A STUDY ON THE THERMAL PROPERTIES OF 100% BAMBOO ON KNITTED FABRICS

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ABSTRACT: A knitted fabric consist of forming yarn(s) into loops, each of which is typically only released after a succeeding loop has been formed and intermeshed with it so that a secure ground loop structure is achieved. In the knitted fabric, bamboo has different loop structure (single jersey, cross tuck, cross miss, twill weave). These fabrics are subjected to the testing air permeability, wicking test, thermal conductivity, water vapour permeability. *Bamboo Knit Fabric* ***is naturally bacteria and odor resistant, and is the practical, yet eco-friendly choice. True to a natural fiber, bamboo knits are already absorbent and breathable. The strength of bamboo adds to the durability of the fabric and is found to work well for those who are allergic to other natural fibers. Bamboo textiles are cloth, yarn, and clothing made out of bamboo fibers.***

Keywords: knitted, structure, bamboo, tencel

INTRODUCTION:

Knitting is a method of forming fabric from a single strand of yarn, using two needles. The resulting fabric has given more than woven fabric. It is a technique to turn thread or yarn into a piece of cloth. Knitted fabric consists of horizontal parallel courses of yarn which is different from woven cloth. The courses of threads or yarn are joined together by interlocking loops in which a short loop of one course of yarn or thread is wrapped over another course. Fabric can be formed by hand or machine knitting, but the basic principle remains exactly the same i.e. pulling a new loop through the old loop.

Fabric Structures

A knitted fabric consist of forming yarn(s) into loops, each of which is typically only released after a succeeding loop has been formed and intermeshed with it so that a secure ground loop structure is achieved. There are two different types of knitting, Warp Knitting and Weft Knitting. In Warp Knitting the yarn travels in a predominately vertical direction through the fabric (like the warp threads in a woven fabric). In Weft Knitting the yarn travels in a predominately horizontal direction across the fabric. Weft knitted structure can also be produced using weft knitting machines or by hand knitting techniques, whereas warp knitted structures can only be produced using Warp knitting machines. The structures of Woven fabric and the direction of travel of yarn in warp and weft knitted fabrics.

Structure

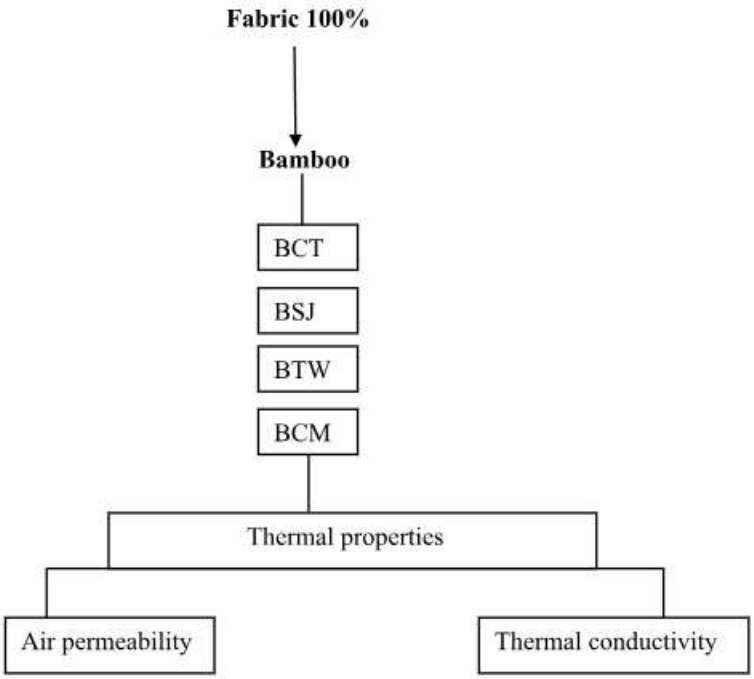
- Courses and Wales.
- Weft and warp knitting.
- Knit and purl stitches.
- Right- and left-plated stitches.
- Edges and joins between fabrics.
- Cables, increases, and lace.
- Ornamentations and additions.

