, and reducing waste and environmental load.

The fiber bundle for artificial hair according to one embodiment of the present invention having the above features can be used for hair accessory products of various styles, and is particularly suitable for a braid including plaiting such as braiding and twisting.

[0039]

1.3 Method for Producing Fiber Bundle for Artificial Hair

The method for producing the fiber bundle for artificial hair according to one embodiment of the present invention includes a resin composition preparation step for a fiber for artificial hair and a spinning step, and may include a drawing step, a heat treatment step, and a gear processing step.

[0040]

1.3.1 Resin Composition Preparation Step for Fiber for Artificial Hair

In the resin composition preparation step for a fiber for artificial hair, a raw material containing a resin can be mixed to obtain a resin composition for a fiber for artificial hair. Here, the raw material includes a base resin and may include other components as necessary.

[0041]

A mixing method is not particularly limited, and a conventionally known method can be adopted. For example, a powdered resin composition (a powder compound) can be obtained using a known mixing device such as a Henschel mixer, a super mixer, or a ribbon blender, and the powder compound can be melt-mixed to obtain a pellet-shaped resin composition (a pellet compound). The method for producing the powder compound may be a hot blend or a cold blend, and as one example, in order to reduce volatiles from the resin composition, a hot blend can be performed with a cut temperature during mixing set to 105 to 155°C. The method for producing the pellet compound can be the same as a general method for producing a pellet compound of a polyvinyl chloride-based resin. For example, a pellet compound can be made using a kneading machine such as a single-screw extruder, a counter-rotating twin-screw extruder, a conical twin-screw extruder, a co-rotating twin-screw extruder, a kneader, a planetary gear extruder, or a roll kneader. The conditions for producing the pellet compound are not particularly limited, but it is preferable to set the resin temperature to be 185°C or lower in order to prevent thermal degradation of the resin composition. Also, to remove metal pieces from a screw or fibers attached to protective gloves that may be mixed in a small amount in the pellet compound, a mesh can be installed near a tip of the screw. A cold cut method can be adopted for the production of the pellets. A means for removing fines (fine powder generated during pellet production) that may be mixed in during the cold cut may be adopted. Also, since a cutter may chip after being used for a long time, making it easy for fines to be generated, it is preferable to replace it as appropriate.

[0042]

1.3.2 Spinning Step

In the spinning step, the resin composition for a fiber for artificial hair is melt-spun to obtain a fiber for artificial hair. As one example, the above resin composition (for example, a pellet compound) can be extruded and melt-spun from a heated cylinder via a nozzle. As an extruder, a conventionally known extruder can be used, and examples include a single-screw extruder, a counter-rotating twin-screw extruder, a conical twin-screw extruder, and the like.

[0043]

The conditions for melt spinning can be appropriately set according to the type of resin composition so that the resin melts and a structure joined at the joint portion is formed. As one example, a cylinder temperature may be 150 to 190°C, and a nozzle temperature may be 180 ± 15°C.

[0044]

An undrawn yarn melt-spun from the nozzle can be introduced into a heated cylinder (for example, a heated cylinder temperature of 250°C), instantaneously heat-treated, and wound by a take-up machine installed at a position directly below the nozzle (for example, about 4.5 m).

[0045]

The nozzle for melt extrusion of the fiber for artificial hair according to one embodiment of the present invention may be appropriately selected according to the shape of the fiber for artificial hair to be obtained, and the hollow ratio, as well as the average hollow ratio, standard deviation, and coefficient of variation.

As one example, when producing the fiber for artificial hair having a circular cross-section shown in FIG. 1A, a nozzle having a C-shaped nozzle hole may be used. When producing the fiber for artificial hair having a two-lobed cross-section in which two C-shapes are joined as shown in FIG. 1C, a nozzle having two C-shaped nozzle holes may be used. When producing the fiber for artificial hair having a three-lobed cross-section in which three C-shapes are joined as shown in FIG. 1D, a nozzle having three C-shaped nozzle holes may be used. Also, when producing the fiber for artificial hair having a substantially triangular cross-section as shown in FIG. 1E, a nozzle having three rectangular nozzle holes may be used, and when producing the fiber for artificial hair having a substantially quadrangular cross-section as shown in FIG. 1F, a nozzle having four rectangular nozzle holes may be used.

[0046]

The nozzle preferably has nozzle holes capable of simultaneously discharging a plurality of fibers, and it is preferable that the plurality of nozzle holes have a distribution in shape and size, and are adjusted so that the average hollow ratio, standard deviation, and coefficient of variation of the finally obtained fiber for artificial hair fall within desired ranges.

[0047]

1.3.4 Drawing Step and Heat Treatment Step

The method for producing the fiber for artificial hair according to one embodiment of the present invention can also include a drawing step and a heat treatment step.

