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(54) Titre : FIBRE SYNTHETIQUE CONTENANT DES ACIDES GRAS VEGETAUX ET PROCEDE POUR LA FABRICATION DE LADITE FIBRE

(54) Title: SYNTHETIC FIBER CONTAINING PLANT FATTY ACID AND METHOD FOR MANUFACTURING THE SAME

(57) Abrégé/Abstract:
The present invention relates to a synthetic fiber containing plant fatty acids and to a method for manufacturing same. The method for manufacturing the synthetic fiber according to the present invention involves enabling polymeric materials for forming a fiber to contain 0.1 to 10.0 wt % of plant fatty acids, and melt-spinning the polymeric materials using a conventional method. The synthetic fiber manufactured by the method of the present invention contains 0.01 to 10.0 wt % plant fatty acids, and emits the scent of a plant. Not only are the basic physical properties, such as strength and elongation, of the synthetic fiber manufactured by the method of the present invention superior to those of general synthetic fibers, but the bulkiness, expansion and contraction, whiteness, touch, hygroscopicity, dyeing properties, gloss properties, etc., thereof are significantly excellent. The synthetic fiber of the present invention exhibits antistatic performance and emits the scent of a plant, and therefore can be widely used as a material for high-quality clothing. [Index words] synthetic fiber, strength, elongation, gloss properties, plant fatty acids, appearance features.

# 【ABSTRACT】

Disclosed are a synthetic fiber comprising a plant fatty acid and a method for manufacturing the same. The method comprises incorporating a plant fatty acid in an amount of from 0.1 to 10.0 wt% into a fiber-formable polymer; and melt-spinning the plant fatty acid-incorporated polymer. The synthetic fiber comprises a plant fatty acid in an amount of from 0.01 to 10.0 wt%, and emanates a plant fragrance.

In addition to being superior to general synthetic fibers in physical properties including strength and elongation, the synthetic fiber exhibits excellent bulkiness, elasticity, whiteness, touch sensation, hygroscopicity, dyeability, and gloss. Further, the fiber is highly antistatic and gives off a plant fragrance, so that it is useful as a material for high-quality clothes.

# 【DESCRIPTION】

## 【Invention Title】

SYNTHETIC FIBER CONTAINING PLANT FATTY ACID AND METHOD FOR MANUFACTURING THE SAME

## 【Technical Field】

The present invention relates to a plant fatty acid-containing synthetic fiber and a method for manufacturing the same. More particularly, the present invention relates to a plant fatty acid-containing synthetic fiber which exhibits excellent physical properties including strength and elongation and is significantly improved in appearance and anti-staticity, and a method for manufacturing the same.

## 【Background Art】

Synthetic fibers including polyester fibers are widely used as materials for clothes thanks to their excellent strength, elongation and durability.

However, synthetic fibers are disadvantageous in that they are stiff, give a feeling of repulsion upon contact with the skin, and give rise to significant static electricity.

A lot of effort has been put into overcoming these problems. Exemplary are the disclosure of Korean Patent Nos. 10-0726409 and 10-0515808, which describe the direct coating

and fixation of synthetic fibers with plant extracts. However, the synthetic fibers coated with plant extracts do not persistently exhibit antibacterial activity because the extracts bleed out of the fibers upon washing.

A method of microencapsulation of plant extracts in which the plant extracts are trapped inside microcapsules and the microcapsules are attached to the surface of the fibers was suggested as a solution to the problem. This method was however problematic in that the microcapsules readily separate from the fibers under the conditions of friction, washing, light exposure and the like.

Melt spinning may be contemplated as a method for manufacturing plant extract-containing fibers. However, typical melting points for synthetic fibers are on the order of 200 ~ 300°C at which plant extracts or vegetable oils, if used in advance of melt spinning, may undergo evaporation, degradation and/or denaturation and thus cannot be incorporated into fibers or will not exhibit sufficient functionality even if incorporated.

In an effort to solve this problem, Korean Patent No. 10-0910241 teaches an electrospinning method by which fine fibers can be drawn at low temperatures from a solution of (a) at least one component selected from among plant extracts and vegetable essential oils and (b) at least one fiber-formable polymer in (c) a solvent.

In electrospinning, a solution is erupted from a nozzle by the electrical force formed between a collector and the nozzle and becomes a jet stream which is then dried into nanofibers as the solvent evaporates when it reaches an incomplete region.

