A STUDY ON WATER VAPOUR 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 water vapour permeability of the fabrics were observed to increase with increase in Modal fibre content. Statistical analysis also indicates that the results are significant for water vapour permeability and wicking test of the fabrics. Wicking test was done which gives fabric absorbency of water that how much it takes and results.

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 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 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.

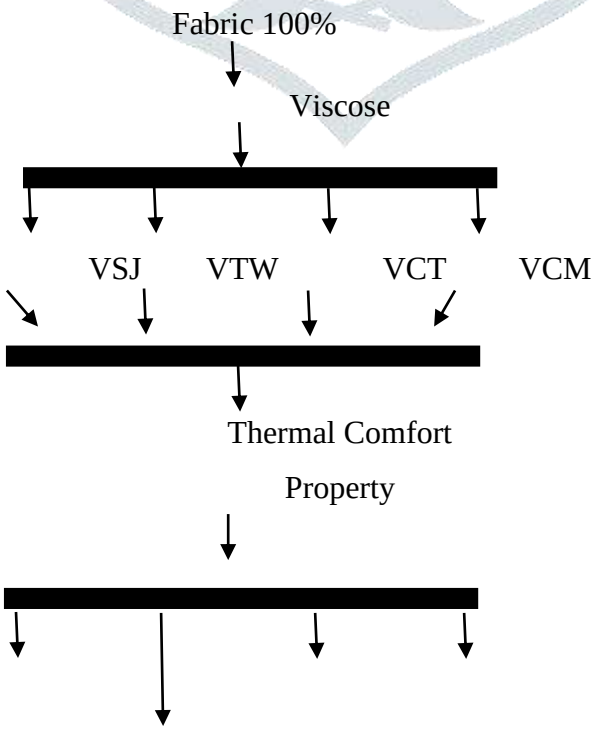
Air Permeability: The air permeability is a very important factor in the performance of some textile materials. Especially, it is taken into consideration for clothing, parachutes sails, vacuum cleaners, fabric for air bags and industrial filter fabrics. The air permeability is mainly dependent upon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

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



Thermal Water Wicking
Conductivity vapour
Air permeability
Permeability

VSJ -Viscose Single Jersey
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).

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 weft thread 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 WATER VAPOUR PERMEABILITY & WICKING TEST ARE DISSCUSSED BELOW.

Water Vapour Permeability Test

Water vapour permeability of fabric samples was determined using an SDL Atlas instrument (M261, USA) according to ISO 14596. A test specimen was sealed over the open mouth of a test dish which contains water, and the assembly was placed in a controlled atmosphere. After establishing equilibrium water vapour pressure gradient across the sample, successive weightings of the assembled dish were made and the water vapour permeation through the specimen was determined. The water vapour permeability (WVP) in g/m²/day was calculated by the equation; $WWWWWW$=24×$MM\ AA$×tt

where M is the loss in mass of the assembly over the time period t (in g), t is the time between successive weighing of the assembly in hours, A is the area of exposed test specimen (equal to the internal area of the test dish (in m²).

Wicking Test

Wicking behaviour of fabric samples was determined according to DIN 53924. Ten specimens were cut along the warp and weft directions respectively to dimensions of 200 mm × 25 mm and suspended in a reservoir of 1% K2CrO4 with their bottom ends at a depth of 30 mm into the water. The height of the solution raised was measured and recorded in terms of mm after 60 seconds.

Moisture transfer properties and drying rate of fabrics are two major factors affecting the physiological comfort of garments. Moisture transfer and quick dry behaviour of textiles depend mainly on the capillary capability and moisture absorbency of their fibbers. 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 behaviour and quick drying capability of functional fabrics.

RESULTS AND DISCUSSION

In this study, the results on the thermal comfort properties of , water vapour permeability and wicking test has been seen and discussed.

The result of the study discussed below

Water Vapour Permeability Test

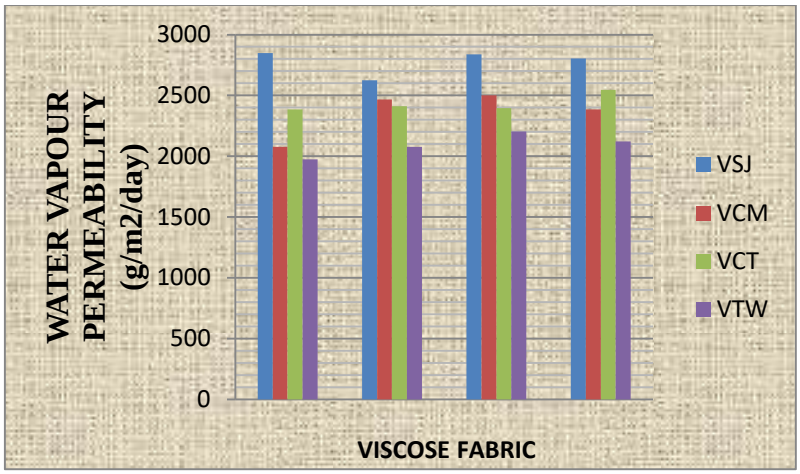
The bi-layer knitted structures of fabrics had higher water vapour transport than the other fabrics because their thickness and weight were lower than for the others fabrics. This is because, in a steady state, moisture vapour transport through fabrics is controlled by the diffusion process, which is influenced by the fabric structure.

