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(54) Title: A STRETCHABLE, LIGHT WEIGHT, WOVEN POLYTRIMETHYLENE TEREPHTHALATE BASED FABRIC

(57) Abstract: A stretchable woven fabric having a GSM of 70 -130, wherein the fabric being a weft yarn being polytrimethylene terephthalate in the weft direction and a warp yarn being a staple fiber yarn in the warp direction wherein the staple fiber yarn is selected from polytrimethylene terephthalate, cotton, viscose, PET, and blends thereof.



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**A STRETCHABLE, LIGHT WEIGHT, WOVEN
POLYTRIMETHYLENE TEREPHTHALATE BASED FABRIC**

This application claims the benefit of India provisional patent
5 application 3197/DEL/2011 filed November 11, 2011 which is
incorporated herein as reference.

FIELD OF INVENTION

This invention relates to a low GSM stretchable woven fabric.
10 This invention particularly relates to low GSM stretchable woven fabric
comprising a polytrimethylene terephthalate (PTT) based filament yarn in
the weft direction.

BACKGROUND OF THE INVENTION

15
Light weight woven fabrics are usually manufactured, from fine
yarn count above 40s Ne or linear density less than 70s D, in gram per
square meter (GSM) range of 70 to 130. "Ne" or English count is the
measure of fineness of yarns. "D" or Denier is the system of measuring the
20 weight of a continuous filament fiber. Stretchable light weight fabrics that
have a comfort fit with the body are not only comfortable but are also
aesthetically appealing. This can be achieved if the yarn used to
manufacture these light weight fabrics is made out of stretchable materials
such as core spun yarns (CSY) with a Lycra[®]/spandex core, or any
25 stretchable yarn in the desired direction. There are several challenges
associated with manufacturing a CSY with such a fine counts. In order to
obtain a light weight stretchable fabric using CSY, the sheath covering the
Lycra[®]/spandex (core) also needs to be minimal. This could expose parts
of the core leading to damage to core filament during fabric washings,

rubbing or abrasion during daily use. In a course of time desired properties such as stretchability of the fabric is lost. Although there is a demand for stretchable filament based low GSM fabric, such currently available in the market it are not very popular due to synthetic hand feel.

5 Hence there is a need for light weight woven fabrics that are comfortable to wear, and have high stretch properties coupled with good stretch recovery and less growth and which are not core spun yarns. There was need for a fabric that also addresses practical aspects of repeated / frequent wash wherein the fabric has excellent acid and alkali resistance.

10 The property is needed for the long life of the fabric.

In addition to all the above features there was a need for a fabric that could also afford UV protection and thereby provide the wearer reduced exposure to harmful UV rays that are known to cause several types of skin damages and also diseases like cancer.

15

SUMMARY OF THE INVENTION

Disclosed herein is a stretchable woven fabric having a GSM of 70 -130, wherein the fabric comprises a weft direction yarn comprising polytrimethylene terephthalate being in the weft direction and a warp
20 direction yarn comprising a staple fiber yarn being in the warp direction wherein the staple fiber yarn selected from a group consisting of polytrimethylene terephthalate, cotton, viscose, PET, and blends thereof.

DETAILED DESCRIPTION OF THE INVENTION

25 A fabric as disclosed herein that is manufactured using a yarn made of PTT filament yarn derived from biological or petroleum sources. The PTT yarn is used in the weft direction. The PTT yarn may be 100% PTT filament , or the PTT filament may be optionally combined with other

fibers and/or filaments used in the textile industry forming a yarn.

Another commercially available staple fiber yarn is used in the warp direction. Examples of such staple fiber yarn are: PTT, cotton, viscose, polyethylene terephthalate (PET) or blends thereof.

5 The invention provides a light weight woven fabrics that is comfortable to wear, has high stretch properties coupled with good stretch recovery and less growth.

 The fabric in addition to the above features also addresses practical aspects of repeated / frequent wash wherein the fabric has excellent acid
10 and alkali resistance. In addition to all the above features the fabric also affords UV protection so that the wearer experiences reduced exposure to harmful UV rays.

 An embodiment provides a fabric made of a yarn in the weft direction made of 100 % PTT filaments. The embodiment includes
15 another commercially available staple fiber yarn in the warp direction such as PTT, cotton, viscose, PET or blends thereof.

 An aspect of the invention provides a woven low GSM fabric being 10 – 50 % of polytrimethylene terephthalate (PTT) based filament yarn wherein the fabric consists of a yarn made of 100% of
20 polytrimethylene terephthalate in the weft direction.