In the drawing step, an undrawn fiber for artificial hair obtained in the above melt-spinning step can be drawn with a drawing machine to obtain a drawn fiber for artificial hair. As one example, in the drawing step, the undrawn fiber for artificial hair can be drawn 2 to 5 times at 90 to 110°C in an air atmosphere, for example.

Further, in the heat treatment step, the drawn fiber for artificial hair can be heat-treated using a heat treatment machine. As one example, in the heat treatment step, the drawn fiber for artificial hair can be heat-treated at 90 to 110°C in an air atmosphere so as to have a ratio of 0.5 to 3.0, and heat-shrunk until a total length of the fiber shrinks, to obtain a heat-treated fiber for artificial hair having a desired fineness.

[0048]

1.3.5 Gear Processing Step

The method for producing the fiber for artificial hair according to one embodiment of the present invention can also include a gear processing step.

In the gear processing step, a crimp can be applied by passing a fiber bundle between two meshing hot gears. A material of gears used in the gear processing step, a shape of gear waves, a number of gear teeth, and the like are not particularly limited. In the gear processing step, a shape of the obtained fiber for artificial hair can be controlled by appropriately adjusting conditions such as a depth of a groove of the gear waveform, a surface temperature of the gears, a processing speed, and a pressure between the gears, in consideration of a fiber material and a fineness. These processing conditions are not particularly limited, but as one example, the depth of the groove of the gear waveform may be 0.2 mm to 6 mm, preferably 0.5 mm to 5 mm, the surface temperature of the gears can be 30°C to 100°C, preferably 40°C to 80°C, and the processing speed can be 0.5 to 10 m/min, preferably 1.0 m/min to 8.0 m/min.

[0049]

The method for producing the fiber for artificial hair according to one embodiment of the present invention can also include other steps, for example, a surface treatment agent adhesion step.

Note that in the present invention, the fiber for artificial hair includes the fiber for artificial hair after spinning, and includes the fiber for artificial hair before the drawing step, the fiber for artificial hair after the drawing step, the fiber for artificial hair before the heat treatment step, the fiber for artificial hair after the heat treatment step, the fiber for artificial hair before the gear processing step, and the fiber for artificial hair after the gear processing step.

[0050]

3. Hair Accessory Product

A hair accessory product (hair decorative product) according to one embodiment of the present invention comprises the above-described fiber for artificial hair. Further, the hair accessory product according to one embodiment of the present invention comprises the above-described fiber bundle for artificial hair.

[0051]

The fiber for artificial hair according to the present invention can be used for a hair accessory product. Examples of the hair accessory product include a wig, a hairpiece, a braid, an extension hair, doll hair, a hair wig, a false hair, a hair band, and the like. The hair accessory product obtained from the fiber bundle for artificial hair according to the present invention can simultaneously achieve a natural color and glossiness with moderate variation like human hair, and a reduction in unraveling and sticking out after hot water treatment.

In addition, the hair accessory product obtained from the fiber bundle for artificial hair according to one embodiment of the present invention is excellent in texture.

Furthermore, in the hair accessory product obtained from the fiber bundle for artificial hair according to one embodiment of the present invention, the hollow structure of each fiber is maintained with high reliability and the hair accessory product is lightweight. This brings about

many advantages such as being able to form a desired voluminous hairstyle with a small amount of attached hair, realizing a wide range of hairstyles including voluminous long styles, reducing damage to natural hair and the scalp, and reducing waste and environmental load.

The hair accessory product according to one embodiment of the present invention having the above features is applicable to various styles, but is particularly suitable for a braid including plaiting such as braiding and twisting.

Examples

[0052]

Hereinafter, the present invention will be described in more detail based on examples, but the present invention is not to be construed as being limited thereto.

[0053]

(Example 1)

<Resin Composition Preparation Step for Fiber for Artificial Hair>

70 parts by mass of a polyvinyl chloride-based resin (manufactured by Taiyo Vinyl Corporation, product name: TH1000), 30 parts by mass of a vinyl-based copolymer resin (manufactured by Denka Company Limited, GR-AT-6S) comprising 68% by mass of a styrene monomer unit and 32% by mass of an acrylonitrile monomer unit, a total of 5 parts by mass of additives such as a plasticizer, a stabilizer, and a lubricant (specifically, 3 parts by mass of a stabilizer composition, 1 part by mass of an epoxidized soybean oil, 0.4 parts by mass of a phosphorus-based chelating agent, and 0.6 parts by mass of a polyethylene wax), and 0.5 parts by mass of a carbon black were mixed with a blender. The blended material was kneaded using a single-screw extruder with a diameter of 40 mm to obtain a Resin composition 1 for a fiber for artificial hair in a pellet form for spinning.

The stabilizer composition used to obtain the resin composition has the following components and composition.

