US 20060029800A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2006/0029800 A1**

Kang et al. (43) **Pub. Date: Feb. 9, 2006**

(54) **FLUORESCENT ELASTIC YARN AND METHOD FOR PRODUCING THE SAME**

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(21) Appl. No.: **11/151,826**

(22) Filed: **Jun. 13, 2005**

Related U.S. Application Data

(63) Continuation-in-part of application No. 10/238,936, filed on Sep. 9, 2002, now abandoned.

(30) **Foreign Application Priority Data**

Apr. 18, 2002 (KR) 2002-21159

Publication Classification

(51) **Int. Cl.**
D02G 3/00 (2006.01)

(52) **U.S. Cl.** **428/375**

(57) **ABSTRACT**

Disclosed is a fluorescent elastic yarn and method for producing the same. The fluorescent elastic yarn which is finished with the spinfinish oil containing the fluorescent agent can fluoresce sufficiently to allow a fine elastic yarn to be seen by the naked eye when ultraviolet light is irradiated to the fluorescent elastic yarn. Therefore, the fluorescent elastic yarn of the present invention is advantageous in that CSY (Core spun yarn) producers are able to identify its presence inside of the hard fiber covering it more easily and timely and thus minimize the numbers of inferior CSY products which are not spun with elastic yarn strands. In addition to this merit, the fluorescent elastic yarn of the present invention gives CSY producers the other advantage that the fluorescent agent can be easily removed from the elastic yarn during the general scouring process posterior to the CSY production process, and therefore there is no possibility that the fluorescent agent is still remain on the fabric made with the CSY.

FLUORESCENT ELASTIC YARN AND METHOD FOR PRODUCING THE SAME

[0001] This application is a Continuation-in-Part of application Ser. No. 10/238,936, filed Sep. 9, 2002, which application is incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the invention

[0003] The present invention relates, in general, to a fluorescent elastic yarn and a method for producing the same. In particular, the present invention relates to a fluorescent elastic yarn which is finished with the spinfinish oil containing the fluorescent agent which can fluoresce sufficiently to allow a fine elastic yarn to be seen by the naked eye when ultraviolet light is irradiated to the fluorescent elastic yarn, and a method of producing the same.

[0004] 2. Description of the Prior Art

[0005] An elastic yarn has been applied to various fields, and a process of knitting and weaving the elastic yarn covered with a natural fiber has been widely used in the art. Various types of elastic yarns, for example, a core spun yarn (CSY) in which cotton or a rayon fiber is covered on the elastic yarn, and a covered yarn in which a synthetic fiber such as nylon and polyester is covered on the elastic yarn, are used to produce elastic textile fabrics or knitted goods requiring elasticity.

[0006] However, there is a problem during a covering process of the elastic yarn in that a breakage of the elastic yarn cannot be discovered in real time, and so inferior products having only the covered yarn wound without the elastic yarn to be inserted may be produced. This problem causes a reduction in productivity of the covered elastic yarn and a waste of the covered yarns. Accordingly, there remains a need for the development of a novel method capable of finding effectively a breakage of the elastic yarn in real time. In addition to this necessity, there is a definite need for a tracer applied to the elastic yarn which can be easily removed from the elastic yarn under routine scouring process.

[0007] In a conventional art, titanium-based or magnesium-based inorganic additives have been added into the elastic yarn, and these inorganic additives may emit a faint dark violet ray when irradiated by ultraviolet light. However, these inorganic additives have not been added into the elastic yarn to find a breakage of the elastic yarn, but rather to improve dulling effect, anti-blocking property, and chlorine resistance, and so the inorganic additives are definitely not classified as tracers for a yarn breakage.

[0008] Even though these inorganic additives may be added to the elastic yarn to find a yarn breakage, this method is disadvantageous in that when thickness of the elastic yarn is less than 40 deniers, or a small capacity device such as a portable UV irradiator generally used in a workplace is used to identify a breakage of the elastic yarn, it is impossible to find the breakage of elastic yarn strand inside of hard fibers covered on. Accordingly, in case of the conventional method, the existence of the elastic yarn inside of the covered yarn can be identified under a stationary high power UV light only after the covering process is finished and the covered yarn products are manufactured.

SUMMARY OF THE INVENTION

[0009] Therefore, it is a feature of the present invention to provide a fluorescent elastic yarn which can be discriminated by fluorescence when ultraviolet light is irradiated to it.

[0010] It is another feature of the present invention to provide a method for producing the fluorescent elastic yarn.

[0011] It is yet another feature of the present invention to provide a hard fiber-covered fluorescent elastic yarn using the fluorescent elastic yarn.

[0012] In accordance with an aspect of the present invention, there is provided a method for producing a fluorescent elastic yarn comprising the step of finishing the fluorescent elastic yarn with spinfinish oils whose main components are a silicone oil, a hydrocarbon oil(in other words, paraffin oil) and a fluorescent agent capable of being soluble or dispersed effectively in the hydrocarbon oil, and being scoured easily in a routine scouring process, wherein the content of fluorescent agent ranges from 0.001 to 1 wt % of a resulting elastic yarn weight.

[0013] In accordance with another aspect of the present invention, there is provided a method for producing a hard fiber-covered fluorescent elastic yarn, comprising the step of covering a core yarn, wherein the core yarn is the fluorescent elastic yarn.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

[0014] A segmented polyurethaneurea useful for production of a fluorescent elastic yarn of the present invention is produced by reacting organic diisocyanate with polydiol to produce a capped glycol, and then dissolving the capped glycol in an organic solvent and reacting with diamine and monoamine.

[0015] The organic diisocyanate used to produce the segmented polyurethaneurea includes, not limited to, diphenylmethane-4,4'-diisocyanate, hexamethylenediisocyanate, toluenediisocyanate, butylenediisocyanate, and hydrogenated P,P-methylenediisocyanate.

[0016] The polydiol used to produce the segmented polyurethaneurea includes, not limited to, polytetramethylene ether glycol, polypropylene glycol, and polycarbonate diol.

[0017] Furthermore, a diamine such as ethylene diamine, propylene diamine, and hydrazine can be used as a chain extender, and a monoamine such as diethylamine, monoethanol amine, and dimethyl amine can be used as a chain termination agent.

[0018] The hard fiber useful for covering the elastic yarn according to the present invention may be cotton, rayon, nylon, polyester, or cellulose.

[0019] The fluorescent agent may be added into a spinfinish oil which is applied to elastic yarn strands posterior to the spinning process, and prior to the winding process around a paper cores. The fluorescent agent is added to the elastic yarn in such an amount that a fluorescent agent content ranges from 0.001 to 1 wt % in the resulting elastic yarn.

[0020] When the fluorescent agent content is less than 0.001 wt %, the fluorescent effect is poor. On the other hand, when the content is more than 1 wt %, dispersibility or solubility of the fluorescent agent in a spinfinish oil is the worst and so the fluorescence of the fluorescent elastic yarn is non-uniform throughout the yarn package though the fluorescence is the brightest. In addition, the fluorescent elastic yarn cannot be produced economically due to the heavy cost of the fluorescent agent and serious winding discontinuity problems.

[0021] The fluorescent agent used in the present invention include, not limited to, a stilbene-based fluorescent agent, a pyrazolone-based fluorescent agent, an imidazole-based fluorescent agent, an oxazole-based fluorescent agent, a coumarin-based fluorescent agent, a rhodamine-based fluorescent agent, and a fluorescein-based fluorescent agent. Specific examples of each fluorescent agent are as follows:

[0022] Stilbene-based fluorescent agent: C.I.(Color Index) Fluorescent agent No. 24, 77, 84, 85, 90, 97, 132, 151, 153, 154, and 166, which are kinds of ((Bis)triazinylaminostilbene)) or derivatives thereof;

[0023] Pyrazolone-based fluorescent agent: C.I. Fluorescent agent No. 54 and 124;

[0024] Imidazole-based fluorescent agent: C.I. Fluorescent agent No. 45, 133, 140, 150, 189, 228, and 2-isopropylimidazole (CAS(Chemical Abstract Society)# 36947-68-9);

[0025] Oxazole-based fluorescent agent: C.I. Fluorescent agent No. 170, 171, 219, 258, 259, and (2,2'-2,5-diophenydil)bis[5-(1,1-dimethylethyl)]-benzoxazol (usually referred to as 'ubitex OB');

[0026] Coumarin-based fluorescent agent: C.I. Fluorescent agent No. 52, 69, 78, 91, 130, 152, 156, 162, Coumarin 1(CAS# 91-44-1, 7-diethylamino-4-methyl coumarin), and Coumarin 6(CAS# 38215-36-0, 3-(2-benzotiazolyl)-7-diethylamino coumarin);

[0027] Rhodamine-based fluorescent agent: Rhodamine B (CAS# 81-88-9, N-[9-(2-carboxyphenyl)-6-diethylamino-3H-xanthen-3-ylidene]-N-ethylethanammonium chloride), and Rhodamine isocyanate (CAS# 36877-69-7); and

[0028] Fluorescein-based fluorescent agent: Fluorescein (CAS# 2321-07-5), and Fluorescein asocyanate (CAS# 3326-32-7).

