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(54) **Polyvinyl chloride fibers for artificial hair and production of the same**

Polyvinylchloridfasern für künstliches Haar und Herstellung dieser Fasern

Fibres de chlorure de polyvinyle pour cheveux artificiels et fabrication de ces fibres

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to polyvinyl chloride fibers for artificial hair and a process for producing the same. More particularly, the present invention relates to polyvinyl chloride fibers for artificial hair having good processability, functions and cosmetic or beauty properties such as feeling when used for wigs, hair accessories and doll hair.

Description of the Related Art

As artificial hair fibers, modacrylic fibers (e.g. fiber comprising a copolymer of 50 % by weight of acrylonitrile and 50 % by weight of vinyl chloride), polyvinyl chloride fibers, polyvinylidene chloride fibers and polyester fibers are commercially available. From US-4012346 it is also known to use fibers made from copolymers comprising up to 90% by weight of vinyl chloride.

Since none of the conventional fibers satisfies all the properties required for the hair fibers such as heat resistance, curling properties, feeling and the like, hair products such as wigs which satisfy various requirements have not been able to be produced with a single kind of the fiber. Then, the hair products which have specific properties corresponding to the kind of fiber are produced and used.

Typical beauty properties required for the artificial hair fibers are as follows:

Properties relating to curling

(1) Brush accommodation

A direction of curling is easily changed with brushing and curling does not come loose.

(2) Maintenance of curling

Spirally curled plural hairs (for example, 100 hairs) maintain their shapes without drooping by their own weight.

(3) Maintenance of up-curling

Plural hairs (for example, 100 hairs) are bundled and up-curled, that is the hairs are spirally curled upwardly with their roots down. When the up-curled hairs are swung, the hair bundle at the curled part does not come loose and the up-curled shape is maintained.

(4) Resiliency of spirally curled hair

When the spirally curled hairs are suspended and swung up and down, they swing rhythmically while the direction of curling does not shift right and left.

Organoleptic properties

(5) Voluminess

When brushing, the roots of hairs or skins do not appear and a natural puff suitable for each hair style is maintained.

(6) Feel (close to natural hairs)

When the hair is hold between fingers, it gives soft and voluminous feeling, and when the hair is drawn between the fingers, it gives smooth and slipping feeling.

(7) Gloss

The hair has gloss similar to natural hair.

(8) Combability

When the hairs are combed, there is no resistance in a middle portion, or the comb is not caught at the tips of hairs and gets through the hairs smoothly.

As described above, the conventional artificial hair fibers have their own advantages and disadvantages.

For example, the modacrylic fibers have voluminess, feeling and gloss similar to the natural hair and good combability although reasons for these properties are not known, while they have poor curling properties such that their bundle tends to be twisted when curled (poor maintenance of up-curling), their curling comes loose as time passes (poor maintenance of curling) or they have less resiliency. Because of these reasons, the modacrylic fibers are mainly used in products with a natural style (namely, hairs with slight wave or no wave).

The polyvinyl chloride fibers have good curling properties. For example, they are easily curled although the reason for this is not known, the curled hairs do not go out of shape as time passes, and when spirally curled, they have resilient

feeling. However, they lack the organoleptic properties, that is, they have poor voluminess, or feeling and gloss close to synthetic fibers. Then, they are mainly used in products of wave style or straight style (in which only the tip parts are curled).

In view of the above circumstances, hair product makers have tried to use a combination of two or more kinds of synthetic fibers to produce the hair products which satisfy all the beauty characteristics. Since the fibers have different heat resistance, it is difficult to select adequate processing conditions. Further, the fibers have different hue and gloss, the hair products have unnatural appearance. Therefore, the users should use incomplete hair products.

SUMMARY OF THE INVENTION

One object of the present invention is to provide a synthetic fiber from which a hair product satisfying various beauty requirements can be produced.

Another object of the present invention is to provide a synthetic fiber which can provide a wide variety of hair styles.

According to the present invention, there is provided a vinyl chloride base fiber for artificial hairs which comprises a copolymer comprising 85 to 70 % by weight of repeating units derived from vinyl chloride, 15 to 30 % by weight of repeating units derived from acrylonitrile and 0 to 5 % by weight of repeating units derived from at least one ethylenically unsaturated monomer copolymerizable therewith.

