Quadrant II – Notes

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Notes :

Rayon

Rayon fibre is a manufactured fibre composed of regenerated cellulose in purified form. Rayon is probably the first manmade fibre that was commercialized as early as 1895. The probability of making an artificial fibre just like silk had been predicted by Robert Hooke in 1664. The credit of inventing rayon fibre goes to Count Hilaire de Chardonnet who is regarded as “Father of Rayon’

The first rayon was produced from nitrocellulose. Commercially viscose rayon became successful by 1919 and many factories mushroomed around the globe.

The Textile Fibre Product Identification Act (TFPIA) defines rayon as ‘a manufactured fibre composed of regenerated cellulose in which substituents have replaced not more than 15 per cent of the hydrogens of the hydroxyl radicals’.

The production of rayon basically is converting the cellulosic raw materials chemically into another form, which is then changed into

cellulose again in purified form. Two principle types of rayon produced are:

- Cuprammonium
- Viscose rayon

High wet modulus rayon is also produced whenever more wet strength is required.

The raw material used for this process is cotton lints or wood pulp made from specific wood types.

- The wood is made into chips, cooked, bleached, treated and pressed and purified sheets of white wood pulp containing cellulose
- The cellulose sheets are soaked in caustic soda to form alkali cellulose
- Cellulose crumbs are made by breaking up these alkali cellulose sheets into fluffy white flakes.
- The cellulose crumbs are aged for 2 to 3 days under controlled humidity & temperature.
- Carbon disulphide solution which is in light orange shade is added to the cellulose crumbs which are transformed into cellulose xanthate, still in crumb form.
- The xanthate crumbs are dissolved in a weak solution of caustic soda and transformed into a thick viscose solution resembling honey colour & consistency.

- The viscose solution is aged, filtered & vacuum treated to remove water bubbles which interfere with its formation into continuous filament.
- The dope is forced through the holes of a spinneret into an acid bath wherein it gets coagulated in a linear filamentous form.
- The coagulating bath is composed of sulphuric acid, sodium sulphate and water, additives such as glucose & zinc sulphate which control the rate of regeneration & influence the type of cross section of the fibre.
- The filaments formed on coagulation contain pure cellulose free from all chemicals.
- The filaments are thoroughly washed to remove impurities.
- The filaments are doubled and drawn to spin them into fine yarns. Drawing improves the orientation there by the strength & modulas of rayon filaments.
- The filaments that leave the coagulation bath are put through three methods of processing.
    - **Pot or box spinning**: The filaments are led through a funnel moving up & down in a cylinder called topham box which revolves making the filament to deposit along the walls of the cylinder forming a hollow cake. It is removed, washed, treated with chemicals to remove impurities, rinsed, dried and wound on spools.
    - **Spool spinning**: The filaments are made to pass over the rollers and wound on perforated cylinder which later facilitates its washing and other processing and finally wound on spools.

- **Continuous Process**: The filaments are put through a continuous process of washing and subsequent processing and wound on desired package.

Properties of Rayon: The properties of viscose rayon and high-wet-modulus rayon differ in their structure, properties and intended end use.

Structure: Viscose rayon is characterized by discontinuous longitudinal lines called striations. These lines are the result of its 'serrated' cross sectional shape due to the loss of zinc sulphate during coagulation. As zinc sulphate is less in the coagulating bath of high wet modulus, the shape is round and thereby no striations are present.

The degree of polymerization is 300 to 400 as against 10,000 in the case of natural cellulosic fibre, cotton. Even though both are cellulosic fibres, the differences occur in their properties due to the difference in degree of polymerization.

Luster: Rayons by nature are very bright and their brightness is controlled by the addition of titanium dioxide making it semi-dull and dull depending on the quantity added.

Density: The density of rayon is 1.50 gm/cubic cm as the basic material is cellulose in its purified form.

