YARN TYPES, STRUCTURE AND THEIR CLASSIFICATION

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Abstract. *Fundamentally discusses the principal requirements for both knitted and woven fabrics with regard to their end uses. Knitted and woven fabric properties are presented in relation to both fiber and yarn properties. Fiber types, classification, performance and end uses are introduced. A classification of yarn types with regard to their fiber content, structure, twist and method of manufacture, as well as a survey of their physical and mechanical properties, is given. The criteria for the choice of fibers and yarns to suit fabric end uses and performance are outlined.*

Keywords: *fibers, yarns, fabric properties, requirements for knitted and woven fabric properties, criteria for choice of fibers and yarns*.

ВИДЫ ПРЯЖ, СТРУКТУРА И ИХ КЛАССИФИКАЦИЯ

Аннотация. *Принципиально обсуждаются основные требования как к трикотажным, так и к тканым материалам в отношении их конечного использования. Свойства трикотажных и тканых тканей представлены в отношении свойств как волокна, так и пряжи. Представлены типы волокон, классификация, производительность и конечное использование. Дана классификация видов пряжи по составу волокна, структуре, крутке и способу изготовления, а также обзор их физико-механических свойств. Изложены критерии выбора волокон и пряжи в соответствии с конечным использованием ткани и ее характеристиками.*

Ключевые слова: *волокна, пряжа, свойства тканей, требования к свойствам трикотажных и тканых полотен, критерии выбора волокон и нитей.*

INTRODUCTION

Several classifications have been introduced in the literature. However, most address only one or two aspects of the classification. The author has, therefore, introduced a classification of yarn types according to four categories which encompass almost all yarns available in the industry.

The four categories are:

1. Fiber type and content
2. Yarn structure
3. Yarn twist level
4. Method of manufacturing.

MATEREALS AND METHODS

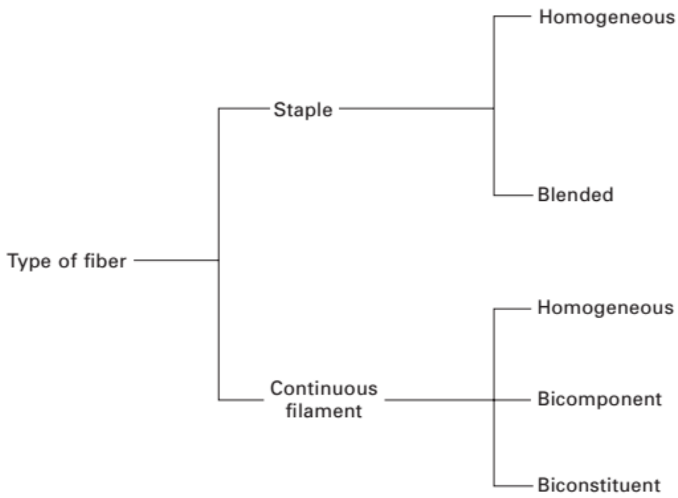
Figure 1 shows the classification of yarn according to fiber type and content. In the textile industry, yarns are made of one or two types of fibers.

These are:

❖ Staple fiber yarns, spun from short or long staple fibers. In this case, the yarns are spun from 100% homogeneous fibers or blends of two or more types of fibers. Blended yarns provide certain characteristics and properties which cannot be obtained when using only one type of fiber.

Fig-1.

Classification of yarns according to fiber type and content.



❖ Continuous filament yarns, which are mostly produced from man-made fibers. These yarns could also be of 100% homogeneous, bicomponent or bi-constituent filaments. Bicomponent continuous filament yarns are made by simultaneously extruding two molten filaments of different polymers which combine to form one continuous filament yarn. Figure 2 illustrates the formation of bicomponent filaments. Bi-constituent continuous filament yarns are made by having one polymer dispersed within another polymer before they are extruded into a yarn, as also shown in Fig..

