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Rayon is the oldest commercial manmade fiber. The U. S. Trade Commission defines rayon as “ manmade textile fibers and filaments composed of regenerated cellulose”. The process of making viscose was discovered by C. F. Cross and E. J. Bevan in 1891. The process used to make viscose can either be a continuous or batch process. The batch process is flexible in producing a wide variety of rayons, with broad versatility. Rayon’s versatility is the result of the fiber being chemically and structurally engineered by making use of the properties of cellulose from which it is made. However, it is somewhat difficult to control uniformity between batches and it also requires high labor involvement. The continuous process is the main method for producing rayon. Three methods of production lead to distinctly different rayon fibers: viscose rayon, cuprammonium rayon and saponified cellulose acetate. Of the methods mentioned, the viscose method is relatively inexpensive and of particular significance in the production of nonwoven fabrics.

For a very long period of human history, man depended on natural elements to make fibers for clothing. These were natural fibers. However, with the technological advances many manmade synthetic fibers were developed. Man-made fibers have two main categories: One that are made from natural products (cellulosic fibers) and the other that are synthesized from chemical compounds (non cellulosic polymer fibers). Rayon fiber is a natural-based material made from the cellulose of wood pulp or cotton fiber. In fact, they are made from reformed or regenerated cellulose. As such, they are identified as regenerated cellulose fibers.

MANUFACTURING PROCESS

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While there are many variations in the manufacturing process that exploit the versatility of the fiber, the following is a description of the procedure that is used in making regular or viscose rayon.

Regardless of whether wood pulp or cotton linters are used, the basic raw material for making rayon must be processed in order to extract and purify the cellulose. The resulting sheets of white, purified cellulose are then treated to form regenerated cellulose filaments. In turn, these filaments are spun into yarns and eventually made into the desired fabric.

Processing Purified Cellulose:

- 1. Sheets of purified cellulose are steeped in sodium hydroxide (caustic soda), which produces sheets of alkali cellulose. These sheets are dried, shredded into crumbs, and then aged in metal containers for 2 to 3 days. The temperature and humidity in the metal containers are carefully controlled. •
- 2. After ageing, the crumbs are combined and churned with liquid carbon disulfide, which turns the mix into orange-colored crumbs known as sodium cellulose xanthate. The cellulose xanthate is bathed in caustic soda, resulting in a viscose solution that looks and feels much like honey. Any dyes or delusterants in the design are then added. The syrupy solution is filtered for impurities and stored in vats to age, this time between 4 and 5 days. •

Producing Filaments:

- 3. The viscose solution is next turned into strings of fibers. This is done by forcing the liquid through a spinneret, which works like a shower-head, into an acid bath. If staple fiber is to be produced, a large spinneret with large holes is used. If filament fiber is being produced, then a spinneret with smaller holes is used. In the acid bath, the acid coagulates and solidifies the filaments, now known as regenerated cellulose filaments. •

HIGH-WET-MODULUS RAYON

Manufacture:

The process for manufacturing high-wet-modulus rayon is similar to that used for making regular rayon, with a few exceptions. First, in step #1 above, when the purified cellulose sheets are bathed in a caustic soda solution, a weaker caustic soda is used when making HWM rayon. Second, neither the alkali crumbs (#1 above) nor the viscose solution (step #2) is aged in the HWM process. Third, when making HWM rayon, the filaments are stretched to a greater degree than when making regular rayon.

QUALITY CONTROL:

As with most chemically oriented processes, quality control is crucial to the successful manufacture of rayon. Chemical make-up, timing and temperature are essential factors that must be monitored and controlled in order to produce the desired result.

The percentages of the various fibers used in a blended fabric must be controlled to stay within in the legal bounds of the Textile Fiber Identification

Act. This act legally defines seventeen groups of man-made fibers. Six of these seventeen groups are made from natural material. They include rayon, acetate, glass fiber, metallics, rubber, and azion. The remaining eleven fabrics are synthesized solely from chemical compounds. They are nylon, polyester, acrylic, modacrylic, olefin, spandex, anidex, saran, vinal, vinyon, and nytril.

Within each generic group there are brand names for fibers which are produced by different manufacturers. Private companies often seek patents on unique features and, as could be expected, attempt to maintain legal control over their competition.

BYPRODUCTS:

As one of the industry's major problems, the chemical by-products of rayon have received much attention in these environmentally conscious times. The most popular method of production, the viscose method, generates undesirable water and air emissions. Of particular concern is the emission of zinc and hydrogen sulfide.

At present, producers are trying a number of techniques to reduce pollution. Some of the techniques being used are the recovery of zinc by ion-exchange, crystallization, and the use of more purified cellulose. Also, the use of absorption and chemical scrubbing is proving to be helpful in reducing undesirable emissions of gas.

RAYON AND ITS PRODUCTION

Rayon, artificial textile material composed of regenerated and purified cellulose derived from plant sources. Developed in the late 19th century as a substitute for silk, rayon was the first man-made fiber.