BRIEF DESCRIPTION OF THE DRAWING

Fig. 1 is an H-shaped cross section of the fiber of the present invention, and

Fig. 2 is an dumbbell-shaped cross section of the fiber of the present invention.

DETAILED DESCRIPTION OF THE DRAWING

The vinyl chloride units in the copolymer of the present invention impart a well knit curl shape which does not come loose as time passes to the artificial hair fibers and give resiliency when the hairs are spirally curled. The acrylonitrile units impart feeling or voluminess close to the natural hair and good combability.

When the content of the vinyl chloride units is less than 70 % by weight, the fiber does not have satisfactory curling properties such as knitting of curl shape, maintenance of curling, resiliency and the like. When the content of the vinyl chloride exceeds 85 % or the content of the acrylonitrile units is less than 15 % by weight, the fiber does not have satisfactory organoleptic properties which are imparted by the acrylonitrile units, such as feeling and voluminess close the natural hair, or combability.

The optionally contained ethylenically unsaturated monomer improves the properties such as dyeing properties or processability of the fiber. Examples of such monomer are acrylic acid and methacrylic acid or their salts or esters, vinylidene chloride, vinyl bromide, vinylidene bromide, methallylsulfonic acid and styrenesulfonic acid or their salts, acrylamide, vinyl acetate and the like.

The copolymer is preferably used independently, although it can be used in combination with a small amount of at least one of other resins.

Examples of the other polymers are vinyl chloride resin, polyacrylonitrile, vinyl chloride-acrylonitrile copolymer, vinylidene chloride-acrylonitrile copolymer and the like. The amount of the other resin is determined according to the final use of the fiber, and usually not more than 30 % by weight, preferably not more than 20 % by weight based on the total weight of the polymers.

The cross sectional profile of the fiber of the present invention is not critical. Although the cross section of a round shape, a horseshoe shape, a star shape or a Y shape may achieve the objects of the present invention, the fiber of the present invention preferably has a cross section of an H shape or a dumbbell shape as shown in Figs. 1 and 2, respectively since the fiber with the H shaped or dumbbell shaped cross section has gloss, depth of color and flexibility which are close to the natural hair.

The difference between the H shape and the dumbbell shape is as follows:

When the vertical size and the horizontal size of the cross section are "a" and "b", respectively, the H shaped cross section has the ratio of b/a of less than 1.5 and preferably not less than 0.5 as shown in Fig. 1, and the dumbbell shaped cross section has the ratio of b/a of not less than 1.5 and preferably not larger than 3 as shown in Fig. 2.

The fineness of the fiber is not critical in the present invention, and any fiber having the fineness which is suitable for the artificial hair can be used. Preferably, the fiber has the fineness of 40 to 70 deniers. When the fineness is less than 40 deniers, the fiber may be too thin as the hair fiber so that the maintenance of curling may be deteriorated. When the fineness is larger than 70 deniers, the fiber may be too thick and stiff for the artificial hair.

Now, the production of the artificial hair fiber of the present invention is explained.

The copolymer to be used in the present invention may be prepared by any of conventional polymerization methods

in an aqueous system such as suspension polymerization or emulsion polymerization.

If desired, the other resin is added to the copolymer, and the copolymer or the mixture of the copolymer and the other resin is dissolved in a solvent to form a solution preferably of a concentration of from 25 to 35 %. Examples of the solvent are dimethylformamide, dimethylacetoamide, dimethylsulfoxide, acetone, acetonitrile, etc.

The polymer solution as such can be used as a spinning solution, although any of conventional additives such as titanium oxide, colloidal silica, calcium sulfate, aluminum hydroxide and the like may be added to the spinning solution to improve the properties of the spun fiber.

The spinning solution is spun by a conventional wet or dry spinning method, dried and drawn followed by heating at a temperature of 100 to 140°C by dry heat or at a temperature of 80 to 110°C by wet heat.

The heating after drawing relieves strain of the fiber generated during drawing and is carried out usually for 0.5 to 5 minutes. When the dry heat is applied at a temperature lower than 100°C or the wet heat is applied at a temperature lower than 80°C, the produced hair fibers easily shrink at a temperature at which the fibers are set in the desired style, for example, 80 to 110°C during the production of hair products from the fibers. When the dry heat is applied at a temperature higher than 140°C or the wet heat is applied at a temperature higher than 110°C, the fibers are fused together during heat treatment at such high temperature.