 As used herein the terms polytrimethylene terephthalate or PTT have been used interchangeably.

 Low GSM fabrics find application in manufacturing shirting and other light weight garments. GSM is measured using standard ASTM
25 international procedures (see Table 1).

 In one embodiment, the fabric of this invention has a weft yarn of linear density of 30 to 150 denier, and preferably 35- 85 denier, and most preferably 75 denier.

In another embodiment, the fabric of this invention has stretch properties in the range of 8 to 25%, preferably in the range of 12 to 20%.

In another embodiment, the fabric of this invention has growth of less than 2.5%, and preferably less than 2%. The fabric of this invention
5 therefore has a high stretch recovery of 70 to 95 %.

In another embodiment, the fabric of this invention has a durable press rating in the range of 3.0 – 4.0, and preferably in the range of 3.3 – 3.8.

In another embodiment, the fabric of this invention has an
10 ultraviolet protection (UVP) factor of 25-105.

In another embodiment, the fabric of this invention has excellent acid and alkali resistance. The weight reduction seen in the fabrics of this invention during an acid and alkali treatment is much lesser as compared to PET based fabrics.

15 In one embodiment the fabric of this invention has a low GSM of 70 -130, has stretch properties of 8 to 20%, durable press rating of 3.0 – 4.0, ultraviolet protection factor of 40-105 (unit), less growth % of 1-2% or combinations thereof.

In an embodiment a fabric consists of a yarn made up of 100% of
20 polytrimethylene terephthalate in the weft direction. The weft yarns are either all weft yarns of 100% PTT, or weft yarns being a combination of 100% PTT yarns and yarns made from other fibers like cotton, viscose, PET or blends thereof. Other commercially available staple fiber yarns are used in the warp direction. The warp yarns are selected from a group
25 consisting of cotton, viscose, modal, PET, PTT, and blends thereof.

In another embodiment a fabric consists of a yarn made up of weft yarns being 100% PTT filaments combined with other fibers and/or filaments used in the textile industry forming a yarn, and other yarns made

from other fibers like cotton, viscose, PET or blends thereof. Other commercially available staple fiber yarns are used in the warp direction. The warp yarns are selected from a group consisting of cotton, viscose, modal, PET, PTT, and blends thereof.

5

In one embodiment of the invention, the polytrimethylene terephthalate used to make the yarns for the fabric are bio-based. The fabrics of this invention can be for example selected from plain fabric, piece-dyed fabric, printed fabric, checked or striped fabric.

10

The fabrics of this invention are woven by the techniques well known in the art. Some examples of weaving processes include plain weaving, satin weaving, and twill weaving.

15 In one embodiment, the process of manufacture of the plain fabric comprises the steps of;

a) beam warping;

b) sizing;

c) weaving;

20

d) desizing;

e) finishing;

f) sanforizing; and

g) optionally, when the fabric contains cotton additional steps of scouring, mercerizing and bleaching may be involved;

25

h) optionally the processing steps may include the step of dyeing for a piece-dyed fabric; and

i) optionally the process further comprise the step of disperse printing for obtaining a printed fabric.

In one embodiment the stripped or checked variation of the fabric of this invention is manufactured by the steps comprising;

- a) yarn dyeing;
- b) sectional warping;
- 5 c) sizing;
- d) weaving;
- e) desizing;
- f) finishing; and
- g) optionally further steps of scouring, mercerizing are performed for
- 10 cotton based fabrics.

In one embodiment of this invention, the fabrics can be printed. The process of manufacture of the printed fabric comprises the steps of;

- a) beam warping;
- 15 b) sizing;
- c) weaving;
- d) desizing;
- e) heat setting;
- f) mercerization (only for cotton staple fiber yarns);
- 20 g) bleaching (only for cotton staple fiber yarns);
- h) disperse printing;
- i) finishing; and
- j) sanforizing.

- 25 Yet another embodiment the fabric has very soft handle like 100% superfine cotton and unlike other synthetic fiber/filament yarns.

Some of the steps in the manufacturing process can be omitted depending on the desired final product. For example, the steps of mercerization and bleaching are done only when cotton staple fiber yarns

are also present in the fabric. The process of dyeing is required only for colored fabrics. It is obvious for someone with skill in the art that the step of dyeing is omitted when a plain fabric is desired.

Core spun yarn is created by twisting staple fibers around a central
5 filament core, usually made of polyester for extra strength. It is about 40% to 50% stronger than normally spun yarn of the same weight, and reduces the number of broken stitches when sewing seams and hems on denim.

The term “GSM” used herein refers to the fabric weight measured
10 in grams per square meter of fabric.

The term “linear density” used herein refers to the weight of the yarn in a fixed length, and is measured in units called Denier, wherein Denier is a system of measuring the weight of a continuous filament fiber, in gram, in length of 9000m yarn. A fine yarn has a denier in the range of
15 40 to 150 D. Linear Density is measured using standard ASTM international procedures (see Table 1).

UPF is the ratio of the average effective radiation (UV-R) irradiance transmitted and calculated through air to the average effective
20 UV-R irradiance transmitted and calculated through fabric. The UPF value gives you an indication of how good a fabric is at blocking ultraviolet rays can be measured using method AATCC 183. A fabric with a UPF of 20 will only allow 1/20th of the ultraviolet rays to pass through it, a fabric with a UPF of 50 will only allow 1/50th of the ultraviolet rays to pass
25 through it e.g. a very good UPF value fabric is about 24-39 and above 39 fabric have excellent ultraviolet protection.

A “woven fabric” is used to define a fabric manufactured by interlacing of two sets of threads called warp and weft threads. Warp runs in the fabric in lengthwise direction and weft yarns goes in the fabric in width wise direction.

5

The term “stretch” as used to describe this invention, refers to the ability of an article to be stretched at least eight percent in the warp or weft direction (that is, at least 1.08 times its original length), preferably at least ten percent, and then the fabric returns to a value closer to its original dimensions after release of the stretching force as per ASTM D3107-1980.

10

ASTM refers to American Society for Testing and Materials (ASTM International; West Conshohocken, PA). ASTM International publishes the Annual Book of ASTM Standards each year in print, CD and online versions. The online version was available by subscription and cost was based upon usage. All the standard tests mentioned in this invention are available to any user who refers to ASTM.

15

The terms “DP rating” or “durable press rating (wrinkle resistance)” can be used interchangeably. The DP rating (as determined according to AATCC 143-1996 for garments or AATCC 124-2001 for fabrics) should be at least 3.0.

20

AATCC refers to American Association of Textile Chemists and Colorists. AATCC has developed more than 200 textile-related test methods and evaluation procedures. These methods are published each year in the AATCC Technical Manual.

25

The terms “high acid resistance” and “high alkali resistance” used herein mean the resistance of the fabrics towards alkaline conditions of upto 15% NaOH, and acidic strengths of up to 35% HCl.

5 The term “stretch property” or “stretch properties” used herein refers to the property of a fabric to extend to a certain length percentage when a fixed amount of load is applied. A fabric with good stretch property is defined by the ability of the fabric to extend and recover to its maximum with minimum amount of growth left in the fabric, after
10 removal of the applied load. A good stretch property has approximate 15% stretch level. Stretch property and growth is measured using standard ASTM international procedures (see Table 1).

The term “printed” refers to the fabric which is printed in the fabric form.

15 The term “beam warping” used herein refers to a process of winding the yarns on a warp beam.

The term “sizing” used herein refers to a process of coating the threads normally with starch. The term “weaving” used herein refers to a process where the fabric is manufactured on a loom in weaving process
20 with warp threads coming from weavers beam interlace, with weft yarns put in width wise direction.

The term “desizing” used herein refers to a process of removing the size applied on the warp with the help of enzyme or any other chemical. The term “mercerization” used herein refers to a process of
25 treating the fabric with alkali. This process removes convolutions from cotton fiber structure and make it round which improves the hand feel of the fabric make it more lustrous and in cotton base fabric it improves the strength of the fabric as well.

The term “scouring” refers to removal of impurities present in the fabric by treating it with soap and caustic.

The term “bleaching” used herein refers to a process where any contaminations, colored or oil stain etc., are removed from the fabric.

5 Bleaching is normally done by treating the fabric with sodium hypochlorite or hydrogen peroxide solution. The term “dyeing” used herein refers to a process where the fabric after bleaching is dyed with the color of interest. The fabric is dyed for warp cotton yarn and weft PTT yarn so both the parts are dyed separately by their respective known
10 dyeing method.

The term “heat setting” is a thermal process taking place mostly in dry heat (160 °C to 180 °C for 30 to 45 s) environment. The effect of the process gives the fabric a dimensional stability and, very often, other
15 desirable attributes like wrinkle resistance or temperature resistance.

