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Education for All

Dr. Babasaheb Ambedkar Open University

(Established by Government of Gujarat)

DIPLOMA IN FASHION DESIGNING

TEXTILE SCIENCE AND FABRIC CONSTUCTIONS

DFD-06

Message for the Students

Dr. Babasaheb Ambedkar Open (University is the only state Open University, established by the Government of Gujarat by the Act No. 14 of 1994 passed by the Gujarat State Legislature; in the memory of the creator of Indian Constitution and Bharat Ratna Dr. Babasaheb Ambedkar. We Stand at the seventh position in terms of establishment of the Open Universities in the country. The University provides as many as 54 courses including various Certificate, Diploma, UG, PG as well as Doctoral to strengthen Higher Education across the state.

On the occasion of the birth anniversary of Babasaheb Ambedkar, the Gujarat government secured a quiet place with the latest convenience for University, and created a building with all the modern amenities named 'Jyotirmay' Parisar. The Board of Management of the University has greatly contributed to the making of the University and will continue to this by all the means.

Education is the perceived capital investment. Education can contribute more to improving the quality of the people. Here I remember the educational philosophy laid down by Shri Swami Vivekananda:

> ***"We want the education by which the character is formed, strength of mind is Increased, the intellect is expand and by which one can stand on one's own feet".***

In order to provide students with qualitative, skill and life oriented education at their threshold. Dr. Babaasaheb Ambedkar Open University is dedicated to this very manifestation of education. The university is incessantly working to provide higher education to the wider mass across the state of Gujarat and prepare them to face day to day challenges and lead their lives with all the capacity for the upliftment of the society in general and the nation in particular.

The university following the core motto 'स्वाध्याय: परमम् तप:' does believe in offering enriched curriculum to the student. The university has come up with lucid material for the better understanding of the students in their concerned subject. With this, the university has widened scope for those students who are not able to continue with their education in regular/conventional mode. In every subject a dedicated term for Self Learning Material comprising of Programme advisory committee members, content writers and content and language reviewers has been formed to cater the needs of the students.

Matching with the pace of the digital world, the university has its own digital platform Omkar-e to provide education through ICT. Very soon, the University going to offer new online Certificate and Diploma programme on various subjects like Yoga, Naturopathy, and Indian Classical Dance etc. would be available as elective also.

With all these efforts, Dr. Babasaheb Ambedkar Open University is in the process of being core centre of Knowledge and Education and we invite you to join hands to this pious *Yajna* and bring the dreams of Dr. Babasaheb Ambedkar of Harmonious Society come true.

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FASHION DESIGN – DIPLOMA COURSE
DFD: 06
TEXTILE SCIENCE AND FABRIC CONSTRUCTION

UNIT:1 INTRODUCTION TO TEXTILE

STRUCTURE:

1.0 OBJECTIVE

After studying this unit,

- Students will have knowledge about historical words of textile and meaning.
- Importance of textile in every aspects of life.
- Basic knowledge regarding scope of textile industry in India and problems associated with textile sector.

1.1INTRODUCTION

The word 'textile' comes from the Latin adjective textilis, signifying 'woven', which itself originates from textus, the past participle of the verb texere, 'to weave'.

The word 'texture' also derives from Latin, with roots in the Proto-Indo-European language. Stemming most recently from the Middle French fabrique, or 'building, thing made', and earlier from the Latin fabrica ('workshop; an art, trade ; a skilful creation, structure, fabric'), the noun fabrica comes from the Latin faber, or 'artisan who works in hard materials', which itself is derived from the Proto-Indo-European dhabh-, signifying 'to fit together'.

The word 'fabric' derives from the Old English clað, which means a 'cloth, woven or felted material to wrap around one', from the Proto-Germanic kalithaz, like the Old Frisian klath, the Middle Dutch cleet, the Middle High German kleit and the German kleid, all signifying 'garment'.

- **What is textile?**

A textile is an flexible material made by making an interlocking network of yarns or threads, which are created by spinning raw fibers (from either natural source or synthetic sources) into long and twisted lengths. Textiles are then shaped by weaving, knitting, crocheting, knotting, tatting, and felting, bonding or braiding these yarns together.

The related words "fabric" and "cloth" and "material" are often utilized in assembly trades (like tailoring and dressmaking) as equivalents for textile. However, there are subtle differences in these terms in specific use. A textile is any material made of the interlacing fiber, including carpeting and geotextiles, which may not really be utilized in the production of additional products, like apparel and upholstery. A fabric is a material made through weaving, knitting, spreading, felting, sewing, crocheting or bonding that might be utilized in the creation of further products, like apparel and upholstery, in this way requiring a further step of the production. Cloth may likewise be utilized synonymously with fabric, yet often specifically alludes to a piece of fabric that has been processed or cut.

1.2 SCOPE OF TEXTILE IN INDIA

Key facts related to Indian textile industry:

- India's textile sector which covers everything from fiber to garments is the second-largest employment generation sector after agriculture, utilizing an expected 32 million laborers.
- Textile industry gives livelihoods to a large number of families, yet is a storage facility of traditional skills, legacy (heritage) and a carrier of heritage and culture as well.
- India's textile sector is perhaps the oldest industry in Indian economy.
- Textile sector is perhaps the largest contributors of India's export with approximately 11% of absolute (total) exports.
- Textile industry is a labor intensive industry.
- The textile industry comprises of two broad segments - Organized and Unorganized sector. The unorganized sector comprises of handloom, handicrafts and sericulture, which are worked on a small scale and through traditional tools and techniques. While the organized area comprising of spinning, apparel and articles of

clothing segment which apply current modern machinery and strategies like economies of scale.
- India's overall textile exports during FY 2015-16 remained at US$ 40 billion.

Importance of textile industry in India:
- Textiles industry has made a significant contribution to the national economy as far as direct and indirect employment generation and net foreign exchange income.
- The area contributes about 14% to industrial production, 4% to the gross domestic product (GDP), and 27% to the country's foreign exchange inflows.
- It provides direct employment to more than 45 million individuals.
- The textile sector is the second biggest supplier of work after agriculture.
- Growth and all round development of this industry has an immediate bearing on the improvement of the India's economy.

Reasons for decline in Indian textile industry:
- Global recession is one of the factor responsible for the decline of Indian textile industry.
- Less export orders because of decreases in inventories by worldwide retail giants like Wal-Mart.
- Infrastructure bottlenecks like power, especially in Tamil Nadu.

Problems associated with textile sector:

Lack of finance: Inadequate credit accessibility has dried the production and export limit of these power looms.
International tax: The tax on Indian textile changes from 3 to 14% which is extremely high when compared with duties on Pakistan, Egypt, Japanese and Vietnamese textiles. Hence India is losing ability because of right around zero tariff on textile from Pakistan, being imported by US and China.
Expensive cotton trade: Cotton corps of India exported great quality cotton abroad at costs higher than global market that may have prompted moment benefits but ultimately made Indians to lose their textile market.
High input costs: Costly raw material and transaction costs (high excise and custom duties) made this sector more unviable. Long staple cotton imported from Uganda, Egypt and so on are extravagant.
High MSP: Minimum support price for cotton was too high which further made the Indian textile area unviable.

Challenges before Textile industry:
- This area is going through an immense stir because of computerization, digital printing and the relentless rise of E-commerce.

- The world operated under a patently unreasonable quota system called the Multi Fiber Agreement (MFA), has shackled the development of India's textile and clothing exports.
- India’s share of textile exports in total exports remained, at 12%, is half of what it was in 1996. While other sectors like petrol and diesel went from zero to 20% of export share.

Comparison with other countries:

- Bangladesh's clothing exports surpassed India's in absolute terms back in 2003. At present it exports more than $ 35 billion worth of garments, double that of India.
- Even late starter Vietnam overlook India in 2011, and now exports pieces of clothing worth $ 32 billion.
- These two countries (Bangladesh and Vietnam) have special admittanceto the European Union and US markets. Their growth in exports has been at 20 % each year, against India's 8%.
- India’s share in international textile trade is 5%, against china’s 39%
- In the sub-portion of synthetic filaments, India's share is only 2%, against China's 66%.
- India has a rich mix of man-made and natural fibers and yarns, including cotton, jute, silk, polyester and viscose however it remains a cotton-focused country
- The presence of cotton in yarn, fiber, fabric and garments is near 70% of utilization within India, which is likewise reflected in exports. Just 30% is from synthetics and man-made filaments. The worldwide trend is actually the obverse, for example 70% consists of man-made fibers. So India's domestic and export mix is opposite of global fashion and demand trends.
- The other enormous factor looming large on the sector is the shade of excess capacity in the fiber and yarn sectors in China. This results into a downward pressure on costs.

Some statistics related to textile industry in India:

- India is first in worldwide jute production and shares 63% of the global textile and clothing market. India is second in global textile manufacturing and furthermore second in silk and cotton production.
- 100% FDI is allowed via automatic route in textile sector.
- Indiais the second biggest producer of fiber on the world and the major fiber produced is cotton.
- Other filaments produced in India incorporate silk, jute, wool and man-made fibers.
- India's is the biggest producer of raw jute and jute products and the second largest exporter after Bangladesh.

Government Initiatives

- The Indian government has come up with a various export promotion policies for the textile field. It has likewise permitted 100% FDI in the Indian textiles sector under the automatic route.
- Rs 6,006-crore special package for textile and clothing sector was carried out in June, expected to make one crore new jobs in three years, attract investments of USD 11 billion and generate USD 30 billion in trades.
-

The key activities reported in the Union Budget 2017-18 to support the textile sector are listed beneath:

- Encourage new entrepreneurs to invest in sectors, for example, knitwear by expanding allotment of assets to Mudra Bank from Rs 1,36,000 crore (US$ 20.4 billion) to Rs 2,44,000 crore (US$ 36.6 billion).
- Upgrade labour work skills by allocating Rs 2,200 crore (US$ 330 million)

Some of activities taken by the government to further promote the industry are as under:

- The Government of India intends to present a mega package for the power loom sector, which will incorporate social welfare schemes, insurance cover, group development, and upgradation of obsolete, with tax benefits and marketing support, which is required to improve the status of power loom weavers in the country.
- The Ministry of Textiles has signed Memorandum of Understanding (MoU) with 20 e- commerce organizations, aimed at providing a platform to artisans and weavers in various handloom and handicraft groups across the nation for selling their products straightforwardly to the customer.
- Memorandum of Understanding (MoU) worth Rs. 8,835 crore (US$ 1.3 billion) in territories like textile parks, textile processing, machinery, carpet development and others, were endorsed during the Vibrant Gujarat 2017 Summit.
- The Clothing Manufacturers' Association of India (CMAI) has signed a notice of comprehension (MOU) with China Chamber of Commerce for Import and Export of textile (CCCT) to explore potential areas of common co-operation for expanding apparel exports from India.
- The Government of India has started promotion of its 'India Handloom' activity via social media like Facebook, Twitter and Instagram so as to connect with clients, particularly youth, to order promote high quality handloom items.

The Government of India has implemented some export promotion measures, for example,

- Specified technical textile items are covered under Focus Product Scheme.

- Under this plan, exports of these items are entitled for obligation (duty) credit scrip comparable to 2 percent of freight on board (FOB) value of exports.
- Under the Market Access Initiative (MAI) Scheme, monetary help is accommodated export promotion exercises on focus countries and focus item countries.
- Under the Market Development Assistance (MDA) Scheme, monetary help is accommodated a range of export promotion activities executed by Textiles Export Promotion Councils.

Why there is need for new textile policy?

- The previous for textile industry was formed around 17 years prior, during that time world was working under a plainly unfair quota system called the Multi Fiber Agreement (MFA)
- While MFA was dismantled in 2005, India didn't update its policy in like manner.
- During past twenty years, India has been left behind by both Bangladesh and Vietnam in textile fares.
- Global Technological development in the field of synthetic filaments requires that India ought to reconsider and adjust its policy accordingly.
- As this sector utilizes a critical populace, government can't manage the cost of it to die out.
- It will make Indian pieces of clothing more competitive in worldwide markets by reducing the cost of production.

Solutions:

- Need a national textile policy document, a verbalization similar as the national telecom policy of 1999.
- There is need for massive ability upgradation.
- There is likewise need to concoct a fiber-natural tax strategy.
- A big digital push in design and computerization
- Meeting the requirements of the e – commerce phenomenon
- India additionally need to expand its fares market and discover all the more large clients other than China.

Conclusion:

It is a high time that the government along with different stakeholders take steps for supportability and growth of Indian textile industry. The Indian textile industry needs to focus on all major sectors right from fiber to fashion and plan for an organized growth across the supply chain in order to contend with China and different nations like Pakistan, Vietnam, and Thailand. There is need for revised nation textile policy which can cater to the current day challenges faced by industry. With effective implementation of sector related policies, considerable financial help from government and creation of investments opportunities, textile sector has potential to contribute essentially in 'Make in India' program.

1.3 IMPORTANCE OF TEXTILE

Material products plays an important role in meeting man's basic needs. We often only consider textiles to be the garments we wear. Obviously, the garments industry is the place where most of textiles are produced and used. However textiles are also significant in all parts of our lives from birth to death. The utilization of textile has been traced back more than 8500 years. The technological advances of textile in different enterprises don't always get recognized as they do in the apparel industry. The accompanying paragraphs describe some significant roles that textiles play in other industries.

Food Industry:
Farmers wear protective attire to spray their crops with pesticides. Textiles are utilized to cover plants and wrap trees for protection from climate and creepy crawlies. Coffee filters and tea bags are made of a non-woven textile material. The annual production of tea bags string would stretch around the equator multiple times.

Building Materials:
Textiles are used in our homes to protect them from heat and cold. The furniture, on which we sit and sleep, is made out of different kinds of textile products. Textiles are used in roofing materials, wire covers, wall coverings, blinds, air ducts and window screens.

Transportation:
The transportation business depends on textiles to line the beds of the streets before they are cleared. A tire gets 75% of its strength from textiles. Kevlar aramid is frequently used to strengthen radial tyres since it is lightweight and multiple times stronger than steel. The interiors of a wide range of transportation vehicles are covered with textiles. Textiles are additionally utilized in the brake linings, gaskets, seals, safety belts, air bags and filters of vehicles. The Lear Fan Jet plane body is made out of 100% carbon fiber composite material. This carbon material is half the weight of aluminum and as strong as steel. The heat shields on spacecraft are made out of a fiber that will withstand 20,000 degrees Fahrenheit.

Health Industry:
Textiles are utilized as lifesaving gadgets in the health care industry. The artificial kidney utilized in dialysis is made of 7,000 hollow filaments and is just two inches in diameter. The Jarvik-7 artificial heart is made out of more than 50% textiles and has Velcro fittings. More than 150,000 individuals in the United States have artificial arteries made of knitted polyester, which helps in preventing clotting and dismissal. The innovation of disposable apparel helps prevent the spread of bacteria. Stitches for wounds are presently made of a dissolvable textile fiber.

Projects for broken bones, surgical masks, bandages and gloves are different instances of textiles used in the medical services industry.

Protective Textiles:

Bulletproof vests are made of 7 layers of Kevlar 29 aramid, which can shield an individual from a knife slash and stop a .38-type caliber bullet fired at a range of 10 feet. Firemen and race-car drivers wear clothes made of Nomex aramid to protect them from the extreme heat they encounter in their professions. Space travelers wear $100,000 suits made of Nomex aramid that protect them from the elements of space. Sports players wear defensive helmets and pads made of textiles.

Sporting Products

Athletic equipment like boats, hockey sticks, fishing rods, golf clubs, tennis rackets and canoes are made out of textile fibers. Kevlar aramid is utilized in this kind of athletic equipment due to its light weight and strength. Backpacks, balls, life jackets and artificial playing surfaces are likewise made of textile fibers.

Miscellaneous Textile Products:

Different items made out of textiles that are not usually considered as textile products are as per the following:

- Toothbrushes
- Hair Brushes
- Dental Floss
- Artificial Flowers/Plants
- Book Bindings
- Candle Wicks
- Communication Lines
- Circuit Boards

Just by reviewing the textile products contained in the paragraphs above helps us with acknowledging how significant textiles are to our lives. The significance of textiles additionally addresses another need, which is employment. Today the textile industry employs over 1.4 million individuals, more than some other industry. As textile technology progresses, so will the significance of textiles in our lives.

Check Your Progress

Q : 1. Why is it called textile?

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Q: 2. What is the importance of textiles?

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Q:3. What are the reasons for decline in Indian textile industry?

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____
____
____
____
____

Multiple Choice Questions

1) What is the other word for textile?
   (A) Accessories
   (B) Cloth
   (C)Dyes
   (D)None of above

2) A tire gets ___________ of its strength from textiles.
   (A)20%
   (B)45%
   (C)75%
   (D)96%

3) Textile sector provides direct employment to more than__________individuals.
   (A) 10 million
   (B) 22 million
   (C) 17 million
   (D) 45 million

1.4 LET US SUM UP

Textile is a significant segment of material culture. It may be viewed as the products of innovation, as cultural symbols, as works of art, or as things of trade. The textile arts are a major human action, expressing symbolically a lot of what is valuable in any culture.

Textiles industry has made a significant contribution to the national economy as far as direct and indirect employment generation and net foreign exchange income.

The area contributes about 14% to industrial production, 4% to the gross domestic product (GDP), and 27% to the country's foreign exchange inflows.It provides direct employment to more than 45 million individuals.

1.5 KEY WORDS

Etymology	word source, Word history
Equivalents	Synonyms, Similar, Comparable
Alludes	Refers, Suggest, Imply
Legacy	Heritage
Comprising	Consisting, Contain
Admittance	Access
Extravagant	Expensive, Profligate
Hollow	Empty, Void, Unfilled
Dismissal	Rejection
Scrip	Receipt

1.6 SOME USEFUL BOOKS

- **https://en.wikipedia.org/wiki/Textile**
- **https://blog.forumias.com/growth-scope-for-indian-textile-industry/#:~:text=Textile%20sector%20is%20one%20of,segments-%20Organised%20and%20Unorganised%20sector.**
- **https://www.fibre2fashion.com/industry-article/3396/the-importance-of-textiles**

Answer

Check your progress

Ans:1

The term derived from the Latin textilis and French textere, meaning "to weave," and it originally referred only to woven fabrics. It has however, come to include fabrics produced by other methods.

Ans:2

Material products plays an important role in meeting man's basic needs. We often only consider textiles to be the garments we wear. Obviously, the garments industry is the place where most of textiles are produced and used. However textiles are also significant in all parts of our lives from birth to death. The utilization of textile has been traced back more than 8500 years. The technological advances of textile in different enterprises don't always get recognized as they do in the apparel industry. Textile industries plays important role in different sectors, which are following as:

- **Health industry**
- **Transportation**

- **Food industry**
- **Miscellaneous Textile Products**
- **Protective Textiles**
- **Building Materials**

Ans: 3

Reasons for decline in Indian textile industry:

- Global recession is one of the factor responsible for decay (decline) of Indian textile industry.
- Less export orders because of decreases in inventories by worldwide retail giants like Wal-Mart.
- Infrastructure bottlenecks like power, especially in Tamil Nadu.

Multiple Choice Questions

Ans: 1 B

Ans: 2 C

Ans: 3 D

UNIT: 2 PROPERTIES OF TEXTILE FIBER

STRUCTURE:

2.0 Objectives
2.1 Introduction
2.2 Properties of textile fiber
2.2.1 Physical properties of textile fibers
- Length
- Density
- Flexibility
- Loft and Resiliency
- Dimensional stability
- Color and Luster
- Spin ability
- Moisture Regain
- Moisture Content

2.2.2 Mechanical properties of textile fiber
- Strength
- Uniformity
- Elasticity
- Static electricity
- Flammability and other thermal reactions

2.2.3 Chemical properties of Textile fiber
- Acid and Alkali
- Water
- Absorbency
- Heat
- Sunlight
- Biological agent

2.2.4 Structural properties of textile fiber
- Circular cross sectional fiber

Check Your Progress
Multiple Choice Questions

2.0 OBJECTIVES

After studying this unit, students will understand:

- Textile fibers have some fundamental characteristics according to their source.
- Textile fiber's properties are divided in some specific categories.
- Learn about fiber's physical, mechanical, chemical and structural properties.

2.1 INTRODUCTION

Filaments can be divided into natural and man-made or synthetic substance, their properties can influence their performance in numerous applications. These days, man-made fiber materials are replacing other regular materials like glass and wood in various applications. This is because man-made filaments can be designed synthetically, truly, and precisely to suit specific specializes engineering. In choosing a fiber type, a manufacturer would balance their properties with the technical requirements of the applications. Different filaments are chosen for manufacturing.

2.2 PROPERTIES OF TEXTILE FIBER

The filaments which are utilized for the production of yarn and fabric are called textile fiber. There might be various kinds of filaments that look like textile fibers however, all the filaments are not textile fibers. To be a textile fiber it ought to have some of the fundamental characteristics like length to insert twist, strength, fineness, cohesiveness, flexibility, moisture recovery and elasticity etc. Various types of textile fibers are utilized in the textile business. Some of them we get from natural sources and some of them are man-made.
In this unit we will discuss few Physical, Mechanical, Chemical, and structural properties.