❖ Combinations of staple fiber and continuous filament. Presently, there are yarns which are made by combining either staple fiber wrapped by continuous filament or staple fiber wrapped around a continuous filament in the core of the yarn. Core-spun yarn may be made with an elastomer core, such as Spandex, covered by another fiber to produce a stretch yarn. Core-spun yarns are used extensively in medical braces for knees, elbows and ankles. The staple fiber on the surface provides sheerness and comfort, especially when used in swimwear, active wear, underwear and hosiery.

Fig 2.

Formation of bicomponent and biconstituent fibers

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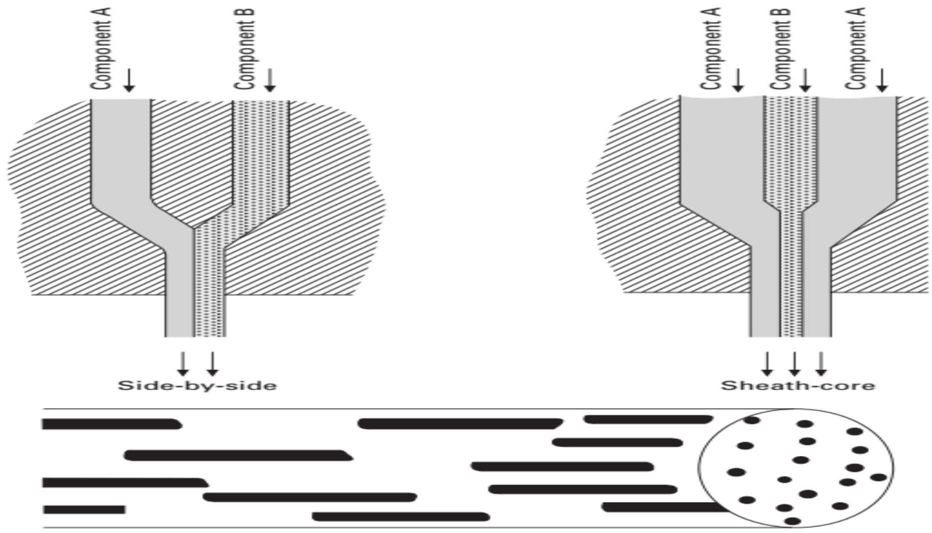


Longitude and cross-section of matrix fiber structure. The black area represents fibrils of one fiber and the second fiber is represented by the white.

RESULTS

Aside from the type of fibers converted into singles yarns, they can be classified according to their structural form as shown in Fig. 3. which also depicts their general appearances. The structural forms shown are:

- Single yarns
- Ply or multifold yarns
- Cabled or cord yarns
- Complex or core-spun yarns
- Fancy yarns, sometimes known as novelty yarns
- Modified continuous filament yarns.
- These are described in turn below.

Singleyarns

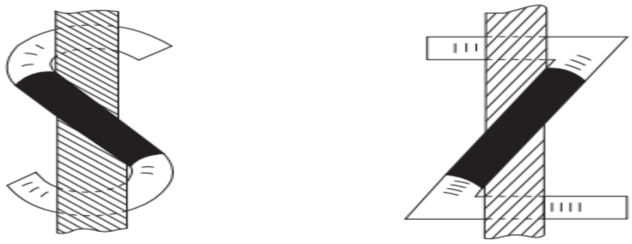
Single yarns occur in one of the following forms:

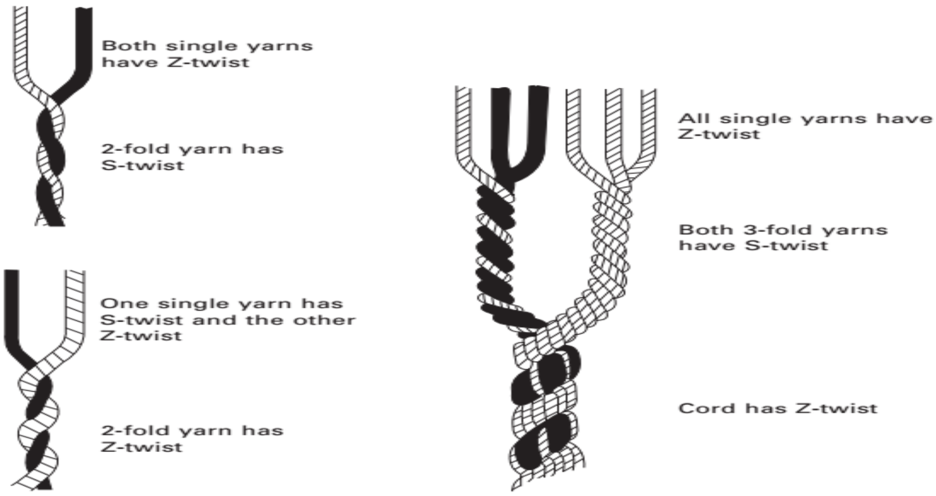
- A number of staple fibers (short too long in length) are twisted together to form a spun yarn.
- A number of filaments laid together with a small amount of twist (producer twist).
- Single filament with or without twist (monofilament).

