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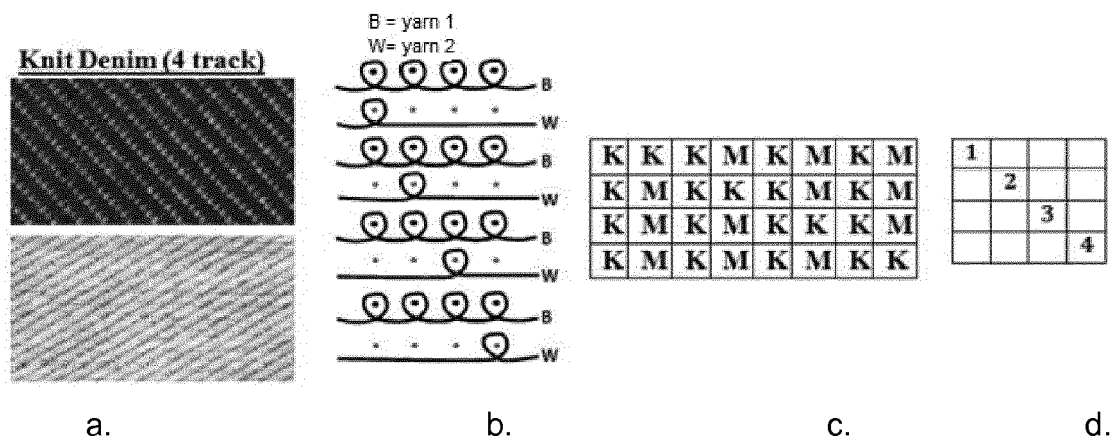
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(54) **DENIM FABRIC AND ITS USE**

(57) This invention relates to a fabric consisting of at least a first yarn containing cellulosic fibers modified by a cationic modifier and a second yarn containing cellu-

losic fibers not modified by a cationic modifier, and to the use of this fabric in order to obtain a denim appearance.

Fig. 2:



Description

[0001] This invention relates to a fabric consisting of at least a first yarn containing cellulosic fibers modified by a cationic modifier and a second yarn containing cellulosic fibers not modified by a cationic modifier, and to the use of this fabric in order to obtain a denim appearance.

Prior Art

[0002] Denim is a kind of comfortable, fashionable, durable, casual textile fabric and popular in all age groups and all countries. Due to its typical, unique appearance - in particular the wash-out effect and its reputation as a durable fabric - garments made of denim have a cult item status.

[0003] Essential for this is the dyeing with indigo and the fabric construction, where the outer surface of the fabric in the garment typically is blue and on the inner surface white colour is dominating.

[0004] The traditional denim is woven-made by interlacings of warp and weft yarns feature to create fabric construction with color fading feature, and it is normally a stiff, heavy weight and high-density fabric. The fabric construction usually is 3/1 or 2/1 twill and 1/1 chambray construction. Fig. 1 shows a typical fabric construction.

[0005] To obtain the typical denim appearance with a dominantly coloured outside and a dominantly white inside of the garment, a coloured yarn and a white yarn have to be used for the weaving. Usually the coloured yarn is used as the warp yarn while the white yarn is used as the weft yarn. When denim is woven, it is done in such a way that 60% of the material's coloured warp is on the outside of the garment and 40% of the white weft is on the inside. This means, among others, that the weaver has to keep at least two kinds of yarn in stock. If various coloured fabrics are needed, further yarns already dyed to the target fabric colour have to be kept in stock. Yarn dyeing generally is performed in specific dyeing equipment and therefore more costly than e.g. fabric dyeing or piece dyeing. Furthermore only a very limited number of colours suitable for denim-look dyeing is available.

[0006] Traditionally, indigo dyestuff is commonly used for denim dyeing. The indigo pigment is a kind of water-insoluble vat dye. It has no affinity for the cellulosic fibre. A lot of chemicals like sodium hydroxide and sodium hydrosulfite are required to convert the indigo into a water-soluble form which is a kind of fibre-affinitive leuco form. To convert 1kg of indigo granules into the leuco form, 0.8kg of sodium hydrosulfite and 0.67kg of sodium hydroxide for the reduction process are needed. The workflow of the typical indigo yarn dyeing process is as follows: Prewetting - rinsing - scouring - rinsing - yarn indigo dyeing (rope dyeing) - rinsing/softening - rebeaming.

[0007] Indigo dyeing even nowadays is done in dye houses with waste water treatment plant and causes high cost for water treatment. Furthermore the fabrics show

low wet rubbing fastness. In a typical indigo yarn dyeing factory where 10 tons indigo yarn per day are dyed with a recipe as follows: Indigo pigment: 4g/l; Sodium hydrosulfite 3.2g/l; sodium hydroxide 2.68 g/l; pick-up 70%, 10 dips, the consumption is 280 kg indigo, 224kg sodium hydrosulfite and 188kg sodium hydroxide per day, most of it need to treat before going into the water streams. There are over thousand indigo yarn dyeing factories in the world.

