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A STUDY ON THE THERMAL PROPERTIES OF 100% VISCOSE FABRICS

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Abstract

The thermal comfort properties of fabric structures made from Viscose yarns. 100% Viscose were spun into yarns of identical linear density. Each of the yarns produced was converted to single jersey knitted fabrics, cross tuck fabric, cross miss fabric & twill fabric. The thermal conductivity of the fabrics was generally found to decrease with increase in the proportion of Viscose fibre. The Air permeability of the fabrics was observed to increase with increase in Viscose fibre content. Statistical analysis also indicates that the results are significant for Air permeability and Thermal conductivity of the fabrics. The air permeability, thermal conductivity properties was investigated. It was found that the higher air permeability was shown in case of twill yarn & lower air permeability for single yarn.

Key words: Viscose fabric, Water vapour permeability & Wicking.

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 as said by Prakash. C (2012). 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. A knitted fabric consist of forming yarns into loops, each of which is typically only released after a succeeding

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loop has been formed and intermeshed with it so that a secure ground loop structure is achieved by Koushik. C.V. 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 by Milenkovic, L.

Viscose is a type of rayon. Originally known as artificial silk, in the late 19th century, the term *"rayon"* came into effect in 1924. The name *"viscose"* derived from the way by which fibre is manufactured; *a viscous organic liquid used to make both rayon and cellophane*. Viscose, more commonly known in the U.S. as Rayon, it is a man-made fiber created from cellulose chemically extracted from trees. It's a little weaker in strength than cotton, and thus is often used to make delicate, lighter clothing. Viscose rayon is a fiber of regenerated cellulose; it is structurally similar to cotton but may be produced from a variety of plants such as soy, bamboo, and sugar cane. As a manufactured regenerated cellulose fibre, it is neither truly natural (like cotton, wool or silk) nor truly synthetic (like nylon or polyester) – it falls somewhere in between. Viscose is a low-cost fabric, which is a popular thanks to its myriad of qualities.

Thermal properties: Physical property of a solid body related to application of heat energy is defined as a thermal property. Thermal properties explain the response of a material to the application of heat. Important thermal properties are

- Heat capacity
- Thermal expansion
- Thermal conductivity
- Thermal stresses
- Air Permeability
- Water Vapour Permeability

Heat capacity: External energy required to increase temperature of a solid mass is known as the material's heat capacity, it is defined as its ability to absorb heat energy. Heat capacity is not an intrinsic property i.e. it changes with material volume/mass. Specific heat - For comparison of

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different materials, heat capacity has been rationalized. Specific heat is heat capacity per unit mass. It has units as J/kg-K or Cal/kg-K. With increase of heat energy, dimensional changes may occur. Hence, two heat capacities are usually defined. Heat capacity at constant pressure, Cp, is always higher than heat capacity at constant volume; Cv. Cp is only marginally higher than Cv. Heat is absorbed through different mechanisms: lattice vibrations and electronic contribution.

Thermal expansion: Increase in temperature may cause dimensional changes. Linear coefficient of thermal expansion (α) defined as the change in the dimensions of the material per unit length.

Thermal conductivity: It is ability of a material to transport heat energy through it from high temperature region to low temperature region. Heat energy transported through a body with thermal conductivity. It is a microstructure sensitive property and has units as W/m.K.

Thermal stresses: Stresses due to change in temperature or due to temperature gradient are termed as thermal stresses. Thermal stresses in a constrained body will be of compressive nature if it is heated, and vice versa. Engineering materials can be tailored using multi-phase constituents so that the overall material can show a zero thermal expansion coefficient. Eg.: Zerodur – a glass-ceramic material that consists of 7080% crystalline quartz, and the remaining as glassy phase. Sodium-zirconium-phosphate (NZP) have a near-zero thermal expansion coefficient.

Air Permeability: The air permeability is a very important factor in the performance of some textile materials. Especially, it is taken into consideration for clothing, parachutes sails, vacuum cleaners, fabric for air bags and industrial filter fabrics. The air permeability is mainly dependent upon the fabric's weight and construction.

Water vapour permeability: Water vapor permeability is a measure of the passage of water vapor through the material. It is also known as water vapor transmission rate (WVTR) or moisture vapor transmission rate (MVTR). It is the mass of water vapor transmitted through a unit area in a unit time under specified conditions of temperature and humidity. Breathability or also referred to as Water Vapor Permeability can be described as the ability of a fabric to allow moisture vapour to be transmitted through the material.

