Abstract

The properties of fibers like cross-sectional shape and linear density are important in determining the arrangement of fibers in yarn assembly and subsequently yarn and fabric properties, since contribution of yarn and fabric structure to the quality of apparel fabrics is transmitted through the linear density, surface geometry and cross-sectional shapes of the constituent fibres. To investigate the effect of such fiber features on yarn and fabric characteristics, polyester fibers of four different cross-sections viz. circular, trilobal, scalloped oval, tetrakelion were taken and blended with Viscose fibers in the ratio 67:33 to spin yarns of 19.66 tex on ring spinning system. For comparison, yarns of 100% polyester and 100% viscose of the same linear density were also produced. Polyester fibers of circular cross-section of varying fiber linear densities viz. 1.33 dtex, 1.55 dtex, 1.66 dtex and 2.22 dtex were also spun into yarns of the same linear density 19.68 tex at three different levels of tex twist factors (27.26, 30.14 and 33.0). Following this scheme, 57 yarn samples were prepared. All these yarns were doubled on ring doubler with 90% twist of respective single yarns. All doubled yarns made from single yarns of 30.14 twist factor both in 100% and 67:33 category were selected to prepare 19 woven fabric samples with 2/1 twill weave.

It was observed that among non-circular fibers yarns spun of trilobal fibres exhibit maximum packing fraction, while those of tetrakelion a minimum. Increase in fiber linear density leads to reduction in yarn packing coefficient. Addition of viscose fibers in polyester improves the uniformity but deteriorate the imperfections level of the yarn. Regarding the influence of twist, yarn evenness decreases with the twist level. Trilobal fibers exhibit higher nep levels in comparison to their circular counterpart but opposite trend is observed in case of scalloped oval and tetrakelion fibres. Increase in polyester fiber decitex reduces the tendency of nep formation. Micro denier fibers show highernepping tendency during the spinning operation due to low bending rigidity.

Young's modulus of yarns made of trilobal fibres and tetrakelion is more than that of their corresponding circular fibres while in case of scalloped oval it is lower than its equivalent circular. Blending of viscose to polyester marks a significant improvement in young’s modulus of yarns, but their flexural rigidities are governed by average of individual fiber rigidities of blend components. As far as yarn hairiness is concerned, higher the polyester fiber denier, higher will be the hairiness count. Yarns made of scalloped oval fibers exhibit maximum numbers of hairs followed by tetrakelion and lastly the circular.
Regarding mechanical properties, it has been observed that the fiber strength translation efficiency increases, as the fiber becomes finer. Scalloped oval fibers contribute more towards yarn strength as against tetrakelion and circular, while Trilobal contribute lesser than its corresponding circular fibers. Blending of viscose drops the tenacity of polyester yarns and this drop in tenacity goes on increasing with the increase in polyester fiber linear density. Maximum drop has been witnessed with circular fibers followed by tetrakelion and, the minimum reduction is seen in case of scalloped oval fibers.

The principal thermal properties of fabrics, like thermal absorptivity, thermal resistance and thermal conductivity were experimentally evaluated, using Alambeta instrument. The study of the obtained results established that fabrics of non-circular cross-sections as against circular one and rising fiber linear density attained comparatively higher thermal resistance, lower thermal conductivity and lower thermal absorptivity.

Wicking behaviour of fabrics was studied under two conditions- wicking from an infinite liquid reservoir (transplaner wicking) and wicking from a finite liquid reservoir (single drop wicking into the fabrics). Increase in fibre linear density enhances trans-planer wicking but slows down the spreading speed of water drop. Air permeability and and rate moisture vapour permeability has been found to be positively correlated with fiber decitex. Role of fiber cross-sectional shapes in influencing mass flow characteristics is quite considerable. Use of non-circular polyester in place of circular augments the wickability of liquid water along with permeability of air and moisture vapour through the fabrics revealing their high porosity and large specific surface which assists air and moisture to propagate.

Mixing of viscose to polyester brings down the air permeability and moisture vapour transmission rate (MVTR) of fabrics which is attributable to improvement of its compactness. Moisture absorption of viscose is the factor playing an important role in influencing the moisture transport characteristics including both transplaner wickability and MVTR of 100% viscose and P/V blended fabrics.

Increase in fiber denier increases all four mechanical characteristics of their fabrics namely compressibility, extensibility, bending and shear and results in elevated formability. But influence of cross-section is very specific. Trilobal and tetrakelion being stiffer produces bulky yarn, thereby, resulting in generation of stiff fabrics with enhanced formability as compared to their comparable circular. Scalloped oval fibers because of their possessing less bending and torsional rigidity produce fabric of low rigidity and formability but moderate compression and high extensibility. Blending of viscose in the fiber mix tends to reduce down the stiffness (both bending and shear) but improves extensibility and formability.