2.2.1 Physical properties of textile fibers

A textile fiber should have some of the following physical properties

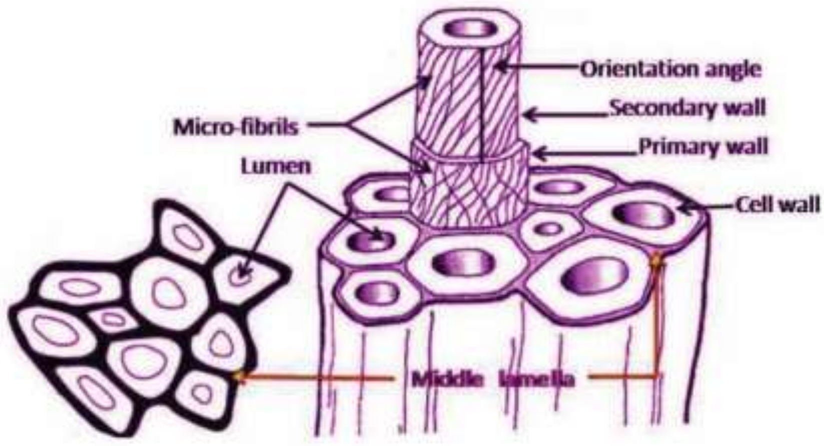

Figure: 1 Physical properties of textile fiber

Length

Length Staple length is utilized to express the dimension i.e., length only. The fiber should be long and fine enough. This is basically because the two most significant fibers like cotton and wool are available with an unequivocal length and fineness. The length changes in cotton fiber from 1.5 cm to 4 cm and in wool 3 cm to 40 cm. Further, for blending, man-made fibers are cut into length (staple fiber)

This staple length should coordinate with the length of other component fibers, utilized in blending. Generally, in a particular fiber, the more long the fiber, stronger and finer is the yarn. Additionally fine fibers are more useful for soft, smooth and uniform fabric. For coarse filaments, like higher diameter fibers, the fabric will be coarse and harsh (rough).

Density

The particular gravity of a fiber shows density relative to that of water. All textile fibers are heavier than water with the exception of olefin filaments. Density is the general weight of fiber as float on water. Cotton, wool filaments are weighty and nylon is comparatively lighter. A pound of wool and a pound of nylon weigh equal however there are more fibers in nylon than in wool. High-density brings about heavy fabrics. Low-density brings about lightweight fabrics. A lightweight filament help the fabric to be warm without being weighty.

Flexibility

Fibers should be bendable, pliable or flexible if they are to be made into yarns or fabrics that can have the ability to move with the body and ought to consider the free movement and furthermore be comfortable. A stiff fiber will make fabrics stiff which can't be used comfortably.

Loft and Resiliency

Loft is the capacity of a fiber to spring back to original thickness after being compressed. Resiliency is the capacity of a fiber to bounce back to original shape following pressure, twisting or similar deformation. Wool and silk fabrics are stronger. They can be twisted, squashed or wrinkled during wear yet they come to shape after hanging.

Dimensional stability

The length and width of fabric gets changed subsequent to finishing cycle or after washing fabric gets shrunk so it is essential to have great dimensional stability of a fabric to retain the original shape.

Color and Luster

The natural fibers have different color tones. Wool fibers can, for example, vary in shading from black to white, usually being creamish in shading. Fibers are generally white when manufactured however can be colored to practically any tone, either during manufacturing or in this manner. At the point when synthetic fibers are mass dyed (additionally called dope dyeing, mass pigmentation or mass- coloring), the shading matter is incorporated in the polymer before the fibers are formed (for example expelled). The color and surface qualities of various fibers majorly affect fabric appearance, including luster (the amount and nature of light reflected by a fiber, yarn or fabric).

A smooth surface and more regular cross-sectional shape (for example the smooth, trilobal state of silk fibers) will reflect light more firmly and evenly, consequently making a high luster. A fiber like cotton, which has a rough surface and irregular, twisted cross-sectional shape, has a lower luster

Spin ability

Spin ability is also very important property. It indicates that the individual fibers should be capable for being spun into a yarn and then a fabric with adequate strength. For better Spin ability, the fiber should have better cohesiveness. Strangely, 'Spin ability' term is regularly utilized in case of man-made fiber producing manufacturing process. It fundamentally indicates whether a constant thread can be produced from a viscous material by expulsion, and the thread can be hardened. If a fluid continuously develops a flow jet without any breaks, the fluid is spinnable under a given twisting condition. Technically, higher the length of the thread produced, better is the Spin ability of the material. These above properties were named as essential properties, which are most basic properties of popular natural filaments.

Moisture Regain

Moisture recover is expressed as percentage. It is the ratio of oven dry weight of a material to the weight of water in this material and multiple of hundred.

Moisture Content

Moisture content is additionally expressed as rate. It is the proportion of oven dry weight of a material to the total weight (oven dry weight + weight of water in this material) of the material.

2.2.2 Mechanical properties of textile fiber

A textile fiber should have some of the following mechanical properties –

Strength

It is important that the fabric ought to be durable enough. For sturdiness, the fabric should be strong enough. The strength of the fabric is more-affected by the strength of the fiber present in the fabric. Additionally, strong fibers can withstand the tension for its conversion into yarn and then into fabric.

The strength shows the resistance sustained by the fibers, the yarns or the fabrics to break, when force is applied on them. The strength might be tensile, twisting (bending) strength, bursting strength etc. according to the direction of application of force.

Uniformity

Uniformity of the staple is another fundamental property. It is fundamental that there ought to be limited variations in length and diameter between fibers to fiber. Or the fiber ought to be more uniform which will ensure consistencyin the yarn just as in the fabric.

Elasticity

The essential property of the textile fiber is versatility. Versatility is the property demonstrating the ability of the material to recover original shape, after being deformed by application of force. The desirable feature of a fabric is that the fabric should not twist its shape, during its application. This indicates that the material ought to have a high elasticity. Higher versatility demonstrates higher recovery from deformation. For example, 1000 cm of yarn is stretched to 1050 cm subsequent to applying some load to it.After the load is removed, assuming the fiber measures 1000 cm, it tends to be said that the fiber has a flexiblerecuperation of 100 % .But if the length after removal of the load is 1010 cm, the elastic recuperation is 80 % .But for this situation, the yarn is elongated to 1010 cm and the stretching is 1 %. So it may be said that flexibility goes against extension. Elasticity or elastic recuperation is for the most part affected by the extent of stretch, time during which material is kept in its stretched condition and time to recover.

Static electricity

This is electricity produced by the friction of fabric against itself or some other subject. Static electricity produced via friction quickly creates in a cold and dry atmosphere. If material interacts with a decent conductor, a shock or transfer happens, it might create a spark in a gaseous climate. Static electricity makes the fabric cling to the body of the wearer. It attracts most dust and thus gives an unattractive appearance.

Flammability and other thermal reactions

A fiber with good moisture absorbency will be a poor conductor of heat and electricity, example cotton. All synthetic filaments shrink and melt. Cellulosic fibers continue consuming (burning) and falling. Thermal characteristics impact temperature for washing, ironing, and dry cleaning. We feel good when we wear some garments and we feel hot for some other garments, this is mainly because of the heat conductivity of fabrics.

2.2.3 Chemical properties of Textile fiber

Acid and Alkali

Acid or Alkali is destructive for cellulose and protein fiber. Thus, the effect of acid and alkali should be known during dying, bleaching and finishing. Various fibers react differently with acid and alkali. For example, Cotton and Linen get damaged when they are subjected to conc. Hydrochloric, Sulphuric and Nitric acids. Additionally dilute solution of those acids can make damage to the filaments. Then again, conc. alkaline solution is not harmful to Cotton and Linen. Wool is not influenced by dilute solution of acid. In any case, conc. acid and alkali damage wool easily. So acid or alkali should be chosen with caution when they are to be used for different purpose and processing.

Water

Water is vital to determine the properties of filaments. As per the behaviors of fibers with water, filaments are classified into two groups – hydrophobic and hydrophilic. Water is utilized in process like scouring, dyeing etc.

Absorbency

Generally, textile fibers absorb moisture. The capacity of fiber to take up the moisture is known as absorbency. The absorbency is expressed in the terms of moisture regain. Among all the filaments cotton assimilates easily. For the property cotton requires more time to dry. Moisture recovery in wool is 16%. It is 10% for silk. However, it seems dry after regain for silk. The cloths we wear are more comfortable and the ability to absorb is higher.

Heat

Effect of heat is an imperative point during dyeing, ironing, steaming and some different activities. Various filaments behave differently under heat. A few fibers burn where some fibers scorch when heat is applied. Some fibers are not combustible, for example, mineral fiber, and glass fiber and so on. Cotton is easily flammable, wool is hardly flammable fiber.

Sunlight

At the point when we wear cloth or fabric it comes into the touch of sunlight. It is very familiar to us. Effect of sunlight should be remembered for general people. Sunlight reduces the strength of cotton and it becomes yellow. Linen is better than cotton in sunlight. In any case, cotton is better than silk.

Biological agent

If the fibers are assaulted by bacteria, dark spots are seen on the filaments because of which the strength of fiber is reduced. Its significance of fibers attached by micro-organisms or not upon which strength of items depends. Cotton, Linen and Rayon assaulted by fungus. Silk, wool, acetate, tri-acetate and spandex have better protection from mildew and other insects.

2.2.4 Structural properties of textile fiber

A textile fiber should have some of the following structural properties –

- **Fine structure and Appearance**
- **Micro structure**
  - **Cross-Sectional view**
  - **Longitudinal view**

Circular cross sectional fiber

Circular cross-sectional shape gives strong luster to the fiber or filament because the incident light is reflected so unevenly, this tends to result in a rather harsh, strong luster. Harsh luster is because the fiber might be twisted in the yarn or fabric; its round shape permits reflecting similar amount of occurrence light in spite of the unevenness of its reflection.

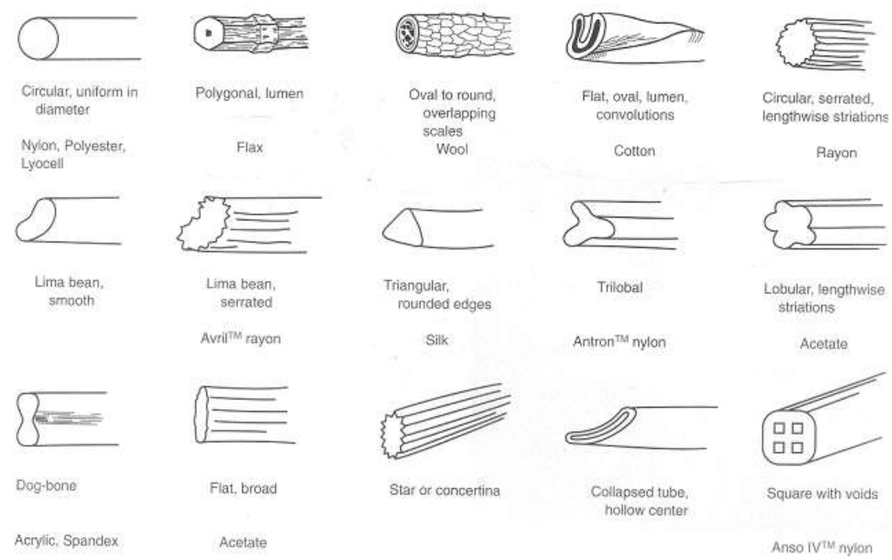

Figure: 2 Textile fibers

Circular cross-sectional shape brings about high bending stiffness, unbending or rigid, least flexible and least pliable fiber because of its regular diameter. Smooth ordinary surface of fiber brings about a waxy, slippery and makes the fiber or filament connect with the skin. This is aesthetically undesirable.

Check Your Progress

Q: 1 What are the properties of textile fiber?

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Q: 2 Write about any three physical properties of textile fiber.

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Q: 3 Write about any two chemical properties of textile fiber.

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____
____
____
____

Multiple Choice Questions

1) Moisture recovery of wool is __________.
(A) 11%
(B) 16%
(C) 24%
(D)None of above
2) ________ is Physical properties.
(A) Acid and Alkali
(B) Density
(C) Flexibility
(D) (B) and (C) both

2.3 LET US SUM UP

Textile fibers are those which have properties that allow them to be spun into yarn or directly made into fabric. This means they need to be strong enough to hold their shape, flexible enough to be shaped into fabric or yarn, elastic enough to stretch, and durable enough to last.

The inherent characteristics of fiber properties are directly related to the performance and required care and maintenance of the finished fabric. This unit gives you basic information about some physical, mechanical, chemical and structural properties of textile fibers. Every fiber has their different characteristics.

2.4 KEY WORDS

Unequivocal	Definite, Unmistakable
Adequate	Sufficient, Enough
Sturdiness	Durability, Firmness, Better stability
Conversion	Change, Transformation
Consistency	Uniformity, Regularity, Stability
Versatility	Elasticity, Adjustability
Recuperation	Recovery, Cure
Assimilates	Absorbs, Identify, Match
Assaulted	Attacked

2.5 SOME USEFUL BOOKS

- https://en.wikipedia.org/wiki/Fiber
- https://www.textiletrick.com/2019/03/essential-properties-of-textile-fibre.html
- https://textilevaluechain.in/in-depth-analysis/articles/textile-articles/introduction-to-textiles/#:~:text=Primary%20fiber%20properties,all%20fibers%20must%20possess%20strength.

- https://www.texcoms.com/wp-content/uploads/2019/06/Textile-Fibres.pdf
- http://textilestudy365.blogspot.com/2017/10/chemical-properties-of-textile-fibers.html

Answer

Check your progress

Ans: 1

To be a textile fiber it should have some of the fundamental characteristics like length, strength, flexibility, luster,Spin ability, density, flexibility, moisture recovery, heat, and elasticity etc.

Ans: 2

1.) **Length**

Length Staple length is utilized to express the dimension i.e., length only. The fiber should be long and fine enough. This is basically because the two most significant fibers like: cotton and wool are available with an unequivocal length and fineness. The length changes in cotton fiber from 1.5 cm to 4 cm and in wool 3 cm to 40 cm. Further, for blending, man-made fibers are cut in length (staple fiber)

This staple length should coordinate with the length of other component fibers, utilized in blending. Generally, in a particular fiber, the more long the fiber, stronger and finer is the yarn. Additionally fine fibers are more useful for soft, smooth and uniform fabric. For coarse filaments, like higher diameter fibers, the fabric will be coarse and harsh.

2.) **Spin ability**

Spin ability isalso a very important property. It indicates that the individual fibers should be capable for being spun into a yarn and then a fabric with adequate strength. For better Spin ability, the fiber should have better cohesiveness

Strangely, 'Spin ability' term is regularly used in case of man-made fiber producing manufacturing process. It fundamentally indicates whether a constant thread can be produced from a viscous material by expulsion, and the thread can be hardened. So a fluid is spinnable under given twisting condition if consistent state continuous elongation of fluid jet proceeds without a break of any kind. Technically, higher the length of the thread produced, better is the Spin ability of the material. These above properties were named as essential properties, which are most basic properties of popular natural filaments.

3.) Density

The particular gravity of a fiber shows density relative to that of water. All textile fibers are heavier than water with the exception of olefin filaments. Density is the general weight of fiber that float on water.

Cotton, wool filaments are weighty and nylon is comparatively lighter. A pound of wool and a pound of nylon weight equal however the fibers are more in nylon than in wool.

Ans: 5

1.) **Acid and Alkali**

Acid or Alkali is destructive for cellulose and protein fiber. Thus, the effect of acid and alkali should be known during dying, bleaching and finishing. Various fibers react differently with acid and alkali. For example, Cotton and Linen damaged when they are subjected to conc. Hydrochloric, Sulphuric and Nitric acids. Additionally dilute solution of those acids can cause damage to the filaments. Then again, conc. alkaline solution is not harmful to Cotton and Linen. Wool is not influenced by dilute solution of acid. In any case, conc. acid and alkali damage wool easily. So acid or alkali should be chosen appropriately to use in different purpose and processing.

2.) **Biological agent**

If the fibers are assaulted by bacteria, dark spots are seen on the filaments because of which the strength of fiber is reduced. Its significance of fibers attached by micro-organisms or not upon which strength of items depends. Cotton, Linen and rayon can be assaulted by fungus. Silk, wool, acetate, tri-acetate and spandex have better protection from mildew and other insects.

Multiple Choice Questions

1(B)

2 (D)

Reference

Fifure:1https://4.bp.blogspot.com/-Sr-XMDAEW4Q/WeHZzrR77tI/AAAAAAAAF8w/d3-fw_L4QhUSSx6gS0KOclyA6Rz6uCvtwCLcBGAs/s1600/016.jpg

Figure: 2https://gemsw.files.wordpress.com/2015/03/wpid-textile1.gif

UNIT: 3 TYPES OF FIBERS

STRUCTURE:

3.0 OBJECTIVE

After studying this unit, the student will be able to:

- Classify the textile fibers.
- Discriminate between the vegetable and manmade fibers.
- List the method used for identifying different types of textile fibers.

3.1 INTRODUCTION

This unit gives the information about different types of textile Fibers. There are various types of fibers used in the textile industry. A "fiber" is defined as any product capable of being woven or otherwise made into fabric. It is smallest visible unit of textile product. A fiber can be defined as a "pliable" hair like strand that is very small in diameter in relation to its length". Fibers are the fundamental units or the building blocks used in the making of textile yarns and fabrics. Thus fibers are the essential components and basic units for making yarns. These fibers are of many types.

3.2 CONCEPTS AND PRINCIPALS OF FIBERS

Fibers are the beginning part for garments. The textile industry uses several methods and processes to improve the fibers and their basic properties go a long way in determining how the fabric and garment makers can make use of these. We cannot make a quality garment without understanding how different fibers behave during their conversion into fabrics and garments. Since the fashion business invariably procures fabrics from the traders, mills or processors, it becomes important likewise to realize their arrangement dependent on fiber content for speaking with them correctly and clearly.

3.2.1 Textile fibers

A fiber is defined as a small thread like structure. There are many types of textile fibers that have been used or developed in textile production such as cloth, rope, household and etc. The Textile Institute defines a fiber as a ‘textile raw material, generally characterized by flexibility, fineness and high ratio of length to thickness. In textile industry, fiber can be classified into two different types based on their sources which are Natural fiber and Synthetic fiber or well-known as Man-made fiber. The textile fibers need also to be strong enough to withstand the mechanical actions of spinning, weaving, knitting, etc.

3.3 CLASSIFICATION OF TEXTILE FIBERS

Fibers for textiles can be classified by many systems. In 1960, the Textile Fiber Products Identification Act became effective in USA. One of the basic ways to classify a textile fiber is by its origin, and even today, this is the most commonly employed method. There are various types of fibers used in the textile industry, each having their unique properties. These characteristics are largely dependent upon their origins. Natural fibers are obtained from nature, where the source - could be a plant, an animal, or a mineral. Regarding plants, we obtain fibers from seeds (cotton, coir), from leaves (sisal), and from stems (jute, flax, ramie, etc.).

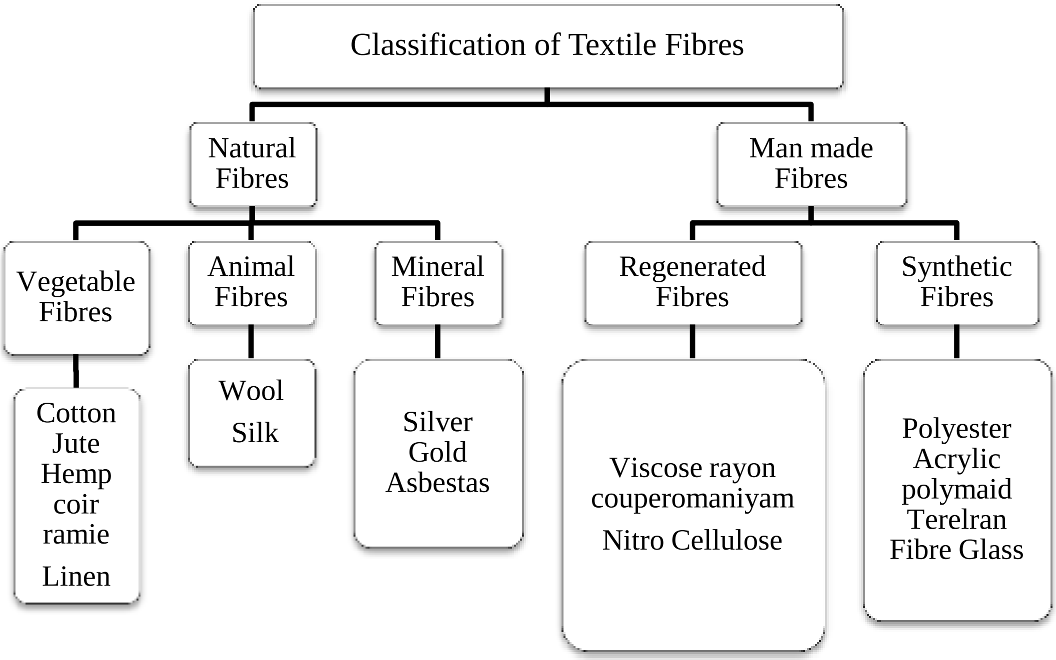

Figure 1: Classification of Textile fibers

3.3.1 Natural fibers

Natural fibers are those fibers which are directly available from the natural sources. These fibers are found in the form of worms, animals, water, leaves or minerals. Natural fibers are classified, according to their origin.