Electrospinning is considered to be a solution to most of the problems associated with conventional spinning methods. However, electrospun fibers exhibit poor mechanical properties because they are not accompanied by the strength enhancement imparted by the molecular orientation of the polymer. For this reason, electrospun fibers are not used for clothes.

Korean Patent No. 10-0563560 discloses "a phytoprotein synthetic fibre" which is composed of vegetable protein and polyvinyl alcohol. Based on the total amount of these two materials, the amount of the vegetable protein that is used is 5 to 23 parts and the polyvinyl alcohol (B, parts) is used in an amount of from 77 to 95 parts.

The phytoproteins are prepared from beans, peanuts and cottonseeds by pulverizing them to separate proteins in a wet manner to separate proteins, skimming the proteins and coagulating the skimmed proteins.

The fibers manufactured using this method are highly permeable to air and have properties similar to those of cashmere, but are not unsuitable for use in clothes due to their poor strength and durability.

In order to reduce the generation of static electricity in synthetic fibers, electroconductive carbon black or metal has been employed in the fibers (Korean Patent Application No. 10-2006-0138108).

However, the electroconductive fibers are too expensive to be used suitably in general clothes.

**[Disclosure]**

**[Technical Problem]**

It is an object of the present invention to provide a synthetic fiber which has significantly improved general physical properties including strength and elongation.

It is another object of the present invention to provide an antistatic synthetic fiber.

It is a further object of the present invention to provide a synthetic fiber having excellent appearance and yarn evenness.

It is still a further object of the present invention to provide an insect-repellent synthetic fiber.

It is still another object of the present invention to provide a synthetic fiber exhibiting superior dyeability and sensation when touched.

It is yet another object of the present invention to provide a synthetic fiber letting off a plant fragrance.

**【Technical Solution】**

In accordance with an aspect thereof, the present invention provides a synthetic fiber containing a plant fatty acid in an amount of from 0.01 to 10.0 wt%.

In accordance with another aspect thereof, the present invention provides a method for manufacturing a synthetic fiber, comprising incorporating a plant fatty acid in an amount of from 0.1 to 10.0 wt% into a fiber-formable polymer and melt-spinning the plant fatty acid-incorporated polymer.

A detailed description will be given of the present invention, infra.

Examples of the plant fatty acids useful in the present invention include linoleic acid, oleic acid, stearic acid, palmitic acid, licanic acid, and ricinol acid, which are abundantly found in linseed oil, sunflower seed oil, rapeseed oil, camellia oil and castor oil.

Ingredients of linseed oil are summarized in Table 1, below.

TABLE 1

| Ingredient | Content (g/100g Fatty Acid) |
|---|---|
| Myristic acid | 0.04021 |
| Pentadecanoic acid | 0.02228 |
| Palmitic acid | 5.27593 |
| Palmitoleic acid | 0.05897 |

| | |
|---|---|
| Margaric acid | 0.06364 |
| Heptadecenoic acid | 0.04187 |
| Stearic acid | 3.47834 |
| Oleic acid | 18.56481 |
| Linoleic acid | 15.39735 |
| Linolenic acid | 56.41282 |
| Arachidic acid | 0.14637 |
| Gadoleic acid | 0.13117 |
| Eicosadienoic acid | 0.04389 |
| Eicosadienoic acid | 0.02286 |
| Heneicosanoic acid | 0.04995 |
| Behenic acid | 0.12625 |
| Erucic acid | 0.01942 |
| Lionaceric acid | 0.10388 |

On the whole, the physical properties of synthetic resins become worse when they are mixed with an additive. In contrast, the physical properties of synthetic fiber are improved rather than degraded, which in our opinion is attributed to the formation of chemical bonds between the fatty acids and the fiber-formable polymer.

Extraction of fatty acids may be accomplished using a solvent method or a heat compression method. Preferable is the latter. The reason is that volatile matters with low molecular weights are removed naturally from the plants during compression at a typical temperature of 80~220°C. When volatile matters with low molecular weights are contained within the fiber-formable polymer, the resulting fibers are

likely to have poor physical properties because the matters are evaporated or degraded at relatively low temperatures.

