STUDY OF MOISTURE TRANSFER CHARACTERISTICS OF DOUBLE-FACE KNITTED FABRICS

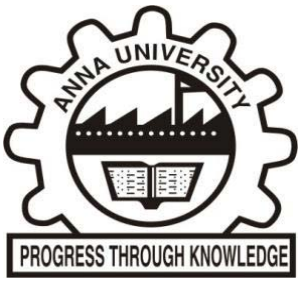
ABSTRACT

Submitted by

SATHISH BABU B

in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY



FACULTY OF TECHNOLOGY

ANNA UNIVERSITY

CHENNAI 600 025

JULY 2017

ABSTRACT

Moisture transfer in a fabric performs a key role in maintaining the body heat at ambient body temperature of 37^0C which is essential for a fabric in deciding its comfort level. Whatever heat the human body produces must flow out through the fabric via the body surface by conduction, convention and radiation. Sports which involve higher level of physical exertion cause the body to sweat and it should be evaporated in making the body cool. So the clothing must ensure a higher level of moisture transmission. Fabric must have the property of transferring the sweat out of the body and making the wearer to feel comfortable. So moisture management can be defined as the ability of a fabric to transport moisture away from the skin to the fabric outer surface and to release it into the surrounding air. Hence wetting, wicking and moisture vapour transmission characteristics are the critical aspects of a fabric in deciding the clothing comfort of the wearer.

Moisture transfer properties of fabrics have great influence on thermo-physiological comfort of human body in maintaining the perspiration. The cloth worn next to skin should be able to transfer the perspiration to the atmosphere so that the thermal balance of human body can be maintained. The mechanism of moisture transfer through clothing during transient conditions plays a key role in deciding the dynamic comfort of the wearer.

The properties of any clothing is decided by the constituent of its fibres, yarn and fabric structure. As clothing it should satisfy the wearer both in functional and aesthetic aspects. Thermal comfort is related to the temperature of the body and micro environment between the fabric layer and the skin. The heat generated by the human body during strenuous activity must be dissipated to the external environment through the clothing. So the clothing worn next to skin should have the property of transferring the perspiration from the skin and to transfer the moisture to the atmosphere thus

making the wearer to feel comfortable. Moisture transfer refers to the transfer of both moisture vapor and perspiration away from the body.

Through this research work an attempt has been made to study the influence of yarn type, yarn linear density and tuck density on moisture transfer characteristics of double-face knitted fabrics and study of moisture management properties of double-face knitted fabrics have also been studied.

Influence of yarn type on moisture transfer characteristics of double-face knitted fabrics were carried out to find out the type of yarn which gives better level of moisture transfer characteristics. In order to study this effect five different yarns such as cotton, polypropylene, polyester, acrylic and nylon were selected. The polypropylene, polyester, acrylic and nylon selected were multifilament dyed yarn of 120 denier (with 24 filaments) and the cotton of 40s combed hosiery grey yarn. The selected yarns were knitted by using high speed double circular knitting machine with speed of 25 rpm to produce four different double-face fabrics of Cotton/Polypropylene (C/PP) fabric, Cotton/Polyester (C/P) fabric, Cotton/Acrylic (C/A) fabric and Cotton/Nylon (C/N) fabric containing 3 mm stitch length having tuck stitch at every 6^{th} wale and every 9^{th} course with inner layer as manmade fabric and outer layer as cotton fabric. The double-face fabrics produced were tested for the moisture transfer characteristics such as wetting, longitudinal wicking, transverse wicking, moisture vapour transfer and dryness, air permeability and thermal conductivity. Comparing all the selected double-face knitted fabrics of C/PP fabric, C/P fabric, C/A fabric and C/N fabric it was found that 40sC/120D PP fabric had given better level of moisture transfer properties and suits in making sportswear.