(1) Vegetable Fibers
(2) Animal Fibers
(3) Mineral fibers

(1) Vegetable Fibers:

The basic material of all plant life is cellulose. Cellulose is made up of elements like carbon, hydrogen and oxygen. These cellulose fibers have certain common properties like low resilience, high density, and good conductor of heat. They are highly absorbent and are resistant to high temperature. Vegetable fibers are of different types.

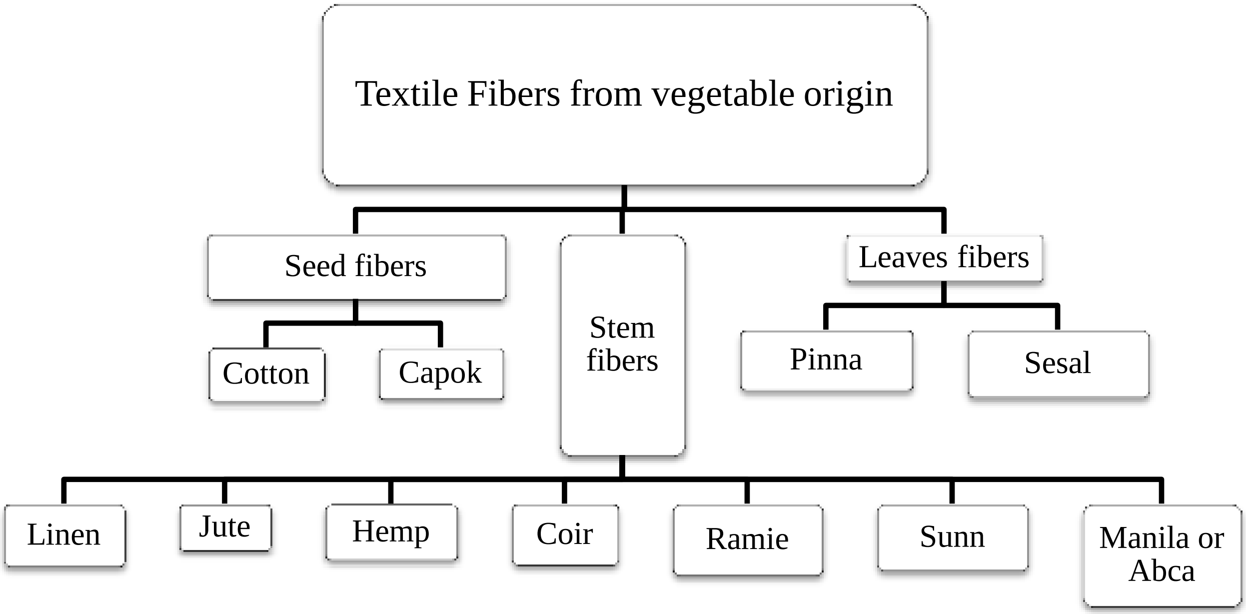

Figure 2: Textile fibers from vegetable origin

(A) Seeds Fibers:

Fruit fibers are stuck around the seed. Such contributions are collected and the seeds are separated from them so they are called seed fibers. Cotton and Kapok are examples.

- **Cotton:** Cotton is the most important of the natural cellulosic fibers. Cotton is the fabric for every home and is the most widely produced of textile fabrics today. The cotton plant grown in the tropics needs a climate with 6 months of summer weather to blossom and produce pod. Cotton plants are grown and cultivated in warm climates. Cotton is one of the most important natural textile fiber crops, both from the agricultural and manufacturing sectors' point of view. It is the biggest source of clothing as well as being used to produce apparel, home furnishings, and industrial products. The main countries producing cotton in the world are China, United States, India, Pakistan, Uzbekistan, Turkey, and Brazil, which together account for over 80% of the world's cotton production.

- **Kapok**: Kapok is natural cellulosic fiber. Kapok fiber is a silky cotton-like substance and originates from the Kapok tree, which is also known as ceilbakentandra. Kapok tree can grow up to 4 meters (13 feet) per year. Kapok is eight times lighter than cotton. Kapok fiber is also non-allergic, non-toxic, resistant to rot and odorless. Kapok has been used as a filling material or for nonwovens originally.

(B) Bast Fibers:

Bast fiber or skin fiber is a plant fiber collected from the phloem or bast surrounding the stem of certain, mainly dicotyledonous plants. They support the conductive cells of the phloem and provide strength to the stem. Most of the technically important bast fibers are obtained from herbs cultivated in agriculture, as for instance flax, hemp or ramie, but also bast fibers from wild plants, as stinging nettle and trees such as lime or linden, have been used to some extent. Corchorus are also bast fibers. Normally, bast fibers are thick and boast high-tensile strength. Therefore, they are usually processed for use in coarse textiles such as ropes, carpet yarn, traditional carpets, geo textile, and hessian or burlap sacks. In addition, they can be used in composite technology industries manufacturing nonwoven mats and carpets, and composite boards such as furniture materials and car-door panels, for example.

- **Linen:** In the recent years bulk linen production has moved to Eastern Europe and China, but high quality fabrics are still confined to niche producers in Ireland, Italy and Belgium, and also in countries including Poland, Austria, France, Germany, Sweden, Denmark, Belarus, Lithuania, Latvia, the Netherlands, Spain, Switzerland, India. Linen is a flax-based textile that is predominantly used for home ware applications. While linen is similar to cotton, it is made from fibers derived from the stems of the flax plant instead of the bolls that grow around cotton seeds. Flax plants are ready for harvesting after about 100 days of growth. Flax stems are yellow and their seeds are brown, these plants are ready to be harvested. Its fibers seem to disintegrate. These fibers contain a substance called pectin glue. Fibers are prepared by its various processes.

- **Jute :** Jute is one of the most affordable natural fibers and is second only to cotton in the amount produced and its variety of uses. Jute is known as the 'golden Fiber' due to its golden brown colour and its importance. Jute fiber is 100% bio-degradable and recyclable and thus environmentally friendly. India and Bangladesh are the biggest producers of jute in the world. Jute is a cellulosic fiber under the category of bast fibers. Among the natural fibers, the length of the jute plant is 8 to 12 feet. When the plant starts flowering on this plant, the crop is cut and then it is allowed to dry so that the top bark melts and the jute fibers start to separate. Jute is yellow color and is used to make rope, matte, and carpet. It is also the most used product in gunny sacks to store rice, wheat, grains etc.

- **Hemp:** Hemp (C. sativa) is a tall, slender annual plant, with a vigorous growth habit, of the Cannabaceae family. Fiber production from hemp (Cannabis sativa) has been conducted over many centuries, for end users from textiles, ropes and sails, to matrices for industrial products in the modern age. Hemp is a bast fiber harvested from the hemp plant and processed in a manner similar to flax. It is a coarser fiber than flax, darker in colour and difficult to bleach. The hemp plant is now cultivated in almost every European country, and in many parts of Asia. Important producing countries include the Soviet Union, Yugoslavia, Romania and Hungary. In modern times, hemp has been used for industrial purposes including paper, textiles, biodegradable plastics, construction, health food, fuel, and medical purposes with modest commercial success, as well as for clothing and household goods.

- **Ramie:** Ramie fiber is one of the strongest and longest natural fine textile fibers in the world. Ramie is produced in India and china. Ramie fiber, also known as China grass or Rhea in china. These fiber looks like a small knot when viewed under a microscope. Ramie is used in many diverse applications like suiting, shirting, sheeting, dress materials, table cloths, napkins, towels, handkerchiefs, fine furniture upholstery, draperies, mosquito netting, gas mantles, industrial sewing thread, packing materials, fishing nets, fire hose, belting, canvas, marine shaft packing, knitting yarns, hat braids, filter cloths, etc. The fabric is even more absorbent than cotton. It has many similarities with linen. The appearance of ramie looks a bit like silk since it is shiny and lustrous.

- **Sunn:** Sunn production is higher in the southern parts of Asia. In India its production is taken in two months, one in October-November and the other in May-June. This plant also receives fibers from its branches. After, flower grows on the plant, the plant cut and cultivate. The fibers of the sun can be dyed with bright colors. This fiber is most used in the paper industry and making fishing net.

- **Coir:** Coir is extracted from coconut husks. These fibers are as long as 10 inches. The fibers are separated, spun into yarn, and woven into rugs, ropes, floor coverings, mattresses, brush, and many other kinds of products. These fibers are strong, durable and coarse as they have no special color and can be dyed with darker colors. Fibers made from coconut fibers are very strong.

(C) Leaves fibers:

- **Pina:** Pina fiber iss obtained from the leaves of the pineapple tree". In the Philippines beautiful garments are made from the fibers of pina. These fibers have long length. The pina cloth is woven manually. It is used to make table linens, bags, mats and other clothing items.

- **Sisel:** Sisel fiber is one of the most widely used natural fiber and is very easily cultivated. It is obtain from sisal plant. The plant is known formally as Agave sisalana. Sisal fiber is fully biodegradable and its green composites are fabricated with soy protein resin modified with gelatin. It is a stiff fiber traditionally used in making twine, rope and also dartboards Sisal fiber is manufactured from the vascular tissue from the sisal. The fibers of sisal are glossy strong and durable but thick and rough.

(2) Animal fibers:

Fibers obtained from animals and worms are known as animal fibers. Silk fibers are obtained from silkworms while wool fibers are obtained from animals such as sheep, goats, camels. These fibers are made up of proteins. There are similarities. It contains carbon, hydrogen, oxygen and nitrogen. There are two types.

(A) Wool
(B) Silk

(A) Wool: Wool is a natural protein fiber. Wool comes from sheep hair and goat's hair, but wool is also obtained from camel's hair and special rabbit's hair. Excellent wool is obtained from merino sheep. The quality of wool depends on the breed and nutrition of the sheep. The hair is first removed from the body of the animal to get the wool. The wool is then produced by various processes. Wool is used to make clothes to protect from the cold atmosphere.

(B) Silk: silk is a protein fiber made by silk worms and is the only natural fiber that is a filament fiber. Silk it is also called 'Queen of fibers'. Silk is produced in India, China, Japan and Thailand. China is the largest producer and supplier of silk. The cloth of silk is world famous. In ancient times silk fabric was worn by kings. Silk fibers are beautiful, shiny, soft, and long, delicate and soft. These fibers are obtained from the worms of silk. The worm is raised on a mulberry silkworm. The saliva gets wrapped around its body and dries out. These worms are known as cocoons. It is dipped in boiling water and the fibers are passed over the reel. Then it is taken to make cloth.

(3) Mineral Fibers:

Silver and gold garments are mentioned in Ramayana and Mahabharata. It decorates the garments with metals so the garments become attractive.

(A) Gold: A small wire is made from gold. This wire is mixed with silk fiber to make beautiful garments which are very expensive. Since gold is very expensive at present, it is used to make cheap garments by glazing gold on copper wire.

(B) Silver: The fibers of silver are shining white. Silver is heated to make thin wire. It is woven with silver wire to make clothes. This garment is made of silver wire. So in a short time it turns black. Therefore, it is very difficult to take care of it.

(C) Asbestos: These fibers are thin, soft, white, flexible and strong. Clothing is made from asbestos fibers. The fibers of asbestos do not burn in fire. These fibers are fire retardant, moisture resistant. It can be found in a wide variety of products from yarn, rope and textiles to cement, insulation boards, friction materials, gaskets and thermoplastics. Asbestos yarns were used in the manufacture of asbestos cloth for fire protective clothing, gloves and in fire blankets. They may also have been used in gaskets or packing materials.

3.3.2 Man-made fibers

Manmade fibers are manufactured using chemical technologies. And fall in to the following categories.

(1) Regenerated Fibers:

Regenerated fibers are widely used in clothing. Regenerated cellulose fiber is a type of manufactured or man-made fiber that uses cellulose (mainly from wood or plant fibers) as a raw material. Regenerated cellulose fiber was the first man-made fiber applied in the textile and apparel industry and in the early days. The three types of regenerated cellulosic fibers are Viscose rayon, couperomaniyam, and Nitrocellulose.

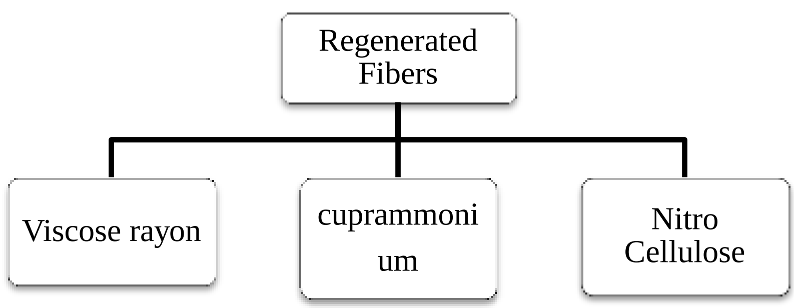

Figure 3 regenerated fibers

(A) Viscose rayon: Viscose is the oldest manufactured fiber, first being produced in 1883 as a cheap alternative to silk. Viscose is a semi-synthetic material used in clothes. Viscose production generally begins with wood pulp, and there are several chemical and manufacturing techniques to make it. The soft, lustrous and lightweight viscose fabric drapes perfectly.

(B) Cuprammonium: The rayon cuprammonium is named after the copper oxide and ammonium. Cuprammonium rayon is made by exposing the cellulose of a plant product, such as cotton clothing, to a mixture of ammonium and copper. These two elements combine with the cellulose to make a new substance, and then the mixture is dropped into caustic soda and extruded through a spinneret.

(C) Nitrocellulose: This method is very expensive. It was started by Count Hillary D. Chardonette of France. In this method small fibers of cotton are chemically processed between nitric acid and sulfuric acid. It is dissolved in ether or alcohol. Colloid ion prepares its thick solution. It is passed through a spinneret to form a long soft, shiny prepare thread. This method is not famous as it is very expensive.

(2) Synthetic Fibers:

Synthetic fibers are man-made fibers that are derived from chemical resources. Synthetic fibers are made from chemically synthesized polymers. Synthetic fibers are used for making clothes and many other useful things. They may be entirely synthetic or semi synthetic. First nylon salt is made. The fibers are then passed through a finely perforated spinner to form a dry cloth. Chemical fibers can be made in many ways.

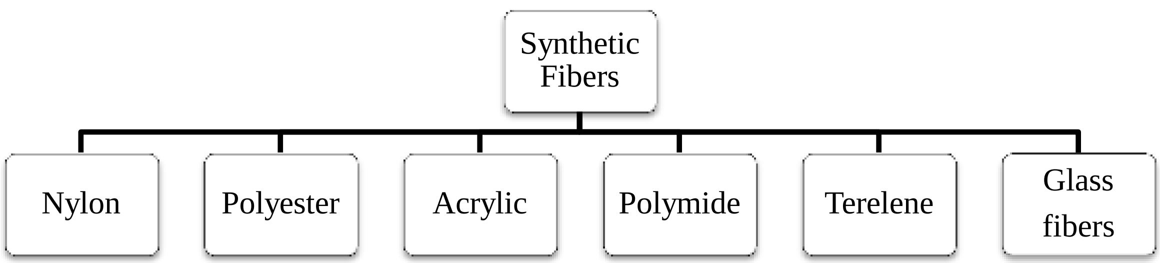

Figure: 4 Synthetic fibers

(A) Nylon: Nylon does not absorb water. While nylon takes many forms, it made its name as a textile fiber and revolutionized the textile industry. Nylon has some of the look and feel of silk. It is used in sheer hosiery, sails, parachutes, blouses, gowns and veils, swimsuits, lingerie, and even car tires. Nylon fibers are exceptionally strong and elastic and stronger than polyester fibers.

(B) Polyester: Polyester is the most commonly used synthetic fiber. The fabrics made from polyester fiber have good elasticity, wrinkle resistance, shape retention, excellent wash-and-wear performance and durability, and so on so that it is widely used in all kinds of apparel fabrics. However, because polyester fiber is poor in moisture absorption, its clothing makes the wearer feel hot and sticky, produces static electricity easily which results in clothing absorbing dust and clinging to the body, and has poor comfort.

(C) Acrylic: Acrylic fibers are soft and flexible, producing lightweight, lofty yarns. The length of these fibers is kept as desired. It can be used to make shiny fabrics like satin.

(D) Polyimide: Polyimides have been in mass production since 1955. Polyimide is a polymer of imide monomers. With their high heat-resistance, polyimides enjoy diverse applications in end uses demanding rugged organic materials, e.g. high temperature fuel cells, displays, and various military roles.

(E) Terylene: Terylene polyester staple fiber is being used in staple-fiber form in blends with both natural and other synthetic fibers to produce an increasing number and variety of woven and knitted fabrics for apparel wear. Terylene is a very strong fiber and will suffer very little loss in strength when wet. It is elastic in nature and posses the property of resist creasing. Terylene is easily washed and dries quickly. Terylene is mainly used in making plastic bottles and clothing.

(F) Glass fibers: Glass fibers are used without matrix as filters and fibrous blankets for thermal and acoustical insulation. Glass fibers are used as reinforcement of polymers in various fields such as automobile, marine, sporting and leisure goods, and construction and civil engineering. Glass fiber is made up of fine fiber of glass. Glass fibers are composed mainly of silica ($SiO2$), like window glasses. Glass fibers are commonly used for reinforcement of polymers.

3.4 SOME OTHER FIBERS

Special hair fibers:

Specialty hair fiber, any of the textile fibers obtained from certain animals of the goat and camel families, rarer than the more commonly used fibers and valued for such desirable properties as fine diameter, natural luster, and ability to impart a pleasing hand to fabrics. Specialty hair fibers obtained from the goat family include mohair, from the Angora goat, and cashmere, sometimes referred to as cashmere wool, from the Kashmir goat. Common goats yield the less-valuable goat hair that is used mainly in low-cost felts and carpets manufactured for the automobile industry. Fibers obtained from animals of the camel family include camel hair, mainly from the Bactrian camel, and guanaco, llama, alpaca, and vicuña fibers, all from members.

Modified fibers:

Some fibers change their shape and properties during chemical processing. Its shape and form are different from the original fiber. E. g. Mercerized cotton is made by chemical processing on the fibers of cotton. Many other types of mercerized fabric are also made this way. New fibers are created by making changes in this way.

Mixed fibers:

Blended fabrics are created when two or more different kinds of fibers are mixed together to create a new fabric with unique properties. The demand for mixed fibers is increasing now days. Expensive fibers are mixed with cheap fibers to make garments. It has the properties of both fibers and is cheap and good for wearing.

3.4 CLASSIFICATION OF TEXTILE FIBERS BASED ON THE LENGTH

There are two main kinds of fibers.
Fibers of short length, called staple fibers
Fibers of indefinite (very long) length, known as filaments

Staple fibers: The word staple means something important or main. These fibers are natural fibers and have varying lengths. Staple fibers have to be twisted together. In the staple fiber manufacturing process, a large bundle of filaments are cut into specified short lengths of fibers. Staple fibers are measured in inches or centimeters. They include almost all natural fibers except.

Filament fibers: Filaments are generally combined and twisted together to form yarns. Filament fibers measured in yards or meters. A fiber of continuous length is known as a filament. A fiber of extreme length is a filament. Fibers can occur naturally or can be produced artificially. A filament is very long enough to be used in a fabric manufacturing process such as weaving or knitting directly. Majority of filaments currently used are man-made in nature. The only naturally occurring fibrous material in the filament form is silk.

Check Your Progress

1. What is a fiber?

2. **What is glass fiber and where it is used?**

3. From where jute is obtained and explain its uses.

4. Enlist the qualities of jute

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5. State the types of fibers. Name some natural fibers.

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6. State the list of synthetic fibers. Explain about one synthetic fiber.

____
____
____
____
____
____

Multiple Choice Questions

1) Jute fibers are _____________.
(a) Stem fiber
(b) Bast fiber
(c) Leaves fiber
(d) All

2) Which one of the following is not a natural fiber?
(a) Cotton
(b) Flax
(c) Nylon
(d) wool

3) Which is a natural fiber?
(a) Silk
(b) Nylon
(c) Rayon
(d) All of these

4) Which of the following is a plant fiber?
a) Wool
(b) Silk
(c) Cotton
(d) Nylon

5) Wool and silk are examples of _____________.
(a) Plant Fibers
(b) Animal Fibers
(c) Natural Fibers

(d) Synthetic Fibers

6) Cotton, wool, silk are examples of ____________.