The present invention will be illustrated by following Examples, in which "%" is by weight unless otherwise indicated.

PREFERRED EMBODIMENTS OF THE INVENTION

In the following Examples, the beauty properties of the fibers are evaluated as follows:

Fibers cut to a predetermined length or fibers cut to a predetermined length and arranged in parallel with each other are wound around an aluminum pipe having a diameter of 10 to 40 mm according to styles and heat treated in an oven at a temperature of 80 to 110°C or about 180°C in case of polyester fibers. Then, the curled fibers are fixed on a cap base with a sewing machine or a filling needle to produce an artificial hair of the head and subjected to the evaluations on the properties listed in the beginning of the specification.

The cross section of the fiber is observed with a scanning electron microscope.

Example 1

By emulsion polymerization using a redox catalyst, 73 % of vinyl chloride and 27 % of acrylonitrile were copolymerized. The copolymer was dissolved in acetone to obtain a spinning solution of a resin concentration of 30 %. Then, the spinning solution was spun through an orifice having H shaped pores, coagulated, washed with water, dried and drawn followed by heat treating with dry heat at 125°C to obtain fibers having a fineness of 55 deniers and a cross section of H shape.

The beauty properties of the fibers were evaluated. The results are shown in Table 1.

From the results in Table 1, it is understood that the fibers had excellent properties.

Table 2 includes the accommodation of the fibers to various styles. These results indicate that the fibers of the present invention can be arranged in various styles.

Example 2

In the same manner as in Example 1, a spinning solution was prepared and spun through an orifice having dumbbell shaped pores, coagulated, washed with water, dried and drawn followed by heat treating with dry heat at 125°C to obtain fibers having a fineness of 55 deniers and a cross section of dumbbell shape.

The beauty properties of the fibers were evaluated. The results are shown in Table 1.

From the results in Table 1, it is understood that the fibers had excellent properties.

Table 2 includes the accommodation of the fibers to various styles. These results indicate that the fibers of the present invention can be arranged in various styles.

Example 3

In the same manner as in Example 1, a spinning solution was prepared and spun through an orifice having round pores, coagulated, washed with water, dried and drawn followed by heat treating with dry heat at 125°C to obtain fibers having a fineness of 55 deniers and a cross section of horseshoe shape.

The beauty properties of the fibers were evaluated. The results are shown in Table 1.

From the results in Table 1, it is understood that the fibers had very good properties, although the feeling and gloss of these fibers were slightly inferior to the fibers having the H shaped cross section or the dumbbell shaped cross section.

Example 4

By emulsion polymerization using a redox catalyst, 80 % of vinyl chloride, 19 % of acrylonitrile and 1 % of sodium styrenesulfonate were copolymerized. The copolymer was dissolved in a mixed solvent of acetone and benzene weight ratio of 80:20) to obtain a spinning solution of a resin concentration of 28 %. Then, the spinning solution was spun through an orifice having round pores, coagulated, washed with water, dried and drawn followed by heat treating with wet heat at 90°C to obtain fibers having a fineness of 60 deniers and a cross section of horseshoe shape.

The beauty properties of the fibers were evaluated. The results are shown in Table 1.

From the results in Table 1, it is understood that the fibers had excellent properties as in Example 3.

Example 5

In acetone, 85 % of the copolymer prepared in Example 1 and 15 % of a copolymer of 50 % of vinyl chloride, 49 % of acrylonitrile and 1 % of sodium styrenesulfonate were mixed and dissolved to prepare a spinning solution Then, the a spinning solution was spun through an orifice having dumbbell shaped pores, coagulated, washed with water, dried and drawn followed by heat treating with dry heat at 130°C to obtain fibers having a fineness of 55 deniers and a cross section of horseshoe shape.

The beauty properties of the fibers were evaluated. The results are shown in Table 1.

From the results in Table 1, it is understood that the fibers had excellent properties as in Examples 3 and 4.

