



RESEARCH ARTICLE

A STUDY ON THE THERMAL PROPERTIES OF 100% TENCEL FABRIC

^{1,*}Divya, R. and ²Manonmani, G.

¹Department of Costume Design and Fashion, PSG College of Arts and Science, Coimbatore, Tamil Nadu, India

²Department of Home Science, Mother Teresa University, Kodaikanal, India

ARTICLE INFO

Article History:

Received 18th April, 2018

Received in revised form

20th May, 2018

Accepted 27th June, 2018

Published online 30th July, 2018

Keywords:

Knitted, Structure, Bamboo, Tencel.

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 vapor 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. Tencel is the registered trade name for a type of lyocell, a biodegradable material made from wood pulp cellulose. Result where analyzed for the better knit structure between bamboo and 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.

Tencel

Tencel is the registered trade name for a type of lyocell, a biodegradable material made from wood pulp cellulose. This material started to grow in popularity in the late 1990s and is now used in a variety of ways. Though the exact characteristics of the material depend on how it's processed, it tends to be durable and soft. Often said to be environmentally friendly, it is fully biodegradable and made from trees managed for sustained harvest.

MATERIALS AND METHODS

Tencel (Tencel cross tuck)

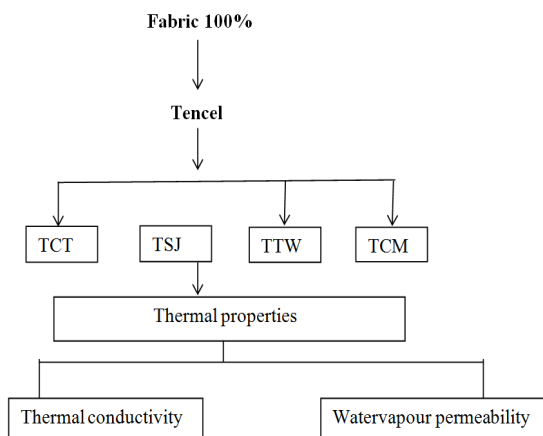
- A tuck stitch is composed of a held loop, one or more tuck loops and knitteloops.
- It is produced when a needle holding its loop also receives the new loop.
- The tuck loop assumes an inverted U-shaped configuration.
- Tuck loops reduce fabric length and length-wise Elasticity⁷ because the higher yarn tension on the tuck

*Corresponding author: Divya, R.,

Department of Costume Design and Fashion, PSG College of Arts and Science, Coimbatore, Tamil Nadu, India.

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

Flow chart



Tencel (Tencel 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. However, this recovery by knit stitch rearrangement generally is not complete because cotton yarns, which are not elastomeric, do not a have a recovery force to rearrange the stitches. For jersey knit constructions in circular knitting machines, the process of co-knitting spandex is called “plating”. 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.

Tencel (Tencel 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 $\frac{2}{1}$ is read as "two up, one down" (the fraction for plain weave is $\frac{1}{1}$). The minimum number of harnesses needed to produce a twill can be determined by totaling the numbers in the fraction.

Tencel (Tencel 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.

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°C. Start testing until the temperature of testing plate, protection plate and base plate reach 35°C 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. Preheating time is from 30 min to 60 min, preheating is to make the equipment reach the standard temperature at normal temperature.

Watervapour permeability

Breathability or also referred to as Water Vapor Permeability can be described as the ability of a fabric to allow moisture vapor to be transmitted through the material. It is an essential supporting property to thermal and Physiological Comfort clothing, and is hugely important in filtration and medical textiles.

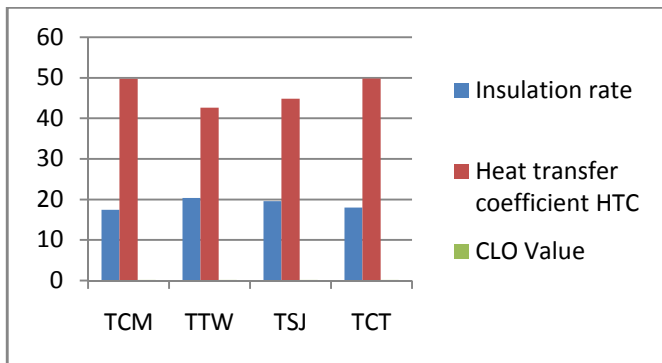
- For the constant head arrangement, the specimen shall be connected through the top inlet to the constant head reservoir.
- Open the bottom outlet.
- Establish steady flow of water.
- The quantity of flow for a convenient time interval may be collected.
- Repeat three times for the same interval.

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, tencel yarns were statistically significant. The result of the study discussed below.

Thermal conductivity of tencel fabric

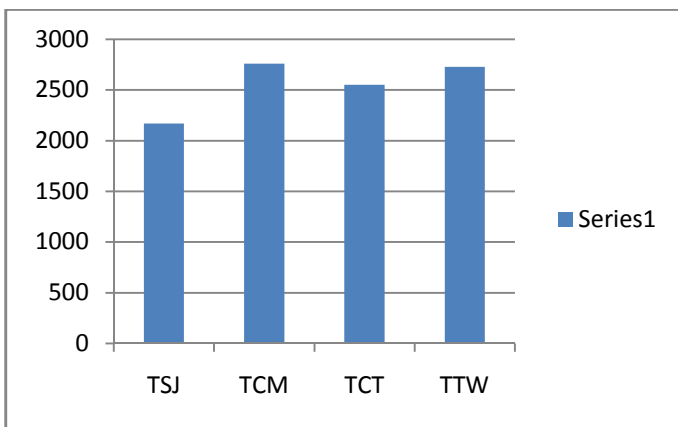
S.No	TCM	TTW	TSJ	TCT
Insulation rate	17.44	20.36	19.60	18.03
Heat transfer coefficient HTC	49.77	42.64	44.82	49.78
CLO Value	0.13	0.15	0.14	0.13



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

Water vapour permeability test for tencel

S.No	TSJ	TCM	TCT	TTW
1	2170.062	2758.672	2552.437	2727.626



From the above figure show that the it tencel from the four structures in the test of the Water Vapour permeability of tencel Cross miss gives good result compared to single jersey, cross tuck & twill.

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% tencel fabrics are analyzed. This study has been done to analyze the thermal property of the fabrics tencel. Also to know the better knit structure between cross tuck, cross mix, twill and single jersey of tencel. All the thermal properties; thermal conductivity, watervapour permeability are significance level by fabric structure and loop length. The influence of studied parameters on the tencel thermal comfort properties was investigated. In that tencel Fabric we get the result that from the four structures of tencel Cross miss, Twill, Single Jersey & Cross Miss. Tencel cross miss gives good result for water vapour permeability testing. Among the four structural variation of tencel cross tuck, tencel cross miss, tencel twill, tencel single jersey, the heat transfer coefficient value of thermal conductivity in tencel cross tuck gives good result among the other knit structure. In the insulation rate tencel twill weave is higher.

REFERENCES

Clayton FH. The Measurement of the Air Permeability of Fabrics; *Journal of the Textile Institute*, 1935; 26:71-86.
 ASTM D737-04; Standard Test Method for Air Permeability of Textile Fabrics, 2012.
 Čiukas R, Sadauskas D. Theoretical Determination of Area Density and Tightness Factor for Weft knitted Fabrics International Textile, Clothing and Design Conference. Proceedings. Dubrovnik, Croatia, 2004: p. 669-674.
 Soane DS, Offord DA. Modified textiles and other materials and methods for their preparation, Google Patents, 2003. natural and stretch yarns. *Fibres & Textiles in Eastern Europe*. 2011; 19(3):86