(a) Plant Fibers
(b) Animal Fibers
(c) Synthetic Fibers
(d) Natural Fibers

3.5 LET US SUM UP

This unit gives you knowledge of fibers. What we learnt first was basic textile fibers. Textile fibers provided an integral component in modern society and physical structure known for human sustainability and comfort. We classifying fibers based on their sources and fibers length. Man is an ancient friend of fashion. The better garment and apparel led to the development of textile fiber production and textile manufacturing process. We also learnt some others special mixer fibers. The content may serve as a useful learning of natural and manmade fibers.

3.6 KEY WORDS

Cultivate
To prepare land for the raising of crops cultivate a field.
Colloidion
A highly flammable, colorless or yellowish syrupy solution of nitrocellulose, ether, and alcohol, used as an adhesive to close small wounds and hold surgical dressings, in topical medications, and for making photographic plates.
Spin rate
A device for making rayon, nylon and other synthetic fibers, consisting of a plate pierced with holes through which plastic material is extruded in filaments
Cocoons
A similar natural protective covering or structure, such as the egg case of a spider.

3.7 SOME USEFUL BOOKS

Materials Selection for Natural fiber Composites - Faris M. AL-oqla and Mohd S. Salit – WOOHEAD PUBLISHING
Identification of textile fibers- Edited by Max M. Houk - WOOHEAD PUBLISHING
Textile Technology knowledge series Volume I
TEXCOMS TEXTILE SOLUTIONS MARCH 31,2019

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Answers

Check your progress

1. A fiber is a small thread. There are many types of textile fiber. The Textile Institute defines a fiber as a 'textile raw material, generally characterized by flexibility, fineness and high ratio of length to thicknesses. In textile industry, fiber can be classified into two different types' fibers which are Natural fibers and Synthetic fibers or well-known as Man-made fibers.

2. Glass fiber is made up of fine fiber of glass. Glass fibers are used as reinforcement of
polymers in various fields such as automobile, marine, sporting and leisure goods,
construction and civil engineering. Glass fibers are composed mainly of silica, like window
glasses. Glass fibers are commonly used for reinforcement of polymers.

3. The jute plant is normally harvested at flowering stage. The stems of harvested plants are bundled and immersed in water for 10 to 15 days. The stems rot and fibers are separated by hand. These fibers are converted into yarns to make fabrics.

4. The qualities of jute are:

1. It is 100% biodegradable and recyclable.
2. It is strong and durable.
3. It can easily be blended with other fibers.

5. There are two types of fibers used in the textile industry. 1) Natural fibers 2) Manmade fibers. Natural fibers are obtained from nature, where the source could be a plant, an animal, or a mineral. Manmade fibers are manufactured using chemical technologies.

Natural fibers: Vegetable fibers: cotton, jute, hemp, ramie, coir
Animal fibers: wool, silk
Mineral fibers: silver, Gold, Asbestas

6. There are different types of synthetic fibers: Nylon, polyester, Acrylic, Terelene, Glass fibers.

Polyester: Polyester is the most commonly used synthetic fiber. The fabrics made from polyester fiber have good elasticity, wrinkle resistance, shape retention, excellent wash-and-wear performance and durability, and so on so that it is widely used in all kinds of apparel fabrics. However, because polyester fiber is poor in moisture absorption, its clothing makes the wearer feel hot and sticky, produces static electricity easily which results in clothing absorbing dust and clinging to the body, and has poor comfort.

Multiple Choice Questions

1. (b) Bast fiber
2. (c) Nylon
3. (a) Silk
4. (c) Cotton
5. (b) Animal fibers
6. (d) Natural fibers

UNIT: 4 VEGETABLES FIBERS

STRUCTURE:

4.0 OBJECTIVE

After studying this unit, the student will be able to:

- Understand the manufacturing process of cotton, linen and jute.
- Understand various characteristics of vegetable fibers.
- Identify structure and composition of fiber.

4.1 INTRODUCTION

This unit gives the information about cotton, linen and jute fibers. The various properties such as physical and chemical properties of cotton, linen, and jute. And also information about uses of fibers. The last section deals with the properties of specific types of vegetable fibers like cotton linen and jute.

4.2 COTTON

Cotton fiber is the purest source of cellulose and the most significant natural fiber. Cotton is an obtained plant source and it is classified as a natural material as it is obtained from the seeds of cellulose seed. As per its consumption of fibers by weight it is called as the king of all fibers in the world.

Cotton is the fabric for every home and is the most widely produced of textile fabrics today. It has now been proved that India was the first country to manufacture cotton. Among the recent findings at Mohenjo-Daro were a few scrapes of cotton sticking to the side of a silver vase. Cotton is the white downy covering of the seed grown in the pods. Cotton is a staple fiber, which means it is composed of different, varying lengths of fibers. Cotton is made from the natural fibers of cotton plants.

Cotton is primarily composed of cellulose, an insoluble organic compound crucial to plant structure, and is a soft and fluffy material. The term “cotton” refers to the part of the cotton plant that grows in the ball - the encasing for the fluffy cotton fibers. Cotton is spun into yarn; it is then woven to create a soft, durable fabric.

Figure: 1 Cotton

4.2.1 History and origin of cotton

India had been an exporter of fine cotton fabrics to other countries since the ancient times. Sources such as Marco Polo, who traveled India in the 13th century, Chinese travelers, who traveled Buddhist pilgrim centers earlier, Vasco Da Gama, who entered Calicut in 1498, and Tavernier, who visited India in the 17th century.

The word cotton comes from the Arabic word “quton.” The earliest production of cotton was in India. The first cotton gin, which is a tool that separates the cotton fluff from the plant seeds, was invented in India in the thirteenth century. The cotton gin made the production of cotton much easier and faster, helping the fiber spread as a widely-used textile.

Indian cotton, particularly the one from Kolkata (then Calcutta) has been a tough competitor in world trade. India draws lines of the quality and dominance of the cotton textile and throughout the ancient period, the medieval period and the modern period Indian cotton has ruled the markets. The history of the cotton industry in India has held a monopoly. But it is not a cakewalk to rule the world of trades. The cotton textile industry of India has scaled heights and also has had a great fall.

The American Eli Whitney's invention of the mechanical cotton gin led to increased production of the material in the United States and Europe. This new tool, which separated the seeds from the cotton quickly and efficiently using machine power, cut down the hours of manual labor needed to produce a bale of cotton from 600 hours to just 12. Around the same time, America, particularly the Southern states, began producing more high-quality cotton, as the fibers were slightly longer and stronger.

During the Industrial Revolution, with the invention of new technologies like the spinning jenny, spinning frame, and spinning mule, Britain became one of the leading cotton producers. All of these spinning machines allowed manufacturers to spin cotton at increased rates.

The first cotton mill in India was established in 1818 at Fort Gloster near Kolkata but was a commercial failure. The second cotton mill in India was established by KGN Daber in 1854 and was named Bombay Spinning and Weaving Company. This mill is said to mark the true foundation of the modern cotton industry in India. In Ahmedabad - also referred to as the 'Manchester of India' - the opening of Shahpur mill in 1861 and Calico mill in 1863 marked the city's spectacular rise as one of the world's prime cotton manufacturing locales.

In modern, independent India, the cotton industry could, once again, compete in the world market. There is still great diversity in the traditions and methods used to produce Indian cotton. Weavers often work in close family structures where ancient skills are passed from generation to generation and there is a great pride in the work, the fiber and the rich history surrounding even the most simple cotton fabric.

4.2.2 Types of cotton

There are three types of cotton:

1) Long staple cotton

It has the longest fiber whose length varies from 24 mm to 27 mm. These fibers are long fine and shining. It is used for making good quality cloth. About half of the total cotton produced in India is long staple. It is largely grow in Punjab, Gujarat, Maharashtra, and Madhya Pradesh.

2) Medium staple cotton

The length of its fiber is 20 mm to 24 mm. About 44 percent of the total cotton production in India is of the medium staple fiber. Rajasthan, Uttar Pradesh, Madhya Pradesh, Punjab, Karnataka are its main producers.

3) Short staple cotton

This is inferior cotton with fiber less than 20 mm long. About 6 percent of the total production is of short staple cotton. Telangana, Andhra Pradesh, Rajasthan, Haryana and Punjab are its main producers.

4.2.3 Cultivation of cotton

The principal cotton producing regions are Egypt, Southern United States, India, Brazil the Western and Southern coast of America and East Indies. America produces more than 40 % of the world's cotton. India ranks second to the United States as a producer and exporter of cotton.

Some important points for cultivation of cotton:

1) Climate

A hot and moist climate is a requirement for proper boll formation. More sunshine and warm humid climate is needed to grow the cotton crop. 25 C is ideal temperature for cotton cultivation. The low temperature at the boll opening creates problem in harvest.

2) Soil

The depth of soil should not be less than 20 to 25 cm and should have proper drainage. Black soil is best for cotton. Irrigated cotton should be grown in medium black to deep soil having a pH range of 6 - 8.

3) Rain

150 cm to 200 cm rain fall is essential for cotton farming.

4) Time

Cotton plants take about 200 days to prepare.

4.2.4 Manufacture of handmade and machine made cotton in India

Handmade cotton in India

The tools and appliances used by cotton weaves consist of a spinning wheel (charkha) and a spindle (takli). The cotton is first 'separated' and 'carded'. A bow shaped beater known as 'dhun' is used for the purpose. The string of the bow is placed on the cotton and is made to vibrate by means of a wooden hammer. These vibrations cleanses all foreign matter such as seeds and leaves leaving soft fine cotton behind. The fine cotton is rolled on stick to form a cylinder about half a cubit (6 inches) long and half an inch in diameter. This is tied to a spindle or takli. The charkha wheel is turned and the thin thread is gently drawn out until it is about 300 yards long and rolled on a charkha which is wound on to a bamboo reel. The yarn is sent to weaving unit where it is woven in to a cloth.After weaving the cloth is calendared with a blunt beater to give it a gloss and to soften it. The cloth is then stamped, ticketed and made ready for sale.

Machine made cotton

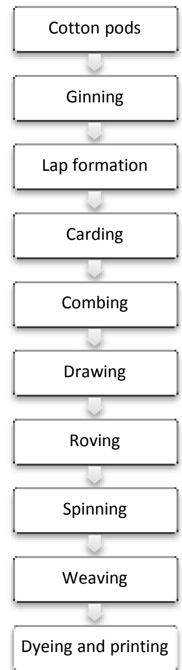


Figure 2: Machine made cotton process

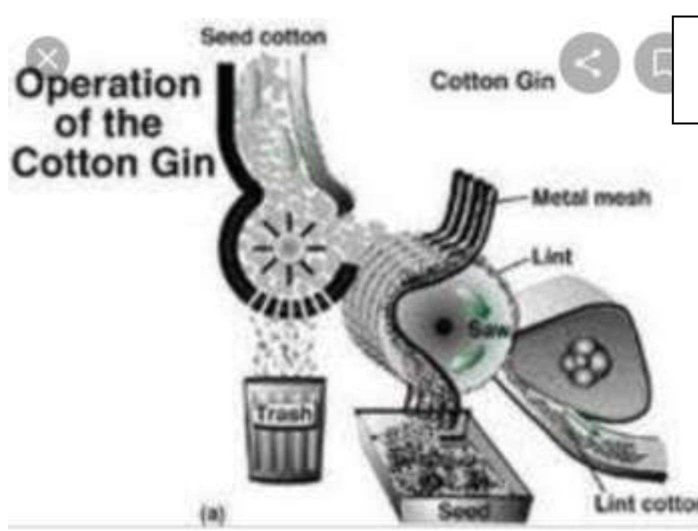
Cotton pods

After the plant flowers, the cotton fibres (lint) develop on the seed in the boll. As the

boll opens, the fiber cells rapidly dry, collapse and die.

Ginning

The fiber is first removed from seeds in a gin. This processis called ginning. A cotton gin separates cotton seeds from bolls and removes dirt and trash. Every bit of the cotton fiber is used in manufacturing. The fiber mass is then compressed into bales and shipped into spinning mills.



Cotton ginningmachine

Figure 3: Cotton ginning machine

Lap formation

In this step, the dirt from cotton fiber is removed and fibers are made in to a soft roll or lap. Then several laps are combined into one.

Carding

Carding is the process of forming cotton fibers in to large stand.

Combing

All cotton yarns for fabrics are carded but not all are combed. Yarns that are combed are finer even and free from all woody stalk of the plant. They are used for finer quality fabrics such as voile and organdie. Fabrics made from these fabrics are expensive too. The slivers are called combed slivers. It is used to make high quality garments.

Drawing

The slivers are then combined, smoothened and stretched. The slivers may be drawn, reduced further in size and given a slight twist by a process called roving in which the slivers is passed through rollers and wound on to bobbins set into spindles. It is done in a speed frame.

Roving

The bobbins are placed on the roving frame where further drawing and twisting takes place until the cotton stock is about a pencil lead in diameter.

Spinning

Done on the spinning frame where the stock passes through sets of high speed rollers and gives the yarn of desired thickness.The strand and spun create yarn

Weaving

The yarn is then knitted or woven in any one of the variety of weaves and structures. Warp yarns are usually more strongly twisted than filling yarns since they must withstand greater strain in weaving and finishing.Dye stuffs may be applied to raw cotton, yarn or piece goods.

Dyeing and printing

The thread or fabric is dyed to make it attractive.Depending on the usefulness of the fabric, the colors and designs are printed. Discharge, roller, block print, screen print are used for printing.

Finishing

It includes starching, calendaring, sanforizing, mercerizing or other finishes as it is necessary for the particular use for which the cloth is intended.These finishes may be applied to yarns but are usually applied to fabrics. The fabrics may be given these special finishes before or after dyeing.

4.2.5 Properties of cotton

1) Physical properties

Color and luster

The color of cotton fiber could be white, creamy, bluish, yellowish white or grey.

Length and diameter of fiber

The fiber diameter (ribbon width) various from 11 mm to 22 mm. The finer cottons are generally longer and the coarser ones shorter.

Microscopic structure

Mature cotton looks like a flat, twisted, ribbon or a collapsed twisted tube. A large number of convolutions are usually found.

Immature cotton also looks like a flat twisted ribbon but has a lower number of convolutions. Mercerised mature cotton is almost cylindrical in shapes and has very few convolutions.

This misshapes the fiber structure. As drying increases the wall of the fiber shrinks, collapse, lumen become smaller and the fiber develops convolution.

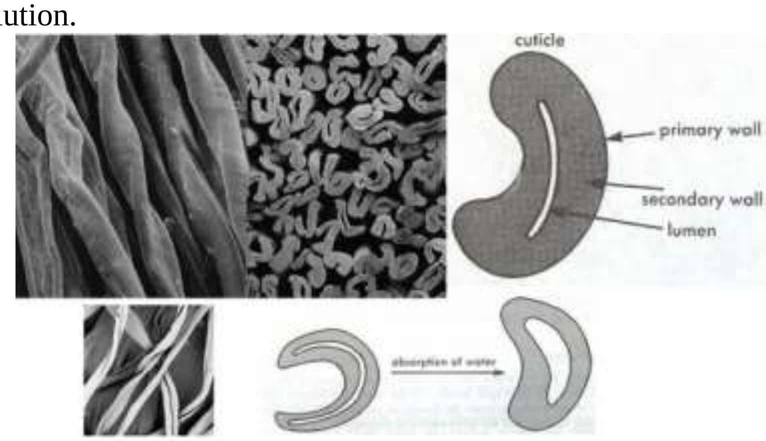


Figure 3: Microscopic structure of cotton

Elasticity

Cotton fibers lack elasticity so they cannot be stretched. Cotton is relatively inelastic because of its crystalline polymer system and for this reason cotton clothes wrinkle and crease readily.

Strength and tenacity

The fibers of cotton are strong and powerful even though they are small. When wet, its strength increases up to 50%. It can be easily washed. It has tenacity of 3-5 gm / den.

Resilience

Cotton wrinkles easily. Some wrinkle resistant finishes may reduce this property.

Crease resistance

Wrinkles appear only when cotton is worn once or twice. It can be made a wrinkle barrier by artificial finishing.

Cleanliness and wash ability

Cotton absorbs dust due to its rough nature. It can be washed easily in the hot water, soda and soaps without damaging the fiber.

Effect of sunlight

Cotton cloths are weak in sunlight. As well as its color also turns yellow. Excessive heat causes white clothing to turn yellow and colored clothing to fade.

Shrinkage

The fiber itself does not shrink but cotton fiber which has been stretched in the finishing process tends to relax back creating shrinkage.

Absorbency

Cotton is a good absorbent of fiber. Cotton cloth is more comfortable in sunlight. The moisture resistance of cotton is 7.5 %.

2) Chemical properties

Effect of acid

Cotton fibers are weakened and destroyed by acids. This is due to the hydrolysis of cotton polymer at glycoside oxygen atoms and the formation of hydrocellulose. The DP is lowered by such hydrolysis and these results in lower strength.

Effect of Alkalis

Cotton fibres are much more resistant to alkalis. Concentrated alkalis do not usually harm cotton. Concentrated sodium hydroxide in particular causes the cotton fibre to swell. The fibre will increases in thickness and contracts in long. This process is thought as mercerisation. A better alignment of molecules in the polymer system and an increased formation of hydrogen bonds due to the mercerisation result to better properties in generally. Mercerisation below tension causes the fibre to become smoother, more regular and nearly cylindrical. The cross sectional shape of mercerised cotton is round to oval and almost absent. The longitudinal read appears cylindrical and has only a few convolutions.

Effect of bleaching

If bleaching agents are used with care and control with regard to concentration, pH, temperature and time, cotton is not broken. If any of those variables go out of control, chemical harm occurs, oxycellulose is formed and therefore the fiber weakens. Cotton is quickly bleached by solutions of sodium and calcium hypochlorite peroxide and sodium chlorite.

Effect of dyes

Cotton is considered to be a relatively easy fiber to dye and print. This is due to the presence of polar chemical groups in the polymer. Direct, napthol, vat, reactive and sulphur dyes can be applied to cotton.

Cotton takes in dyes higher than linen but not as readily as silk and wool.

If a mordant is used

Cotton is easy enough to dye mordant colors, direct or substantive dyes ought to be applied to the cotton.

Effect of sweat

Cotton can withstand dry heat up to 140^0 C. At 245^0 C, it scorches and burns. Cotton textiles can thus withstand domestic ironing without yellowing provided that their contact with the hot iron is kept to the required minimum.

Check your progress I

1. What is Cotton fiber?

2. Write about properties of cotton fibers?

3. In which states of India does cotton grow?

4. What is ginning?

4.3 LINEN

Linen is created from fibers of the flax plant stem. The word linen is obtained from the Latin for flax plant, a part of the genus *Linum* within the flax family *Linaceae*.

The word "linen" comes from the Latin name for flax, "*linumusitatissimum*." Linen textile is one of the oldest in the world, made from a minimum of 10,000 years ago.

Linen is a natural fiber, like cotton, however it takes longer to harvest and make into fabric, as flax fibers can be difficult to weave. The fibers are extracted from the plant and kept for long periods of time to soften the fibers. Garments made of linen are desirable in hot and wet climates.

High quality flax is generally grown in Western Europe and Ukraine. The high quality fabrics are made in Ireland, Italy and Belgium, but linens are also made in many other European countries and in India. However bulk linen production is seen especially in Eastern Europe and China.

4.3.1 History and origin of linen

Linen is one of the longest-produced textiles, and its history could stretch back even farther than the most ancient evidence that modern archaeology has uncovered.

Due to the Egyptian climate, it had been necessary to devise apparel that resisted the sun's rays and allowed speedy sweat cooling.
In fact, the Ancient Egyptians typically used linen as an actual type of currency. This fabric was also used to build the burial shrouds and wrappings for mummies.

The Ancient Greeks used linen to create clothes and home wares, and therefore the Phoenicians later introduced linen production to Western Europe. However, historical records recommend that there was no effort on behalf of European powers to manage flax production among farming communities until the twelfth century AD.

Later, Ireland the middle of European linen production, and by the eighteenth century, the city of capital became called "Linen polis" because of its thriving line trade. Linen remained standard throughout the colonial era, however as cotton production became cheaper and easier, the central role that linen used to hold within Europe's textile economy gradually diminished. These days, linen is primarily a distinct segment product that remains in production to manufacture a handful of textile products. Linen is no longer in vogue due to the laborious and time-intensive processes used to make this fabric. Ironically, production difficulties originally disincentive linen production thousands of years ago; whereas the challenges facing line producers these days are quite different than they were in antiquity, this fabric remains finicky and expensive to produce.

4.3.2 Manufacturing Process of linen

Planting
Flax plants are prepared for harvest after about 100 days of growth. Since flax plants do not tolerate heat, they need to be planted within the cooler a part of the year to avoid crop death.
Harvesting of plants
Once flax stems are yellow and their seeds are brown, these plants are able to be harvested. Whereas it's possible to harvest flax by hand, machines are sometimes used for this process.
Fiber separation
After flax stalks are harvested, they are processed through a machine that removes leaves and seeds. Then, manufacturers separate flax's fibrous outer stalk from its soft, woody interior. This method is called retting, and

unless it is expertly accomplished, the delicate flax fibers used for textile production could be damaged.