[0029] It is preferable that the fluorescent agent is dispersed in an organic solvent prior to being mixed with a spinfinish oil. The organic solvent includes, not limited to, methanol and hexylene glycol (CAS# 107-41-5, 2-methyl-2,4-pentandiol).

[0030] When the fluorescent elastic yarn is produced using the spinfinish oil containing the fluorescent agent, the fluorescent elastic yarn is advantageous in that the fluorescent elastic yarn is readily visually inspected because the fluorescent agent is coated on the surface of the elastic yarn. Also, the fluorescent agent can be applied to diverse uses of elastic yarn because the fabrics knitted or woven with the fluorescent elastic yarn is easily scoured during a normal and routine scouring process in which sodium dioxide or perchloroethylene is used as a scouring agent.

[0031] A better understanding of the present invention may be obtained by reading the following examples which are set forth to illustrate, but are not to be construed to limit the present invention.

EXAMPLE 1

[0032] 518 g of diphenylmethane-4,4'-diisocyanate was reacted with 2328 g of polytetramethyleneether glycol (molecular weight: 1800) under a nitrogen gas atmosphere at 85° C. for 90 min to produce a capped glycol containing isocyanate groups positioned at both polymer ends thereof. The capped glycol thus produced was cooled to room temperature, and 4643 g of dimethylacetamide was added to the cooled capped glycol and dissolved the capped glycol to produce a capped glycol solution.

[0033] After that, a solution, in which 54 g of propylene diamine and 9.1 g of diethylamine were dissolved in 1889 g of dimethylacetamide, was added to the capped glycol at 10° C. or less to produce a segmented polyurethaneurea polymer solution.

[0034] Additives such as a UV stabilizer, an antioxidant, a anti-fuming agent, a dye enhancer, a magnesium-based anti-blocking agent, and a titanium-based dulling agent were added to the above segmented polyurethaneurea polymer solution. The resulting polyurethaneurea polymer was subjected to a deaerating process, drawn at a spinning temperature of 250° C. by a dry spinning process, and then finished with the spinfinish oil prepared by blending polydimethylsiloxane, paraffin oil, and the fluorescent agent by a conventional kissing roller.

[0035] As one candidate for fluorescent agent, Coumarin 1 (CAS# 91-44-a, 7-diethyl amino-4-methylcoumarin) was dispersed in hexylene glycol (CAS# 107-41-5, 2-methyl-2, 4-pentanediol) in a weight ratio of 2:8 to produce a dispersion liquid, and the dispersion liquid was added to the spinfinish oil in such an amount that the dispersion liquid is 10 wt % of the spinfinish oil weight. The % FOY(Finish on Yarn) was 5 wt % of the elastic yarn weight as usual. Here, the % FOY means the weight % of the spinfinish oil to the weight of elastic yarn.

[0036] With the FOY % applied, the resulting elastic yarn was wound on a paper core to produce a polyurethaneurea elastic yarn package with a thickness of 10 denier. In this elastic yarn, the fluorescent agent content was finally 0.1 wt %. And then, the polyurethaneurea elastic yarn was covered with a polyester false twist yarn with a thickness of 75 denier with the use of conventional covering machine. The luminosity of the polyurethaneurea elastic yarn package (spool) itself, visual inspection of a single strand of elastic yarn strand, and visual identification of the presence of a single strand of elastic yarn strand inside of hard fiber covered on were evaluated, and results are described in Table 1.

EXAMPLES 2 TO 4

[0037] The procedure of example 1 was repeated except that the resulting polyurethane elastic yarns were 20, 40, and 140 deniers in thickness. The luminosity of the polyurethaneurea elastic yarn package (spool) itself, visual inspection of a single strand of elastic yarn strand, and visual identification of the presence of a single elastic yarn strand inside of hard fiber covered on were evaluated, and results are described in Table 1.

