

# **CHAPTER -1**

## **INTRODUCTION**

With the progress of civilization, clothing became the second most important basic needs of mankind after satisfying their hunger (Roti, Kapada, and Makan). From the very beginning, humans started to protect themselves from the fury of nature with the help of available natural recourses like animal skins, plants leaves & barks, natural caves etc. Gradually humans started preparing fabrics from natural fibers like cotton, wool, jute, hemp, silk etc. In the 20th century, with the advent of science and technology man-made fibers (regenerated cellulose and pure synthetic) were invented. Textile fibers are normally classified into two broad groups:

- A. Natural fibers
- B. Man-made fibers

Further natural fibers are subdivided into following heads:

- Animal fibers (Wool, Mohair, Angora)
- Vegetable Fibers (Cotton, Jute, Hemp, Sisal etc.)
- Mineral Fibers (Asbestos)

And Man-made fibers are classified into:

- Organic sources
- Inorganic Sources (Glass, Metallic, Carbon, and Ceramics)

From Organic Sources further we have:

- Artificial fibers (Viscose, Acetate, Modal, Cupro, Lyocell, acetate)
- Synthetic Fibers (Acrylic, Fluoro fiber, Polyamide (Nylon), Aramid, Polyethylene, Polypropylene, Polycarbide, Polyester(PET) )

Presently polyester fiber is one of the most economic & extensively used fibers in the field of the textiles. Due to its low-cost PET fiber (polyester) is replacing other costly fibers like Nylon and Viscose in several fields of the applications.

## **1.1 HISTORY**

In 1939, W.H. Carothers of DuPont [2] found that carboxyl acids and alcohols can be used to produce esters which can be converted into fibers. In 1941, the British scientists John Whinfield, James Dickson, W.K. Britwhistle and C.G. Ritchie further extended Carother's work and were the first to manufacture polyester fiber in England and named it "Terylene". After Second World War in 1946, DuPont of USA further refined the process of polyester manufacturing in 1951 and has given it trade name "Dacron". In 1958, Eastman Chemical Products, Inc. developed a type of polyester called Kodel. Since then polyester market kept expanding. Even presently it is expanding at a CAGR of 6% annually. This fiber is kept on expanding till date, many spinners in India, especially in south Gujarat started to produce polyester fiber/filament due to its durability and low cost of production. Nowadays polyester is one of the most vulnerable textile fiber and replacing other costly competitive fibers like Nylon and Viscose in various applications

Earlier polyester is regarded as an uncomfortable fiber but recently with the development of special luxury polyester fibers/filaments like very fine denier multifilament yarns, hollow fiber etc., and this very image has changed.

## **1.2 PRESENT SCENARIO**

Polyester fiber with a market share of 72% is the most extensively used synthetic man-made fiber worldwide [3]. Not only is its cost of production, the lowest among competing fibers, but it is successfully used in many textile applications as well as in the automotive industry. Since the last ten years, the growth of PET fiber has enjoyed CAGR [4] of about 6% annually. The main reasons of MMF growth particularly PET fibers are: -

- The limited area under cultivation for natural fibers.
  - The uncertainty of rainfall and threat of insects for cotton, jute, and silk production.
  - Rapid urbanization and population growth.
  - GDP growth rate and cotton availability are by far most important driver.
  - Growing healthcare and automobile industries.
- Cotton faces stiff competition from other MSP based crops over the long term and provides support for the diving demand of MMF.
- Lower per capita fiber consumption, 5Kg in India against 12Kg globally and 19Kg in China [5].

Polyester monofilament has a cost advantage as well as better mechanical and chemical properties as compared to another man-made fiber like polyamide and acrylic. Asia as a region accounts for about 92% of global PET fiber production and 86% of global consumption. Due to extensive use of PET fibers emphasis has been given to modifying PET fibers for various applications [6]. In textile and apparel industries POY, FDY, DTY and draw twisted yarns are produced as PET multifilaments and PET fibers are mixed to manufacture PC, PV, and PVC

blended yarns through conventional spinning. Another encouraging field is PET monofilaments manufacturing which is mostly used in zippers, various types of brushes, sports industry, automotive industry, agriculture industry, geotextiles, medical textiles, airbags, heavy duty tires, intimate apparels, swim wears and also others various technical textiles.[7]

Earlier polyester monofilaments are manufactured through a two-stage process that is first producing LOY at spinning and then drawing LOY on D/T machines to produce final drawn PET monofilament yarns. The two-stage process involves lots of investment and cost of production per Kg was also quite high that is around Rs.75/Kg. Rapid industrial growth in technical textiles has attributed to the multifold increase in polyester monofilaments consumption. Spinners started expanding their monofilament capacity. Leading machine suppliers like TMT (Japan) and Barmag (Germany) are offering special lines for polyester monofilaments but these are quite costly. To avoid such huge investment spinners started to take trails and modify their existing FDY lines to produced PET mother yarns which can be further split to PET monofilaments.

Initially, Nylon monofilaments are used for zippers, fishnet and in filter clothes but due to its higher cost PET monofilaments are replacing nylon slowly. However no scientific study for converting regular FDY lines to produce polyester mother yarn was made, only trial and error methods were adopted.