The term “finishing” used herein refers to a process performed on yarn or fabric after weaving or knitting to improve the look, performance, or "hand" (feel) of the finished textile or clothing. Using different type of
20 finishing agents, the different finishing techniques are bio-polishing, raising, fulling, calendaring, anti-microbial finish, anti-static, aero mechanical beating, non-slip finish etc. and others known in the art.

The term “sanforization” used herein refers to a process of
25 treatment used for cotton fabrics mainly and most textiles made from natural or chemical fibers. It is a method of stretching, shrinking and fixing the woven cloth in both length and width, before cutting and producing to reduce the shrinkage which would otherwise occur after washing.

The term “yarn dyeing” used herein refers to a process the yarn used for in warp and weft yarns are needs to be dyed. This is done in a high temperature and high pressure dyeing machine. The term “sectional
5 warping” used herein refers to a process of winding the yarns on a drum as per color pattern. Once all the yarn patterns are wound on the drum they can be wound to a warper beam to insert in the fabric as per stripe effect needed in the fabric.

10 The bio-based polymers could be those such as Sorona® which is a unique polymer based on 1,3 propanediol (PDO). Its beneficial properties are derived from a unique, semi-crystalline molecular structure featuring a pronounced “kink.” When stress is exerted on the molecule, strain deformation occurs first in its crystalline, lower modulus regions. As
15 stress is released, the crystalline structure locks in, allowing a complete recovery to the initial shape.

In conjunction with this distinctive characteristic, fibers made with Sorona® offer additional advantages over both polyester
20 (PET) and nylon. It has a softer feel and supports easier, more versatile dyeability with excellent washfastness and UV resistance.

The following non limiting examples are only for illustration and are should not be construed to limit the scope of the invention.
25

EXAMPLES

All chemicals mentioned were commercially sourced unless otherwise stated. All machinery used are well known machines in the art.

EXAMPLE 1

This example illustrates a process of making a piece-dyed fabric

Step 1: Beam Warping

660 cones of cotton staple yarns were creeled on a warping machine (Karl
5 Mayer) and wound on warp beam. The warping speed was 750 mpm.

Step 2: Sizing of the yarns

Twelve warp beams were combined together to make a sheet of cotton
yarn with total numbers of yarn end in warp sheet in the beam are 7920 on
10 the creel of sizing machine. The sheet of cotton yarns were further coated
with modified starch in sizing machine. The sheet was run through a size
liquor bath containing starch in 7% concentration. Other water soluble
chemicals are also added to the liquor bath e.g. polyvinyl alcohol (PVA),
carboxymethyl cellulose (CMC), acrylates used to bind the size with yarn,
15 protect the yarn from insects (moth), gives pliability to the threads
required during weaving. Two such size baths are used in a sizing machine
process. After each size bath extra size is squeeze out from yarns. After
this the warp sheet is run through six big drying cylinders to avoid the
sticking of yarns together in weavers beam. The dried sized yarn is finally
20 wind on weaver's beam. The speed of sizing is normally kept 30
meters/min.

Step 3: Weaving of the fabric

75 D /72 F draw textured Sorona® filament yarn was used in weft, and
25 air-jet weaving machines (Toyota JAT 900) at the following parameters:

Loom Speed = 750 RPM

Fabric width = 74.25 inches

Ends per inch = 138

Picks per inch = 88

Warp count = 80s Ne combed 100 % cotton combed compact yarn

Weft count = 75D/72F draw textured Sorona® filament yarns

The warp and weft ends per inch are less by 10 % from the conventional fabric of same GSM to allow the space for the yarns to shrink which

5 reveals as a stretch property in the final fabric.

Step 4: Desizing of the fabric

The fabric was padded using standard enzymatic desizing method for 15 to 20h. The fabric was washed with hot water followed by a cold

10 water wash in a Jigger machine.

Step 5: The fabric is heat set on a stenter at 180 °C for 30s to avoid wrinkle formation in dyeing process.

15 **Step 6: Mercerization (only for cotton staple fiber yarns)**

The fabric was then treated with 18.5 g/L solution of NaOH at 85 °C for 30 min in the Jigger machine.

Step 7: Bleaching (only for cotton staple fiber yarns)

20 The fabric was then treated with hydrogen peroxide solution (15 ml/kg) in a continuous bleaching range (CBR) machine. The solution temperature is kept at 80 °C to 85 °C.

Step 8: Dyeing

25 The cotton part of the fabric was dyed in black color using a standard continuous pad batch process at 25 °C for 12h. The fabric was then washed in the Jigger machine. The PTT part of the fabric was then dyed in black color at 110 °C for 40 min using a disperse dyeing process The

fabric was again washed in the same Jigger machine, and then dried in a stenter machine (Monforte) at 130 °C for 30s.

Step 9: Finishing

- 5 Aero mechanical finishing, in Bianclani finishing machine, is done in the fabric for 30 to 40 min. The fabric was then padded with standard finishing agents and passed through a heating chamber at 155 °C for 30 s.

Step 10: Sanoforization

- 10 The fabric was then passed through sanforizing machine adjusting skew, length and width shrinkage by passing over a rubber roller in a steam chamber (Monforte) at 50 mpm.

Table 1 below shows the properties of the piece-dyed fabric as prepared in example 1.

15

TABLE 1: Fabric Test results for 80sNe X 75D/72F PTT, Piece-dyed fabric

Tests	Method type	Units	Results
Warp (Cotton)		Threads/	174
Weft (PTT)		Inch	90
Fabric Weight	ASTM-D-3776	g/m ²	98
Overall Width of the Fabric		Cm	119.5
Useable Width		Cm	117.5
Stretch	ASTM-D-3107	%	20.2

Growth		%	2.0
DP Rating	AATCC-124	Rating	3.5
Tensile Strength	ASTM-D-5034	Kg Warp Weft	38.3 14.5
Tear Strength	ASTM-D-1424	g Warp Weft	1631 1175
Seam Slippage	ASTM-D-434	Kg Warp Weft	>20.0 >20.0
Dimensional Stability	AATCC-135	% Warp % Weft	+0.3 0.0

Another fabric was made with changes in weft and warp count. The process of dyeing and finishing was kept as described above.

Table 2 below shows the properties of the fabric as prepared in example 1.

5

TABLE 2: Fabric Test results for 60sNe X 75D PTT, Satin weave

Tests	Method type	Units	Results
Warp (Cotton)		Threads/	165
Weft (PTT)		Inch	105
Fabric Weight	ASTM-D-3776	g/m ²	125.9
Overall Width of the Fabric		Inch	160
Useable Width		Inch	156.5
Stretch	ASTM D 3107	%	8
Growth		%	1
DP Rating	AATCC-124	Rating	3.5

Tensile Strength	ASTM-D-5034	Kg Warp	96.2
		Weft	134.1
Tear Strength	ASTM-D-1424	g Warp	3.6
		Weft	3.3
Seam Slippage	ASTM-D-434	Kg Warp	77.7
		Weft	53.3
Dimensional Stability	AATCC-135	% Warp	-1.5
		% Weft	-0.8
Mean UPF (Ultraviolet protection factor) (dry)	AATCC -183		104.8

EXAMPLE 2

This example illustrates a process of making a striped fabric.

5 **Step 1: Yarn Dyeing**

A cotton staple yarn package of 900g was dyed with a hot brand reactive blue dye using a package dyeing process at a 90 °C for 6 h.

Step 2: Sectional Warping

- 10 A yarn pattern was made with the dyed cotton yarn and white cotton yarn by winding on the drum as per the color pattern. Then the patterned sheet is wound on to a warper beam to insert in the fabric as per stripe effect needed in the fabric. 12 sections of such patterns were made from 660 cotton yarn cones. The speed of the sectional warping machine was 550
- 15 mpm.

Step 3: Sizing

The sheet of cotton yarns were further coated with modified starch using a sizing machine. The sheet was run through a size liquor bath of size percentage of 7% concentration. Other water soluble polymers may be added to the liquor bath e.g. polyvinyl alcohol (PVA), carboxymethyl cellulose (CMC), acrylates are used to protect the yarn. This process is repeated twice. After this the warp sheet is run through six big drying cylinders to avoid the sticking of yarns together in weavers beam. The dried sized yarn is finally wind on weaving beam. The speed of sizing is normally kept 30 meters/min.

Step 4: Weaving

75 D /72 F draw textured Sorona® filament yarn was used in weft, and air-jet weaving machines (Toyota JAT 900) at the following parameters:

Loom Speed = 750 RPM
Fabric width = 74.25 inches
Ends per inch = 134
Picks per inch = 74
Warp count = 80s Ne combed 100 % cotton compact yarn
Weft count = 75D/72F draw textured Sorona® filament yarns.

