Chapter 1

Introduction

Apart from fibre assembly structure and their physical properties, the performance of high-value added synthetic-fibre products is greatly affected, not only by the properties of the polymer itself, but also by the fibre form, which can be controlled for particular uses. It is not uncommon that many textile goods are produced by using standard methods of textile technology and improved by changing the construction parameters of fibre assemblies, but, in order to make sophisticated improvements in the fibrous products much more effective, it is usually advisable to change the properties of the fibres by modifying its structure and physical form. Indeed, to realize higher levels of performance, various developments and modifications of the form and structure of fibres are required. From the technological point of view, the combination of a new polymer and advances in the technology of fibre spinning will introduce innovative and refined textile materials. Presently, there is a growing interest in fibre variants instead of developing new generic fibres. Fibre producers are broadening their range of fibre variants to include finer deniers, uncommon filament counts, modified cross-sections, and luster variations. The production of fibre variants is likely to grow because of the trend towards light weight, supple fabrics to satisfy the demand of fashion and performance.

Among manufactured fibres, polyester dominates the market. World-wide maximum share of polyester fibre in use is a reflection of its versatility. It has a number of outstanding characteristics such as excellent dimensional stability, crease resistance, bulk, elasticity, warm handle and complete resistance to moths, mildews and micro organisms that lead to its multiple applications especially in the textile field and therefore, popular of all fibres. However, it also has some negative features such as poor moisture absorption, difficult dyeability, tendency to pill and formation of static charge. Over the past two decades, the fibre producers have put in continuous efforts to develop modified polyester fibers to overcome/subside these negative features. One of these endeavors has been the development of different profile fibres. Melt spin filaments are generally produced in circular cross-section. Most aesthetic fibers have non-circular cross-section produced with non-circular orifices, namely; Hollow, Triangular (thick and thin), W-Shaped (self crimping), Pentagonal, U-Shaped, Flat, Arrow like, random and multishaped. The materials produced from
such aesthetic fibres are highly fashionable having superior aesthetic and sensual factors such as appearance, colour, handle and touch, softness, bulkiness, and special texture.

Various cross-sections have long been studied in the expectations that a new non-round cross-section could create new fibre characteristics [1-3], most prominently to imitate the natural fibres. Differentiation of the cross-section greatly influences the properties related to appearance and touch (feel), handle like luster, dry or wet feel, handle etc. Non-circular cross-sections give the fibre, not only a different luster, but also a remarkable change in bending stiffness and handle. For instance, a regular triangular cross-section gives a fibre with 1.2 times larger bending stiffness [4, 5].

It has been mentioned that slight deviation from circularity of cross sectional shape can lead to substantial differences in fiber processing behavior and in the performance characteristics of textile structures. Fibre cross-sectional shape affects the cohesion and bulkiness (volumetric packing density) of fiber assemblies. In fibers with non smooth, non circular cross-section, however, a spiraling edge is generated (similar to that of a screw) there by restricting the potential for inter fiber contact and fiber packing. The less circular the cross-sectional shape of the fibre, the larger this restriction. Also, the capillaries on a fibre surface composed of a modified section, including a multilobal section have a water absorbing effect. In this way, these profile fibres acquire high loft, porosity, high moisture absorption and heat insulation properties [4-6].

The characteristics of hollow fibres are lightness, a novel appearance and Superior warmth because of the inclusion of air [6-8] compared to ordinary fibres of the same linear density; they are stiffer and more resistant to bending and torsion and have a more opaque appearance caused by diffused reflection of light. These fibres are generally used for enhancing the lively hand of the fabric.

Fiber fineness is another property having substantial effect on its product characteristics. Finer especially Microdenier fibres offer superior softness, drape, comfort and are used in various applications like high grade woven/knitted fabrics with a soft hand, water/oil absorbent fabrics, wiping clothes, filter clothes, moisture permeable, water proof high density woven fabrics. In these end-uses, a suitable combination of the fibre assembly structure and fibre material is important in realizing excellent performance [6, 9-10]. Fine fibres have lower bending resistance and increase the aesthetics and drapeability of the fabrics. Polyester microfibers are also used in high density fabrics for sportswear and rainwear.
Polyester apparel comfort can be improved by a variety of techniques including apparel design, fabric construction, yarn construction, fibre modification, blending fibres of different generic classes and topical finishing. These methods can be used singly or in combination. Among various options, fibre fineness and fibre cross-section play a crucial role in deciding the appearance, handle and comfort characteristics of the products made out of them. They affect how soft or how prickly, how cool or how warm, how dry or how wet the fabric feels when it is worn next to the skin. Since, the bending and twisting of fibres influence the behaviour of yarns and drape and handle of the fabrics. Presence of indentations on fiber surface due to non-circular cross-section and change in specific surface as a result of change in fineness and cross-sectional shapes have a considerable effect on thermo-physiological comfort characteristics [5-6].

This study concentrates mainly on assessing how the different polyester fibres behave in self and in blends with viscose and establishing an interactive relationship among variables relating to fibres, yarn and fabrics.

Objectives of the Project

1. To study the effect of polyester fiber characteristics especially fiber fineness and cross-sectional shapes on their arrangements in the yarns made of all-polyester and 67:33 P:V blended forms including fiber packing fraction, twist geometry, mass irregularity and imperfections count etc.

2. To study the selected yarn properties like bending rigidity, tensile properties and hairiness and relate them with fiber characteristics and yarn parameters.

3. To investigate the role of polyester fiber fineness and cross-sectional shapes in influencing the fabric properties directly linked with human physiological comfort like air permeability, wettability, wickability, moisture vapor diffusivity, heat transmission characteristics and handle properties.