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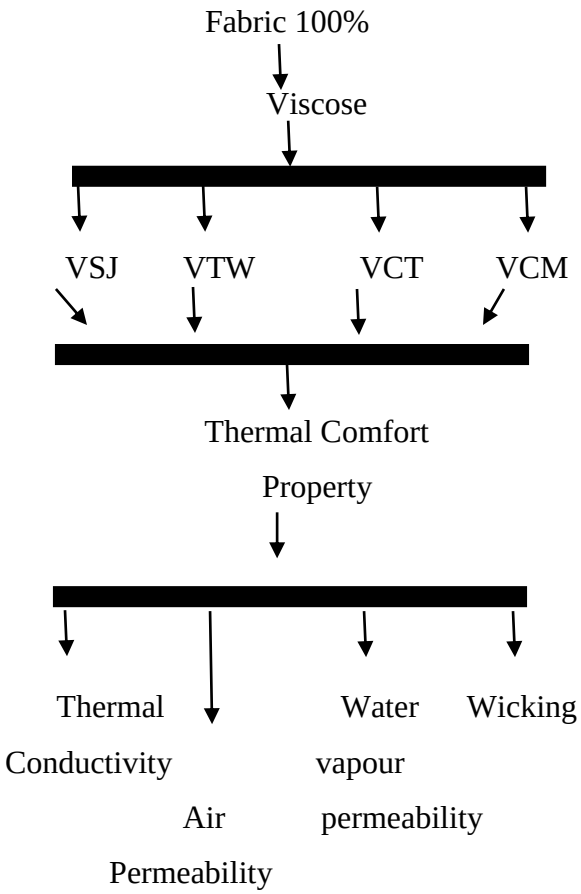
Wicking: Moisture transfer properties and drying rate of fabrics are two major factors affecting the physiological comfort of garments. Moisture transfer and quick dry behavior of textiles depend mainly on the capillary capability and moisture absorbency of their fibers. These characteristics are especially important in sport garments next to the skin or in hot climates. In these situations, it is critical that textiles are able to absorb large amounts of perspiration, draw moisture to the outer surface and keep the body dry. Therefore, in order to optimize these functionalities in sport clothing, and to support moisture management claims, it is necessary to determine the wicking behavior and quick drying capability of functional fabrics.

METHODOLOGY

FLOW CHART



VSJ -Viscose Single Jersey

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VTW - Viscose Twill

VCT - Viscose Cross Tuck

VCM - Viscose Cross Miss

Fabric

100% Modal and viscose fabric is being used for the process of regenerated cellulosic fabric.

Viscose

The viscose process dissolves pulp with aqueous sodium hydroxide in the presence of carbon disulfide. This viscous solution bears the name *viscose*. The cellulose solution is used to spin the viscose rayon fiber, which may also be called viscose. Viscose rayon fiber is a soft fiber commonly used in dresses, linings, shirts, shorts, coats, jackets, and other outerwear. It is also used in industrial yarns (tyre cord), upholstery and carpets, and in the casting of cellophane.

Fabric Production

(Production of Weft Knitted Fabric with 0.30cm Loop Length)

The following stitch combination of fabrics are produced for our study

- Knit Stitch – Single Jersey
- Knit and Tuck – Cross Tuck
- Knit and Miss – Cross Miss
- Knit, Tuck & Miss – Knitted Twill

Single Jersey

Jersey fabric is a type of knit textile made from cotton or a cotton and synthetic blend. Some common uses for jersey fabric include t-shirts and winter bedding. The fabric is warm, flexible, stretchy, and very insulating, making it a popular choice for the layer worn closest to the body. Jersey also tends to be soft, making it very comfortable.

Tuck and miss stitch

Apart from the knitted loop stitch the two most commonly produced stitches are the tuck stitch and the miss stitch (float stitch).

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Tuck

A tuck stich is composed of a held loop, one or more tuck loops and knitted loops. It is produced when a needle holding its loop also receives the new loop. The tuck loop assumes an inverted U-shaped configuration.

Miss

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 stitch.

Twill

Twill is a type of textile weave with a pattern of diagonal parallel ribs (in contrast with a satin and plain weave). This is done by passing the weftthread over one or more warp threads then under two or more warp threads and so on, with a "step," or offset, between rows to create the characteristic diagonal pattern.[1] Because of this structure, twill generally drapes well.

THERMAL PROPRERTIES OF MODAL FABRIC IN AIR PERMEABILITY & THERMAL CONDUCTIVITY ARE DISSCUSSED BELOW.

Thermal Conductivity

Before testing the sample must be conditioned. Sample conditioning is done by Humidity Chamber. Specifications of Humidity Chamber are as follows;

- Machine Name – Humidity Cabinet
- Make- MAG Solvics PVT LTD, Coimbatore
- Serial No-7854670016
- Year-2017
- Capasity-20-90% RH
- Product Name-MAG-G0651

The conditioning process is as follows

- Keep the sample inside the cabinet tray.