Rayon is described as a regenerated fiber because the cellulose, obtained from soft woods or from the short fibers (linters) that adhere to cottonseeds, is converted to a liquid compound, squeezed through tiny holes in a device called a spinnerette, and then converted back to cellulose in the form of fiber. The first practical steps toward producing such a fiber were represented by attempts to work with the highly flammable compound nitrocellulose, produced by treating cotton cellulose with nitric acid. In 1884 and 1885 in London, British chemist sir Joseph Wilson Swan exhibited fibers made of nitrocellulose that had been treated with chemicals in order to change the material back to nonflammable cellulose. Swan did not follow up the demonstrations of his invention; thus, the development of rayon as a practical fiber really began in France, with the work of industrial chemist Hilaire Bernigaud, comte de Chardonnet, who is frequently called the father of the rayon industry. In 1889 Chardonnet exhibited fibers made by squeezing a nitrocellulose solution through spinnerettes, hardening the emerging jets in warm air, and then reconvertng them to cellulose by chemical treatment. Manufacture of "Chardonnet silk," an early type of rayon and the first commercially produced man-made fiber, began in 1891 at a factory in Besançon.

Rayon remains an important fiber, although production has declined in industrial countries because of environmental concerns connected with the

release of carbon disulfide into the air and salt by-products into streams. Such concerns have led to the development of new types of rayon such as lyocell. Lyocell is produced by dissolving wood cellulose in a nontoxic amine oxide solvent, which is washed from the regenerated fibers and recovered for reuse.

As the oldest manmade fiber, Rayon has been in existence for over 100 years. Originally devised as a cheaper alternative to silk, Rayon is a versatile fabric made from natural substances such as wood pulp and plant cellulose. The result is a semi-synthetic, versatile fabric that carries many of the same characteristics of all natural fibers (such as silk, wool, cotton and linen).

Viscose is a favorable fabric due to its soft feel, capacity to absorb moisture (up to 50% more than cotton), and ability to be easily dyed. Viscose, especially those fabrics with fine fibers, drapes wonderfully. Rayon can also withstand a higher heat threshold than other synthetic or semi-synthetic fibers. Yet, like wool or silk, viscose rayon has very little stability when wet, and can lose up to 70% of its original strength. Consequently, when viscose rayon is saturated, it has the propensity to shrink (by as much as 10%), as well as distort the original shape of the garment. This characteristic also makes it a poor fabric to hold pleats or a wrinkled appearance. Additionally, viscose rayon is a poor insulator and is not conducive for trapping body heat.

SUMMARY

Rayon is a synthetic fiber produced from cellulose. Developed in an attempt to produce silk chemically, it's originally called artificial silk or wood silk.

Rayon is regenerated fiber because cellulose is converted to liquid compound and then back to cellulose in the form of fiber.

The characteristics of rayon fibers are:

(a) They are highly absorbent

(b) Soft and comfortable

(c) Easy to dye

(d) Drape well

EXPERIMENT

1. AIM:

To prepare rayon threads from filter papers using cuprammonium process

2. REQUIREMENTS:

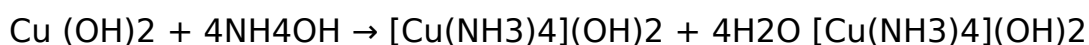
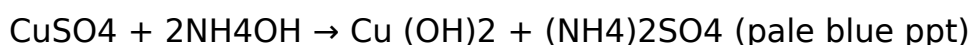
Beakers, conical flasks, filtration flask vacuum pump, bent tube, glass rod, 50% ammonia solution, dil. NaOH solution, dil. H₂SO₄, filter paper or waste paper

3. THEORY:

Natural fibers are the chief raw material for the preparation of rayon. The term rayon includes all synthetic fibres obtained from cellulose and are used commercially in fiber manufacturing. Cellulose can be converted into cupra silk, acetate rayon. Among these, viscose rayon is the most common.

Cellulose is an insoluble material which is first converted into a soluble derivative called viscose. The viscose is then forced through fine orifices into some reagent and the resulting thread is kept under tension to form the fibers of required tensile strength. Rayon also called artificial silk is used for manufacturing of fabrics like stocking, shirts, sarees, etc.

4. REACITONS:



5. PROCEDURE:

The cellulose is dissolved in cuprammonium hydroxide $[\text{Cu}(\text{NH}_3)_4](\text{OH})_2$ and the procedure to be followed is given below:

1. To prepare cuprammonium hydroxide solution: weigh about 20.0g of crystalline copper sulphate in a clean watch glass. Dissolve it in 100ml of water taken in a beaker. Add dil. NaOH solution to this solution slowly with stirring and note the separation of precipitate of $\text{Cu}(\text{OH})_2$. Filter the precipitate on water pump and wash the precipitate thoroughly with water so that a portion of filtrate does not indicate presence of sulphate ions on testing with BaCl_2 solution. Now transfer the precipitate to a 250ml beaker and add 50ml of liquor ammonia. The precipitate will dissolve resulting in deep blue solution of cuprammonium hydroxide (Schweitzer's solution). This is the solvent for dissolving cellulose.

2. Dissolving the cellulose matter. Weigh about 1 g of ordinary filter paper and cut it into small pieces. Add these pieces to the cuprammonium solution taken in the conical flask. Close the flask with rubber stopper and allow it to stand for 3-4 days. In this time, filter paper completely dissolves leaving a viscose solution called viscose.

6. PRECAUTIONS:

1. Addition of excess NH should be avoided
2. Before taking the viscose in the syringe make sure that it does not contain any particles of paper, otherwise it will clog the needle of the syringe.

BIBLIOGRAPHY

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