The structure of single yarns will be discussed and explains the fiber/yarn interaction that influences the yarn structure.

Fig-3.

Direction of twist and construction of plied and cord (cabled) yarn





Ply or multifold yarns

These yarns are produced by twisting together two or more single yarns. This type of yarn has different properties from a single yarn of the same count. It has higher strength, higher uniformity and better abrasion and gives better fabric appearance. Fabrics made of this yarn in the warp do not need a sizing (or slashing) process before weaving. This type of yarn has a balanced twist, achieved by ply twisting the two singles yarns in the direction opposite to their twist, and therefore does not tend to snarl or untwist during the knitting or weaving process, neither will it need steaming or conditioning prior to these processes. This is achieved by usually having the singles twist in the Z- direction and that of the ply in the S-direction. This yarn is more expensive than singles of the same count.

Cabled or cord yarns

This yarn is obtained by twisting together a multiple (i.e. multifold) of yarns. This type of yarn is mostly used in the tire industry and is designated as tire cord. It is manufactured to exhibit specific properties. Another example of the end use of this type of yarn is as a sewing thread. The performance of this yarn in the examples cited could not be obtained by any other yarn type, since the major properties provided are its strength, tensile modulus and elongation.

Complex or core-spun yarns

These yarns are made with a central core of one fiber around which is wrapped or twisted an exterior layer of another fiber. Core-spun yarns may be made with elastomer core, such as Spandex, covered by another fiber to produce a stretch yarn. Other core-spun yarns include sewing thread made with a polyester core and cotton cover, suitable for high speed industrial sewing processes in which 100% polyester thread could melt due to the high temperature that the sewing needle may reach.

Fancy or novelty yarns

These yarns are mainly of decorative interest. They are made by introducing special forms of irregularities or hairiness into either spun or continuous filament yarns. Many different yarns of this type are available in the industry, such as boucle yarns, flake or seed yarns, nub yarns, slub yarns, spiral or corkscrew, and chenille yarns.

DISCUSSION

Modified continuous filament yarns

Continuous filament yarns are made from straight filaments which are smooth and slippery to the touch. They lack the bulk, comfort and tactile hand of yarns spun from staple fibers. Producers of continuous filament yarns tried to simulate the effects obtained by staple fiber yarns. First, they modified the luster of the filament from bright to semi-bright to dull. Second, they modified the structure of the filament by adding bulk and stretch, by various texturing processes. These processes are primarily to increase bulk for comfort, resilience and hand or to provide stretch to the yarn.

CONCLUSION

From the topics presented in this chapter and throughout other chapters, the following conclusions could be outlined:

1. The scientific, engineering and technological advances that have been applied in the different phases of the textile industry, have highlighted the way to a greater understanding of the different interactions between fiber and machine, fiber and yarn, and yarn and fabric.

2. There is an endless variety of yarns that can be created by using different fibers, by twisting fibers more or less tightly, and by combining two or more individual yarns to form a more innovative product.

3. The potential for variation in fabric structure is enormous, resulting in an endless variety of textile structures that are produced to suit the different end uses and provide the utmost performance.

4. Those involved in testing and quality control, assessment and evaluation are provided with standard test methods which provide them with the information they need and/or the specifications for the products' end use and performance.

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