The warp and weft ends per inch are less by 5 % from the conventional fabric of same GSM to give the space to yarns when they shrink during the process.

Step 5: Desizing of the fabric

The fabric was padded using standard enzymatic desizing method for 15 to 20h. The fabric was washed with hot water followed by a cold water wash in a Jigger machine.

Step 6: Mercerization (only for cotton staple fiber yarns)

The fabric was then treated with 18.5 g/L solution of NaOH at 85 °C for 30 min in the Jigger machines.

5 **Step 7:** Finishing

The fabric was then padded with standard finishing agents and passed through a heating chamber at 155 °C for 30 s.

Step 8: Sanofirization

10 The fabric was then passed through sanforizing machine adjusting skew, length and width shrinkage by passing over a rubber roller in a steam chamber (Monforte) at 50 mpm.

Table 3 below shows the properties of the blue stripe fabric as prepared in example 2.

15

TABLE 3: Fabric Test results for 50sNe X 75D/72F PTT, Blue Stripe fabric

Tests	Method type	Units	Results
Warp (Cotton)		Threads/	134
Weft (PTT)		Inch	74
Fabric Weight	ASTM-D-3776	g/m ²	114
Overall Width of the Fabric		Cm	134.5
Useable Width		Cm	131.5
Stretch	ASTM-D-3107	%	8.4
Growth		%	0.4
DP Rating	AATCC-124	Rating	3.5

Tensile Strength	ASTM-D-5034	Kg Warp Weft	39.2 37
Tear Strength	ASTM-D-1424	g Warp Weft	1605 1302
Seam Slippage	ASTM-D-434	Kg Warp Weft	11.2 >20.0
Dimensional Stability	AATCC-135	% Warp % Weft	-1.2 -0.2

Another fabric was made with changes in weft and warp count. The process of dyeing and finishing was kept as described above.

Table 4 below shows the properties of a micro striped stripe fabric as prepared in example 2.

5

TABLE 4: Fabric Test results for 80sNe X 75D PTT, Micro striped

Tests	Method type	Units	Results
Warp (Cotton)		Threads/	147
Weft (PTT)		Inch	90
Fabric Weight	ASTM-D-3776	g/m ²	86.3
Overall Width of the Fabric		Inch	138
Useable Width		Inch	135.3
Stretch	ASTM D3107	%	13.6
Growth		%	1.2
DP Rating	AATCC-124	Rating	4
Tensile Strength	ASTM-D-5034	Kg Warp Weft	48.9 46.7
Tear Strength	ASTM-D-1424	g Warp	3.7

		Weft	3.5
Seam Slippage	ASTM-D-434	Kg Warp Weft	18.8 34.3
Dimensional Stability	AATCC-135	% Warp % Weft	-1.2 -0.5
Mean UPF (Ultraviolet protection factor) (dry)	AATCC- 183		29.4

EXAMPLE 3

This example illustrates a process of making a checked fabric.

Step 1: Yarn Dyeing

- 5 A cotton staple yarn package of 900g was dyed with a hot brand reactive purple dye using a package dyeing process at a 90 °C for 6 h.

Step 2: Sectional Warping

- 10 A yarn pattern was made with the dyed cotton and white cotton yarn by winding on the drum as per the color pattern. Then the patterned sheet is wound on to a warper beam to insert in the fabric as per checked effect needed in the fabric. 12 sections of such patterns were made from 660 cotton yarn cones. The speed of the sectional warping machine was 550 mpm.

15

Step 3: Sizing

- The sheet of cotton yarns were further coated with modified starch using a sizing machine. The sheet was run through a size liquor bath of size percentage of 7% concentration. Other water soluble polymers may be added to the liquor bath e.g. polyvinyl alcohol (PVA), carboxymethyl cellulose (CMC), acrylates are used to protect the yarn. This process is repeated twice. After this the warp sheet is run through six big drying
- 20

cylinders to avoid the sticking of yarns together in weavers beam. The dried sized yarn is finally wind on weaving beam. The speed of sizing is normally kept 30 meters/min.

5 **Step 4: Weaving**

75 D /72 F draw textured Sorona® filament yarn and 80s Ne combed 100 % yarn dyed cotton compact yarn by pick and will method to get the checked effect in the fabric on air-jet weaving machines (Toyota JAT 900) at the following parameters:

10 Loom Speed = 750 RPM

Fabric width = 74.25 inches

Ends per inch = 146

Picks per inch = 86

Warp count = 80s Ne combed 100 % yarn dyed cotton compact yarn

15 Weft count = 75D/72F draw textured Sorona® filament yarns+ Ne combed 100 % yarn dyed cotton compact yarn. The warp and weft ends per inch are less by 7 % from the conventional fabric of same GSM.