Incorporating the antibacterial plant extract into the fiber-formable polymer may be carried out by (i) coating synthetic resin chips with plant fatty acids, and melt spinning the coated chips or compounding the coated chips into master batch chips, (ii) preparing a master batch chip in the presence of the plant fatty acids and melt spinning the master batch chip alone or in combination with another typical synthetic chip, (iii) feeding plant fatty acids to a melting zone of an extruder, or (iv) adding the plant fatty acids during the polymerization of the fiber-formable polymer.

Preferable is the method of (iii) in order to minimize the thermal degradation of plant fatty acids. When the method of (iii) is employed, suitable control is necessary to prevent the pressure of the extruder from decreasing.

In the method of (i), that is, the method of coating synthetic resin chips with plant fatty acids, it is preferable that drying be conducted using a rotary-type hot-air drier or a radio-frequency drier least in order to minimize the thermal degradation of plant fatty acids during a drying process.

To enhance the workability in the method of (i) or (ii), the plant fatty acids may be emulsified with water in the presence of an emulsifier.

Preferably, the plant fatty acids are used in an amount

of is from 0.1 to 10 wt%. When too little fatty acid is used, no effects according to the addition of the fatty acids are detected. On the other hand, an amount exceeding the upper limit makes it difficult to manufacture fibers and has an adverse influence on the physical properties of the fibers.

If necessary, ordinary additives such as antioxidants, thermal stabilizers, viscosity improvers, etc. may be used in the melt spinning process.

Additionally, workability in mixing or coating processes may be enhanced by adding a desiccant to plant fatty acids. Also, plant fatty acids may be heated in air or under an aerobic condition to improve the binding rate.

## 【Advantageous Effects】

In addition to being superior to general synthetic fibers in physical properties including strength and elongation, the synthetic fibers of the present invention exhibits excellent bulkiness, elasticity, whiteness, touch sensation, hygroscopicity, dyeability, and gloss. Further, the fibers of the present invention are highly antistatic, with a surface resistivity of less than $1.0\times10^{14}(\Omega)$, and give off a plant fragrance. Therefore, they are useful as material for high-quality clothes.

## 【Mode for Invention】

A better understanding of the present invention may be obtained through the following examples which are set forth to illustrate, but are not to be construed as limiting the present invention.

PREPARATION EXAMPLE 1

After being heated to 180°C, 8,500 kg of linseeds was pressed using an oil press to squeeze oil therefrom. They were left for 15 days to settle solid matter, after which filtration afforded 2,000 kg of linseed oil.

EXAMPLE 1

Polyethylene chips were coated with the linseed oil prepared in Preparation Example 1 by incubating 98 wt% of the chips with 2 wt% of the oil for 15 days. The resulting coated chips were mixed at a weight ratio of 1: 2 with ordinary polypropylene chips and melt-spun at 230°C using a pilot spinning machine to produce 500 g of 150 denier/28 fila filaments.

The raw fibers were knitted into socks and dyed. The socks were found to have excellent color presentation, gloss and touch sensation and to emanate a characteristic plant fragrance.

EXAMPLE 2

Using a twin screw master batch extruder (W&P, Germany), 97 kg of polyamide chips was mixed with 3 kg of the linseed oil prepared in Preparation Example 1 and extruded in a typical manner into master batch chips. These chips were compounded at a weight ratio of 1 : 3 with ordinary polyamide chips, dried in a typical manner and melt spun at 240°C into 150 denier/28 fila filaments using a pilot spinning machine.

The fibers were knitted into socks and dyed. The socks were found to have excellent color presentation, gloss and touch sensation and to emanate a characteristic plant fragrance.

EXAMPLE 3

A mixture of 3 kg of commercially available rapeseed oil and 97 kg of polypropylene chips was used to prepare master batch chips which were then melt spun at 230°C into 150 denier/28 fila filaments using a pilot spinning machine.

The fibers were knitted into socks and dyed. The socks were found to have excellent color presentation, gloss and sensation when touched and to be antistatic.

EXAMPLE 4

A mixture of 3 kg of commercially available castor oil and 97 kg of polypropylene chips was used to prepare master batch chips, as stated in Example 3. The master batch chips were then compounded at a weight ratio with 1 : 1 with ordinary polypropylene chips and melt spun at 230°C into 150 denier/28 fila filaments using a pilot spinning machine.