Hydrotalcite compound ($\text{Mg}_4\text{Al}_2(\text{OH})_{12}\text{CO}_3 \cdot 3\text{H}_2\text{O}$) 72.6 parts by mass

Zinc stearate 13.1 parts by mass

Silica ("CARPLEX (registered trademark) #80" manufactured by DSL. Japan Co., Ltd.) 2.2 parts by mass

Dibenzoylmethane 2.3 parts by mass

Dipentaerythritol 0.9 parts by mass

Vinyl chloride resin (manufactured by Taiyo Vinyl Corporation, product name: TH1000) 8.9 parts by mass

Other additives used to obtain the resin composition are as follows.

Epoxidized soybean oil: "ADK CIZER (registered trademark) O-130P" manufactured by ADEKA CORPORATION

Phosphorus-based chelating agent: "ADEKA STAB (registered trademark) 1030" manufactured by ADEKA CORPORATION

Polyethylene wax: manufactured by Mitsui Chemicals, Inc.

[0054]

<Spinning Step>

The obtained pellet-shaped resin composition for a fiber for artificial hair was spun using a 40 mm diameter single-screw melt spinning machine. A discharge rate and a winding speed were adjusted to prepare an undrawn yarn from the molten resin discharged from the nozzle. Note that a cylinder temperature and a nozzle temperature of the spinning machine were set to 140 to 180°C.

For melt spinning, a nozzle capable of simultaneously discharging 100 fibers having a hollow portion was used. The nozzle has nozzle holes corresponding to each of the 100 fibers having a hollow portion. Further, the 100 nozzle holes had a distribution in shape and size, and were adjusted so that the coefficient of variation of the hollow ratio of the finally obtained fiber for artificial hair was 0.04.

[0055]

<Drawing Step and Heat Treatment Step>

The obtained undrawn yarn was drawn at 100°C, and then annealed at 100°C to 200°C to obtain a fiber for Artificial hair 1. A draw ratio was 3 times, and a relaxation rate during annealing was 0.5 to 3%. The relaxation rate during annealing is a value calculated as (rotational speed of take-up roller during annealing)/(rotational speed of feed roller during annealing).

[0056]

(Examples 2 to 11, Comparative Example 1)

Fibers for artificial hair having different hollow ratios, coefficients of variation thereof, and finenesses were obtained by changing the nozzle used in the spinning step, and the conditions of the spinning step, the drawing step, and the heat treatment.

[0057]

[Table 1]

Table 1			Unit	Example											Comparative Example
				1	2	3	4	5	6	7	8	9	10	11	1
Fiber for artificial hair	Fineness		d	50	50	50	50	50	50	50	50	50	30	70	50
	Hollow Ratio	Average Value	%	25	25	25	25	25	25	25	10	40	25	25	25
		Standard Deviation	%	1	2	3	4	5	6	7	1	6	4	4	8
		Coefficient of Variation	%	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.10	0.15	0.16	0.16	0.32
Properties	Appearance			C	B	A	A	A	A	B	B	A	A	A	C
	Texture			A	A	A	A	A	A	B	A	A	A	C	B
	Finish after Hot Water Treatment			A	A	A	A	B	B	C	A	B	A	C	D
	Structure Retention Rate		%	99	99	99	98	98	98	97	99	95	95	98	95

[0058]

(Evaluation Method of Fiber for Artificial Hair)

The obtained fiber for artificial hair was evaluated by the following methods. In cross-section observation, a yarn bundle of the fiber for artificial hair cut to an appropriate length was wrapped with a vinyl tape, and the yarn bundle was cut with a utility knife so as to be perpendicular to the longitudinal direction to prepare a cross-section.

[0059]

<Fineness>

A mass of one fiber per 90 cm was measured to calculate fineness (unit: d, denier). As a measuring instrument, an electronic balance (manufactured by Shimadzu Corporation, AUW220) was used.

[0060]

<Hollow Ratio, Average Hollow Ratio, Standard Deviation of Hollow Ratio, Coefficient of Variation>

Using a laser microscope, a cross-sectional photograph of the fiber was taken at a magnification of 400 times, and an area ratio of the hollow portion in the cross-section (hollow ratio) was measured.

Hollow ratio = Area enclosed by inner surface/Area enclosed by outer surface

Note that a controller VK-X150 manufactured by Keyence Corporation was used for the calculation of the hollow ratio.

With N=50, the average hollow ratio was calculated. Further, the standard deviation of the hollow ratio was determined by the following formula.

$$S = \sqrt{\frac{1}{N} \sum_{i=1}^N (X_i - X_{average})^2}$$

[0061]

Here, S indicates the standard deviation, N indicates the number of fibers for artificial hair for which the hollow ratio was measured, X_i indicates the hollow ratio of each fiber for artificial hair, and $X_{average}$ indicates the average hollow ratio.

Using the obtained standard deviation and average hollow ratio, the coefficient of variation was calculated by the following formula.