Breaning and Scutching

Next, the decomposed stalks are broken up, which separates the unusable outer fibers of flax stalks from their usable inner fibers. To accomplish this step, the flax stalks are sent through rollers that crush them, and then rotating paddles remove the outer fibers from the stalks.

Combing and hackling

Now that the inner fibers are separated from the opposite fibers, they can be combed into skinny strands. Once the fibers are combed, they will be prepared for spinning. The short fibers are combed out with hackling combs, leaving behind the long, soft flax fibres.

This "raw" flax is collected into bunches by hand. By feel, this flax is fed into a jumbo mechanical contraption for "hackling," a machine that hasn't modified in a hundred years. The flax is stripped, stretched, clean and eventually twined into a rough rope.

Roving

This rope is more stretched and wound into finer strands of linen fibers in aisle after aisle of "roving" machines, continuously spinning below the watchful management of career craftsmen.

Spinning

Spinning of flax yarn used to be accomplished with a foot-powered flax wheel, however recently, flax producers use industrial machines for this method. To spin flax fibers, these short, combed fibers are connected with devices referred to as spreaders, and also the ensuing strings, referred to as roving, are ready to be spun.

Dyeing

The spools are bleached and subsequently dyed in a smorgasbord of colors.

Weaving

This requires the maximum amount technical ability as creativity, and below the knowledgeable hands of those craftsmen, the unique texture and feel of the fabric takes shape. This method is endlessly customizable and can be adapted to make any kind of pattern, color combination, grain and consistency.

Finishing

Every yard of the fabric is washed, boiled, starched, ironed, and processed in different ways from microbial resistance to wrinkle-free.

4.3.3 Properties of linen

Linen fabric feels cool; it is also breathable and is stronger and extra lustrous than cotton. The more it’s washed, the softer it gets. Linen is stronger once wet than when it is dry.

It is available in many colors: natural linen is available in shades of ivory, ecru, tan and grey (pure white linen is produced by heavy bleaching). As linen is a natural fiber, it also can be simply dyed in a variety of colors.

Linen fabric absorbs and loses water rapidly, so it can absorb moisture without feeling unpleasantly damp to the skin. This is why it is often worn in hot climates or during the summer.

Linen also has natural water-wicking qualities, which suggests it attracts sweat out of the skin and dries quickly.
Elasticity is the extent to which a fiber is often elongated or stretched and comes back to its normal condition and size. Linen is a natural fabric and the least elastic
Another property of linen is that the fiber absorbs moisture and dries more quickly. It is wonderful for producing towels and handkerchiefs.

The most common bleaches used on linen textile materials are sodium hypochlorite and sodium perborate. They are: oxidizing bleaches and bleach because of the oxygen liberated from them, are resistant to alkalis and relatively unaffected by normal wash. The resistance is because of the lack of attraction between the flax polymers and alkalis.
4.3.4 Uses of linen
Linen is used to create home article items like table cloths, upholstery, soft furnishings and curtains. It is additionally used for making types of garments and for making a strong sewing thread. Linen is commonly embroidered, especially on women's garments and home article items.
The use of linen has modified. In the 1970s about 5 % of linen was used for fashion while the rest was used for household articles. However, about 70 % of linen production is currently used for fashion.

4.4 JUTE

Jute is a beautiful and versatile fiber with an aesthetic attractiveness. The Golden Fiber has gained immense popularity around the globe because of its bio-degradable character.

Jute fabric may be a kind of textile fiber made up of the jute plant. Whereas there are a few different botanical kinds of jute, one of the main species used to make jute fabric is *Corchorusolitorius* (white jute). However, another species of jute, called *Corchoruscapsularis* (tossa jute) is considered to be superior even though it is harder to cultivate.
While jute isn't very popular in the Western world, it is one of the primary textile fibers of India and neighboring countries. Jute fibers are among the longest natural textile fibers in the world.

4.4.1 History and origin of jute

Jute has been grown for textile purposes on the Indian subcontinent for at least 5,000 years. The earliest evidence for the production of this plant fiber dates to approximately 3000 BC, but it's entirely possible that the Indus valley civilization or preceding societies also cultivated jute for fiber purposes before this date.

While jute had also been grown in Scotland for several centuries, jute production in Bengal and different components of India quickly overtook Scottish production. Due to the immense profits being made by jute barons in India, many Scottish jute producers immigrated to this British colony to partake in the jute boom.

Jute production remained a big sector of the economy of the British Empire till the late 19th century, and after Indian independence, jute remained a significant export of this region. With the arrival of synthetic fibers, however, jute production slackened within the latter half of the 20th century, and it wasn't until the early 21st century that production of this plant fiber again became a significant economic factor in Bengal, Bangladesh, and other areas of the Indian landmass.

4.4.2 Manufacturing Process of jute

The production of jute material has remained largely the same for centuries. In most cases, mature jute stalks are harvested by hand, and they are then defoliated. Jute fibers are often derived from both the inner stem and also the outer skin of the stalk.

A method referred to as retting is used to remove the non-fibrous material from the stem and skin of the jute stalk. Retting softens the stalks and makes it possible to separate the fibrous material from the unusable material by hand.

After the jute stalk has been retted, it is possible to separate the long, smooth fibers and comb them in to long strings. These combed fibers will then be spun into yarn. While it's technically possible to make jute yarn with automated machines, most jute-producing communities still consider analog spinning wheels for this method.

Once jute fiber has been spun into yarn, it should be subjected to a range of chemical processes to dye it, with water resistance, or make it fire-resistant. Then, the finished reels of jute fiber are shipped out to textile production facilities to be plain woven into apparel or industrial textiles.
In the case of jute apparel, a range of softening techniques is used to make the finished apparel products more comfortable. Some manufacturers may agitate the jute yarn to reduce its roughness, or chemical techniques may be used to achieve the same effect. Jute fiber used for industrial purposes can generally be left in its original condition without using any softening techniques.

4.4.3 Properties of jute

- 100 % bio-degradable recyclable and eco friendly natural fiber
- Natural fiber with golden & silky shine
- The second most significant and wide cultivated vegetable fiber after cotton
- Very versatile natural fiber that has been used in raw materials for packaging, textiles, non-textile, and agricultural sectors

- Jute stem has very high volume of cellulose that can be procured within 4 - 6 months, and thus it can also save the forest and meet wood requirement
- High tensile strength with low extensibility

4.4.4 Uses of jute

The finest quality of jute are used for making home furnishing items like curtains and can also be blended with other fine fabrics like wool, etc for making the other similar items.

- Making sacks, bags, wrapping materials, etc
- Making cable filler
- For making ropes
- Camp beds
- Handbags
- In making mattress
- Jute sofas

Besides these few, there are many more things that are made from jute. The application list of jute is unimaginable. And because of this reason, the fabric retailers have started making the maximum profit by selling jute. Another fabric that has also captured a prominent place in the fashion market today is lace.

Check your progress II

5. What are the properties of linen fibers?

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6. State the uses of linen fibers.

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7. Name the process used for manufacturing of linen.

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____

8. What is jute?

____
____
____

Multiple Choice Questions

1. Which city is called “Manchester” of India?
(a) Rajkot
(b) Ahmedabad
(c) Surat
(d) Vadodara

2. Which type of soil is that for cultivation of cotton?
(a) Black soil
(b) Sandy soil
(c) Humid soil
(d) a and c both

3. _______ is bio-degradable fabric.
(a) Silk
(b) Rayon
(c) Jute
(d) None of above

4. Select the correct match
(a) Natural fiber- Linen
(b) Synthetic fiber- Cotton
(c) Animal fiber- Jute
(d) Plant fiber- Silk

4.6 LET US SUM UP

This unit gives you summery view of vegetable fibers from their origin and history. We also learnt that not all types of vegetable fibers are useful for the textile industry. We studied all the properties such as strength, fineness, durability, elasticity, resilience and absorbency as well as effect light, chemicals on different vegetable fibers.

4.7 KEY WORDS

Inferior	Lower, nether
Moist	clammy, humid, moderately wet
Irrigated	supply water to (land or crops) to help growth
Tenacity	the quality of properties of holding together firmly
Resilience	Flexibility
Stalk	stem, cane, branch
Aisle	path, lane, passage
Elongated	lengthen, widen, and enlarge
Defoliate	remove leaves from (a tree plant or area of land)
Disincentive	deterrent, discouragement

4.8 SOME USEFUL BOOKS

- Mr. W. Stanley Anthony - WOODHEAD PUBLISHING LIMITED
- Edited by S. Gordon and Y.L. Hsieh – Cotton: Science and Technology - WOODHEAD PUBLISHING LIMITED
- https://www.masterclass.com/articles/what-is-cotton#where-did-cotton-originate
- https://www.investindia.gov.in/team-india-blogs/cotton-textile-industry-india#:~:text=The%20history%20of%20the%20cotton%20industry%20in%20India%20dates%20back%20millennia.&text=The%20first%20cotton%20mill%20in,Bombay%20Spinning%20and%20Weaving%20Company.
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Answers

Check your progress I

1. Cotton is made from the natural fiber of cotton plants. Cotton is cellulosic and most significant natural fiber. Cotton obtained from the seed of cellulose. Cotton is a staple fibers.

2. Physical properties of cotton

Color and luster

Length and diameter of fibers

Microscopic structure

Elasticity

Strength and tenacity

Resilience

Crease resistance

Cleanness and wash ability

Effect of sunlight

Shrinkage

Absorbency

3. As cotton is grown in Gujarat, Maharashtra, Punjab, Rajasthan, and MadhyaPradesh.
4. The process of separation of cotton fibers from cotton seeds it's called ginning.

Check your progress II

5.Linen fabric is cool and stronger once wet than when it is dry. It is stronger and lustrous than cotton. Linen fabric absorbs water quickly. Linen has a less elasticity.
6. Linen is commonly used in women's garments and home articles items like table clothes, sofa furnishing, curtains etc.
7. Manufacturing process if linen
Planting
Harvesting of plants
Fiber separation
Breanning and Scutching
Combing and Hackling
Roving
Spinning
Dyeing
Weaving
Finishing
8. Jute is beautiful and versatile fabric. Jute fabric may be a kind of textile fiber made up of the jute plant. Jute is a 100% bio-degradable recycle fabric. It's called golden fiber. Jute fibers are among the longest natural fiber in the world.

Multiple choice questions
1. (b) Ahmedabad
2. (a) Black soil
3. (c) Jute
4. (a) Natural fiber- Linen

UNIT: 5 ANIMAL FIBER

STRUCTURE:

5.0 OBJECTIVES

After studying this unit, students will have,

- Basic knowledge about animal fibers.
- Knowledge regarding history of animal fibers and their properties.
- Basic idea about cultivation of silk and wool.

5.1 INTRODUCTION

Animal fibers are the natural filaments that can be sourced from animals. These fibers are usually made up of various types of proteins.

The most popular example of animal fibers incorporates silk and wool. Note that animal filaments that are removed from various animals usually have different properties. And, the kinds of fibers may likewise vary from one animal category to another. For example, both Cotswold and Merino are different kinds of wool (extracted from different sheep species). The previous is known for its coarse texture though the latter is known for its soft surface. It can likewise be noticed that natural filaments differ in consistency whereas synthetic fibers are known to be more uniform.

The textile filaments that are derived from animals are typically animal fibers. Such fibers are generally produced from animal hair, animal fur, animal skin, or certain secretions (like the silkworm). When removed, animal filaments are generally woven or knitted (or some of the time felted) to form lovely animal fabrics. Historically, animal fibers have been utilized in the production of soft and warm jackets, wraps, overcoats, shawls, ponchos, coats and different types of garments and accessories. Rugs, covers, and carpets are generally made of moderately rougher animal filaments.

5.2 SILK

Silk is loved by numerous individuals as it is "natural" protein fiber. This animal fiber can be woven into textile. The protein fiber of silk is composed mainly of **Fibroin** (about 80%) and **Sericin** (about 20 %) The most ordinarily known type of silk is the one that is obtained from the cocoons (that are delivered in captivity) by the silkworm hatchlings of the Bombyx mori species. The practice of silk rearing is regularly alluding to as sericulture. It can likewise be noticed that the degummed fibers that are obtained from the Bombyx mori species are known to have a width going from 5 to 10 μm. Particular kinds of silk are popular for their shimmery appearance, which is normally a result of the triangular prism like cross-sectional structure of the fibers. Such prism like fibrous constructions allow the light that is incident to the silk fiber to be refracted at various angles.

It is important to note that one whole silkworm cocoon yields one long fiber. Subsequently, care must be taken while unwinding the fibers from the silkworm cocoons. Furthermore, the quality of the silk fibers likewise relies upon the strength of the silkworm larvae which, is subject to the food and the everyday environments they are provided with.

One of the most powerful natural filaments known to man is spider silk. Indeed, the strongest dragline silk known to man is accepted to be more than three times tougher than Kevlar and more than five times more grounded than steel. Particular sorts of spider silk are additionally known for their elasticity. For example, the silk that is woven by the ogre-faced spider is known to have the ability to stretch to more than five times its length without supporting harm.

5.2.1 History of silk

First appearance of silk

The earliest proof of silk was found at the destinations of Yangshao culture in Xia County, Shanxi, where a silk cocoon was discovered cut in half by a sharp knife, dating back to between 4000 and 3000 BC. The species was recognized as Bombyx mori, the trained silkworm. Sections of a primitive loom can likewise be seen from the sites of Hemudu culture in Yuyao, Zhejiang, dated to around 4000 BC.

The earliest example of a woven silk fabric is from 3630 BC, and was utilized as wrapping for the body of a child.

During the later age, the information on silk production was spread outside of China, with the Koreans, the Japanese and, later, the Indian public acquiring information on sericulture and silk fabric production. Inferences to the fabric in the Old Testament show that it was known in Western Asia in scriptural times. Scholars accept that beginning in the second century BC, the Chinese set up a business network pointed toward exporting silk toward the West. Silk was utilized, for instance, by the Persian court and its ruler, Darius III, when Alexander the Great conquered the empire. Even however silk spread quickly across Eurasia, with the conceivable exemption of Japan, its production remained only China for three century.

5.2.3 Types of silk

There are 4 types of natural silk which are monetarily (commercially) known and delivered in the world. Among them mulberry silk is the most significant and contributes as much as 90 % of world production, accordingly, the term "silk" in everyday alludes to the silk of the mulberry silkworm. Three other commercially significant sorts fall into the category of non-mulberry silks to be specific: Eri silk; Tasar silk; and Muga silk. There are likewise different sorts of non-mulberry silk, which are mostly wild in Africa and Asia, are Anaphe silk, Fagara silk, Coan silk, Mussel silk and Spider silk.

Mulberry Silk

Bulk of the commercial silk produced in the world comes from this variety and often generally refers to mulberry silk. Mulberry silk comes from the silkworm, Bombyx mori L which exclusively benefits from the leaves of mulberry plant. These silkworms are totally domesticated and raised indoors. Mulberry silk contributes to around 90 % of the world silk production.

Non-mulberry silk

Tasar Silk

The tasar silkworms have a place with the class Antheraea and they are altogether wild silkworms. There are many varieties, for example, the Chinese tasar silkworm Antherae pernyi Guerin which creates the biggest amount of non-mulberry silk in the world, the Indian tasar silkworm Antheraea mylitte Dury, next in significance, and the Japanese tasar

silkworm Antheraea yamamai Querin which is particular to Japan and produces green silk thread.
The Chinese and Japanese tasar worms feed on oak leaves and other partnered species. The Indian tasar worms feeds from leaves of Terminalia and a few other minor host plants. The worms are either uni- or bivoltine and their covers like the mulberry silkworm cocoons can be reeled into raw silk.

Eri silk

These belong to either of two species in particular Samia ricini and Philosamia ricini. P.ricini (likewise called as castor silkworm) is a trained one reared on castor oil plant leaves to produce a white or brick red silk popularly known as Eri silk.
Since the fiber of the cocoons spun by these worms is neither continuous nor uniform in thickness, the cocoons can't be reeled and, hence, the moths are permitted to emerge and the penetrated cocoons are utilized for spinning to produce the Eri silk yarn.

Muga silk

The muga silkworms (Antheraea assamensis) also belong to the similar family as tasar worms, however produce an unusual golden yellow silk thread which is attractive and strong. These are discovered distinctly in the province of Assam, India and feed on Persea bombycina and Litsaea monopetala leaves and those of different species.
The amount of muga silk produced is tiny and is for the most part utilized for the production of traditional dresses in the State of Assam (India) itself.

5.2.4 Cultivation of silk

Sericulture

Sericulture, or silk cultivating, is the development of silkworms to deliver silk. Despite the fact that there are a few business types of silkworms, Bombyx mori (the caterpillar of the homegrown silk moth) is the most generally utilized and seriously considered silkworm. Silk was accepted to have first been delivered in China as early as the Neolithic Period. Sericulture has become a significant cottage industry in nations like Brazil, China, France, India, Italy, Japan, Korea, and Russia. Today, China and India are the two main makers, with over 60% of the world's yearly production.
Production
The silkworms are taken care of with mulberry leaves, and after the fourth moult, they climb a twig set close to them and spin their silken cocoons. The silk is a consistent fiber involving fibroin protein, discharged from two salivary glands in the head of each worm, and a gum called sericin, which cements the fibers. The sericin is taken out by placing the cocoons in hot water, which liberates the silk fibers and

prepares them for staggering. This is known as the degumming process. The drenching in hot water also kills the silk moth pupa.

Single fibers are joined to shape thread, which is drawn under tension through a few aides and wound onto reels. The threads might be piled to shape yarn. Subsequent to drying, the raw silk is packed according to quality.

Stages of production

The stages of production are as per the following:

1. The female silk moth lays 300 to 500 eggs.
2. The silk moth eggs incubate (hatch) to frame hatchlings or caterpillars, known as silkworms.
3. The larvae feed on mulberry leaves.
4. Having developed and moulted a few times, the silkworm expels a silk fiber and structures a net to hold itself.
5. It swings itself from one side to another in a figure '8', distributing the saliva that will frame silk.
6. The silk cements when it contacts the air.
7. The silkworm spin around one mile of fiber and totally encloses itself in a cocoon in around 2 to 3 days. The amount of usable quality silk in each cocoons is small. Therefore, around 2,500 silkworms are needed to deliver a pound of raw silk.
8. The intact cocoons are boiled, killing the silkworm pupa.
9. The silk is gotten by brushing the undamaged cocoon to find down the external finish of the fiber.
10. The silk fibers are then wound on a reel. One cocoon contains roughly 1,000 yards of silk fiber. The silk at this stage is known as raw silk. One thread includes up to 48 individual silk fibers.

5.2.5 Properties

Tenacity

The silk filaments have awesome strength because of presence of numerous hydrogen bonds to be shaped in a more regular pattern. At the point when it comes into contact of water (wetting conditions) it gets debilitated because of hydrolization of huge quantities of hydrogen bonds present in it by water particles. Perseverance (tenacity) of silk fiber ranges between 3 to 6 grams / denier.

Elongation:

Silk fiber shows generally excellent lengthening (elongation) properties. Silk fiber has a lengthening at break of 20-25 % under standard conditions. It's lengthening at break gets expanded up to 33% at 100% R.H.

Figure: 1 Microscopic view of Silk fiber

Elasticity

Silk is viewed as more plastic than flexible fiber. If the silk material is stretched exorbitantly, the silk polymers will slide past one another. This occurs because of Beta configuration present in the silk polymers. Countless hydrogen bonds are ruptured because of utilization of stretching force. Subsequently the silk acts like more plastic nature than elastic.

Handle (Touch)

The silk filaments are somewhat stiff in touch due to very crystalline polymers. Surface of the silk feels smooth.

Resistance to Abrasion

Silk fabric has great abrasion resistance just as protection from pilling.

Absorbency

It has more absorbency than cotton. The moisture recover of silk is 11%. It absorbs moisture more quickly than cotton yet it gets dried decently fast as well.

Specific gravity

The particular gravity of silk is 1.25 (degummed silk) It is lighter than cotton.

Thermal conductivity

Silk is more sensitive to heat than wool. The silk fiber begins to burn 175°c (starts to fuse)

Electrical conductivity

Silk is a poor conductor of electricity. It tends to shape static shape, when it is taken care of during various types of processes like weaving and so forth. This causes troubles during processing in dry atmosphere.

Drape

Silk fiber plants great flexibility. The silk fabric poses good draping properties.

Exposure to Sunlight

The silk fiber is more sensitive to light than some other natural fiber. At the point when this comes for long time exposure to sunlight, its tone gets spotted partially. Fabric likewise gets yellowish because of degradation caused by daylight.

- **Chemical properties of Silk fiber**

The chemical properties of silk fiber are given beneath:

Effect of water

At the point when silk fiber is kept in boiled water for a short time period, it doesn't show any sort of effect of boiled water. Silk fiber keeps an eye on misfortune of it's strength somewhat when it is kept in bubbling water for long time. This strength loss happens because of hydrolysis activity of water. Silk fiber withstands, in any case, the effect of boiling better compared to wool.

Effect of acids

Silk fiber reacts with acids all the more rapidly. Silk fiber is solvent in hot and concentrated sulphuric acid and hydrochloric acid. It gets yellowish when it comes into contact of Nitric acid. It is marginally influenced by diluted organic acids at room temperature. The concentrated organic acids dissolve the silk filaments.

