The International Journal Of Engineering And Science (IJES)
|| Volume || 3 || Issue || 10 || Pages || 21-25|| 2014 ||
ISSN (e): 2319 – 1813 ISSN (p): 2319 – 1805

Producing Bi- Layer Sportswear Using Bamboo And Polypropylene Knitted Fabric

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----------ABSTRACT----------

The sportswear textile industry has not only seen in market diversification for fibrous materials but has also contributed towards the elevation of textile science and technology to a level of approaching that of high tech industrial sectors. People undertaking active sports need next-to-skin garments that will move sweat away from the skin and keep the body dry during and after exercise. New technological developments, more fragmented niche markets and increasing customer expectations are some of the factors relentlessly driving the industrial sector. The producers of sportswear have been concentrating their efforts on improving their strategic position, productivity, added value product assortment and niche positions in order to expand their markets.

Date of Submission: 29 April 2014 Date of Publication: 30 October 2014

I. INTRODUCTION

The first clothes were made from natural elements animal skins, furs, grasses and leaves, bones and shells. Clothing which was earlier designed only for protection and now fashion is incorporating many performance oriented functions to enhance human living in a different way. The amount and type of clothing worn depends on functional consideration such as need for warmth or protection from the elements and social consideration. Functionality is the primary purpose of clothing. Clothing may also function as a form of adornment and an expression of personal taste and style. Clothing is not only a cover for the skin but also interacts with and modifies the heat regulating function of the skin and these are influenced by the environment. Sportswear' is the 20th century word. It is popular because of the variety of look that can make by combining separates. The common sportswear garments include short pants, T-shirts, Tennis shirt, Track suit and trainers

According to a recent baseline survey on technical textiles in India done by the office of the textile commissioned and ICRA management consulting service Ltd., Domestic Consumption of Technical Textile India is currently producing technical textiles products in all the 12 categories mentioned. In terms of US dollar, the current consumption of technical textiles in India is around $7.73billion which will grow to $13bn in 2012 – 2013, registering an 11% growth year on year. The value of the global technical textiles production of the same period is $11billion and $127 billion respectively registering a growth rate of 3.16%. The world production is about 7% which is expected to grow to 10% in the next 5 year period.

II. EXPERIMENTAL PROCEDURE

2.1. Selection of Yarns

The following yarns are chosen to produce bi-layer knitted fabric.

Texturised Polypropylene -100 Denier

Bamboo - 40 s Combed yarn

2.2. Knitting Construction

The pre-requisites of ideal sportswear are rapid transport of perspiration away from the body and then it's to keep the fabric dry. This is achieved by bi-layer of fabric construction in which the inner layer is made up of polypropylene yarn which has hydrophobic and having good wicking rate. The fabric constructed by P-knit machine. The fabric which has to form as inner layers was fed in the cylinder needle.

2.3. Machine Parameters

Type	: P – Knit bi-layer machine
Feeder 1 and 4	: Bamboo
Feeder 2 and 3	: Polypropylene
Gauge	: 24 needles/inch
Diameter	: 30 inches
Total needle count	: 3800
Number of feeder	: 24
Knitting speed	: 15 rpm

2.4. Concept of bi-layer fabric structure

Needle Set Out

	N1	**N2**	**N3**	**N4**	**N23**	**N24**
DN1	A	-	-	A	-	-
DN2	-	B	B	-	B	B
CN1	A	-	-	A	-	-
CN2	-	B	B	-	B	B

Cam Set Out

	F1	**F2**	**F3**	**F4**	**F5**	**F6**
DN1	X	-	-	X	-	-
DN2	X	-	-	X	-	-
CN1	-	X	X	-	X	X
CN2	-	X	X	-	X	X

Dial Needle: Two Tracks (Bamboo yarn)

DN1 - Dial Needle Track 1

DN2 - Dial Needle Track 2

N - Needle

F - Feeder

A - Needles moves in Track 1 - 1, 4, 7, 10, 13, 16, 19, 22

B - Needles moving in Track 2 - 2, 3, 5, 6, 8, 9, 11, 12, 14, 15, 17, 18, 20, 21, 23, 24

Cylinder Needles: Two Tracks (Polypropylene yarn)

CN1 - Cylinder Needle Track 1

CN2 - Cylinder Needle Track 2

A - Needles moves in Track 1 - 1, 4, 7, 10, 13, 16, 19, 22

B - Needles moves in Track 2 - 2, 3, 5, 6, 8, 9, 11, 12, 14, 15, ,17, 18, 20, 21, 23, 24

- - Miss cam

X - Knit cam

Feeder 1, 4, 7, 10 - BambooFeeder 2, 3, 5, 6 – Polypropylene

Dial cam has two tracks of DN1 and DN2. The A and B needles moves in Track 1 and Track 2 respectively. This is clearly shown in the needle set out table (VI). The dial and cylinder needle will perform miss and knit stitch simultaneously during fabric production. The feeder 1 forms knit stitch with the dial needle and miss stitch with the cylinder needle. The yarn from feeder 1 forms knit stitch with the dial needle and miss stitch with the cylinder needle. This cycle has been repeated throughout the knitted fabric production. This is shown in the table (VII)**.**

2.5. Bi-layer Fabric Parameters

Course per Inch : 42

Wales per Inch : 38

Fabric Weight : 1573 mg

2.6. Bi-layer Fabric Processing

The bi-layer fabric produced with bamboo and polypropylene is subjected for dyeing using reactive dye.