Step 5: Desizing of the fabric

20 The fabric was padded using standard enzymatic desizing method for 15 to 20h. The fabric was washed with hot water followed by a cold water wash in a Jigger machine.

Step 6: Mercerization (only for cotton staple fiber yarns)

25 The fabric was then treated with 18.5 g/L solution of NaOH at 85 °C for 30 min in the Jigger machines.

Step 7: Finishing

The fabric was then padded with standard finishing agents and passed through a heating chamber at 155 °C for 30 s.

5 **Step 8:** Sanofirizing

The fabric was then passed through sanforizing machine adjusting skew, length and width shrinkage by passing over a rubber roller in a steam chamber (Monforte) at 50 mpm.

Table 5 below shows the properties of the checked fabric as prepared in
10 example 3.

TABLE 5: Fabric Test results for 80sNe X 75D/72F PTT, checked fabric

Tests	Method type	Units	Results
Warp (Cotton)		Threads/	146
Weft (PTT)		Inch	86
Fabric Weight	ASTM-D-3776	g/m ²	85
Overall Width of the Fabric		Cm	138.6
Useable Width		Cm	136.0
Stretch	ASTM-D-3107	%	14.4
Growth		%	1.0
DP Rating	AATCC-124	Rating	3.3
Tensile Strength	ASTM-D-5034	Kg Warp	30.5

		Weft	15.5
Tear Strength	ASTM-D-1424	g Warp	1815
		Weft	1475
Seam Slippage	ASTM-D-434	Kg Warp	13.2
		Weft	20.5
Dimensional Stability	AATCC-135	% Warp	2.2
		% Weft	0.0

EXAMPLE 4

This example illustrates a process of making a Printed fabric

5

Step 1: Beam Warping

660 cones of cotton staple yarns were creeled on a warping machine (Karl Mayer) and wound on warp beam. The warping speed was 750 mpm.

10 Step 2: Sizing of the yarns

Twelve warp beams were combined together to make a sheet of cotton yarn with total numbers of warp sheet in the beams are 7920 on the creel of sizing machine. The sheet of cotton yarns were further coated with modified starch in sizing machine. The sheet was run through a size liquor bath containing starch in 7% concentration. Other water soluble polymers may be added to the liquor bath e.g. polyvinyl alcohol (PVA), carboxymethyl cellulose (CMC), acrylates are used to bind the size with yarn, protect the yarn from moth, insects etc., gives pliability to the threads required during weaving. Two such size baths are used in sizing machine. After each size bath extra size is squeeze out from yarns. After this the warp sheet is run through six big drying cylinders to avoid the sticking of yarns together in weavers beam. The dried sized yarn is finally

15

20

wind on weaver's beam. The speed of sizing is normally kept 30 meters/min.

Step 3: Weaving of the fabric

- 5 75 D /72 F draw textured Sorona® filament yarn was used in weft, and air-jet weaving machines (Toyota JAT 900) at the following parameters:

Loom Speed = 750 RPM

Fabric width = 74.25 inches

Ends per inch = 138

- 10 Picks per inch = 88

Warp count = 80s Ne combed 100 % cotton combed compact yarn

Weft count = 75D/72F draw textured Sorona® filament yarns

Step 4: Desizing of the fabric

- 15 The fabric was padded using standard enzymatic desizing method for 15 to 20h. The fabric was washed with hot water followed by a cold water wash in a Jigger machine.

Step 5: Mercerization (only for cotton staple fiber yarns)

- 20 The fabric was then treated with 18.5 g/L solution of NaOH at 85 °C for 30 min in the Jigger machine.

Step 6: Bleaching (only for cotton staple fiber yarns)

- 25 The fabric was then treated with hydrogen peroxide solution (15 mg/kg) in a continuous bleaching range (CBR) machine.

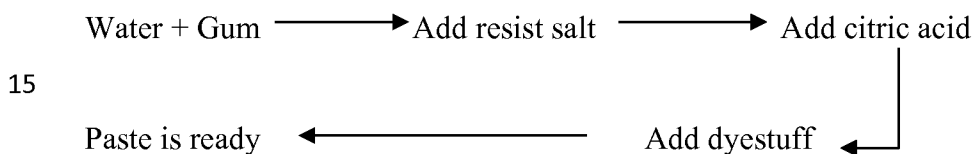
.

Step 7: Printing

The fabric was printed on rotary screen printing machine using disperse dyes with following printing paste ingredients. The recipe for disperse printing is as follows:

- 5 (a) Disperse dye – 2 % (Teracil red)
- (b) Indalka AGBV gum – 6 %
- (c) Resist salt (prevents dye reduction) – 1.5 %
- (d) Citric acid – 3 % (to prevent adverse effect of dye in hot alkaline condition)
- 10 (e) Remaining Water

Preparation Flow Chart is as shown below. A proper stir is required after every following step.



Printed fabric is dried and cured at 180 °C for 4 min to fix the prints.

Step 8: Finishing

- 20 The fabric was then padded with standard finishing agents and passed through a heating chamber at 155 °C for 30 s

Step 9: Sanofirizing

- 25 The fabric was then passed through Sanforizing machine adjusting skew, length and width shrinkage by passing over a rubber roller in a steam chamber (Monforte) at 50 mpm.

Table 6 below shows the properties of the printed fabric as prepared in example 4.

TABLE 6: Fabric Test results for 80sNe X 75D/72F PTT, printed fabric

Tests	Method type	Units	Results
Warp (Cotton)		Threads/	146
Weft (PTT)		Inch	98
Fabric Weight	ASTM-D-3776	g/m ²	89
Overall Width of the Fabric		Cm	136.3
Useable Width		Cm	132.8
Stretch	ASTM-D-3107	%	14.4
Growth		%	1.4
DP Rating	AATCC-124	Rating	3.5
Tensile Strength	ASTM-D-5034	Kg Warp	29.5
		Weft	50.5
Tear Strength	ASTM-D-1424	g Warp	1461
		Weft	1670
Seam Slippage	ASTM-D-434	Kg Warp	>20.0
		Weft	>20.0
Dimensional Stability	AATCC-135	% Warp	-1.3
		% Weft	-0.5

We claim:

1. A stretchable woven fabric having a GSM of 70 -130, wherein the fabric comprises a weft yarn comprising polytrimethylene
5 terephthalate in the weft direction and a warp yarn comprising a staple fiber yarn in the warp direction wherein the staple fiber yarn is selected from a group consisting of polytrimethylene terephthalate, cotton, viscose, PET, and blends thereof.
2. The fabric as claimed in claim 1 wherein the yarn has a linear density
10 of 30 to 150 denier.
3. The fabric as claimed in claim 1 wherein the fabric has stretch properties in the range of 9 to 25.
4. The fabric as claimed in claim 1 wherein the fabric has growth of less than 2.5%.
- 15 5. The fabric as claimed in claim 1 wherein the fabric has a durable press rating of 3.0 – 4.0.
6. The fabric as claimed in claim 1 wherein the fabric that has an ultraviolet protection factor of 25-105.
7. The fabric as claimed in claim 1 wherein the fabric has stretch
20 properties of 8 to 20%, durable press rating of 3.0 – 4.0, ultraviolet protection factor of 25-105, less growth % of 1-2% or combinations thereof.
8. The fabric as claimed in claim 1 wherein the weft yarn comprises 100% polytrimethylene terephthalate yarn.
- 25 9. The fabric as claimed in claim 1 wherein the process of manufacture of a fabric comprises the steps of yarn dyeing, sectional warping, beam warping, sizing, weaving, desizing, and sanofirizing, and optionally comprising the steps of scouring, and mercerization.

10. The fabric as claimed in claim 1 wherein the fabric is used for garments, furnishing, upholstery material or hosiery material.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2012/064341

A. CLASSIFICATION OF SUBJECT MATTER
INV. D03D15/08
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D03D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2006 214056 A (TORAY INDUSTRIES) 17 August 2006 (2006-08-17) Abstarct; paragraph [0047] -----	1-10
X	JP 2006 077338 A (OPELONTEX CO LTD) 23 March 2006 (2006-03-23) abstract -----	1,10
X	CN 102 102 259 A (SUZHOU JIANGFENG SILK CO LTD) 22 June 2011 (2011-06-22) abstract -----	1,10



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

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"&" document member of the same patent family

Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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Patent document cited in search report		Publication date	Patent family member(s)	Publication date
JP 2006214056	A	17-08-2006	NONE	

JP 2006077338	A	23-03-2006	NONE	

CN 102102259	A	22-06-2011	NONE	