Effects of alkalis

At the point when silk fiber comes into contact of alkaline solutions, it starts to grow. It breaks up totally after some time. It is treated with 16 %-18 % solution of sodium hydroxide at low temperature to create crepe impact blended fabric having cotton.

Effect of oxidizing agent

The fibroin present in the silk doesn't get influenced badly by hydrogen peroxide solution. The weight loss happens when it is treated in hydrogen peroxide solution. Chlorine solution affects more badly than Hypochlorite. Low concentration of chlorine arrangement damages the fibroin present in the silk.

5.3 WOOL

The term 'Wool' is generally used to allude to the animal fibers that are derived from the furs of animals that belong to the Caprinae family. Although wool can be typically sourced from sheep fur, it isn't remarkable for wool to be harvested from different animals like rabbits, goats, and alpacas. The essential difference between sheep's wool and hair is that sheep's wool is known to contain scales that tend to overlap (in a way like shingles on a roof). Indeed, a few kinds of wool are known to have more than 20 such bends in a single inch. The diameter of a thread of wool can go from 17 micrometers to around 35 micrometers. The wool fiber is primarily composed of proteins called **hard a – keratins,** which have high sulphur content.

5.3.1 History of wool

Wild sheep were more hairy than wooly. In spite of the fact that sheep were trained approximately 9,000 to 11,000 years ago, archeological proof from statuary found at sites in Iran recommends location for wooly sheep may have started around 6000 BC, with the earliest woven woolen garments having only been dated to 2 to 3 thousand years later. Wooly sheep were introduced into Europe from the Near East in the early part of the four thousand years BC. The most established known European wool textile. 1500 BC, was preserved in a Danish bog. Prior to invention of shears—most likely in the Iron Age—the wool was plucked out by hand or by bronze brushes. In Roman times, wool, linen, and leather clothed the European populace; cotton from India was an anomaly of which just naturalists had heard, and silks, imported along the Silk Road from China, were excessive extravagance merchandise. Pliny the Elder records in his Natural History that the reputation for producing the best wool was appreciated by Tarentum, where particular rearing had produced sheep with superior wools, however which required special care. In medieval times, as trade associations extended, the Champagne fairs revolved around the production of wool cloth in small habitats like Provins. The organization developed by the yearly fairs implied the woolens of Provins may discover their way to Naples, Sicily, Cyprus, Majorca, Spain, and even Constantinople. The wool trade formed into genuine business, a generator of capital. In the thirteenth century, the wool trade turned into the economic engine of the Low Countries and central Italy. Before the end of the fourteenth century, Italy prevailed, however Italian production went to silk in the sixteenth century. Both businesses, based on the export of English raw wool, were rivaled only by the fifteenth century sheep walks of Castile and were a huge kind of income to the English crown, which in 1275 had forced an export tax on wool called the "Incomparable Custom". The significance of wool to the English economy can be found in the way that since the fourteenth century, the presiding officer of the House of Lords has sat on the "Woolsack", a chair loaded down with wool.

5.3.2 Types of wool

The key features of different types of wool are listed below:

Alpaca wool: Alpaca fiber, the wool that is gotten from the fur of an alpaca, is generally known to be lighter in weight than sheep's wool. Besides, it is additionally known to be warmer than sheep's wool.

Angora wool: A type of wool got from the fur of the Angora rabbit, is known to be amazingly delicate (soft) and pleasant to touch. This is the reason behind why this kind of wool is very desirable.

Bison wool: A class of wool that can be typically sourced to the American Bison is generally utilized in textiles.

Cashmere wool: A very popular class of wool is Cashmere wool, which is generally gotten from the fur of the Cashmere goat. This kind of wool is acclaimed for its very delicate and luxurious surface. Cashmere wool is additionally known to have a relatively lower weight (when compared with certain different kinds of wool). The width of cashmere wool is quite often beneath 18.5 micrometers.

Mohair: It is an animal fiber having a surface that is like that of silk. This animal fiber is obtained from the fur of the Angora goat. It is widely known for its strength and durability. Besides, this animal is likewise known to be highly lustrous and a decent acceptor of dye.

Fiber from other animals

Hand spinners additionally use fiber from creatures like llamas, camels, yak, and possums. These filaments are for the most part utilized in garments.

Hair from animals, for example, horses is likewise an animal fiber. Horsehair is utilized for brushes, the bows of musical instruments and many different things. Along with mink hair, it's additionally a common choice for eyelash extensions and similar makeup products. The best artist's brushes are produced using Siberian weasel, many other filaments are utilized including ox hair and hog bristle. Camel-hair brushes are typically produced using squirrel, less expensive ones from pony, hitherto no camels. Chiengora is dog hair.

5.3.3 Cultivation of wool

Sheep shearing is the process by which the woolen downy of a sheep is cut off. Subsequent to shearing, the wool is isolated into four principle categories: wool (which makes up the tremendous mass), broken, bellies, and locks. The quality of wools is determine by a technique known as wool classing, whereby a certified individual, called a wool classer, assembles wools of similar grading to maximize the return for the farmer or sheep owner. In Australia prior to being auctioned, all Merino fleece is objectively estimated for average diameter (micron), yield (counting the measure of vegetable matter), staple length, staple strength, and some of the time colour and comfort factor.

Scouring

Fleece when scouring wool straight off a sheep is known as "raw wool", "greasy wool" or "wool in the grease". This wool contains an undeniable level of valuable lanolin, just as the sheep's dead skin and sweat residue, and by and large additionally contains pesticides and vegetable matter from the animal's environment. Before the wool can be utilized for business purposes, it should be scoured, a cleaning process for the greasy wool. Scouring might be just about as simple as a bath in warm water or as complicated as an industrial process utilizing detergent and alkali in specific equipment. In North West England, unique potash pits were constructed to produce potash utilized in the production of a soft scouring for scouring locally delivered white wool. In business wool, vegetable matter is frequently eliminated by chemical carbonization. In less-handled wool, vegetable matter might be taken out by hand and a portion of the lanolin left intact through using gentler detergents. This semi grease wool can be worked into yarn and knitted into especially water-resistance mittens or sweaters, for example, those of the Aran Island fishermen. Lanolin removed from wool is generally utilized in cosmetic items, for example, hand creams.

5.3.4 Properties

Physical properties of Wool
Durability:
Wool is a hard fiber that retains its nice appearance for quite a while.

Absorption of moisture
As a fabric wool draws dampness (moisture) from the body and absorbs it inside its filaments. Heat is produced as the moisture is consumed so the garment stays warm without feeling wet.

Figure: 2 Microscopic view of Wool fiber

Resistance to dirt:
Wool fibers have an external layer of scales that reduce the capacity of dirt and dust to enter the fiber.

Resistance to fire:
One of the properties of wool is that it doesn't burn without any problem. When exposed to flames, it will smolder instead.

Insulating nature:
Tiny gaps are present between the filaments. These are filled up with bubbles of air, which heat up as the moisture in the center point of the fiber heats up, making wool an ideal insulator.

Chemical Properties of Wool
Effect of Alkali:
The chemical nature of wool keratin is like that it is particularly sensitive to alkaline substances. Strong alkaline effect on wool fiber but weak alkaline does not affect wool.

Check Your Progress

- **Questions**

Q: 1 Give the 5 examples of fabrics derived from animal fibers.

____

Q: 2 Write a short note on Muga silk.

____

Q: 3 Write any two physical properties of silk?

____

Multiple Choice Questions
1) Which fiber is not a type of Silk?
(A) Pashmina
(B) Tasar
(C) Muga
(D) Mulberry

2) Angora wool got from the fur of the Angora ________________.
(A) Yak
(B) Horse

(C) Rabbit
(D) None of above

3) Wool is mainly composed of protein called ____________________________.

(A) Sericin
(B) Forbin
(C) Both **(A)** and **(B)**
(D) Hard a - keratins

5.5 LET-US – SOME-UP

This unit gives you some basic information about animal fibers and their sources and properties. And also knowledge about different animal fiber based manufacturing products that are like carpets, shawl, scarves, and many clothing items. Hand spinners also use fibers from animals like llamas, camels, yak and etc. These fibers are generally used in clothing. And also some animal fibers derived from horse hair that is used in brushes, the bows of musical instruments and many other things. Also this chapter gives you some information about contribution of animal fiber manufacturing sectors in India like: The woolen industry provides work in the organized wool sector to around 12 lakh people with an extra 12 lakh people related in the sheep rearing and farming area. India is the second biggest producer of silk.

5.6 KEY WORDS

Trained	Domesticated
Liberates	Free, Release, Let go
Staggering	Reeling, Swaying
Drenching	Immersion, Saturate
Expels	Extrudes, Ban, Throw out
Debilitated	Weakened, Draining
Exorbitantly	Excessively, Extreme
Anomaly	Curiosity, Peculiarity

5.7 SOME USEFUL BOOKS

- **https://en.wikipedia.org/wiki/History_of_silk**
- **http://www.inserco.org/en/types_of_silk**
- **https://byjus.com/chemistry/animal-fibre/**
- **https://www.textileadvisor.com/2019/08/properties-of-silk-fibre-physical.html**
- **https://www.fibre2fashion.com/industry-article/6419/contribution-of-animal-fibre**
- **https://byjus.com/chemistry/wool-fibre/**

Answer

Ans: 1

List 5 examples of fabrics that are derived from animal fibers are as below

- Silk –Derived from cocoon silkworms
- Cashmere – Derived from the fur of the Cashmere goat
- Bison wool - a class of wool that can be typically sourced to the American Bison
- Angora - a type of wool got from the fur of the Angora rabbit
- Alpaca - the wool that is gotten from the fur of an alpaca

Ans: 2

Muga silk

The muga silkworms (Antheraea assamensis) also belong to the similar family as tasar worms, however produce an unusual golden yellow silk thread which is attractive and strong. These are discovered distinctly in the province of Assam, India and feed on persea bombycina and Litsaea monopetala leaves and those of different species.

The amount of muga silk produced is tiny and is for the most part utilized for the production of traditional dresses in the State of Assam (India) itself.

Ans: 3

The two physical properties of silk is given as below:

Tenacity

The silk filament has awesome strength because of presence of numerous hydrogen bonds to be shaped in a more regular pattern. At the point when it comes into contact of water (wetting conditions),it gets debilitated because of hydrolization of a huge quantities of hydrogen bonds present in it by water particles. Perseverance (tenacity) of silk fiber ranges between 3 to 6 grams / denier.

Absorbency

It has more absorbency than cotton. The moisture recover of silk is 11%. It absorbs moisture more quickly than cotton yet it gets dried decently fast as well.

Multiple Choice Questions

1) (A)
2) (C)
3) (D)

References

Fig:1https://image.slidesharecdn.com/10242013-111120084821-phpapp01/95/fibers-9-728.jpg?cb=1321779614

Fig:2https://reader015.fdocuments.in/reader015/slide/20181230/556dbdded8b42aed2e8b4d48/document-2.png?t=1615942011

UNIT: 6	MAN-MADE FIBERI

STRUCTURE:

6.0 OBJECTIVES

- To gain knowledge about the fundamental characteristic of man-made fibers.
- To understand the basic properties of different types of man-made fibers.
- To learn how to include man-made fibers into different apparel and uses.

6.1 INTRODUCTION

Man-made fiber is a form of regenerated cellulose or synthetic fiber that makes use of cellulose as a raw material. man-made fiber has a smooth and lustrous look just like silk, and a high-quality water absorption cap potential like cotton. fabric made from the man-made fiber

is gentle and excessive drapability withinside the display, making them widely used for apparel including a suit, shirts, skirts, and jackets.
Man-made fibers may be classified into natural and inorganic sorts primarily based totally on the composition of the fibers. natural man-made fibers are in addition classified into regenerated and artificial fibers. maximum man-made fibers along with a natural polymer together with rayon or acetate and artificial-polymer fiber together with polyesters and polyamides (nylons) also are composed of polymers of natural compounds. non-polymer fibers may be categorized as carbon fibers, glass fibers, ceramic fibers, and metal fibers. artificial fibers are strong and durable.

6.2 HISTORY

In 1924, the U.S. Department of Commerce and various industry associations adopted the generic name "Rayon" to identify synthetic fibers. "Ray" (ray of light) represents the brightness of the fiber, and "on" represents the cotton-like structure of the fiber. However, in terms of new synthetic fibers, the market share of synthetic fibers declined, and the global production of synthetic fibers reached a peak in the early 1980s (approximately 2.96 million), accounting for about 5% of the global synthetic fiber production.

These are the most important types of regenerated or man-made cellulose fibers; viscose, lyocell, and acetate.
viscose fibers are obtained from cellulose xanthate through the production of alkaline cellulose and the addition of carbon disulfide. Viscose fiber is the main synthetic fiber, accounting for more than 93% of the market for synthetic and regenerated fibers.

Lyocell viscose fiber is produced by directly dissolving cellulose in the solvent N methyl morpholine Nooxid (NMMO). Lyocell is a new generation of environmentally friendly processed regenerated cellulose fiber processing and improving fiber properties; however, currently, The production of lyocell fiber is still limited, at less than 5% of the viscose fiber market.

Cupro rayon fiber dissolves cellulose in a copper ammonium solution and then wet-spun into artificial cellulose. Because this process uses expensive cotton cellulose and copper salts, cupro rayon fiber cannot compete with viscose. And it was discontinued for commercial use after the First World War. Only a few manufacturers (such as Bemberg in Germany and Ashi in Japan) are still producing viscose copper to open up niche markets for rayon and medical filter media.

Acetate is made by acetylating cellulose using liquid acetic anhydride and a sulfuric acid catalyst. The resulting cellulose acetate is dissolved in acetone and spun into fibers in a dry spinning process.

The manufacture of regenerated cellulose fibers includes two main stages;

1. Dissolve the raw material cellulose through chemical or physical processes and
2. Use natural fibers in the spinning (wet spinning, dry spinning, or dry jet/wet spinning) process Regenerated cellulose.

The first fully synthetic fiber became popular in the early 20th century. In 1940, DuPont introduced the synthetic fiber nylon invented by Wallace Carothers. John Whitfield and James Dixon applied for a patent for polyester terephthalate (PET). Winfield and Dixon and investors Birtwistle and Ritchie created the first polyester fiber called Terylene in 1941.

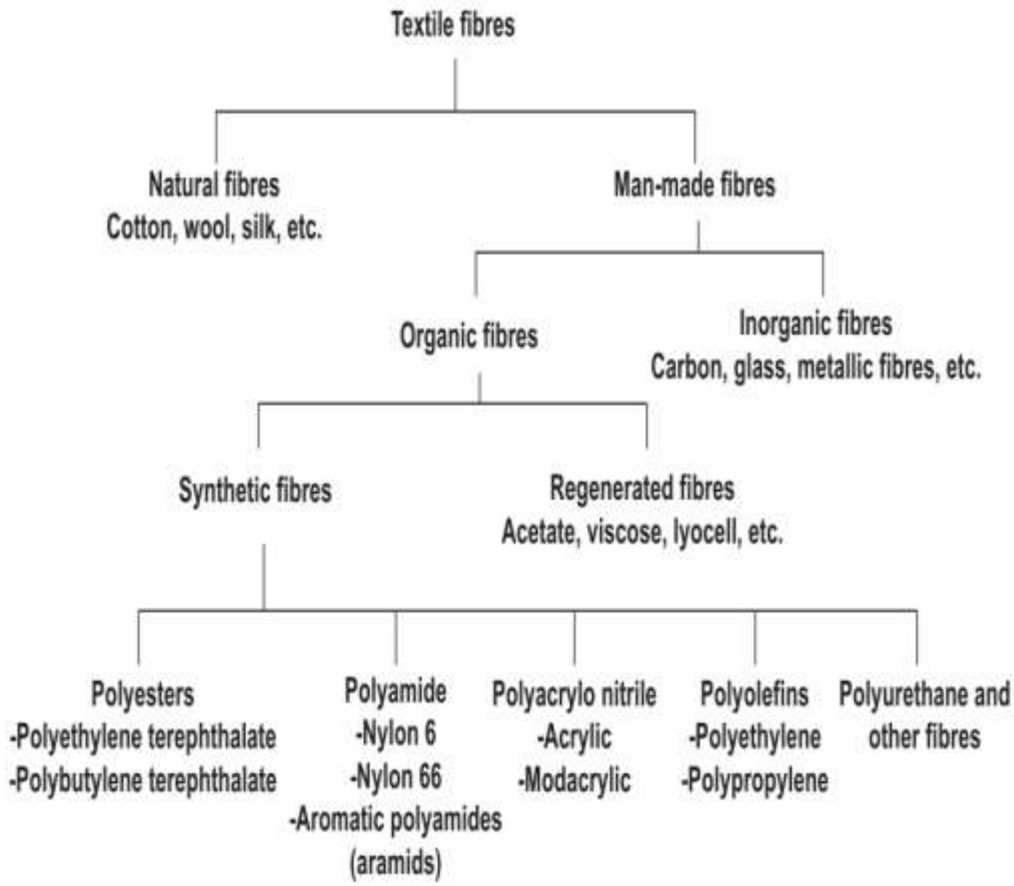
synthetic fibers have the following advantages:
These fibers are not easy to wrinkle.
These fibers are strong and durable.

6.3 CLASSIFICATION OF MAN-MADE FIBER

Figure 6.1 shows the classification of textile fibers into natural fibers and man-made fibers according to their source and manufacturing method. Chemical fibers can be divided into organic and inorganic types according to their fiber composition.

Recycled fiber is made from natural raw materials. Typical examples of synthetic fibers include rayon, cellulose acetate, cellulose triacetate, cuproammonium rayon, and lyocell fibers. synthetic fibers are made of chemically synthesized polymers, the most famous of which are polyester and polyamide fibers, which are widely used in the fashion and apparel industries.

Carbon fiber, glass fiber, ceramic fiber, and metal fiber can be classified as man-made non-polymer inorganic fiber, some of which are made of organic polymer fiber,and Inorganic polymer fiber.



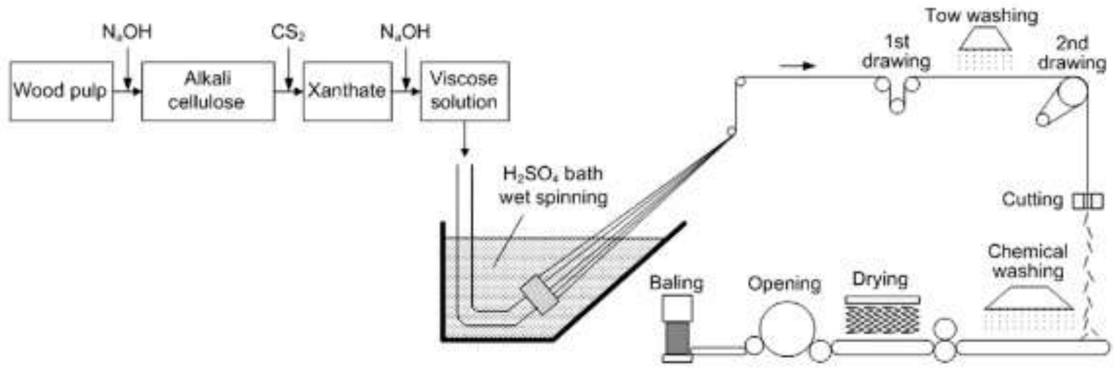
(Figure 6.1 Classification of man-made fibers.)

6.4 STRUCTURE AND PROPERTIES OF VISCOSE RAYON FIBER

Viscose fiber is made of pure cellulose, usually obtained from cellulose for spinning. The pulp must be dissolved in the solution by transformation, which is carried out in two steps, as shown in Figure 6.2.

1. Caustic soda and wood pulp are mixed to form alkaline cellulose,
2. Carbon disulfide is added to react with alkaline cellulose to form sodium cellulose xanthate.

The resulting sodium cellulose xanthate is then dissolved in a weak solution of caustic soda to form a coating called rayon. In the wet-spinning process, viscose solution is extruded through a spinneret in a sulfur bath (H2SO4).



(Figure 6.2. Viscose fiber structure and manufacturing process)

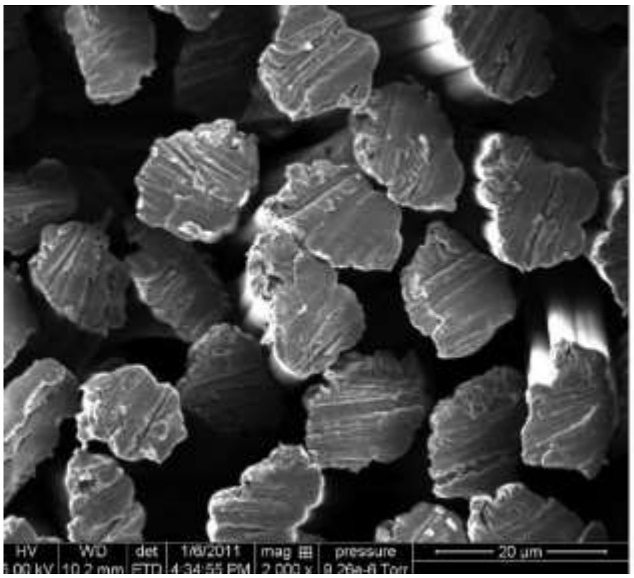
After being neutralized in the sulfur bath, the cellulose in the rayon regenerates continuous fibers, which are pulled through the first and second drawers. There is a carry-out stage to remove carbon disulfide between the two waste gas parts. Put it on the rinsing belt for a series of rinsing steps, including rinsing with hot water to remove residues in the desulfurization bath, such as sulfide and bleaching bath; then, rinse with hot water. After rinsing, the rayon staple fiber is dried, opened, and sent to the baler to pack the rayon fiber. If the cutting step is skipped, the rayon fiber can also be wound directly on the bobine. Viscose fibers are made of short fibers.