COMPARATIVE EXAMPLES 1 TO 4

[0038] The procedure of example 1 was repeated to produce the resulting elastic yarns of 10, 20, 40, and 140 deniers except that a fluorescent dispersion liquid was not applied to the spinfinish oil. The luminosity of the polyurethaneurea elastic yarn package (spool) itself, visual inspection of a single strand of elastic yarn strand, and visual identification of the presence of a single elastic yarn strand inside of hard fiber covered on were evaluated, and results are described in Table 1.

EXAMPLE 5

[0039] The procedure of example 3 was repeated except that a dispersion liquid having a fluorescent agent dispersed therein was added to a spinfinish oil by 0.1 wt % of the spinfinish oil weight. The % FOY (Finish on Yarn) was 5 wt % of the elastic yarn weight as usual, and then the resulting elastic yarn with a thickness of 40 denier was produced and a fluorescent agent content in the resulting elastic yarn was 0.001 wt %.

EXAMPLE 6

[0040] The procedure of example 3 was repeated except that a dispersion liquid having a fluorescent agent dispersed therein was added to a spinfinish oil by 50 wt % of the spinfinish oil weight. The % FOY (Finish on Yarn) was 10 wt % of the elastic yarn weight, and then the resulting elastic yarn with a thickness of 40 denier was produced and a fluorescent agent content in the resulting elastic yarn was 1 wt %.

COMPARATIVE EXAMPLE 5

[0041] The procedure of example 3 was repeated except that a dispersion liquid having a fluorescent agent dispersed therein was added to a spinfinish oil by 0.01 wt % of the spinfinish oil weight. The % FOY (Finish on Yarn) was 5 wt % of the elastic yarn weight as usual, and then the resulting elastic yarn with a thickness of 40 denier was produced and a fluorescent agent content in the resulting elastic yarn was 0.0001 wt %.

COMPARATIVE EXAMPLE 6

[0042] The procedure of example 3 was repeated except that a dispersing agent, hexylene glycol was not used for dispersing a fluorescent agent and that a fluorescent agent was added directly to a spinfinish oil by 20 wt % of the spinfinish oil weight. The % FOY (Finish on Yarn) was 10 wt % of the elastic yarn weight, and then the resulting elastic yarn with a thickness of 40 denier was produced and s fluorescent agent content in the resulting elastic yarn was 2 wt %.

TABLE 1

		Luminosity under UV (25 lux)			Over than	
	Denier (d)	Elastic yarn Package (spool) itself (lux)	Visual inspection of single elastic yarn strand	Identification of the presence of single elastic yarn strand	90% removal of fluorescent agent by routine NaOH scouring	Whiteness
Ex. 1	10	8~10	Possible	Possible	O.K.	⊙
Ex. 2	20	8~10	Possible	Possible	O.K.	⊙
Ex. 3	40	8~10	Possible	Possible	O.K.	⊙
Ex. 4	140	8~10	Possible	Possible	O.K.	⊙
Ex. 5	40	1~2	Possible	Possible	O.K.	○
Ex. 6	40	22~24	Possible	Possible	O.K.	⊙
Co. Ex. 1	10	0~1 (dark violet)	Impossible	Impossible	—	Δ
Co. Ex. 2	20	0~1 (dark violet)	Impossible	Impossible	—	Δ
Co. Ex. 3	40	0~1 (dark violet)	Impossible	Impossible	—	Δ
Co. Ex. 4	140	0~1 (dark violet)	Nearly Impossible	Nearly Impossible	—	Δ
Co. Ex. 5	40	0~1	Impossible	Impossible	O.K.	Δ
Co. Ex. 6	40	22~26	Possible	Possible	About 20% remained	⊙

⊙: excellent,
○: good,
Δ: poor

[0043] From the results of Table 1, it can be seen that a fine elastic yarn of 40 d or less without the fluorescent is difficult to be visually inspected under UV light, and when a fluorescent agent content based on the resulting polymer solid is 2 wt % or more as in the case of comparative example 6, the elastic yarn has an excellent fluorescent effect, but has disadvantages of poor scouring performance and poor dispersibility of a fluorescent agent, which is resulted in precipitation problem of it. On the other hand, if the content of a fluorescent agent is 0.0001 wt % or lower than this as in the case of comparative example 5, the fluorescent effect is hardly exhibited.

EXAMPLES 7 TO 13

[0044] The procedure of example 3 was repeated except that a fluorescent agent and a dispersing agent are different from each other as shown in Table 2. The luminosity of the resulting elastic yarns was evaluated, and results are described in Table 2.