[0008] Due to the stiff handfeel of the woven denim, its application is limited in fashion design, especially for the tight-fit garment or seamless garment sector. However, nowadays customers like to have not only a denim look, but also request softness, comfortability while wearing, and lightness. A knit denim can offer such properties much better than a woven denim.

[0009] The work-flow of the typical denim fabric knitting process is as follows: Introduce indigo-dyed yarn and non-indigo-dyed yarn on the knitting machine - knitting - fabric scouring - enzyme treatment - softening - Stenter dressing.

[0010] Knit denim requires use of a special indigo knit yarn but the availability of such yarn is one of the key hurdles to develop this market, besides the cost. Secondly, during the knitting step the use of the indigo knit yarn will induce contamination with coloured fiber dust at the guiding roller and feeders due to the poor rub fastness of the indigo-dyed fiber and yarn surfaces. The machine downtimes needed for cleaning are significantly reducing the production efficiency. If the resulting contamination is not completely removed before the next production phase, the resulting yarns will cause significant downgrading of the fabrics made therewith.

[0011] Conventional reactive dyeing of cotton does not solve these problems: Reactive dyes on cotton do not allow for a wash-out effect and the general problems caused by yarn dyeing are also not vanishing.

Problem

[0012] In view of this prior art the problem to be solved was to provide a method to produce fabrics with the typical denim appearance in an economic way without pollution of the environment.

Description

[0013] It is an object of the present invention to provide a fabric consisting of at least

a. A first yarn containing cellulosic fibers modified by a cationic modifier,

b. A second yarn containing cellulosic fibers not modified by a cationic modifier.

[0014] The yarn containing cellulosic fibers modified by a cationic modifier can be manufactured by treating it

in a package dyeing machine using a substantially colorless cationic crosslinking modifying agent in an aqueous system. "Substantially colorless" means in the context of this invention that it has no colour visible by the human eye.

[0015] A suitable colorless cationic crosslinking modifier has at least two, but no more than six functional groups reactive with cellulose. Preferably the colorless cationic crosslinking modifier is one out of the group containing trimethylammonium compounds and cationic triazin compounds. A suitable cationic crosslinking modifier is commercially available under the trade name "Eco-fast™ CR-2000" from The Dow Chemical Company. The liquid ratio is 1:4~1:10. The dosage of the cationic modifier (calculated on dry substance) is 1%~10% on weight of fabric ("o.w.f") with 2-4 g/L of sodium hydroxide. The treatment temperature is 40-80°C for 20-40 minutes.

[0016] Preferably the construction of the fabric is such that on the first surface of the fabric mainly the first yarn is visible and on the second surface mainly the second yarn is visible. This is typical for the optical appearance of a denim fabric.

[0017] The fabric may contain a third yarn, in particular an elastane yarn. A typical yarn may be a yarn containing 100% Roica™ elastane fiber with yarn count 20 denier.

[0018] The fabric according to the invention is either a knit fabric or a woven fabric, preferably a knit fabric.

[0019] In a preferred embodiment of the present invention the fabric is a knit fabric of the tuck and miss stitch construction type knitted according to the tuck and miss cam technology; this is crucial to achieve the inventive denim effect by a knit technology.

[0020] For this embodiment of the present invention the general process route would be as follows:

Preparation of the yarns (first yarn being modified by a cationic modifier, second yarn not being modified by a cationic modifier) -> circular knitting of the first and second yarn by tuck and miss cam technology -> fabric dyeing -> enzyme treatment -> softening -> Stenter dressing.

[0021] A typical knitting machine and machine specification may be a Terrot Single jersey jacquard machine, model SHS-90, with Cylinder Diameter: 26", Needle gauge: 28 G, number of feeder: 42, rotation: Anticlockwise. However machine types and specifications may work as well, if the features according to the invention are realized.

[0022] In a preferred embodiment the first yarn may have a lyocell content of between 30 and 80%. Below 30% lyocell the wanted "fading" or "wash down" effect is not visible; above 80% lyocell the fabric or garment looks dirty upon fibrillation. A typical composition may be 50% of Lyocell fibers and 50% of cotton fiber. However variations within the range outlined above are possible and effective, as well.

[0023] The type of yarn (spinning method, yarn count etc.) is very much depending on the type of the final fabric to be achieved and the skilled in the art will know which yarn to choose. For knit denim a ring spin yarn may be

a good choice and for example a yarn count of the first yarn may be Ne 30/2.