Influence of yarn linear density on moisture transfer characteristics of double-face knitted fabrics were carried out to find out the type of yarn linear density which gives better level of moisture transfer characteristics. In order to study these effect three different counts of combed cotton yarn such

as 40s, 30s and 20s and three different denier of dyed polypropylene yarns such as 240D, 180D and 120D were selected for the study. The polypropylene yarn selected was multifilament dyed yarn (with 24 filaments) and the cotton of combed hosiery grey yarn. The selected yarns were knitted using high speed double circular knitting machine with speed of 25 rpm to produce nine different double-face fabrics containing 3 mm stitch length having tuck stitch at every 6^{th} wale and every 9^{th} course of the fabric with inner layer as polypropylene fabric and outer layer as cotton fabric. The double-face fabrics produced were tested for the moisture transfer characteristics such as wetting, longitudinal wicking, transverse wicking, moisture vapour transfer and dryness, air permeability and thermal conductivity. Comparing all the selected nine double-face knitted fabrics of 40sC/240D PP fabric, 30sC/240D PP fabric, 20sC/240D PP fabric, 40sC/180D PP fabric, 30sC/180D PP fabric, 20sC/180D PP fabric, 40sC/120D PP fabric, 30sC/120D PP fabric, 20sC/120D PP fabric, it was found that 40sC/240D PP fabric had given better level of moisture transfer properties and suits in making sportswear.

Influence of tuck density on moisture transfer characteristics of double-face knitted fabrics were carried out to find out the type of tuck density which gives better level of moisture transfer characteristics. In order to study this effect combed cotton yarn of 40s and polypropylene dyed yarn of 240D were selected for the study. Five different double-face knitted fabrics was produced from 40sC/240D PP as 6×9 double-face fabric, 6×6 double-face fabric, 3×3 double-face fabric, 9×9 double-face fabric and 12×9 double-face fabric. The polypropylene yarn selected were multifilament dyed yarn (with 24 filaments) and the cotton of combed hosiery grey yarn. The selected yarns were knitted using high speed double circular knitting machine with speed of 25 rpm to produce five different double-face fabrics containing 3 mm stitch length having tuck stitch at every 6^{th} wale and every 9^{th} course, tuck stitch at every 6^{th} wale and every 6^{th} course, tuck stitch at every 3^{rd} wale and every 3^{rd} course, tuck stitch at every 9^{th} wale and every 9^{th} course

and tuck stitch at every 12^{th} wale and every 9^{th} course of the knitted fabric with inner layer as polypropylene fabric and outer layer as cotton fabric. The double-face fabrics produced were tested for the moisture transfer characteristics such as wetting, longitudinal wicking, transverse wicking, moisture vapour transfer and dryness, air permeability and thermal conductivity. Comparing all the selected five double-face knitted fabrics, it was found that double-face knitted fabrics produced from 40sC/240D PP of 6×9 fabric had given better level of moisture transfer properties and suits in making sportswear.

The moisture management properties of double-face knitted fabrics have also been studied with respect to yarn type, yarn linear density and tuck density. With respect to yarn type, 40s count cotton and 120 denier polypropylene double-face knitted fabric shows better results for the moisture management properties than the other three fabrics. Moisture management test results shows that water poured on the surface of polypropylene layer has found to get wicked and transferred to the cotton layer after 65 seconds but in case of polyester, acrylic and nylon the water poured on their surface remains even upto 120 seconds. With respect to yarn linear density, no significant difference has been found among the nine double-face knitted fabrics for the moisture management properties. With respect to tuck density, 40s count cotton and 240 denier polypropylene double-face knitted fabrics of (6×9 fabric) shows better results for the moisture management properties than the other four fabrics.

Based on the research work, it is concluded that the moisture transfer characteristics of the double-face knitted fabrics are influenced by the type of yarn, linear density of yarn and tuck density of the fabric. The selection of yarn, linear density of yarn and the tuck density of the fabric decides the moisture transfer characteristics of the double-face knitted fabrics which suits in making sportswear.