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- The chamber door has to be closed after keeping the sample inside. The sample can be seen from outside through inspection glass of humidity cabinet.
- Conditioning Fabric: 21±2 ˚C or 27 ± 2˚C
- Relative humidity (RH): 65±2% in chamber for 24 hours before testing.
- ASTM-1777 standard for the sample conditioning.

After conditioning the required sample is ready to test for the Thermal Conductivity Tester.

Air Permeability Test

Air permeability was measured in accordance with ASTM D737-04 [22], by the Tex-Test air permeability tester (FX3300, Switzerland). The air permeability is expressed as the quantity of air in cubic centimetres passing through a square centimetre of fabric per second (cm3/sec·cm2). The air permeability tests were done at a test pressure drop of 100 Pa (20 cm^2 test area). The average of five measurements was used for comparison.

The air permeability is a very important factor in the performance of some textile materials. Especially, it is taken into consideration for clothing, parachutes sails, vacuum cleaners, fabric for air bags and industrial filter fabrics. The air permeability is mainly dependent upon the fabric's weight and construction.

RESULTS AND DISCUSSION

In this study, the results on the thermal comfort properties of air permeability, & thermal conductivity, has been seen and discussed.

Air Permeability Test

Air permeability test of Viscose fabric

The test result of regenerated cellulosic fabric of Viscose 100% of different structure is shown in the table & figure.

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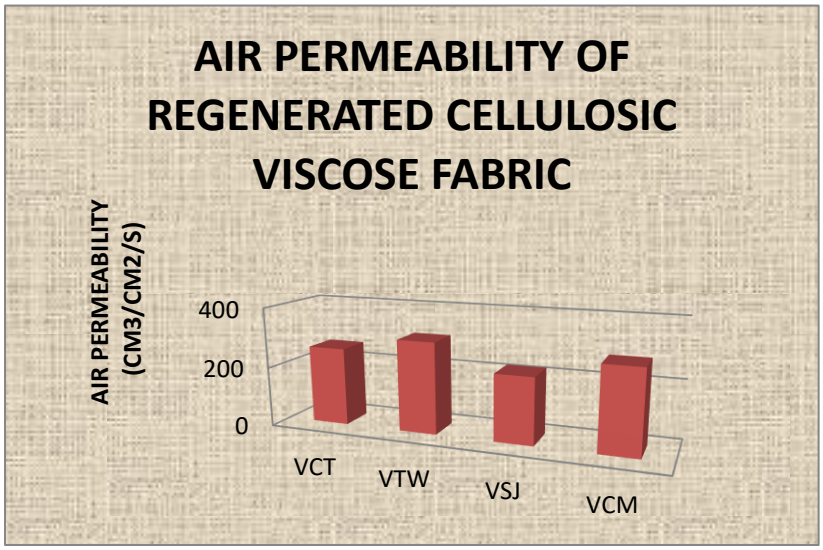
Table - Air permeability Viscose fabric.

Sample Specification	Air permeability (cm3/cm2/sec)
VCT	260.6
VTW	306.4
VSJ	223
VCM	281.2

Figure - Air permeability Viscose fabric.



From the above Table & Figure it is clear that the fabric of Viscose from the four structures in the test of the air permeability of bi-layer knitted fabrics can decrease with increased stitch density and thickness. So it is conclude that Air permeability of Viscose Twill gives good result compared to single jersey, cross miss, cross tuck.

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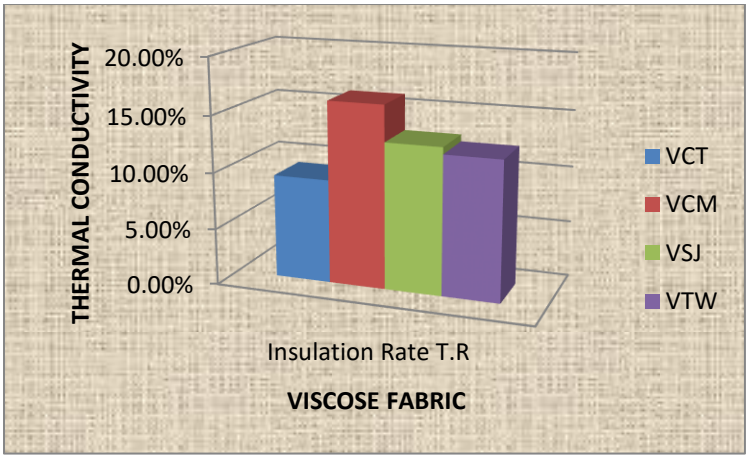
Thermal Conductivity of Viscose fabric Insulation rate

Table -Thermal Conductivity of Viscose fabric – Insulation rate

Sample	VCT	VCM	VSJ	VTW
Insulation Rate T.R (%)	9.23%	16.18%	12.98%	12.37%

Figure - Thermal Conductivity of Viscose fabric – Insulation rate



Thermal conductivity result of Viscose fabric of four structure that are twill, single jersey, Cross miss, Cross tuck, we get the result that in viscose insulation rate Viscose cross miss gives the good rate in insulating.