Viscose staple fiber is often used for blending with natural or synthetic fibers to make blended yarns. Blended viscose fabric is very suitable for making all kinds of clothing. The optical fiber is often twisted before cutting.

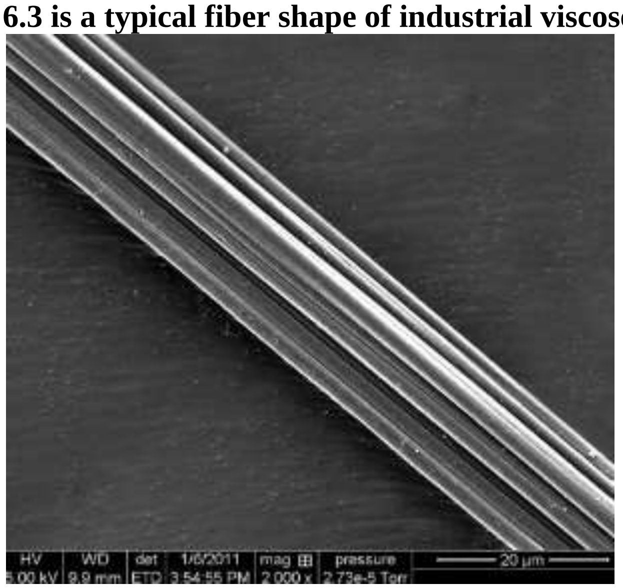
When the reaction conditions and control parameters of viscose change, the properties of viscose fiber will change. The result is the production of modified viscose rayon fibers. High Wet Modulus (HWM) viscose and high-strength viscose are the two most important types of viscose HWM fibers. The aging during alkalization of cellulose and the ripening in xanthation is no longer needed, and the chemical concentration is reduced so that the coagulation speed of cellulose is reduced, and the fiber has more time to harden. When producing high-strength viscose fiber and cellulose, the regeneration rate should be reduced by increasing the concentration of zinc and sulfur in the extrusion bath. HWM viscose fiber has two common names; "modal" and "polynosic".

The appearance of viscose fiber:

Viscose fiber, used in the textile and garment industry, can be short fiber or multifilament fiber. Figure 6.3 shows the typical fiber shape of a commercially available 1.5 denier, 1.5-inch long viscose rayon product. The cross-section is similar to a twisted circle with serrated edges, the fiber surface is smooth but has longitudinal ridges, as shown in Figure 6.4. The luster of rayon fiber can be light-colored, semi-solid, usually 1.5 to 1.5 denier. Viscose microfiber (fineness less than 1 denier) can also be used to produce microfiber fabrics.



(Figure 6.3 is a typical fiber shape of industrial viscose fiber).



(Figure 6.4 the luster of viscose rayon fiber.)

Fiber	Tenacity (g/denier)		Elongation (%)	
	Dry	Wet	Dry	Wet
Viscose	2.6–3.1	1.2–1.8	20–25	25–30
HWM	4.1–4.3	2.3–2.5	13–15	13–15
Tencel	4.8–5.0	4.2–4.6	14–16	16–18
Cotton	2.4–2.9	3.1–3.6	7–9	12–14
Polyester	4.8–6.0	4.8–6.0	44–45	44–45

(Table 1: Tensile strength and elongation of viscose fiber compared with HWM viscose, Tencel, cotton, and polyester fiber).

Viscose mechanical properties:

like other textile fiber materials, tensile strength and elongation at break are the two most important mechanical properties. Made of viscose rayon fiber. The tensile strength of a fiber is usually expressed as tenacity per denier or tex force unit. Table 1 shows the tensile strength and elongation values of viscose fiber compared with HWM viscose, Tencel, cotton, and polyester. The tensile strength of viscose fiber under wet conditions (such as during washing) is lower than that under dry conditions. This difference can more than double. Another mechanical property of viscose rayon fiber is its remarkable elongation of up to 25% (dry) and 30% (wet), which means that viscose fiber has higher strength. And wet conditions, but the elongation at break is low.

Viscose physical properties:

Viscose fiber has a density of 1.529/cm3, which is higher than all other natural fibers and also higher than most synthetic fibers. water absorption capacity is usually described by moisture content and moisture regain rate. The calculation method of moisture content is to divide the weight of the absorbed water by the weight of the tested fiber, which is equivalent to the dry weight of the fiber plus the weight of the absorbed water. Moisture regains rate is defined as the ratio of water absorption weight to fiber dry weight. The moisture regains rate of viscose rayon fiber is 12% to 14%, which is higher than that of all-natural and synthetic fibers used for wool, including the fact that rayon fiber has a water absorption rate due to its low crystallinity. Improve appearance and moisture permeability. Rayon is often used to create a silky surface.
Although rayon has unique drape, softness, and moisture-wicking functions in both formal and casual wear, rayon also has some shortcomings, such as B. Small elongation, poor elastic recovery, poor abrasion resistance, wet shrinkage Small, small wrinkles. To avoid the possibility of these problems in the garment design and manufacturing process, it is very important to evaluate the following characteristics of the fabric.

1. Tensile and shear properties:

Viscose/lyocell stretch is a parameter that affects excessive wetting or loose appearance of the garment. For a given load, it is necessary to control the maximum elongation of viscose rayon fibers.

Lining fabrics made of viscose fibers generally have very low shear stiffness. This can easily lead to difficulties in fabric distribution or inaccurate cutting patterns in garment production, so the shear stiffness of the viscose lining must also be checked when purchasing fabrics. Use the peel method described in ASTM D5035 for testing. The Knowledge tool and fast tool can measure the shear stiffness and tensile properties of the fabric.

2. Abrasion resistance:

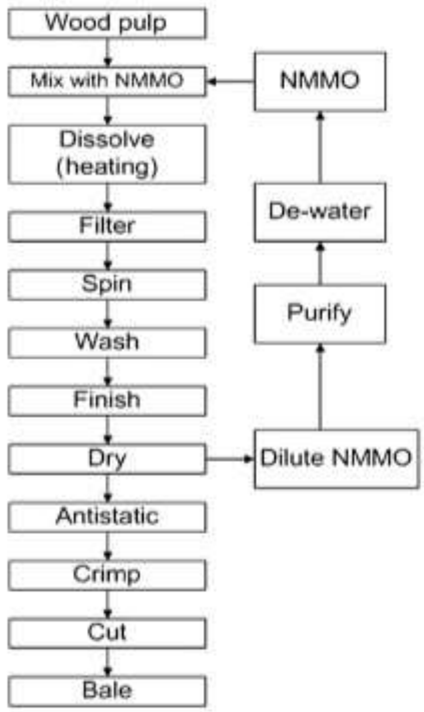
Clothing fabrics made of rayon or rayon lyocell tend to form microfibril surfaces (known as fibrils) after frequent wearing and washing. If the appearance of such fibrils is aesthetical, If it is not necessary, evaluate the abrasion resistance. Tissues are needed to control the fibrillation threshold. Various instruments can be used for tissue wear testing using standard ASTM D 3884, ASTM D 4966, and AATCC 93, methods. The wrinkle resistance of viscose fabrics is evaluated as the minimum specified for the fabric. Tissue recovery angle (AATCC 66) and tissue wrinkle removal (AATCC 128) test methods are widely used to assess resistance to tissue wrinkling.

3. Dimensional stability:

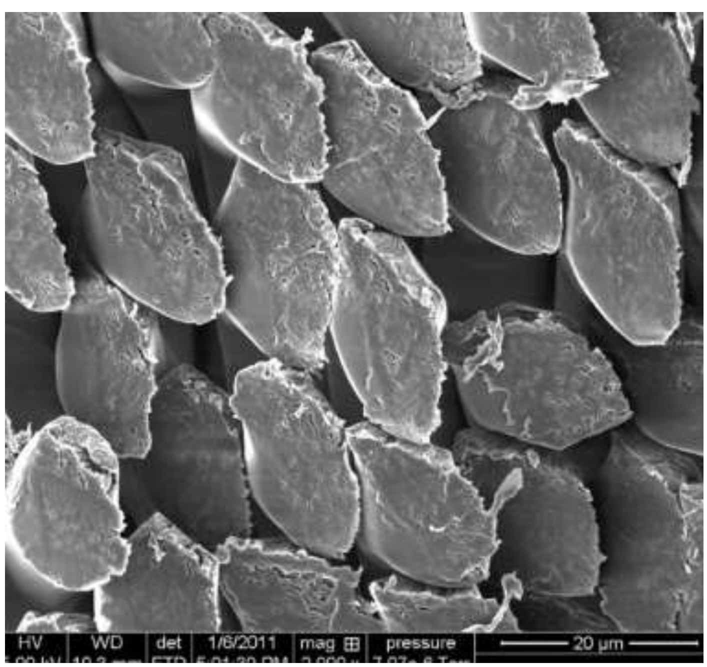
Because the wet shrinkage of rayon fabric will cause the dimensional change of the garment after washing, controlling the dimensional stability of the fabric is very important to ensure garment manufacturing. To ensure high quality, the maximum shrinkage rate of the fabric must be determined. Parts List. Viscose fabric. The AATCC 135 standard method for wool and blended fabrics can be used for size changes.

6.5 THE STRUCTURE AND PROPERTIES OF LYOCELL FIBER

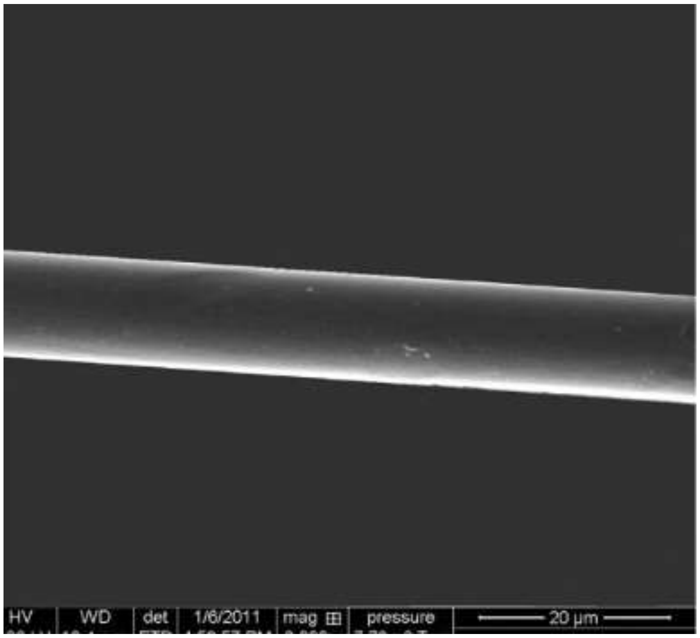
The production of viscose lyocell fiber includes all the steps shown in Figure 6.5. raw cellulose (wood pulp) is mixed with NMMO solvent and heated to dissolve in NMMO. The resulting cellulose solution is called "dope", a solvent spinning technique (also known as dry jet and wet spinning) used to press the dope through the spinneret in the spinning bath to regenerate cellulose fibers Settling in the spinning tank. The NMMO solvent is dissolved in the spinning bath. The formed cellulose fibers are further processed through processes such as water washing, lubrication, drying, and static elimination. The fibers in this process are made of lyocell filaments. The regenerated cellulose fiber produced by Lyocell staple fiber is twisted and cut to length for compression and packaging. In the manufacturing of Lenzing, Lenzing + Lyocell staple fibers, the fibers are cut before the washing and finishing steps. The water from the scrubber is recycled through the solvent recovery system, where the diluted NMMO solvent is concentrated and then pumped into the mixing tank to dissolve the new slurry (+). Compared with viscose fiber production, the lyocell spinning process is an environmentally friendly and environmentally friendly technology that does not require the use of toxic chemicals and chemical reactions and significantly reduces air and water emissions.



(Figure 6.5 The production of lyocell rayon fiber.)



(Figure 6.6 The cross-section of lyocell fiber is almost circular).



(Figure 6.7 Longitudinal surface is very smooth and cylindrical without any striation)

TENCEL®	Fineness (dtex)	Length (mm)
Standard	1.3	38
	1.4	38
	1.7	38/51
	2.2	50
Micro	0.9	34
LF	0.9	34
	1.3	38
	2.2	50
A 100	1.4	38
	3.0	75/98
FILL	2.3	15
	6.7	22/32
	6.7	60

(Table 3. Lyocell mechanical properties)

The appearance of lyocell fibers:

The cross-section of lyocell fibers is almost circular (Figure 6.6). Its longitudinal surface is very smooth, cylindrical, without grooves (Figure 6.7). Lyocell rayon is different from rayon in shape and appearance, and this difference makes the rayon lyocell fabric have a better feel and drape.

Mechanical properties of lyocell fiber:

uses lyocell spinning technology to produce regenerated cellulose fiber with higher dry and wet tensile strength. For reference (Table 3), the dry strength of lyocell fiber is higher than that of HWM rayon and rayon and is almost equal to polyester. Even in wet conditions, lyocell fiber can maintain 85% of dry strength. Compared with rayon, it is the only regenerated cellulose fiber with a wet tensile strength higher than that of cotton. The elongation of lyocell is significantly lower than that of HWM rayon, and the elongation is slightly higher than that of HWM rayon. In terms of crystallinity and crystal orientation, the lyocell fiber has a fibril structure, and the microfibrils are arranged parallel to the fiber axis, which makes the lyocell fiber easy to form a fibrillated surface when mechanical abrasion occurs.

Physical properties of lyocell fiber:
Lyocell fiber is similar to viscose rayon fiber in many aspects, but exhibits enhanced properties in terms of softness, durability, dimensional stability of lyocell fiber is around 11% slightly lower than that of viscose rayon.

6.6 STRUCTURE AND PROPERTIES OF ACETATE FIBER

Cellulose acetate fiber is another type of manufactured fiber made is no longer considered regenerated cellulose fiber because the polymer formula used to form acetate fiber is cellulose acetate (cellulose ester) instead of cellulose.

In 1865, Paul Schutzenberger discovered a way to obtain cellulose acetate when he tried to dissolve cotton in liquid acetic anhydride. When the solution was poured into water, white flakes called triacetate precipitated out, but it was not until 1904 that George Miles discovered a method that converts triacetate into secondary acetate (diacetate). Before the method, the present invention did not directly lead to the progress of spinning acetate fibers. Solve the problem of directly dissolving triacetate fiber spinning.

British company Cellulose Co. GmbH carried out the first commercial production of acetate yarn. In 1921 in Spondon, England. A year later, Camilla Dreyfuss (one of the owners of the British company) started producing acetate. Produced in the United States. Today, acetate fiber is rarely used in the textile and apparel markets.

There are two types of acetate fiber:
1. Regular acetate fiber, also known as secondary acetate fiber or diacetate fiber.
2. Triacetate.

CHECK YOUR PROGRESS

1. Describe the physical properties of viscose rayon.

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2. What is the main application of cellulose acetate fiber?

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3. Describe the classification of man-made fiber.

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4. Describe the history of man-made fiber.

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5. What are man-made fibers?

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____

Multiple Choice Questions

1. _________ fiber is a type of regenerated cellulose or manufactured fiber.

(a) Wool
(b) Cotton
(c) Man-made
(d) Silk

2. Which is the name of fiber commonly used as; “modal” and “polynosic”.
(a) HWM viscose
(b) wool
(c) nylon
(d) cotton

3. Which is the other name of artificial silk?
(a) Wool
(b) Vegetable fibers
(c) Animal fibers
(d) Rayon

4. ________ fiber is seen as "green" and sustainable.
(a) Polymer
(b) Lyocell
(c) Ceramic
(d) Glass

5. fiber produced in factories is called?
(a) Man-made fiber
(b) Natural fiber
(c) Synthetic fiber
(d) both @ and ©

6.7 LET US SUM UP

In this unit, we learned that rayon was the first synthetic fiber invented under the original name "rayon" for the textile and fashion industries. Rayon Rayon and acetate/triacetate are the main types of synthetic fibers used in the textile and apparel industries. Lyocell fibers are considered "green" and sustainable. It can be speculated that synthetic cellulose fiber will become the main fiber for the development of environmentally friendly fashion products.

6.8 KEYWORDS

Cellulose an insoluble substance that is the main constituent of plant cell walls and vegetable fibers such as cotton. It is a polysaccharide consisting of chains of glucose monomers.

Composition how something is put together or arranged.

Disulfide A chemical compound containing two sulfur atoms

	combined with other elements or radicals.
Xanthate	a salt or ester of xanthic acid.
Solvent	able to dissolve other substances.
N-Methylmorpholine	is the organic compound with the formula O(CH2CH2)2NCH3. It is a colorless liquid.
Cuprammonium	a complexion, $Cu(NH_3)_4^{2+}$, formed in solution when ammonia is added to copper salts. The solution is deep blue and is used to dissolve cellulose.
Spun	is having twisted or turned someone or something around and around.
Polycrylonitrile	a polymer of acrylonitrile used in the manufacture of Orlon and other synthetic textiles.
Carbide	a binary compound of carbon with an element of lower or comparable electronegativity.
Polycarbosilane	Any polymer composed of carbosilane residues.
Extruded	to force, press, or push out.
Spinnerette	a small metal plate, thimble, or cap with fine holes through which a chemical solution (as of cellulose) is forced in the spinning of man-made filaments (as of rayon or nylon)
Neutralization	is a chemical reaction in which acid and a base react quantitatively with each other.
Crimped:	compress (something) into small folds or ridges.
Coagulation	is - the process of becoming viscous or thickened into a coherent mass.
Tenacity	the quality or fact of being able to grip something firmly; grip.
Elongation	the action or process of lengthening something
Crystallinity	refers to the degree of structural order in a solid. In a crystal, the atoms or molecules are arranged in a regular, periodic manner.
Lenzing	produces wood-based viscose fibers, modal fibers, lyocell fibers, and filament yarn, which are used in the textile industry - in clothing, home textiles, and technical textiles - as well as in the nonwovens industry.
Dilute	to make (a liquid) thinner or less strong by adding water or another
liquid	to lessen the strength of (something) dilute.
Emission	the act of producing or sending out something (such as energy or gas) from a source. : something sent out or given off.
Striation	the fact or state of being striated
Abrasion	the process of scraping or wearing something away.
Durability:	is defined as the ability of a material to remain serviceable in the surrounding environment during useful life without damage or unexpected

	maintenance.
Regain	to gain.
Drapability	When dealing with technical textiles, drapability is defined as the ability of textile preforms to conform to the surface of molds.
Micro-fibril:	is a very fine fibril, or fibers-like strand, consisting of glycoproteins and cellulose.
Fibrillation:	is the rapid, irregular, and unsynchronized contraction of muscle fibers.
Aesthetically	in a way that gives pleasure through beauty.

6.9 SOME USEFUL BOOKS

1. Introduction to textile fibers by H.V.Sreenivasa mutrhy
2. Textile yarn by B.G.Goswami
3. Man-made fibers by Robert wighton moncrieff
4. Textile and fashion
5. Identification of textile fibers by M.M.Houck

Sources Of Images

All images are from reference books and the internet

Answer

1. The density of viscose fiber is 1.529/cm3, which is higher than all other natural fibers and higher than most synthetic fibers. Therefore, pure viscose fabrics are usually heavier than other fixed-thickness fabrics. ... The water absorption capacity is usually described by the water content and the water recovery rate. The moisture content is calculated as the weight of absorbed water divided by the weight of the tested fiber, that is, the dry fiber weight plus the weight. Absorbed water. The water recovery rate is defined as the ratio of the absorbed water mass to the dry mass of the fiber. The moisture recovery rate of rayon is 12-14%, which is higher than the moisture recovery rate expected for all-natural and synthetic fibers in wool (including rayon). Viscose fiber has excellent water absorption due to its lower crystallinity.

2. In 1865, when Paul Schutzenberger tried to dissolve cotton in a liquid made from acetic anhydride, he discovered a way to produce cellulose acetate. When the solution was poured into water, white flakes called triacetate precipitated, but the present invention did not directly lead to spinning progress. It wasn't until George Miles discovered a way to convert triacetate into secondary acetate (diacetate) in 1904 before cellulose acetate appeared. The invention solves the problem of directly dissolving triacetate for fiber spinning.