2.6.1. Dyeing Recipe

Hot brand reactive dye (Black): 8% (owm)

Sodium chloride : 10% (owm)

Sodium hydroxide : 10% (owm)

M: L ratio : 1:10

Temperature : 90°C

Duration : 3 Hours

The bi-layer fabric of Polypropylene / bamboo fabric is processed in a winch dyeing machine. The bi-layer fabric is dyed in open width system. The fabric is then washed with soap water and then with cold water. Both the fabric is subjected for compacting to have lesser shrinkage and to maintain the width of the bi-layer fabric

III. RESULTS AND DISCUSSION

The results of the study are discussed under the following headings:

3.1. Objective Evaluation

3.1.1. Fabric Thickness

The Table - I explains the fabric thickness of inner and outer layer of the bi-layer knitted fabric.

Table I- Fabric Thickness

S.No.	Samples	Mean Thickness (mm)	Loss or gain over original	Percentage Loss or gain over original	'F' test
1.	P/B (Face)	88	- 1	1.136	3.4615*
2.	P/B (Back)	89			

* - Significant at 5% level

The Table-I clearly shows that the samples of bi-layer fabric thickness of the P/B (Face) decreased when compared to the P/B (Back) at one per cent. It is statistically proved that P/B (Face) and P/B (Back) samples have a significant 'F' value at five per cent level.

3.1.2. Fabric Drape

Table - II shows the drape of inner and outer layer of the bi-layer knitted fabric.

Table II - Fabric Drape

S.No.	Samples	Mean Drape co-efficient (%)	Loss or gain over original	Percentage Loss or gain over original	'F' test
1.	P/B (Face)	0.2548	- 0.4554	178.728	1.0971^{NS}
2.	P/B (Back)	0.7102			

NS - Not Significant

The Table – II clearly show that the drapability of P/B (Face) decreased when compared to P/B (Back) at 179 per cent. It is statistically proved that the P/B (Face) and P/B (Back) samples have no significant difference level.

3.1.3. Dimensional Stability

3.1.3.1. Course wise

The Table - III shows the dimensional stability of bi-layer fabric in course wise direction.

Table III - Dimensional Stability (Course wise)

S.No.	Sample	Mean (mm)	Gain/Loss over Original	Percentage Loss or gain over original	'F' Value
1.	P/B (Face)	14	- 16	11.428	2.8593*
2.	P/B (Back)	15.6			

* - Significant at 5% level

The Table - III clearly shows that the dimensional stability of the P/B (Face) decreased when compared to the P/B (Back) at 11 per cent. It is statistically proved that the P/B (Face) and P/B (Back) samples have a significant 'F' value at five per cent level.

3.1.3.1. Wales wise

The Table - IV shows the dimensional stability of bi-layer fabric in wale wise direction.

Table IV - Dimensional Stability (Wales wise)

S.No.	Sample	Mean (mm)	Gain/Loss over Original	Percentage Loss or gain over original	'F' Value
1.	P/B (Face)	7.2	- 9.4	130.55	2.4091*
2.	P/B (Back)	16.6			

* - Significant at 5% level

The Table - IV clearly show that the dimensional stability of the P/B (Face) decreased when compared to the P/B (Back) at 11 per cent. It is statistically proved that the P/B (Face) and P/B (Back) samples have a significant 'F' value at five per cent level.

3.1.4. Air Permeability

The Table - V shows the air permeability of bi-layer knitted fabric.

Table V - Air Permeability

S.No.	Sample	Mean (cc/sec)	Gain/Loss over Original	Percentage Loss or gain over original	'F' Value
1.	P/B (Face)	15.4	4	25.974	6.5882**
2.	P/B (Back)	11.4			

** - Significant at 1% level

The Table –V clearly shows that air permeability of the P/B (Face) increased when compared to the P/B (Back) at 30 per cent. It is statistically proved that the P/B (Face) and P/B (Back) samples have a significant 'F' value at one per cent level.

3.1.5. Bursting Strength

The Table - VI shows the bursting strength of bi-layer knitted fabric.

Table VI - Bursting Strength

S.No.	Sample	Mean	Gain/Loss over Original	Percentage Loss or gain over original	'F' Value
1.	P/B (Face)	51.8	3.9	7.528	7.169**
2.	P/B (Back)	47.9			

** - Significant at 1% level

The Table - VI shows that the bursting strength of the P/B (Face) increased when compared to the P/B (Back) at 8 per cent. It is statistically proved that the P/B (Face) and P/B (Back) samples have a significant 'F' value at one per cent level.

3.2. Subjective Evaluation

3.2.1. Wear Study

The Bi-layer fabric sportswears were given to sports person of cricket, athletic and basket ball. Wear study was conducted for a period of one month (9a.m. to 4 p.m.). The property such as air permeability, heat transfer, feel and absorbency were evaluated.

IV. CONCLUSION

Bi-layer sportswears become more popular and comfortable. The bamboo layer keeps the body cool, soft and makes to breathe easy. It passes the air quickly to the outer layer. The polypropylene layers have good wick ability thermal conductivity and light weight, no need for ironing. So it is suitable for all climatic condition.