TABLE 2

Ex.	Group of Fluorescent Brightener	C.I.# or commercial name	Dispersing agent	Luminosity under 25 lux UV (lux)	Whiteness
7	Stilbene	24	Methanol	2~4 (blue violet)	○
		77	Hexylene glycol	5~6	⊙
		84	Methanol	5~6 (blue violet)	⊙
		85	Methanol	4-6 (blue violet)	⊙
		90	Methanol	5~6 (blue violet)	⊙
		97	Hexylene glycol	5~6 (blue)	⊙
		132	Hexylene glycol	5~6 (blue)	⊙
		151	Methanol	2~4 (red blue)	○
		153	Methanol	2~4 (blue)	○
		154	Methanol	5~6 (blue)	⊙
		166	Methanol	5~6 (greeen blue)	⊙
8	Pyrazolone	54	Methanol	2~3 (green blue)	○
		124	Methanol	2~3 (blue)	○
9	Imidazole	45	Methanol	4~6 (blue)	⊙
		133	Methanol	4~6 (blue)	⊙
		140	Methanol	4~6 (blue)	⊙
		150	Methanol	5~7 (blue)	⊙
		189	Methanol	4~6 (blue)	⊙
		228	Hexylene glycol	4~6 (blue)	⊙
		2-isopropyl imidazole	Hexylene glycol	4~6 (blue)	⊙
10	Oxazole	170	Methanol	2~4 (blue)	○
		171	Methanol	2~4 (blue)	○
		219	Acetone	1~2 (red blue)	Δ
		258	Acetone	1~2 (blue violet)	Δ
		259	Methanol	2~4 (blue)	○
11	Coumarin	52	Methanol	3~6 (blue violet)	⊙
		69	Acetone	3~6 (blue violet)	⊙
		78	Acetone	3~6 (blue violet)	⊙
		91	Acetone	3~6 (blue violet)	⊙
		130	Hexylene glycol	3~6 (violet)	⊙
		152	Acetone	3~6 (green blue)	⊙
		156	Acetone	3~6 (blue)	⊙
		162	Acetone	3~6 (blue)	⊙
		Coumarin 1	Hexylene glycol	8~10	⊙
		Coumarin 6	Hexylene glycol	8~10	⊙
12	Rhodamine	Rhodamine B	Acetone	6~8 (blue)	⊙
		Rhodamine isocyanate	Acetone	6~8 (blue)	⊙
13	Fluorescein	Fluorescein	Acetone	5~7 (green)	⊙
		Fluorescein isocyanate	Acetone	5~7 (green)	⊙

⊙: excellent,
○: good,
Δ: poor

[0045] As described above, the present invention is advantageous in that a fluorescent elastic yarn of this invention can be visually inspected under UV even though the elastic yarn is covered with a polyester false twist yarn, and also it can be identified, even if the fine elastic yarn of 10 denier, is present, thereby production of inferior CSY (Core Spun Yarn) or covered yarn without a fluorescent elastic yarn is minimized and thus their productivity is improved in a downstream process.

[0046] The present invention has been described in an illustrative manner, and it is to be understood that the terminology used is intended to be in the nature of description rather than of limitation. Many modifications and variations of the present invention are possible in light of the above teachings. Therefore, it is to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A fluorescent elastic yarn finished with fluorescent agent dissolved or dispersed in spinfinish oils and effectively removed during a scouring process.

2. A method for producing a fluorescent elastic yarn comprising the step of finishing the fluorescent elastic yarn with spinfinish oils whose main components are a silicone oil, a hydrocarbon oil and a fluorescent agent capable of being soluble or dispersed effectively in the hydrocarbon oil, wherein the content of fluorescent agent ranges from 0.001 to 1 wt % of a resulting elastic yarn weight.

3. The method according to claim 2, wherein the fluorescent agent is selected from the group consisting of a stilbene-based fluorescent agent, a pyrazolone-based fluorescent agent, an imidazole-based fluorescent agent, an oxazole-based fluorescent agent, a coumarin-based fluorescent agent, a rhodamine-based fluorescent agent and a fluorescein-based fluorescent agent.

4. A method for producing a covered fluorescent elastic yarn, comprising the step of covering a core yarn,

wherein the core yarn is the fluorescent elastic yarn according to claim 1.

5. The method according to claim 4, wherein the fluorescent elastic yarn is covered with at least one selected from the group consisting of cotton, rayon, nylon, polyester and cellulose.

6. A covered fluorescent elastic yarn produced through the method according to claims **4** or **5**.

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