The fibers were knitted into socks and dyed. The socks were found to have excellent color presentation, gloss and sensation when touched.

EXAMPLE 5

A mixture of 3 kg of commercially available camellia oil and 97 kg of polypropylene chips was used to prepare master batch chips, as stated in Example 3. Then, the master batch chips were compounded at a weight ratio with 1 : 2 with ordinary polypropylene chips and melt spun at 230°C into 150 denier/28 fila filaments using a pilot spinning machine.

The fibers were knitted into socks and dyed. The socks were found to have excellent color presentation, gloss and sensation when touched.

EXAMPLE 6

The linseed oil prepared in Preparation Example 1 was added in an amount of 5 wt% into a polymerization test machine immediately before an ES reaction was performed under the following conditions: molar ratio 1 : 1.12; $Sb_2O_3$(250ppm), $TiO_2$(3,000ppm), $H_3PO_4$(200ppm); final reaction temperature 255°C; reaction time 210 min. Subsequently, a PC reaction was performed for 220 min at a final temperature of 287°C under a pressure of 0.4 torr to produce 70 g of polymerized chips.

The molar ratio means {(Amount of EG fed/Mw of EG 62.07)/(Amount of TPA fed/Mw of TPA 166.13)}.

A mixture of 70 g of the polymerized chip and 300 g of polyester semi dull chips was dried at 180°C for 3 hours and melt spun at 285°C into 150 denier/28 fila filaments.

The fibers were knitted into socks and dyed. The socks were found to have excellent color presentation, gloss and sensation when touched.

EXAMPLE 7

Six kilograms of pulverized linseeds, each 2 kg packed in one P.P. non-woven sack, were put into a pressure decoction machine, and 36 kg of water was added. After boiling at 130°C for 3 hours, the decoction was pressurized in a hydraulic linkage to produce 25 kg of an extract which was then filtered

and concentrated down to 8 kg.

A mixture of 3 kg of the concentrate and 97 kg of polyester chips was used to prepare master batch chips in a typical manner.

The master batch chips were compounded at a weight ratio of 1 : 1 with ordinary polyester semi dull chips, dried, and melt spun at 285°C into 150 denier/28 fila filaments using a pilot spinning machine.

The fibers were knitted into socks and dyed. The socks were found to have excellent color presentation, gloss and sensation when touched.

EXAMPLE 8

Into 99.2 wt% of polyester semidull chips was incorporated 0.8 wt% of the linseed oil prepared in Preparation Example 1. To this end, the linseed oil was continuously fed into a connection between a supply pipe line for main chips and an extruder with the aid of a separate supplier (gear pump) during which melt spinning was conducted at 285±5°C to produce 5,300 kg of 1.4 denier/38 mm staple fibers.

The staple fibers were spun into 40S/1, followed by knitting in a single jersey manner. The knitted goods were dyed normally. Physical properties of the obtained staple

fibers are given in Table 2, below. Test results for detrimental substances (eco full test, infant standard) are summarized in Table 3, below. Table 4 shows properties of the staple fibers and the dyed knitted goods. The properties (elasticity, touch sensation, gloss) of the knitted goods were found to remain constant even after 5 washes.

According to a test for anti-staticity, the dyed knitted goods were found to have a charge of 67 V (cotton cloth) and 99 V (woolen cloth) upon frictional electrification (KS K 0555:2010) {test conditions: (20±2)°C, (40±2) % RH, 400 r/min}. Also, they showed a surface resistivity of $1.4\times10^{12}(\Omega)$ (KS K 0170:2008){test conditions: (20±2)°C, (40±2) % RH} {applied voltage: 100V, 60 sec}, which is highly improved, compared to ordinary synthetic fibers ($1.0\times10^{14\sim15}(\Omega)$).

TABLE 2

| ITEM | Standard values | Fiber of Ex. 8 | Test Method |
|---|---|---|---|
| Denier | 1.4±0.05 | 1.39 | ASTM D 1577.DIN53912 |
| Fiber length(mm) | 38±1.5 | 38.2 | KSK 0327(KOREA) |
| Tenacity(g/de) | 5.5 | 5.76 | ATTM D 3822 |
| Elongation(%) | 30.0±5.0 | 35 | ATTM D 3822 |
| Number of crimp(Number/inch) | 13.5±1.0 | 13.2 | JIS L 1074(JAPEN) |

TABLE 3

| Test Item | Result | Criterion |
|---|---|---|
| pH | 6.2 | 4.0~7.5 (standard) |
| Formaldehyde | Pass | Not Detected (N.D.) |
| Heavy metal (eluted) | Pass | N.D. |
| Heavy metal (acid hydrolysis) | Pass | N.D. |
| Residual agricultural chemical | Pass | N.D. |
| Chlorinated phenols | Pass | N.D. |
| PVC plasticizer (Phthalates) | Pass | N.D. |
| Organotin compound | Pass | N.D. |
| Other compound (OPP) | Pass | N.D. |
| Other compound (PFOS) | Pass | N.D. |
| Other compound (PFOA) | Pass | N.D. |
| Arylamine dye | Pass | N.D. |
| Oncogenic dye | Pass | N.D. |
| Allergic acidic dye | Pass | N.D. |
| Other restricted dye | Pass | N.D. |
| Organochlorine carrier | Pass | N.D. |
| Flame retardants (PBB/TRIS/TEPA/PENTABDEOCTABDE/ DECABDE/HBCDD) | Pass | N.D. |
| Offensive odor | Pass | N.D. |

TABLE 4

| Property | Polyester | Fiber of Ex. 8 | Note |
|---|---|---|---|
| Strength | Very good | Very good | Raw fiber |
| Elongation | Very good | Excellent | Raw fiber |
| Bulkiness | Very good | Excellent | Raw fiber and raw fabric |
| Elasticity | Very good | Excellent | Raw fabric after dyeing |
| Softness | Moderate | Excellent | Raw fiber and raw fabric |

| | | | |
|---|---|---|---|
| Whiteness | Very good | Very good | Raw fiber |
| Touch Sensation | Moderate | Excellent | Raw fabric (upon contact with the skin) |
| Hygroscopicity | Very poor | Good | Raw fabric after dyeing |
| Dyeability | Very good | Excellent | Raw fabric after dyeing |
| Fragrance | None | Rich | Raw fabric after dyeing |
| Anti-staticity | Poor | Excellent | Raw fabric after dyeing |
| Gloss | Moderate | Very good | Raw fabric after dyeing |

A single jersey fabric knitted from polyester 40s/1 spun was dyed, dewatered and dried before being immersed in 5 wt% of the linseed oil of preparation Example 1 in softener-containing water (95 wt%). Then, the knitted fabric was allowed to go through a mangle roller and subjected to a tenter process to afford a sample.

This sample showed high gloss and sensation when touched before being washed, but significantly decreased in gloss and touch sensation after 5 washes.

Although the preferred embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

## [CLAIMS]

1. A method for manufacturing a synthetic fiber, comprising:

incorporating a plant fatty acid in an amount of from 0.1 to 10.0 wt% into a fiber-formable polymer; and

melt-spinning the plant fatty acid-incorporated polymer.

2. The method of claim 1, wherein the incorporating is carried out by coating the fiber-formable polymer with the plant fatty acid in advance of the melt-spinning.

3. The method of claim 1, wherein the incorporating is carried out by mixing the plant fatty acid with the fiber-formable polymer to afford a master batch chip.

4. The method of claim 1, wherein the incorporating is carried out by adding the plant fatty acid to the fiber-formable polymer upon polymerization of the fiber-formable polymer.

5. The method of claim 1, wherein the incorporating is carried out by continuously supplying the plant fatty acid into an extruder upon the melt spinning, using a separate supplier.

6. The method of any one of claims 1 to 5, wherein the fiber-formable polymer is a material capable of being melt spun.

7. The method of claim 1, wherein the plant fatty acid is selected from the group consisting of linoleic acid, oleic acid, stearic acid, palmitic acid, licanic acid, ricinol acid, and a combination thereof.

8. A synthetic fiber, prepared using the method of any one of claims 1 to 5, comprising a plant fatty acid in an amount of from 0.01 to 10.0 wt%.

9. The synthetic fiber of claim 8, having a surface resistivity of $1.0\times10^{14}(\Omega)$ or less.

10. The synthetic fiber of claim 9, having a surface resistivity of $1.0\times10^{13}(\Omega)$ or less.

11. The synthetic fiber of claim 8, emanating a plant fragrance.