Bamboo Fabric

Bamboo Knit Fabric is naturally bacteria and odor resistant, and is the practical, yet eco-friendly choice. True to a natural fiber, bamboo knits are already absorbent and breathable. The strength of bamboo adds to the durability of the fabric and is found to work well for those who are allergic to other natural fibers. Bamboo textiles are cloth, yarn, and clothing made out of bamboo fibers. While historically used only for structural elements, such as bustles and the ribs of corsets, in recent years a range of technologies have been developed allowing bamboo fiber to be used in a wide range of textile and fashion applications. Modern clothing labelled bamboo is usually rayon. The bamboo yarn can also be blended with other textile fibers such as hemp or even spandex.

METHODOLOG

Flow chart



Fabric 100%

In this study, 100% bamboo yarn having linear density 30.2 Ne, 12.5% elongation and tenacity, was applied to knit all the knitted fabric structures. Thermal comfort properties of fabrics are really influenced by major factors like: the fibre type, spinning technology, yarn twist, yarn hairiness, fabric thickness and fabric tightness. The hairiness of bamboo yarns is much lower than that of equivalent cotton yarns. Fabrics knitted with higher bamboo content have considerably less thickness, mass per square metre, thermal resistance and more water permeability. As the yarn gets finer the thermal resistance and thermal conductivity of the bamboo knitted fabrics decrease, while the water vapour permeability and air permeability increase.

3.3Bamboo

Bamboo Knit Fabric is naturally bacteria and odor resistant, and is the practical, yet eco-friendly choice. True to a natural fiber, bamboo knits are already absorbent and breathable. The strength of bamboo adds to the durability of the fabric and is found to work well for those who are allergic to other natural fibers. Bamboo textiles are cloth, yarn, and clothing made out of bamboo fibers. While historically used only for structural elements, such as bustles and the ribs of corsets, in recent years a range of technologies have been developed allowing bamboo fiber to be used in a wide range of textile and fashion applications. Modern clothing labelled bamboo is usually rayon. The bamboo yarn can also be blended with other textile fibers such as hemp or even spandex.

BCT(bamboo cross tuck)

- A tuck stich is composed of a held loop, one or more tuck loops and knitteloops.
- It is produced when a needle holding its loop also receives the new loop.
- The tuck loop assumes an inverted U-shaped configuration.
- Tuck loops reduce fabric length and length-wise Elasticity[2] because the higher

yarn tension on the tuck loop causes then to rob yarn from adjacent knitted loops, making them smaller and providing greater stability and shape retention.

BSJ(Bamboo single jersey)

Single jersey fabrics are generally used to make underwear and outerwear such as T-shirts. Compared to woven structures, knit fabric can more easily deform or stretch by compressing or elongating the individual stitches that from the fabric. This ability to stretch by stitch rearrangement adds to wearing comfort that, among other factors, is affected by Properties such as extensibility, air permeability, and heat insulation of garments made from knit fabrics.The knitted loops leave the needles the spacing of courses and wales decrease and the fabric shrinks in both directions thus affecting the properties of knitted fabric.

BTW(Bamboo twill weave)

In a twill weave, each weft or filling yarn floats across the warp yarns in a progression of interlacings to the right or left, forming a pattern of distinct diagonal lines. This diagonal pattern is also known as a wale. A float is the portion of a yarn that crosses over two or more perpendicular yarns.A twill weave requires three or more harnesses, depending on its complexity and is the second most basic weave that can be made on a fairly simple loom.

Twill weave is often designated as a fraction in which the numerator indicates the number of harnesses that are raised (and thus threads crossed: in this example, two), and the denominator indicates the number of harnesses that are lowered when a filling yarn is inserted (in this example, one). The fraction $^{2}/_{1}$ is read as "two up, one down" (the fraction for plain weave is $^{1}/_{1}$.). The minimum number of harnesses needed to produce a twill can be determined by totaling the numbers in the fraction.