[0024] The first yarn may be treated with a cationic modifier. The concentration of the cationic modifier may be between 0,5 and 5 % (w/w) in aqueous solution, preferably between 1,0 and 3,5 % (w/w), most preferably between 1,5 and 2,5 % (w/w). By this treatment the first yarn is able to absorb reactive dyestuff without using sodium sulphate, sodium carbonate and other dyeing auxiliaries.

[0025] In a preferred embodiment the second yarn is composed of 100% Lyocell fibers. Blends with other cellulosic fibers like cotton, modal etc. are also possible, depending on the touch which should be obtained. The yarn count may be Ne 10, spun according to the MVS spinning method. The second yarn is not able to absorb reactive dyestuff without using sodium sulphate, sodium carbonate and other dyeing auxiliary.

[0026] Fig. 2 shows a preferred embodiment of the invention: A circular single jersey weft knitting machine using the knit, tuck and miss cam is used to construct a even twilling pattern on the fabric and produces a dual-plied denim including a back side and a face side of the fabric. The back side is loosely knitted with variable tension/tensile force and a different stitch length than that of face side by adjusting the circular weft-knitting machine. Cam arrangements are set for creating terry twill effect and only twill effect on the fabric. The face side is compactly constructed with high tension/ tensile force by adjusting the machine to a high-density program.

[0027] Fig. 2 shows (from the left to the right):

a. photos of the face side (dark color) and the back side (bright color);

b. a cross-section of the fabric (B = yarn 1 = first yarn; W = yarn 2 = second yarn);

c./d. a knitting machine program to control the movement action of the knitting needles.

[0028] In another preferred embodiment of the present invention the fabric is a woven fabric of the denim type. Preferably the first yarn is the warp yarn and the second yarn is the weft yarn.

[0029] In a particularly preferred embodiment this fabric is a greige, i.e. an essentially colorless or undyed fabric.

[0030] In another particularly preferred embodiment this fabric is dyed to a denim appearance. Therefore a preferred embodiment of the invention is a fabric of essentially blue color, preferably a shade of blue comparable to indigo-dyed cotton fabric. However also other colors (like red, black, green, etc.) are accepted as having a kind of denim appearance. An important aspect of denim appearance in general is the wash-out effect.

[0031] Preferably the first yarn contains between 30 and 80% (w/w) of lyocell fibers, the remainder being preferably cotton.

[0032] Preferably the second yarn consists of cellulosic fibers, more particularly Lyocell fibers. Blends with other cellulosic fibers like cotton, modal etc. are also possible, depending on the touch which should be obtained. In a particularly preferred embodiment the second yarn consists of 100% lyocell fibers.

[0033] In a further preferred embodiment the fabric according to the invention contains a third yarn, in particular made of elastane fibers.

[0034] It is a further object of the present invention to use the fabric described above in a process for making a fabric with denim appearance by dyeing the fabric described above with a reactive dyestuff at a pH of between 6.0 and 8.0, preferably at a pH of between 6.5 and 7.5 in the absence of salt (i.e. the dye bath consists essentially only of water (with only natural mineral content like tap water)) and the reactive dyestuff or mixture of reactive dyestuffs. Depending on the water source it may be necessary to adjust the pH of the water to the range mentioned above first before using it in the process according to the invention.

[0035] According to the invention the reactive dyestuff may be either a single reactive dyestuff or a composition consisting of a mixture of several reactive dyestuffs blended in a way suitable to obtain the requested color on the fabric.

[0036] In a preferred embodiment the use according to the invention is in particular piece dyeing of the tailored garment containing the fabric according to the invention.

[0037] It is yet a further object of the present invention to provide a use of a fabric according to the invention for the manufacture of garments, in particular jeans, jackets, shirts and blouses. Those garments then will show a denim appearance.

[0038] The invention will now be illustrated by examples. These examples are not limiting the scope of the invention in any way. The invention includes also any other embodiments which are based on the same inventive concept

Examples

Example 1:

Cationic treatment (Yarn):

[0039] The first yarn was composed of 50% of Lyocell fibers (from Lenzing Aktiengesellschaft, Austria, under the trade name TENCEL™ Lyocell) and 50% of cotton fiber. The yarn count was Ne 30/2 with ring spun method.

[0040] The first yarn is treated in a package dyeing machine. The cationic crosslinking modifier is commercially available under the trade name "Ecofast™ CR-2000" from The Dow Chemical Company. The concentration of the cationic modifier is 3% o.w.f (i.e. "on weight of fabric") of yarn with 2g/L of sodium hydroxide in the treatment liquid. The liquid ratio is 1:6. The treatment temperature is 80°C for 30 min.