Thermal Conductivity of Viscose fabric – Heat Transfer Coefficient HTC

Table - Thermal Conductivity of Viscose fabric – Heat Transfer Coefficient HTC

Sample	VCT	VCM	VSJ	VTW
Heat Transfer Coefficient HTC	99.65	56.85	73.13	77.27

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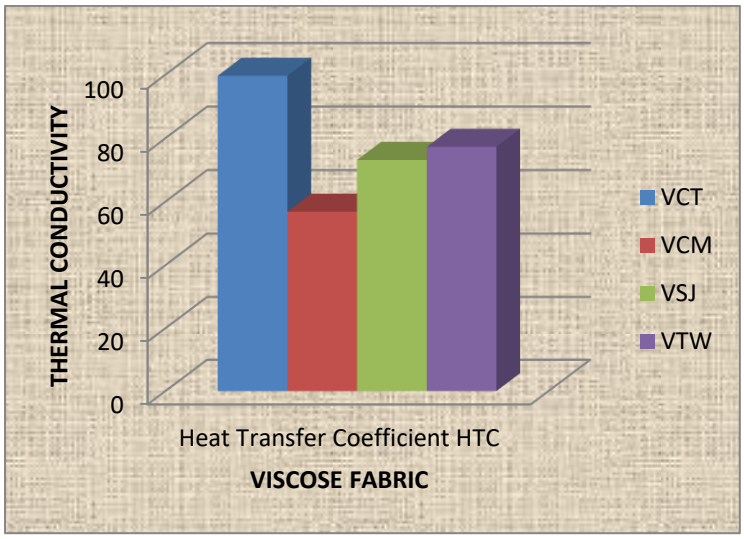
Figure- Thermal Conductivity of Viscose fabric – Heat Transfer Coefficient HTC



Thermal conductivity of heat transfer coefficientof four structural variation that is single jersey,twill, cross miss, cross tuck among from this four we get the result that Viscose cross tuck gives the good result.

Thermal Conductivity of Viscose fabric – CLO VALUE

Table - Thermal Conductivity of Viscose fabric – CLO VALUE

Sample	VCT	VCM	VSJ	VTW
CLO Value	0.06	0.11	0.09	0.08

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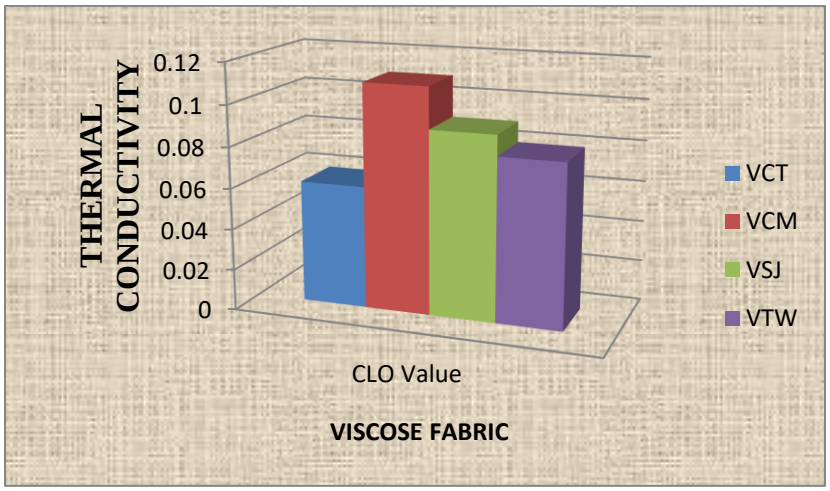
Figure -Thermal Conductivity of Viscose fabric – CLO VALUE



Thermal conductivity of CLO VALUE which is tested in viscose fabric is seen in the four fabric production of weft knitted fabric which are produced are single jersey, cross tuck, cross misss, & knitted twill among the four it is seen that viscose cross miss gives the good result.

Summary & Conclusions

A "Warm – cool feeling" is a very important property, as a result of which a human can feel comfort or discomfort in various activities and environmental conditions. This feeling could be achieved by using different types of yarns. It was determined that higher air permeability is characterized for knits manufactured only from pure yarns.

The thermal comfort properties of single jersey fabrics made from yarns of 100% Modal yarns were investigated.

It is observed that the parameters of air permeability, and thermal conductivity are significantly affected by the Moisture Vapour Transport.

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