Comparative Example 1

By emulsion polymerization using a redox catalyst, 60 % of vinyl chloride and 40 % of acrylonitrile were copolymerized. The copolymer was dissolved in acetone to obtain a spinning solution of a resin concentration of 28 %. Then, the spinning solution was spun through an orifice having round pores, coagulated, washed with water, dried and drawn followed by heat treating with dry heat at 135°C to obtain fibers having a fineness of 55 deniers and a cross section of horseshoe shape.

The beauty properties of the fibers were evaluated. The results are shown in Table 1.

Comparative Example 2

By emulsion polymerization using a redox catalyst, 90 % of vinyl chloride and 10 % of acrylonitrile were copolymerized. The copolymer was dissolved in a mixed solvent of acetone and benzene to obtain a spinning solution of a resin concentration of 26 %.

Then, the spinning solution was spun through an orifice having round pores, coagulated, washed with water, dried and drawn followed by heat treating with wet heat at 90°C to obtain fibers having a fineness of 55 deniers and a cross section of horseshoe shape.

The beauty properties of the fibers were evaluated. The results are shown in Table 1.

Comparative Examples 3-5

With a commercially available modacrylic fiber (50 % of vinyl chloride and 49 % of acrylonitrile) (Comparative Example 3), polyvinyl chloride fiber (Comparative Example 4) or polyester fiber (Comparative Example 5), the beauty properties were evaluated. The results are shown in Table 1. Table 2 includes the accommodation of the fibers to various styles.

Table 1

Example No.	Acrylonitrile content	Cross section of fiber	Brush accommodation	Maintenace of curling	Maintenance of up-curling	Resiliency of spirally curled hair	Voluminess	Feel	Gloss	Combability
1	27 %	H	B	B	A	B	A	A	A	A
2	27 %	Dumbbell	A	B	B	B	A	A	A	A
3	27 %	Horseshoe	B	B	A	B	A	B	B	A
4	19 %	Horseshoe	B	B	A	B	A	B	B	A
5	Blend	Horseshoe	B	B	A	B	A	B	B	A
C. 1	40 %	Horseshoe	D	C	C	D	A	B	B	A
C. 2	10 %	Horseshoe	B	B	B	B	C	C	C	D
C. 3	Commercial modacrylic fiber		D	C	C	D	A	B	A	A
C. 4	Commercial polyvinyl chloride fiber		B	A	A	A	C	C	C	D
C. 5	Commercial polyester fiber		D	A	A	A	D	D	D	D

Note: A: Excellent
B: Good
C: Poor
D: Bad

Table 2

Example No.	Curly	Wave	Straight	Combi-nation	Aflo	Natural
1	B	A	B	A	A	A
2	B	B	A	A	A	A
C. 3	B	C	D	A	B	A
C. 4	C	D	A	B	C	D
C. 5	B	D	D	D	A	D

Note: A: Very suitable
B: Suitable
C: Less suitable
D: Unsuitable

Claims

1. A vinyl chloride base fiber for artificial hairs which comprises a copolymer comprising repeating units derived from vinyl cloride, repeating units derived from acrylonitrile and optionally repeating units derived from at least one ethylenically unsaturated monomer copolymerizable therewith,
characterized in that
the copolymer comprises 85 to 70 % by weight, except 70 % by weight, of repeating units derived from vinyl chloride, 15 to 30 % by weight of repeating units derived from acrylonitrile and 0 to 5 % by weight of repeating units derived from at least one ethylenically unsaturated monomer copolymerizable therewith.

2. A vinyl chloride base fiber according to claim 1, which has an H-shaped cross section and a fineness of 40 to 70 deniers.

3. A vinyl chloride base fiber according to claim 1 which has a dumbbell-shaped cross section and a fineness of 40 to 70 deniers.

4. A process for preparing a vinyl chloride base fiber for artificial hairs which method comprises steps of dissolving a copolymer as defined in claim 1 in a solvent to form a spinning solution, spinning the spinning solution by a wet or dry spinning method, drying and drawing the spun fiber, and thermally treating the fiber with dry heat at a temperature of 100 to 140°c or wet heat at a temperature of 80 to 110°C.