Strength: Viscose rayon is a medium strong fibre having slightly better strength than wool but inferior to cotton and silk. Due to the

filamentous nature, it is possible to produce lightweight sheer fabrics with considerably good strength. Rayon looses its tenacity when wet up to 50 % of its dry tenacity due to its amorphous nature which allows it to absorb more water, thereby facilitating the slippage of molecular chains.

Elasticity: Viscose rayon has great extensability of around 15 to 20 % when dry and wet but poor in their elastic recovery.

Resiliency: The resiliency of viscose rayon is low when compared to wool and silk. The fabrics are soft but readily crease during use. Wrinkles on fabrics pose problems unless finished with suitable resins. A small per cent of rayon used in blends provide softness.

Moisture Regain: Viscose rayon is one of the most absorbent fibres. It has better absorbency than cotton and linen due to its amorphous structure, exceeded by only wool and silk fibres. This property coupled with good heat conductivity enables rayon fabrics to be comfortable during summer. Care should be taken not to sag these fabrics when wet due to loss in strength.

Dimensional Stability: Like cotton, rayon fabrics show more of relaxation shrinkage rather than fibre property. However, rayon shrinks more than cottons. Sometimes finishes are imparted to control relaxation shrinkage.

Drapability: The probability of making tightly woven fabrics couples with weight makes the rayon fabric highly suitable for draperies.

Viscose rayon is a very good conductor of heat and thus very ideal for summer wear. As cellulosic fibre, it takes up the flame readily and burns faster than cotton and leaves a grayish white fluffy ash residue. As with cotton, it also shows an afterglow. Viscose rayon starts decomposing over 150 ^{0}C; ironing should be done at low temperatures.

Effect of alkalies: Even though rayon is cellulosic, its resistance to alkalies is inferior when compared to cotton. Concentrated alkalies disintegrate viscose rayon; therefore, mild soap is recommended for washing.

Effect of acids: Like cotton, rayon also disintegrates in acids. It cannot withstand hot dilute and cold concentrated acids especially mineral acids.

Effect of bleaches: During normal use, rayon does not discolor and retain its white color. If bleaching is required, household bleaches such as sodium hypochlorite (javelle water) sodium perborate and hydrogen peroxide at lower concentration can safely be employed.

Effect of Sunlight: Compared to all natural fibres, rayon possesses good resistance to sunlight. However, prolonged exposure to sunlight may turn white fabrics into yellow and causes subsequent deterioration.

Effect of Mildew: Being pure cellulosic fabric, it becomes a good lost for the growth of moulds. The fabric should not be kept under damp condition for long period.

Effect of Moths: Viscose rayon is not affected by cloth moths.

However, silver fish may damage the fabric.

Effect of Perspiration: Rayon is fairly resistant to deterioration due to perspiration. More than the fabric, the color gets affected.

Finishes given to Rayon:

- Calendering- for smooth finishing.
- Preshrinking- for providing good dimensional stability.
- Flame retardancy- to control the rate of burning and make it fire protected.
- Embossing- for providing decorative effects.
- Stiffening – for providing body.
- Wrinkle resistance – for good shape retention.
- Water repellency – rarely given to make it suitable for rain wear.

Consumer preference:

- Viscose rayon fabrics are lustrous as compared to cotton and other cellulosics and resemble silk.
- Economical when compared to silk and thus sometimes referred to as ‘poor man’s silk’.
- Versatile as the fabric is suitable for many types of apparels.
- Comfortable as it possess good absorbency as well as good heat conductivity.
- Highly suitable for durable draperies as viscose rayon shows good drapability coupled with good sunlight resistance.
- Easy to wash as it’s smooth surface does not attract dust and iron readily.

- Possible to make durable fabrics by carefully choosing the ply yarn and fabric construction.
- Excellent effect of colors and prints on rayon makes them suitable for various end uses.
- Viscose rayon provides softness when blended with other fabrics
- Slippage at seams may be a problem when tailored into garments which needs careful handling.