Coefficient of variation = Standard deviation/Average hollow ratio

[0062]

<Appearance>

For appearance, the fibers for artificial hair of Examples and Comparative Examples were bundled to a length of 250 mm and a mass of 20 g, and evaluated by the judgment of 10 technicians of fiber for artificial hair treatment (with 5 years or more of practical experience) by visual inspection, according to the following evaluation criteria. Note that good appearance means having a natural variation in color and glossiness like human hair.

A: 9 or more technicians evaluated the appearance as good.

B: 6 to 8 technicians evaluated the appearance as good.

C: 3 to 5 technicians evaluated the appearance as good.

D: 2 or fewer technicians evaluated the appearance as good.

[0063]

<Texture>

For texture, the fibers for artificial hair of Examples and Comparative Examples were bundled to a length of 250 mm and a mass of 20 g, and evaluated by the judgment of 10 technicians of fiber for artificial hair treatment (with 5 years or more of practical experience) by touch, according to the following evaluation criteria. Note that for texture, judgment of 2 ranks of "soft" and "hard" was performed based on softness felt when touching the fiber bundle so as to compress it with a palm, and then judgment was made according to the following criteria.

A: 9 or more technicians evaluated it as soft.

B: 6 to 8 technicians evaluated it as soft.

C: 3 to 5 technicians evaluated it as soft.

D: 2 or fewer technicians evaluated it as soft.

[0064]

<Finish after Hot Water Treatment>

The fibers for artificial hair of Examples and Comparative Examples were bundled to a length of 500 mm and a mass of 5 g, braided, and immersed in hot water at 90°C for 15 seconds. Next, after taking the braided structure out of the water, water was wiped off by lightly rubbing the surface of the braided structure 3 times. Then, after naturally drying by leaving it at room temperature (25°C) for 24 hours or more, the finish was visually observed. It was evaluated by the judgment of 10 technicians of fiber for artificial hair treatment (with 5 years or more of practical experience) by visual inspection, according to the following evaluation criteria. Note that a good finish after hot water treatment means that there are few unraveling (unraveling of a part of the braid) and sticking out (a state where short fibers stick out from the surface of the bundled and braided fiber bundle) in the fiber bundle after the hot water treatment. In addition, it is considered that unraveling and sticking out occur when shrinkage between fibers is uneven.

A: 9 or more technicians evaluated the finish as good.

B: 6 to 8 technicians evaluated the finish as good.

C: 3 to 5 technicians evaluated the finish as good.

D: 2 or fewer technicians evaluated the finish as good.

[0065]

<Structure Retention Rate>

Using a laser microscope, a cross-section of the fiber was photographed at a magnification of 400 times. Thereafter, with N=300, the structure retention rate was calculated based on the following formula. The structure retention rate was calculated by the following formula.

$$\text{Structure retention rate} = (300 - i - j)/300$$

i: number of fibers having one or more separated joint portions

j: number of fibers in which the hollow portion has collapsed and the inner surfaces are in contact

The fiber having a separated portion indicates a state where, for example, when the fiber originally has a circular cross-section, the cross-section is not donut-shaped but C-shaped, and a part is separated.

Reference Signs List

[0066]

- | | |
|-----|--|
| 100 | Cross-section of fiber for artificial hair |
| 11 | Outer surface |
| 12 | Inner surface |
| 13 | Joint portion |
| 14 | Joint surface |
| 15 | Hollow portion |
| 16 | Inner protruding portion |
| 17 | Outer protruding portion |

CLAIMS

[Claim 1]

A fiber bundle for artificial hair comprising a plurality of fibers for artificial hair, wherein:
the plurality of fibers for artificial hair comprises a hollow fiber for artificial hair comprising a hollow portion extending in a longitudinal direction of the fiber for artificial hair;
and

when an area ratio occupied by the hollow portion in a cross-section of the fiber for artificial hair perpendicular to the longitudinal direction is defined as a hollow ratio, a coefficient of variation of the hollow ratio of the fibers for artificial hair contained in the fiber bundle for artificial hair is from 0.02 to 0.30.

[Claim 2]

The fiber bundle for artificial hair of Claim 1, wherein an average hollow ratio of the plurality of fibers for artificial hair is from 10% to 40%.

[Claim 3]

The fiber bundle for artificial hair of Claim 1 or Claim 2, wherein a fineness of the plurality of fibers for artificial hair is from 30 to 70 denier.

[Claim 4]

The fiber bundle for artificial hair of Claim 1 or Claim 2, wherein the fiber for artificial hair comprises a vinyl chloride-based resin.

[Claim 5]

A hair accessory product comprising the fiber bundle for artificial hair of Claim 1 or Claim 2.

[Claim 6]

The hair accessory product of Claim 5, wherein the hair accessory product comprises a braid.