BCM(Bamboo cross mix)

A miss stitch or float stich is composed of a held loop, one of more float loops and knitted loops. It is produced when a needle holding its old loop fails to receive the new yarn that passes, as a float loop to the back of the needle, and to the reverse side of the resultant stich.

A single float has the appearance of a U-shape on the reverse of the stitch.

Miss stitch (float stitch) fabrics are narrower than equivalent all-knit fabric because the wales are drawn closer together by the floats, and reducing width-wise elasticity and improving fabric stability.

Air permeability

A widely employed testing standard is ASTM D737–96, 'Standard Test Method for Air Permeability of Textile Fabrics', which gives a test method for measuring the air permeability of textile fabrics. This test method applies to most fabrics including woven fabrics, non-woven fabrics, air bag fabrics, blankets, napped fabrics, knitted fabrics, layered fabrics and pile fabrics.In general, the testing environment must be set up in a standard conditioned laboratory, so that the air being drawn through the specimen is at standard conditions, i.e. 20 ± 2 °C and RH 65 ± 2% following ASTM D1776. A steady-state air permeability test apparatus consists of:

- a clamping device for securing the test specimen in a flat, tensionless state;
- a device to prevent air leaking from the edges of the test area, usually called a guard ring;
- a pressure gauge or manometer to measure the pressure drop from one side of the specimen to the other;
- an air pump to draw a steady flow of air through the clamped specimen;
- a means of adjusting the rate of airflow to achieve and hold the specified pressure drop from one side of the specimen to the other;

Thermal conductivity:

Place the sample covered on the testing plate. The testing plate, base plate and the surrounding protection plate should maintain the same temperature under the electric control. Load the data to the microcomputer by temperature sensor to maintain a constant temperature. The heat of testing plate can only be distributed in the direction of sample. The insulation rate, heat transfer coefficient, CLO value and heating time of testing plate needs to be constant .The temperature is calculated by microcomputer in a certain time.

Turn on the power, the main menu is displayed; choose "set" by the direction key, as shown

Press "yes" key to enter the setting page, select items by "▲ and ▼" keys, press "▶" key to enter set state, press numeric keys to set the flash data . Press "yes" key to exit setup and press "yes" key again to save the settings.

The temperature setting is 35℃. Start testing until the temperature of testing plate, protection plate and base plate reach 35℃ in the same time.

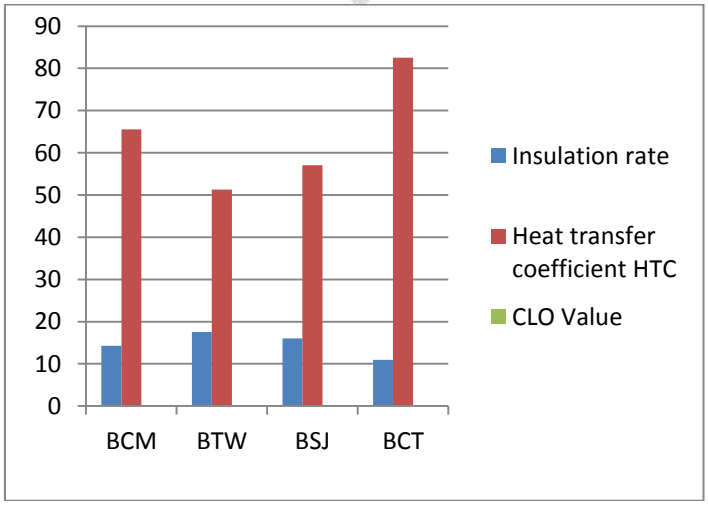
"Heat cycle" is five cycles commonly, test is over after 5 thermal cycles. The heat cycle depends on the thickness of sample.