Example 2:

Knitting of the fabric:

[0041] The first yarn was the yarn of Example 1. The second yarn was composed of 100% Lyocell fibers (from Lenzing Aktiengesellschaft, Austria, under the trade name TENCEL™ Lyocell). The yarn count is Ne 10 with MVS spinning method. The third yarn was 100% Roica spandex, yarn count 20 denier.

[0042] The knitting machine specification was as follows: Terrot Single jersey jacquard machine, model SHS-90, with Cylinder Diameter: 26", Needle gauge: 28 G, number of feeder: 42, rotation: Anticlockwise. The knitting program and the structure of the fabric thus obtained were as in Fig. 2.

Example 3:

[0043] Dyeing and Finishing Process (fabric)

The greige fabric will be heat set at a stenter at 190°C for 2 minutes before the dyeing process. The dyeing process is done by garment dyeing method with the conditions as follows:

Liquid ratio:	1:10
Scouring process:	60°C x 20 minutes
Dyeing process:	60°C x 30 minutes
Dyeing recipe:	
Avitera Deep Blue SE:	2% on weight of fabric
Avitera Red SE:	0.2% on weight of fabric
Enzyme wash process:	50°C x 30 minutes
Enzyme wash recipe:	1g/l Tanazyme CM
	0.2ml/l acetic acid
Softening Process:	40°C x 30 minutes
Softening recipe:	1% Persoftal Nano SIL

Claims

1. Fabric consisting of at least

- a. A first yarn containing cellulosic fibers modified by a cationic modifier,
 - b. A second yarn containing cellulosic fibers not modified by a cationic modifier.
2. Fabric according to claim 1, wherein the construction of the fabric is such that on the first surface of the fabric mainly the first yarn is visible and on the second surface mainly the second yarn is visible.
3. Fabric according to claim 1, wherein the fabric is either a knit fabric or a woven fabric, preferably a knit fabric.

4. Fabric according to claim 1 which is a knit fabric of the tuck and miss stich construction type.
5. Fabric according to claim 1 wherein the fabric is a woven fabric of the denim type. 5
6. Fabric according to claim 1 wherein the fabric is a greige fabric.
7. Fabric according to claim 1 wherein the fabric is dyed to a denim appearance. 10
8. Fabric according to claim 1 wherein the first yarn contains between 30 and 80% (w/w) of lyocell fibers. 15
9. Fabric according to claim 1 wherein the second yarn consists of cellulosic fibers, preferably of 100% lyocell fibers.
10. Fabric according to claim 1 wherein the fabric contains a third yarn, in particular an elastane yarn. 20
11. Use of the fabric of claim 1 for making a fabric with denim appearance by dyeing the fabric with a reactive dyestuff at a pH of between 6.0 and 8.0, preferably at a pH of between 6.5 and 7.5 in the absence of salt. 25
12. Use according to claim 11 wherein the reactive dyestuff is a composition consisting of a mixture of several dyestuffs to obtain the requested color on the fabric. 30
13. Use according to claim 11 wherein the dyeing is in particular piece dyeing of the tailored garment containing the fabric according to claim 1. 35
14. Use of a fabric according to claim 1 for the manufacture of garments, in particular jeans, jackets, shirts and blouses., 40

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Fig. 1:

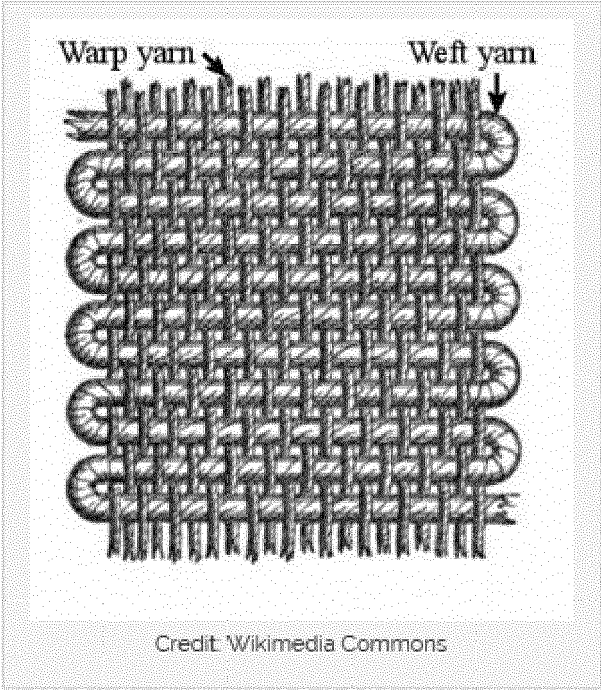


Fig. 2:

