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(54) Filament having ultraviolet ray hiding effect and fabric manufactured from said filament

(57) This invention discloses a filament having ultraviolet ray hiding effect and fabric manufactured from said filament. Said filament is obtained by adding inorganic titanium dioxide particles having average diameter of less than 100 nm and constituting preferably less than 1 weight % of the total filament. When said filaments are used in fabric production in an amount preferably over 50% weight of the fabric, thereby producing a fabric with opening rate preferably in excess of 0.7% but preferably less than 25%. The Ultraviolet Protective Factor (UPF) of said fabric is preferably over 40.

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Description

Background of the invention

[0001] This invention discloses a filament with ultraviolet ray hiding effect use to manufacture fabrics. Specifically, this invention discloses a filament having ultravioletray hiding effect use to manufacture fabrics, whose filaments are formed by adding inorganic titanium dioxide particles preferably less than 1% weight of the total filament. The inorganic titanium dioxide particles have dimensions of preferably less than 100 nm.

Prior arts

[0002] Due to large increase in outdoor activities, the market demand for fabrics with ultraviolet ray hiding effect use to produce various types of sportswear, including sportswear for fishing and golfing have largely increased. Demand for household textiles with ultraviolet ray hiding effect, such as garment, hat gingham and curtains, etc. have also largely increased. Conventional attempts to develop and improve filaments use to manufacture textiles with ultraviolet ray hiding effect have been to increase filament density or add fluorescent or whiting agents to the filaments. However, increasing filament density causes poor air permeability and is not suitable for summer textiles, although a higher degree of ultraviolet ray hiding effect protection is needed. The use of fluorescent or whitening agent causes numerous problems. As an example, textiles with fluorescent or whiting agents have demonstrated poor reflection efficiency for ultraviolet rays.

[0003] Other technologies have used ultraviolet reflection agents or/and ultraviolet absorbent agents to insert ultraviolet ray hiding effect protection in textile producing filaments. An ultraviolet reflection agent or ultraviolet absorbent agent can be an inorganic or an organic compound. Because the physical properties of filaments are easily and negatively influenced by the use of organic compound as agents, inorganic compounds are more frequently used. Examples of inorganic ultraviolet reflection and absorbent agents are titanium dioxide, talcum, kaolin, zinc oxide and ferric oxide. Titanium dioxide, which possesses optimal ultraviolet reflection on visible light is frequently used. Similarly, organic compounds with ultraviolet reflection effect on visible light, such as salicylic acid, benzophenone, benzotriazole, cyanoacrylate are often used as ultraviolet absorbent agents.

[0004] Ultraviolet reflection agents and ultraviolet absorbent agents can be directly added to the filaments during die filament spinning process, or alternatively directly onto the textile produced from the filament during post process coating. Adding ultraviolet reflection and/or absorbent agents onto the textile surfaces during post process coating reduces the air permeability of the textile by clogging the textile aperture. Other drawbacks associated with using post process coating are that the produced textiles are usually warmer, that is, textiles absorb and accumulate more heat when worn, and the absorbent and/or reflection agents are quickly shed after numerous washing, reducing the ultraviolet ray hiding effect. Therefore, the addition of ultraviolet agents, via post process coating is not strongly recommended.

[0005] Many attempts have been made to develop and improve the ray hiding effect of ultraviolet light in filaments and fabrics produced from said filaments. Japanese Patent Application Laid-Opened No. 5-148734, discloses a filament structure having ventilation degree exceeding 5ml/cm^2, which contains ultraviolet reflection or absorbent agent with the following results: the ultraviolet penetration of wavelengths between 290-320 nm is below 5%, the ultraviolet penetration of wavelengths between 290-400 nm is below 10%; and the visible light reflectivity of wavelengths between 400 - 1200 nm is above 60 %.

[0006] Furthermore, Japanese Patent Application Laid -Open No. 5-93343, discloses a core sheath structure filament with ultraviolet ray hiding effect containing metal oxide of between 5-40 weight % of the filament. Said application discloses tatting fabric having hiding (cover) factor of between 700 -1300, knitted fabric having hiding factor of between 200 -500, and an ultraviolet penetration percentage of below 10% for the fabric produced from the core sheath structure filament.

[0007] Japanese Patent Application Laid-Open No.5-186942 discloses a knitted fabric with double-layer construction having surface layer hydrophobic filament of titter above 1 denier per filament. The lining and contact layers are made with filament comprising protective inorganic compounds constituting over 3 % weight of the layers, which protects against reflective visible light and near infrared ray light sources.

[0008] The three patent applications discussed above disclose technologies for improving filament with ultraviolet ray hiding features by adding metallic compounds having ultraviolet reflection or absorbent characteristics in an amount between 1% and 40% weight of the filament. Adding large amount of metallic compounds into a textile producing filaments, as proposed by the Japanese Laid-Opened patent applications, reduce spinning productivity and fiber strength and result in the formation of tinct yellow filaments. Besides the metallic compound are not easily controlled on the filament surfaces, large adding amount of metallic compounds will affect abrasion wear in the yarn path of the machines in the post stages of the weaving and finishing process of filament/fabric manufacturing. This is not good for

product quality, and will also greatly reduce the life span of the machine used, increase manufacturing cost.

[0009] To resolve some of the problems associated with the Japanese laid-open patent applications and other problems associated with conventional methods for creating ultraviolet ray hiding effect in filaments, the inventor discovered that by adding inorganic titanium metal particles having average particle diameter preferably less than 100 nm and potassium tripolyphosphate into textile producing filaments, results in the following: (1) increased the distribution area of the inorganic particles in the filaments; (2) avoided the coagulation phenomena associated with using titanium dioxide metal particle alone; (3) increased distinctly the ultraviolet reflection effect; (4) improved spinning productivity;(5) improved filament strength; (6) improved filament tinct; (7) improved the abrasion wear of yarn path of processing machines.

[0010] Consequently, it is an object of this invention to manufacture filaments use in textile production with ultraviolet ray hiding effect, which contains less than1 % weight of inorganic titanium particles with average particle diameter size of preferably less than 100 nm.

[0011] Another object of this invention is to produce filaments having ultraviolet ray hiding effect, which weighs preferably over 50% of fabric produced from said filaments.

[0012] Still another object of this invention is to produce fabrics, using the filaments of this invention, having opening or permeability rate exceeding preferably 0.7%, but preferably less than 25%, and having an ultraviolet protection factor (UPF) of preferably over 40%.

[0013] Finally, it is still an object of this invention to produce filaments, use for producing textiles, having ultraviolet ray hiding protection containing preferably less than 1 % weight of inorganic titanium dioxide particles mixed with potassium tripolyphosphate to prevent coagulation of the titanium dioxide particles.

Summary of the invention

[0014] This invention relates to an filament having ultraviolet ray hiding effect use to manufacture textile for clothings and for producing household textiles, such as garment, hat gingham and curtains, etc. The ultraviolet ray hiding effect results from inventing a filament containing preferably less than 1% weight of inorganic titanium particles having average diameter preferably less than 100 nm.

[0015] When used to manufacture fabrics, the filament of this invention constitutes preferably over 50% weight of fabrics, produces fabrics having permeability rate preferably exceeding 0.7 % but preferably less than 25 % and produces fabrics having ultraviolet protection factor of preferably over 40 %. Finally, the filament of this invention with ultraviolet ray hiding protection contains preferably less than 1 % uncoagulated titanium dioxide particles obtained by mixing the inorganic titanium particles with potassium tripolyphosphate.

Detailed description of the invention

[0016] To obtain filaments having ultraviolet ray hiding effect use for manufacturing textiles, this invention advances its proven concept of adding inorganic titanium dioxide particles having average dimensions of about 100nm to the filament composition. The addition of titanium dioxide enhances resistance to ultraviolet ray while increasing the distribution surface area of the inorganic particles in the filament thereby increasing permeability or opening rate of textiles manufactured from said filaments.

[0017] Other advantages of adding inorganic titanium metal particles are reduction in using amount during production due to increase distribution surface area of inorganic particles, reduction in overall manufacturing cost as using amount is increased, improvement in spinning productivity, enhancement of filament strength, enhancement of filament tinct, improvement in abrasion wear of yarn path of processing machine. The criticality of adding titanium dioxide particles constituting preferably below 1% weight of a total filament is immense. Having filaments with titanium dioxide particles of weight percentage above 1 would most certainly result in the loss of or drastic reduction in the ultraviolet ray hiding effect in fabrics after repeated washing.

[0018] The manner in which the titanium dioxide particles are added to the filaments affects their ability to maintain its ultraviolet ray hiding effect and may affect the overall quality of fabrics manufactured from said filaments. To avoid phenomenon such as the wash effect - removal of the ultraviolet covering effect due to repeated washing the preferred method of adding the titanium dioxide to the filament is directly, rather than post process coating. Direct addition of the titanium dioxide particles can occur at the polymerization stage of the filament production process or the spinning stage with essentially identical results. However, whether the inorganic particles are added during the polymerization process stage or in master-batch type during the spinning process stage, which can avoid coagulation of the titanium dioxide particles is paramount. The presence of coagulated titanium particles in processing will most certainly impact the spinning productivity and will most certainly reduce the distribution area of the inorganic particles in the filaments thereby reducing the overall ultraviolet ray hiding effect. Therefore, to prevent coagulation of the titanium dioxide particles, a dispersant such as potassium tripolyphosphate is added to the titanium dioxide particles by preparing a titanium dioxide/

potassium tripolyphosphate sub-solution.

[0019] It is well known in the art that ultraviolet ray hiding effect is influenced by the filament composition and the thickness of the fabrics. Tightly woven fabrics have lower air permeability or opening rate. The thicker the texture, the better the ultraviolet ray hiding effect. Because fabrics with ultraviolet ray hiding effect are mostly desired and used during the summer season, the degree of permeability and thickness of fabric will greatly influence the degree of textile comfort when worn. To increase the comfort level of fabrics with ultraviolet ray hiding effect, a cross, Y, W type profile sectional spinneret can be used during the spinning stage of the filament production. The guiding gutter and the large surface area of the profile section of filament can be utilized to make fabric having ultraviolet ray hiding effect and fabric with the ability to absorb moisture while providing enhanced perspiration. Such fabrics will be suitable especially for summer activities.

[0020] Because Ultraviolet Protective Factor (UPF) determines the degree of ultraviolet ray hiding effect in textiles, the fabric manufactured from the filament in this invention can be evaluated as UPF according to the Standard of AS (Australian Standard)/NZS(New Zealand standard) 4399, 1996 : Evaluation and Classification of Sun Protective Clothing. The Ultraviolet Protective Factor value and ultraviolet ray hiding effect in AS/NZS 4399, 1996 revealed the following results; when UPF is between 25-39, the ultraviolet ray hiding effect is considered very good; and when UPF is between 40-50 or above 50, the ultraviolet ray hiding effect is considered excellent.

[0021] The following methods for measuring ultraviolet protective factor, textile opening rate and yarn abradability (abrasion wear of yarn path) were partly used to assess the reliability of the inventive findings:

1. UPF value menstruation:

[0022] Measured with AS / NZS 4399: 1996 standard.

2. Textile opening rate menstruation:

[0023] The measurement of the opening rate using a light microscopic having magnification between 10 -50 comprised of the following steps: placing a light source inside the textile to be measured to make the textile transparent; taking a microscopic photograph of the transparent textile; and calculating the percentage of the total area of the white section with respect to the total area of the textile - the percentage of the white section is the opening rate of the textile.

3. Yarn abradability menstruation:

[0024] The measurement of the yarn abradability comprised the following steps: Grinding the yarn to be measured with copper wire having dimensions of 0.25 mm wire diameter, under a tension of 0.5 gm/denier, and at an elongation rate of 300m/minutes; and recording the passing length of the yarn when the copper wire is grinded and ruptured by the yarn. The longer it takes the yarn to pass through, the more unobvious the measured abradibility of the yarn is.

[0025] By way of examples, the manufacturing processes, conditions and process components, though not limited to examples, of the present invention may be as follows:

Examples

Example 1

[0026] Adding to the polyester chip inorganic titanium dioxide particles with ultraviolet reflection effect having the following parameters: particles with diameter less than 100 nm in amount of 0.5 % weight of the total filament; and particles with diameter exceeding 0.3 μm (micro meter) or 300nm in an amount of 0.4% weight of the filament. Conducting spinning at a temperature of 290°C and at a spinning speed of 3000 m/minute to produce partially oriented yarn (POY). False twisting the POY at a speed of 600 m/minute to produce Draw Textured Yarn (DTY) with ultraviolet ray hiding effect.

Example 2

[0027] Similar to the working conditions include spinning and false twisting to produce DTY with ultraviolet ray hiding effect in example 1, but inorganic titanium dioxide particles of average particle diameter less than 100 nm is added in an amount of 0.9% weight of the filament composition.

Comparative Example 1

[0028] Similar to the working conditions include spinning and false twisting to produce DTY with ultraviolet ray hiding effect in example 1, but inorganic titanium dioxide particles of average particle diameter greater than 0.3 μm is added in an amount of 0.9% weight of the filament composition.

Comparative Example 2

[0029] Similar to the working conditions include spinning and false twisting to produce DTY with ultraviolet ray hiding effect in example 1, but inorganic titanium dioxide particles of average particle diameter greater than 0.3 μm is added in an amount of 1 6 % weight of the filament composition.

Evaluation Result

[0030] The DTY with ultraviolet ray hiding effect produced according to example 1, example 2, comparative example 1 and comparative example 2 are of 75 denier/72 filament (75d/72f), used as weft yarn, while conventional 75d/72f yarn used as warp yarn; tatting 1 / 1 texture, warp density is 112 strip/ inch; weft density is 112 strip/inch; weight per unit area is 92 g/m^2; cloth thickness is 0.28 mm; and the fabric opening rate is 10.6%. The yarn abradability and UPF of fabrics are shown in the following table.

	Yarn abradability (m)	UPF of fabrics (%)
Example 1	14276	60.6
Example 2	40000	66.0
Comparative Example 1	5545	36.0
Comparative Example2	2667	66.0

[0031] The DTY with ultraviolet ray hiding effect produced according to example 1, example 2, comparative example 1 and comparative example 2 are of 150denier/144 filament (130d/144f), 22G PK knitted; weight per unit area is 220 g/m^2; cloth thickness is 1.0mm; and the opening rate of fabric is 5.3%. UPF of fabrics are shown in the following table.

	UPF of fabrics (%)
Example 1	114
Example 2	130
Comparative Example 1	78
Comparative Example 2	126

[0032] From above experimental results, the larger the opening rate of fabric, the poorer the ultraviolet ray hiding effect. When the opening rate of fabric is large, inorganic titanium dioxide particles having average particle diameter less than 100 nm can be added to the filament in an amount less than 1.0 % weight of the total filament composition to provide ultraviolet reflection effect, and the filament can be used to produce fabrics with ultraviolet ray hiding effect. UPF of fabrics having inorganic titanium dioxide with average particle diameter of less than 100nm is apparently superior than similar percentage weight addition of titanium dioxide particles having average particle diameter greater than 0.3 μm or 300nm.

[0033] For fabrics containing inorganic titanium dioxide particles greater than 0.3 μm to have similar ultraviolet reflection and ray hiding effect as fabrics containing inorganic titanium dioxide particles less than 100 nm, the addition amount of the titanium dioxide particles having average particle diameter greater than 0.3 μm has to be increased. However, the increase in addition levels of the latter will affect abrasion wear in the yarn path of the machines in the post stages of the weaving and finishing process of filament/fabric manufacturing. This is not good for product quality, and will also greatly reduce the life span of the machine used, increase manufacturing cost

[0034] It is obvious that the UPF of the fabric manufactured from the filament having ultraviolet hiding effect of this invention is still higher than 40% as the opening rate of said fabric is 25 %. Therefore, the fabric manufactured from the filament having ultraviolet hiding effect of this invention used in the summer season, which not only have excellent ultraviolet hiding effect, but also get rid of skin aging, sunburn and/or skin cancer. Due to excellent permeability, it will

enhance the comfort when wears, such fabrics will be suitable especially for summer activities.

[0035] The present invention comprises the following preferred embodiments:

1. A filament having ultraviolet ray hiding effect use to manufacture fabrics for use as clothing and household textiles, such as curtains capable of preventing skin aging, sunburn and/or skin cancer, while enhancing wearing comfortableness and air permeability comprising:

(a) inorganic particles having average particle diameter less than 300nm; and
(b) said inorganic particles constituting less than 1% weight of the total filament.

2 A filament having ultraviolet ray hiding effect according to embodiment 1, wherein said inorganic particles are titanium dioxide.

3. A filament having ultraviolet ray hiding effect according to embodiment 1, wherein said inorganic particles have average particle diameter of less than 100nm.

4. A filament having ultraviolet ray hiding effect according to embodiment 2, wherein said inorganic particles have average particle diameter of less than 100nm

5 A filament having ultraviolet ray hiding effect according to embodiment 1, wherein the filament comprises over 50% weight of the fabric.

6 A filament having ultraviolet ray hiding effect according to embodiment 2, wherein the filament comprises over 50% weight of the fabric.

7. A filament having ultraviolet ray hiding effect according to embodiment 3, wherein the filament comprises over 50% weight of the fabric.

8. A filament having ultraviolet ray hiding effect according to embodiment 4, wherein the filament comprises over 50% weight of the fabric.

9. A filament having ultraviolet ray hiding effect according to embodiment 2, wherein an opening rate of said manufactured fabric exceeds 0.7% but is less than 25%.

10. A filament having ultraviolet ray hiding effect according to embodiment 3, wherein an opening rate of said manufactured fabric exceeds 0.7% but is less than 25%.

11. A filament having ultraviolet ray hiding effect according to embodiment 4, wherein an opening rate of said manufactured textile exceeds 0.7% but is less than 25%.

12. A filament having ultraviolet ray hiding effect according to embodiment 5, wherein an opening rate of said manufactured textile exceeds 0.7% but is less than 25%.

13. A filament having ultraviolet ray hiding effect according to embodiment 2, wherein an ultraviolet protective factor of said fabric containing said filament is above 40%.

14. A filament having ultraviolet ray hiding effect according to embodiment 3, wherein an ultraviolet protective factor of said fabric containing said filament is above 40%.

15. A filament having ultraviolet ray hiding effect according to embodiment 8, wherein an ultraviolet protective factor of said fabric containing said filament is above 40%.

16. The inorganic particles according to embodiment 15, wherein said particles are uncoagulated.

17. The inorganic titanium dioxide particles according to embodiment 4, wherein said particles are uncoagulated.

18. The inorganic particles according to embodiment 16, wherein said uncoagulated particles results from in-situ preparation of said particles with a dispersant

19. The inorganic titanium dioxide particle according to embodiment 17, wherein said uncoagulated particles results from in-situ preparation of said particles with a dispersant.

20. The dispersant according to embodiment 18 is potassium tripolyphosphate.

Claims

1. A filament having ultraviolet ray hiding effect use to manufacture fabrics for use as clothing and household textiles, such as curtains capable of preventing skin aging, sunburn and/or skin cancer, while enhancing wearing comfortableness and air permeability comprising:

   (a) inorganic particles having average particle diameter less than 300nm; and
   (b) said inorganic particles constituting less than 1% weight of the total filament.

2. A filament having ultraviolet ray hiding effect according to claim 1, wherein said inorganic particles are titanium dioxide.

3. A filament having ultraviolet ray hiding effect according to claim 1 or 2, wherein said inorganic particles have average particle diameter of less than 100nm.

4. A filament having ultraviolet ray hiding effect according to one or more of the preceding claims, wherein the filament comprises over 50% weight of the fabric, and/or wherein an opening rate of said manufactured fabric exceeds 0.7% but is less than 25%.

5. A filament having ultraviolet ray hiding effect according to one or more of the preceding claims, wherein an ultraviolet protective factor of said fabric containing said filament is above 40%.

6. The inorganic particles according to one or more of the preceding claims, wherein said particles are uncoagulated.

7. The inorganic particles according to one or more of the preceding claims, wherein said uncoagulated particles results from in-situ preparation of said particles with a dispersant.

8. The inorganic titanium dioxide particle according to one or more of the preceding claims, wherein said uncoagulated particles result from in-situ preparation of said particles with a dispersant.

9. The dispersant according to claim 8 is potassium tripolyphosphate.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 00 9267

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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

D01F
D03D
D02G
A41D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	2 September 2003	D'Souza, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 03 00 9267

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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