RESULTS AND DISCUSSION

In this study, the results on the thermal comfort properties of air permeability, thermal conductivity, water vapour permeability and wicking test has been seen and discussed. According to testing evaluation, the differences between air permeability, thermal conductivity, water vapour permeability and wicking test values of the fabrics knitted with bamboo, yarns were statistically significant. The result of the study discussed below

Thermal conductivity of bamboo fabric

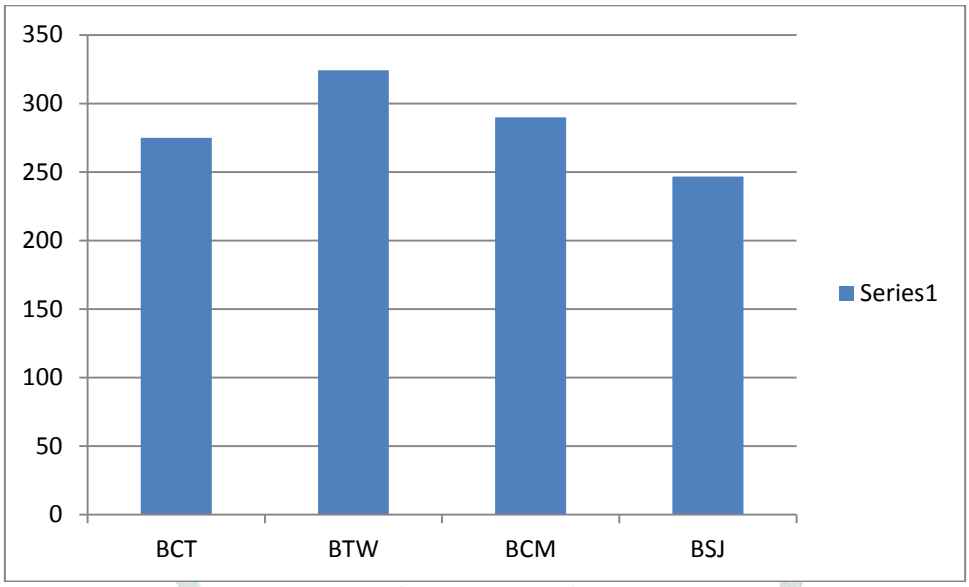
Results	BCM	BTW	BSJ	BCT
Insulation rate	14.28	17.53	16.06	10.91
Heat transfer coefficient HTC	65.55	51.32	57.03	82.55
CLO Value	0.10	0.13	0.11	0.08



Among the four structural variation of bamboo cross tuck, bamboo cross miss, bamboo twill, bamboo single jersey, the heat transfer coefficient value of thermal conductivity in bamboo cross tuck gives good result among the other knit structure. In the insulation rate bamboo twill weave is higher.

Air permeability of bamboo fabric:

S.No	BCT	BTW	BCM	BSJ
1	275	324.2	289.8	246.6



The fabric of bamboo from the four structures in the test of the air permeability. So it is conclude that Air permeability of bamboo Twill weave gives good result compared to single jersey, cross miss, cross tuck.

CONCLUSION

Knitting is a method of forming fabric from a single strand of yarn, using two needles. The resulting fabric has given more than woven fabric. It is a technique to turn thread or yarn into a piece of cloth. Knitted fabric consists of horizontal parallel courses of yarn which is different from woven cloth. Cotton referred to as the "King of fibers". It is most important textile fiber in the world. Cotton is a vegetable fiber which surrounds the seeds of the cotton plant.

In this study the thermal properties of 100% bamboo fabrics are analyzed. This study has been done to analyze the thermal property of the fabrics bamboo. Also to know the better knit structure between cross tuck, cross mix, twill and single jersey of bamboo.

All the thermal properties; thermal conductivity and air permeability are significance level by fabric structure and loop length. The influence of studied parameters on the bamboo thermal comfort properties was investigated.

Among the four structural variation of bamboo cross tuck, bamboo cross miss, bamboo twill, bamboo single jersey, the heat transfer coefficient value of thermal conductivity in bamboo cross tuck gives good result among the other knit structure. In the insulation rate bamboo twill weave is higher.

The fabric bamboo from the four structures in the test of the air permeability. So it is conclude that Air permeability of bamboo Twill weave gives good result compared to single jersey, cross miss, cross tuck.

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