

Quadrant II – Notes

Programme: S Y B Sc (Hons) Home Science

Subject: Home Science

Course Code: CC12

Course Title: Introduction to Textiles

Unit: II Production, Chemistry, Properties and Usage of Fibres

Module Name: Polyester

Module No: 9

Name of the Presenter: Suvarnagouri Y

Notes :

Polyester

Polyester is one among the first developed petroleum based synthetic fibres next to nylon. It was first identified by the Dupont team of scientists under the leadership of Dr.W.H.Carothers along with polyamide fibre nylon. Scientists from Great Britain focused their interest in developing long chain linear polyester polymers. J.R.Whinfield and J.T.Dickson from calico Printers Association are responsible in bringing up the successful polyester fibre in 1941 called 'Terylene'. It was made available to American Consumer from 1951 onwards under the trade mark 'Dacron'. These fabrics found immediate consumer acceptance because of their ease of maintenance and excellent wrinkle resistance recovery. The Textile Fibre Product Identification Act (TFPIA) defines polyester as 'a manufactured in which the fibre forming substance is any long-chain synthetic polymer composed of atleast 85 per cent by weight of an ester of a substituted aromatic, carboxylic acid, including but not restricted to substituted terephthalic units'.

The manufacture of polyester is a simple process of allowing reactions between a dihydric alcohol and dicarboxylic acid for formation of a polymer and melting and forcing it through the holes of a spinnerette.

Ethylene glycol and dimethyl terephthalate or terephthalic acid, petroleum by products.

Process:

- The two chemicals ethylene glycol and terephthalic acid are combined in an autoclave which is like a huge pressure cooker. At high temperatures, both the chemicals react with each other and a polymer that contains about 80 to 100 repeating units is formed.
- The polymer is extruded in a ribbon form which is removed and made into chips or pellets. Sometimes it can be stored in this form and shipped to the spinning mills.
- The chips/pellets from different autoclaves are placed in a hopper and mixed to ensure uniformity.
- The chips are made to fall on a hot grid which makes the polymer to melt.
- The molten polymer is filtered to remove impurities and passed through a vacuum to suck the air bubbles which interfere in formation of continuous filament.
- The purified polymer is forced through the holes of a spinnerette into cool air and then get solidified (melt spinning)
- It is stretched or cold drawn to orient the molecules in the fibres in order to improve strength and fineness. The amount of drawing depends on the end uses of the fibre. Majority of the yarn produced will be utilized for production of textured yarns.
- Generally polyester polymer is drawn 5 times their original length.

The drawn filaments are given slight twist and wound on spools. Each yarn contains many filaments, the number of which depends on the number of holes present in a spinnerette. Based on the end use, the filament yarns are given varied twist and made into versatile yarns.

Due to the desirable characteristics found in polyester, it is very common to find polyester as one of the principal fibres. Thus it is regarded as a 'big mixture' in the textile industry. To facilitate blending, the filaments from various spinnerettes

are collected and made into a 'filament tow' which is textured (crimpy, wavy or coiled) between rollers at high temperature and cut into staple lengths (1" to 5").

Structure Polyester fibres are rod like cylindrical in shape. The diameter is found to be uniform and contains smooth surface. The pitted appearance found in many polyesters is due to the use of titanium dioxide to control its luster. The cross sectional shape is round. Variations in cross sectional shape may be found in special polyesters. The most common are trilobal, T-Shape, pentalobal and trilateral.

Luster: Polyester fabric is lustrous. Lustre depends on the way light is reflected by the fibre and is determined by its cross-sectional shape.

Density: The density of polyester is 1.38. It can be made into a variety of fabrics ranging from light weight to heavy fabrics.

Strength Polyester is a strong fibre when compared to the natural fibres. Its strength can be controlled based on the intended end-use of the fibre in the range of 2.5 gm to 9.5 gm/denier. Fibres with lower tenacities are utilized for apparels. Fibres having more than 7 gm/denier tenacity are utilized for industrial applications. While blending polyester with other fibres, strength will also form an important criterion.

Elasticity Polyester is one of the textile fibres that exhibit good elongation and elastic recovery. The elongation is more in case of fibres of low tenacity and it is less when the strength is high. Polyester fibres exhibit high recovery under low stress. Recovery is 97 % at 2 % elongation.

Resiliency Polyester has excellent resilience. This property helps in resisting wrinkles and provide excellent recovery if creased.

Abrasion resistance Polyester has very good abrasion resistance.

Moisture Regain: Polyester is a hydrophobic fibre and has a regain of 0.4 % at standard conditions. Even at high humidity conditions, it has the moisture regain of 0.6 to 0.8 %. But the fibre has 'wicking' property which means moisture travels on the surface of the fibre, so as to keep the wearer comfortable.

Dimensional Stability: Polyester fabrics are given a finish called 'heat setting' which is a process of setting the dimensions of the fabrics, so that the fabrics neither stretch nor shrink.

Drapability Polyester has satisfactory drape. The drape improves with the change in cross sectional shapes. Heavy polyesters drape well making it suitable for economical draperies.

The heat resistance in polyester is high. The heat conductivity depends on the type of fabric construction. Polyester fibre shrinks away from flame as it is a thermoplastic fibre. It takes up flame readily and burns fast. It continues to burn after removal from flame with an aromatic odour leaving a hard bead residue. Polyester starts melting from 238⁰C to 290⁰C. Ironing temperature of 120⁰C is recommended.

Effect of alkalis: Polyester is resistant to mild alkalis but concentrated alkalis at high temperatures disintegrate the fibre.

Effect of acids: Polyester's resistance to organic acids and mineral acids is good to excellent. Highly concentrated mineral acids disintegrate polyester fibres if exposed to high temperatures.

Effect of bleaches: Polyester is resistant to many household bleaches. It can safely be bleached without any deterioration. Polyesters are produced with optical brighteners which give permanent white color.

Effect of Sunlight: Polyester is highly resistant to ultraviolet rays and sunlight.

Effect of Mildew: Polyester's resistance to mildew is very high.

Effect of Moths: Moths, silver fish and carpet beetles have no effect on

polyester.

Effect of Perspiration: Perspiration has no effect on polyester.

Electrical Conductivity: Polyester is a poor conductor of electricity. Electricity produced on the surface due to rubbing with other objects will not be conducted away and tend to pile on the surface. It is termed as 'static electricity' which poses problems in low humid conditions.

Pilling: The formation of pills on the surface of the fibre due to enlargement of fibre ends is a problem in spun polyester fabrics.

Finishes given to Polyester:

- Heat Setting- for permanent shape retention and wrinkle resistance.
- Calendering-for smoothness and reduced pilling.
- Antistatic finish- for reduced electrical buildup.
- Embossing- for producing raised design for aesthetic look.
- Singeing– for producing smooth surface by burning off fibre ends.
- Soil repellency – helps in easy removal of all stains including oil.

Consumer preference:

- Versatility of Polyester: Polyester is blended with almost all fibres and produce fabrics of desirable characteristics.
- Ease of care: Due to its hydrophobicity it can be cleaned easily and dries faster.
- Wrinkle free fabrics: Keeps up good shape and does not require much ironing.
- Highly durable: It is resistant to most outside elements such as sunlight, acids in the air, bleaches and dry cleaning solvents..
- Very Economical: Polyester fabrics and its blends are available at moderate rates within the reach of all people.