5. A process according to claim 4, wherein the spinning solution has a concentration of 25 to 35 % by weight.

Patentansprüche

1. Faser auf Vinylchlorid-Basis für künstliche Haare, die ein Copolymer enthält, welches von Vinylchlorid abgeleitete Repetiereinheiten, von Acrylnitril abgeleitete Repetiereinheiten und wahlweise Repetiereinheiten, die von mindestens einem ethylenartig ungesättigten Monomeren, das mit den genannten copolymerisierbar ist, abgeleitet sind, enthält,
dadurch **gekennzeichnet**,
daß das Copolymer 85 bis 70 Gew.-%, ausgenommen 70 Gew.-%, von Vinylchlorid abgeleitete Repetiereinheiten, 15 bis 30 Gew.-% von Acrylnitril abgeleitete Repetiereinheiten und 0 bis 5 Gew.-% Repetiereinheiten, die von mindestens einem ethylenartig ungesättigten Monomeren, das mit den genannten copolymerisierbar ist, abgeleitet sind, enthält.

2. Faser auf Vinylchlorid-Basis nach Anspruch 1, die einen H-förmigen Querschnitt und eine Feinheit von 40 bis 70 Denier hat.

3. Faser auf Vinylchlorid-Basis nach Anspruch 1, die einen Dumbbell-förmigen Querschnitt und eine Feinheit von 40 bis 70 Denier hat.

4. Verfahren zur Herstellung einer Faser auf Vinylchlorid-Basis für künstliche Haare, wobei das Verfahren die folgenden Schritte umfaßt:

   - Lösen eines Copolymeren nach Anspruch 1 in einem Lösungsmittel unter Bildung einer Spinnlösung;
   - Spinnen der Spinnlösung nach einem Naß- oder Trockenspinnverfahren;
   - Trocknen und Verstrecken der gesponnenen Faser und
   - thermisches Behandeln der Faser mit trockener Hitze bei einer Temperatur zwischen 100 und 140°C oder feuchter Hitze bei einer Temperatur zwischen 30 und 110°C.

5. Verfahren nach Anspruch 4, in dem die Spinnlösung eine Konzentration von 25 bis 35 Gew.-% hat.

Revendications

1. Fibre pour cheveux artificiels à base de chlorure de vinyle qui comprend un copolymère contenant des motifs récurrents dérivés de chlorure de vinyle, des motifs récurrents dérivés d'acrylonitrile et facultativement des motifs récurrents dérivés d'au moins un monomère éthyléniquement insaturé copolymérisable avec ceux-ci, caractérisée en ce que le copolymère comprend 85 à 70% en poids, à l'exclusion de 70% en poids, de motifs récurrents dérivés de chlorure de vinyle, 15 à 30% en poids de motifs récurrents dérivés d'acrylonitrile et 0 à 5% en poids de motifs récurrents dérivés d'au moins un monomère éthyléniquement insaturé copolymérisable avec ceux-ci.

2. Fibre à base de chlorure de vinyle selon la revendication 1, qui présente une section transversale en forme de H et une finesse de 40 à 70 deniers.

3. Fibre à base de chlorure de vinyle selon la revendication 1, qui présente une section transversale en forme d'haltère et une finesse de 40 à 70 deniers.

4. Procédé de préparation d'une fibre pour cheveux artificiels à base de chlorure de vinyle, qui comprend des étapes de dissolution d'un copolymère tel que défini dans la revendication 1 dans un solvant, en vue de former une solution de filage, de filage de la solution de filage par un procédé de filage humide ou sec, de séchage et étirage de la fibre filée, et de traitement thermique de la fibre par une chaleur sèche à une température de 100 à 140°C ou par une chaleur humide à une température de 80 à 110°C.

5. Procédé selon la revendication 4, dans lequel la solution à filer présente une concentration de 25 à 35% en poids.

Fig. 1

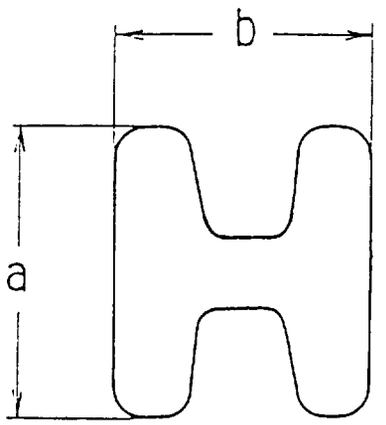


Fig. 2