Water Vapour Permeability of Viscose fabric

Table -Water Vapour permeability Viscose fabric.

WVP (g/m2/day)	VSJ	VCM	VCT	VTW
1	2847.375	2075.656	2386.118	1973.648
2	2625.617	2465.951	2412.729	2077.135
3	2838.505	2501.432	2394.988	2202.798
4	2803.023	2386.118	2545.784	2121.487

Figure - Water Vapour permeability Viscose fabric.



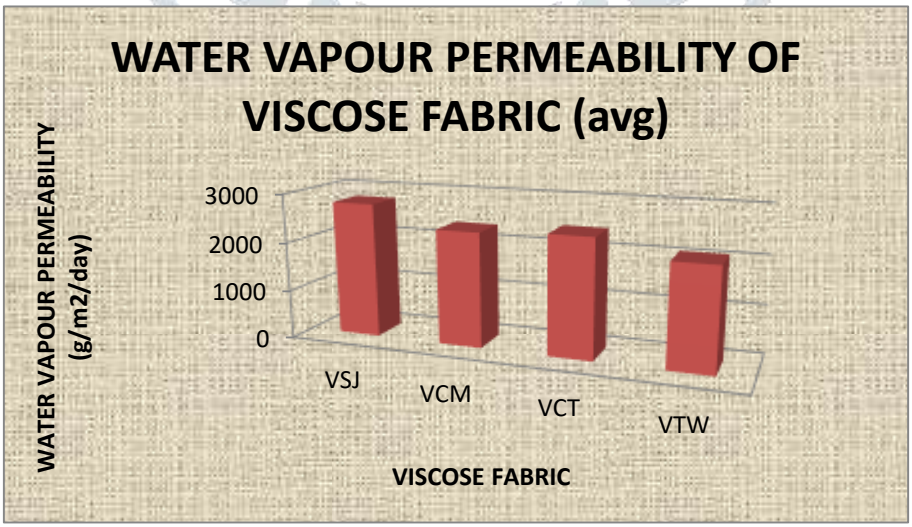
From the above table & figure it is clear that viscose with there four structures which are tested, they are Viscose Single Jersey, Viscose Cross Tuck, Viscose Twill, and Viscose Cross Miss. From these four it is being seen that Viscose Single Jersey gives the good result.

Water Vapour Permeability of Viscose fabric – Average

Table - Water Vapour permeability Viscose fabric- avg

WVP (g/m2/day)	VSJ	VCM	VCT	VTW
Avg	2778.630	2357.289	2434.905	2093.767

Figure Water Vapour permeability Modal fabric- avg



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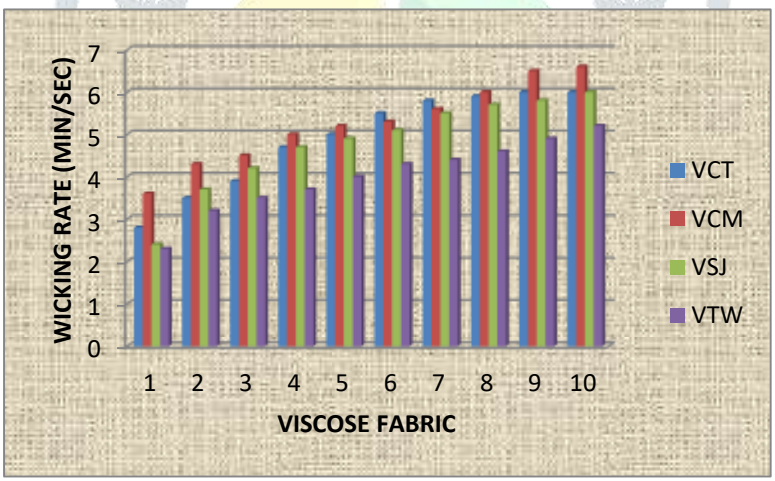
Wicking test of Viscose fabric

Wicking is the spontaneous flow of liquid in a porous substrate, driven by capillary forces. The capillary force caused by wetting is wicking. The longitudinal wicking height determines the liquid transporting ability, and the faster the rate of wicking, the better the sweat transporting ability will be, hence the fabric feels more comfortable to wear.

Table Wicking test of Viscose fabric.

S.NO	VCT	VCM	VSJ	VTW
1	2.8	3.6	2.4	2.3
2	3.5	4.3	3.7	3.2
3	3.9	4.5	4.2	3.5
4	4.7	5	4.7	3.7
5	5	5.2	4.9	4
6	5.5	5.3	5.1	4.3
7	5.8	5.6	5.5	4.4
8	5.9	6	5.7	4.6
9	6	6.5	5.8	4.9
10	6	6.6	6	5.2

Figure Wicking test of Viscose fabric.



Wicking test of viscose fabric from four structural variation of single jersey, cross miss, cross tuck & twill it is being seen that Viscose cross miss gives the good result among all four.

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 water vapour permeability are significantly affected by the Moisture Vapour Transport. An increase in the Modal fibre content in the fabric affects the thermal comfort properties. The wicking height of woven fabric, with longer yarn floats and less crimped yarns, is the highest. Increase in weft yarn density leads to a decrease in porosity, due to increased warp yarn crimp and therefore a decrease in wicking height.

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