3. Textile fibers are divided into natural and man-made according to the fiber source and manufacturing method. For example, synthetic fibers can be divided into organic and inorganic types according to fiber composition. Recycled fibers are made from raw materials. Typical rayon materials include rayon, cellulose acetate, cellulose triacetate, cuprammonium rayon, and lyocell fiber. Synthetic fibers are made of chemically synthesized polymers. The most famous include polyester and polyamide fibers, which are widely used in fashion and clothing. Carbon fibers, glass fibers, ceramic fibers, and metal fibers can be classified as man-made non-polymer inorganic fibers. Some are made of organic polymer fibers such as carbon fiber, polyacrylonitrile fiber, and polycarbosilane silicon carbide fiber, and some fibers. Inorganic polymer fibers are taken into consideration.

4. In 1924, the United States Department of Commerce and various industry associations adopted the common name "rayon" to identify synthetic fibers. "ray" indicates the brightness of the fiber, and "on" indicates the cotton-like structure of the fiber. However, with the development of new synthetic fibers, the market share of synthetic fibers declined, and the global output of synthetic fibers reached its peak in the early 1980s (about 2.96 million. The current world production of synthetic fibers is about 3 million tons/ton). In 2015, it accounted for about 5% of the world's synthetic fiber production.
In the middle of the 19th century, chemical synthetic fibers with better properties than natural fibers appeared. The first fully synthetic fiber became popular in the early 20th century. In 1940, DuPont introduced Wallace Carothers John Whitfield and James Dixon's patented polyethylene terephthalate (PET) polyester synthetic fiber nylon based on Wallace Carothers' original research. Winfield and Dixon and investors Birtwistle and Ritchie created the first polyester fiber called Terylene in 1941. Synthetic fiber is regenerated cellulose or industrial fiber that uses cellulose as a raw material. Very silky appearance and excellent water absorption, just like cotton. Synthetic fiber fabrics are soft and fall heavily on the screen, making them widely used in suits, shirts, skirts, and jackets.

MCQ
1. Man-made
2. HWM Viscose
3. Rayon
4. Lyocell

1. both @ and ©

UNIT : 7	MAN-MADE FIBER II

STRUCTURE:

7.0 OBJECTIVES

- To gain knowledge about the fundamental characteristic of synthetic fibers.
- To understand the basic properties of different types of organic and inorganic man-made fibers.
- To learn how to include man-made fibers into different apparel and uses.

7.1 STRUCTURE AND PROPERTIES OF POLYESTER FIBER

The term "polyester" refers to a polymer containing ester groups in its polymer chain. Polyester is made by the poly-condensation reaction of dicarboxylic acid and diols. Polyester can be broadly divided into two types:

1. Thermoplastic polyester, composed of fibers. Polymers used in teaching and technology, such as PET.

2. Polyester thermostat, essentially a polyester resin (liquid form), forms a highly cross-linked (solid) structure after curing. They are commonly used as a matrix for the manufacture of fiber-reinforced composite materials for connecting fiber structures.

Thermoplastic polyester PET is the most commonly used synthetic polymer. However, there are many variants of polyester. PET is very important for textiles and other economic sectors. Polyester PET is also used to make plastic bottles, foils, canoes, and liquid crystals. High-quality screen (LCD) and lamination. The main advantage of PET polyester is its recyclability.

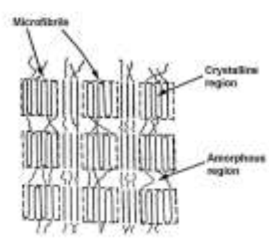
Polyester fiber is the second-largest fiber type after cotton fiber and is produced and consumed worldwide.

PET polyester production:

PET uses two processes for commercial production, one is called the measurement of terephthalate (DMT) process, and the other is called the terephthalic acid (PTA) process.

7.1.1 DMT method:

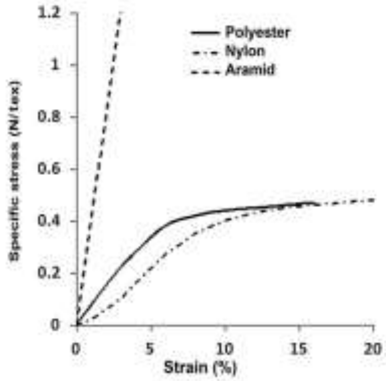
This method involves the use of DMT, which reacts with mono ethylene glycol (MEG) at 150-200°C in the presence of a catalyst (usually a metal oxide) to form monomeric terephthalic acid Diethylene glycol ester (DGT)). DGT then undergoes polycondensation polymerization in the presence of a catalyst (usually a metal acetate) at a temperature of 265 to 285°C and a pressure of 1 mm Hg. Obtain a PET polymer. The chemical reaction of this process is shown in Figure 7.1



(Figure 7.1 DMT method)

7.1.2 PTA method:

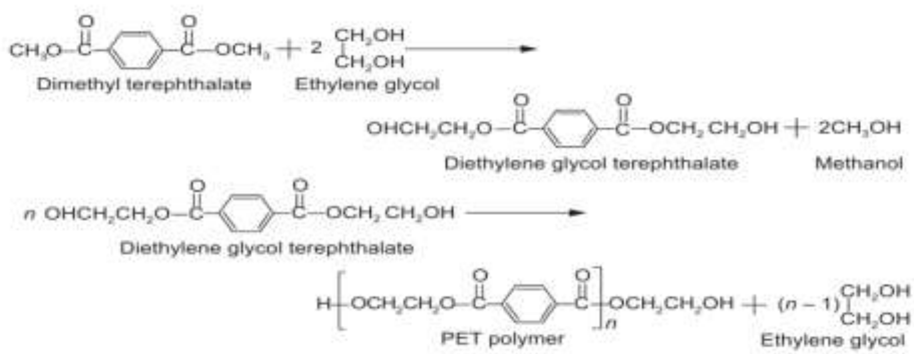
This method uses ethylene glycol to treat terephthalic acid-290 in the presence of a metal oxide catalyst at a temperature of 250°C ℃ to obtain monomer BHET. DGT undergoes polycondensation polymerization to produce PET polymer.



(Figure 7.2 PTA method)

7.1.3 PET fiber formation :

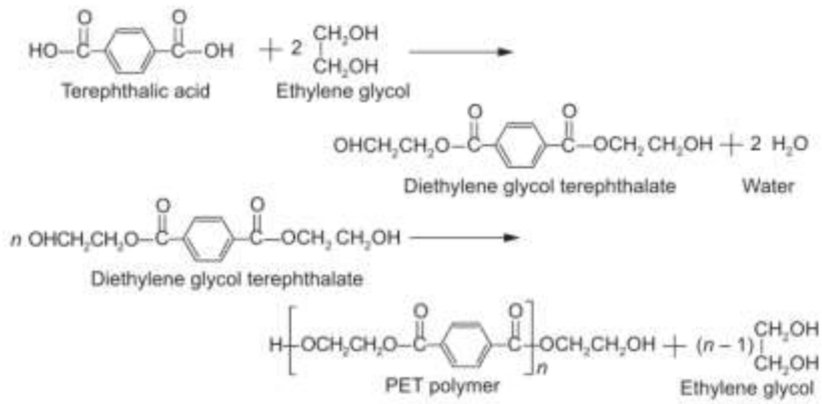
Fiber-grade polyester polymers are formed in chips and fed into the fiber melt spinning procedure, as illustrated in figure 7.3. the hopper feeder melts the polymer, which then feeds into the softened extruder. the extrusion temperature is generally stored at around 280-290`C. the filaments are subjected to a drawing process to enhance fiber properties including tensile strength and stiffness. Depending on the end-use, the polyester fibers are both retained in the filament shape or converted into a short-staple fiber shape.



(Figure 7.3 PET fiber formation)

7.1.4 The chemical properties of polyester fibers:

The chemical structure of PET polyester is given in figure 7.4. the molecular weight of the PET repeat unit is 192. the morphological shape of polyester fibers is much like polyamide fibers, as each is polymeric fiber fashioned by a soft spinning and drawing procedure. The polyester fibers are composed of a partially orientated and in part crystalline shape as proven in discern 7.5. much like that of polyamide fibers. Typically the degree of crystallinity of drawn polyester fiber is 55%. the glass transition temperature of polyester fibers is set 70`C and the melting factor is in the variety of 255-270` C. the density of the polyester fiber is 1.39 gcc.



(Figure 7.4 the chemical properties of polyester fibers)

Properties of polyester fibers include the following:

- Polyester fibers are hydrophobic and have low moisture regain the value of 0.4%. because of its hydrophobicity, the polyester fibers are water repellent and short drying.
- Polyester fibers display excellent tensile strength.
- Resistance to stretching.
- have negligible shrinkage.
- are wrinkle resistant.
- have excellent abrasion resistance.
- easy care.
- resistance to chemicals.
- proof against mildews.

Displays the stress-strain conduct of polyester fibers. The tenacity of polyester fibers is 0.4-0.5 n tex with 15-25% elongation at break. The preliminary extensibility for polyester fibers is decreased compared to that of nylon; otherwise, the general tensile conduct of polyester is much like that of the nylons.

Application: With its excellent tensile conduct resistance to stretch, anti-shrinkage, and smooth-care, polyester fibers tend to be utilized in a massive quantity of applications both in the apparel and business sectors. Polyester is the desired fiber withinside the mixing blend for cotton and wool. Apart from garb programs, polyester is utilized in domestic furniture inclusive of curtains, carpets, draperies, sheets, covers, and upholsteries. Polyester has extensive programs in technical textiles in such merchandise as Tyre cords, belts, ropes, nets, hoses, sails, and car upholsteries, and as fiber-fills for various merchandise inclusive of cushions and furniture.

7.2 STRUCTURE AND PROPERTIES OF POLYMIDE FIBER

Polyamide is the first synthetic polymer developed during DuPont's Wallace Carothers research. Nylon, the first synthetic polymer put on the market, became an instant hit; according to records, 4 million pairs of nylon stockings were sold in the first few hours of sales in May 1940 during World War II. Among other things, nylon fabrics are used for military purposes, for making waterproof tents, and for light shopping. The term "nylon" was introduced to indicate the fineness of the thread. One pound of nylon can be converted to a length equal to the distance between London ("Lon") and New York ("NY)". "Nylon" has become the general term for polyamide polymers.

polyamide is divided into nylon XY and nylon Z. In nylon XY, X is the number of carbon atoms in the diamine monomer, and Y is the number of carbon atoms in the diacid monomer. Refers to the number of carbon atoms in the monomer. Nylon 6 (nylon, Z type) and nylon 66 (nylon, XY type) are the two most commonly produced polyamides, which are commonly used in various clothes, ropes, carpets, and Tire cords for technical textile applications.

These are various other nylon stockings, such as nylon 46, nylon 610, nylon 612, nylon 10, and nylon 12 for special applications. Use monofilament or nylon 610 for bristles and brushes. It can maintain good mechanical properties even at high temperatures as high as 220°C, so it is used in the automotive, electronic, and electrical industries.

7.2.1 Nylon production:

7.2.1.1 Nylon 66:

Nylon XY is synthesized from diacid and diamine, used for nylon 66, hexamethylene diamine (H) and adipic acid (A) react to produce Acid adipic acid (HA). These two components react in methanol at high temperatures to form a salt, which is precipitated from the methanol solution. HA salt is dissolved in water at a concentration of 60%, and then the solution is heated to about 250°C or polycondensation and nylon production. 66. The chemical reactions involved in the process are shown in Figure 7.6.

$$\underset{H}{NH_2\ (CH_2)_6\ NH_2} + \underset{A}{COOH\ (CH_2)_4\ COOH} \longrightarrow \underset{\text{H-A salt}}{H\ [-NH\ (CH_2)_6\ NHCO\ (CH_2)_4CO-]\ OH} + H_2O$$

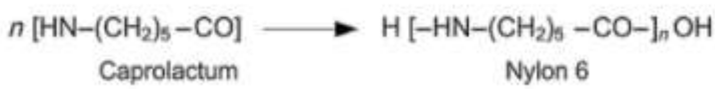
$$n\ \underset{\text{H-A salt}}{H\ [-NH\ (CH_2)_6\ NHCO\ (CH_2)_4\ CO-]\ OH} \longrightarrow \underset{\text{Nylon 66}}{H\ [-NH\ (CH_2)_6\ NHCO\ (CH_2)_4\ CO]_n OH} + (n-1)\ H_2O$$

(Figure 7.6, chemical reaction of nylon 66 process)

7.2.1.2 Nylon 6:

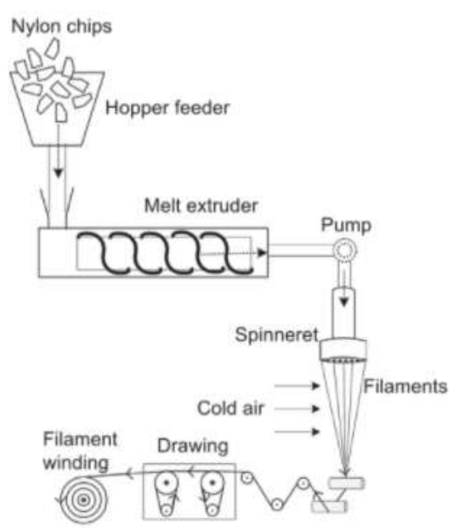
Nylon 6 is made of caprolactam. The conversion of small amounts of caprolactam to epsilon-amino caproic acid requires a catalyst. This in turn supports the aggregation process. Water is usually used as a catalyst to control the polymerization reaction in the temperature range of 225 to

285°C. The chemicals involved in the manufacturing process of nylon 6 are shown in Figure 7.7.



(Figure 7.7 Chemicals used to make nylon 6)

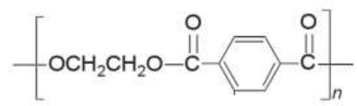
Polyamide made of nylon 6 and nylon 66 The average molecular weight of the polymer is in the range of 18,00020,000. The polymer is then melt-spun and stretched to form a nylon thread, as shown in Figure 7.8. The hopper feeder melts the nylon resin chips and sends them into the extruder. The extrusion temperature of nylon 6 is about 260°C, and the extrusion temperature of nylon 66 is about 280°C. The polymer melt is passed through the extruder and Continuous pumping through the nozzle to form fine fibers with uniform pressure. These filaments undergo a stretching process to improve fiber properties such as tensile strength and stiffness.



(Figure 7.8 Spinning and melt drawing operations used to make nylon filaments)

7.2.2 The chemical properties of polyamide fibers:

Nylon 6 and nylon 66 contain the same chemical groups in the same proportion, and the molecular arrangement is slightly different. Compared with nylon 66, these differences result in the slightly lower crystallinity value of nylon 6. Both nylons are semi-crystalline. The morphological structure of high-strength nylon is composed of microfibrils and inter-microfibril repair, as shown in Figure 7.9.



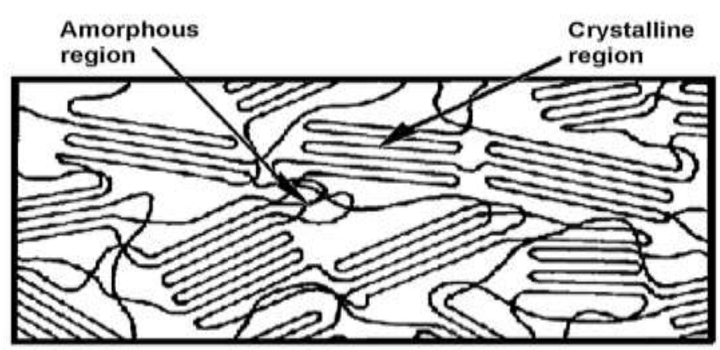
(Figure 7.9 Morphological structure of high-strength nylon)

The density of nylon is 1.14 g/cm³. They are hygroscopic, but the high crystallinity of the fibers limits the moisture content of nylon to 4%. Depending on the humidity, the glass transition temperature of nylon fibers is usually 4055°C. The melting point of nylon 6 is in the range of 215-230°C, and the melting point of nylon 66 is in the range of 250-265°C. These differences result in nylon 66 having a higher temperature resistance compared to nylon 6.

Nylon has the following characteristics:

1. Excellent tensile strength
2. Good elastic recovery
3. Low initial modulus
4. Excellent wear resistance
5. High breaking energy is required to break fibers.
6. Excellent resistance to most chemicals.

A typical stress-strain curve of nylon is proven in figure 7.10. the tensile conduct of polyester and Aramid fibers is likewise included for comparison. initially, nylon is pretty extensible, observed by a yield point and a sigmoid kind of deformation, as proven in the stress-strain curve. Compared with polyester fibers, nylon shows similar strength values however is greater extensible. further nylons have a massive extension to interrupt carbonate 25% mixed with quite excessive strength and, thus result in high work of rupture.



(Figure 7.10 a typical stress-strain curve of nylon)

Application:

Nylon fibers are extensively utilized in each of the garb and business sectors. Lightweight and sheer clothes are made out of nylon 6 and nylon 66, in which extensibility excessive strength and proper abrasion resistance are of particular importance. Nylon fabric made from denier mono-filaments is used for hosiery products, nylon material additionally has terrific form retention because of properly elastic healing conduct. placing in circulation lets in dimensional stability, as required for everlasting pleating. Fabrics made from high-quality nylon filament are appreciably used for dress materials. Faux fur fabric crafted from nylon also is famous because of its healing conduct and lengthy life. Wool is mixed with nylon to enhance its durability, and that is mainly vital whilst the software is for the manufacture of outwear or ground coverings.

In technical textiles, nylon fibers are extensively used for some of the following applications: - carpet fibers, due to resilience and superb abrasion resistance.

- parachute fabric, protection belts in cars, hoses, and lightweight canvas for bags are completely crafted from nylon filaments.
- polyurethane lined nylon fabric is used for making warm air balloons.
- multifilament nylon yarns locate sizable tire twine application for boosting rubber tires. The twisted multi-strand tire cords provide flex fatigue and an excessive floor place for less difficult bonding with latex. Critical application tires for vehicles and airplanes are crafted from nylon tire cords.
- nylon ropes and cordage have strength, durability, and resistance to water.
- completing nets are normally made from nylon cord because of excellent elastic healing and excessive moist strength.
- sailcloth made from nylon lets in optimal deformation because of wind and healing at the discount of wind speed.
- different programs consist of ribbons for printers, bolting cloths, sutures, and toothbrush bristles.

7.3 STRUCTURE AND PROPERTIES OF ARAMID FIBER

Aramid stands for aromatic polyamide. These fibers belong to the same type of polyamide as nylon. Aramid fiber is the result of polycondensation polymerization of aromatic diamine and aromatic diamine acid chloride. Aramid is a strong synthetic fiber with excellent heat resistance, chemical resistance, and abrasion resistance. They are the preferred fibers for protective clothing applications, such as chemical protection, thermal protection, flame retardant coatings, and ballistic protection.

Aramid fibers can be divided into the following categories:

7.3.1 Meta-aramid:

Meta-aramid has an amide bond benzene ring (CONH) at the nearest 1.3 positions; they are resistant to temperature, abrasion, and most chemicals. Its tensile properties are comparable to high-temperature nylon and polyester fibers.

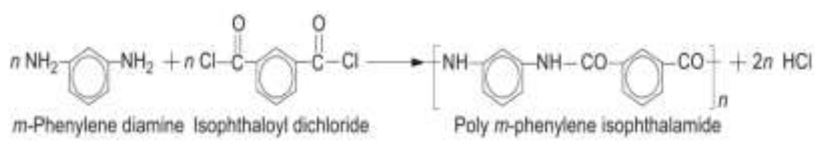
7.3.2. Para-aramid:

Para-aramid's benzene ring is connected by an amide bond (CONH) at the opposite position. It is a highly oriented synthetic fiber with high strength and excellent wear resistance and chemical resistance.

7.3.3 Manufacturing of aramid fiber:

7.3.3.1 Meta-aramid:

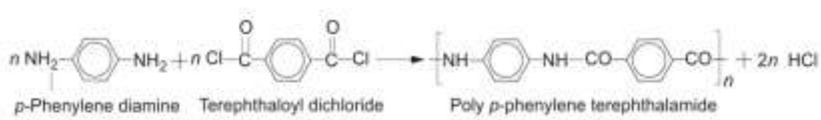
Meta-aramid is synthesized by polycondensation of phenylenediamine and dichloride in n-methyl pyrrolidone solvent. The response is shown in Figure 7.11.



(Figure 7.11 Meta-aramid)

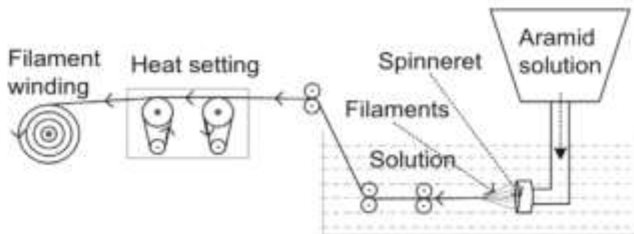
7.3.1.2 Para-aramid:

Para-aramid is also synthesized by polycondensation of phenylenediamine and terephthaloyl chloride in n-methyl pyrrolidone as a solvent. The response is shown in Figure 7.12.

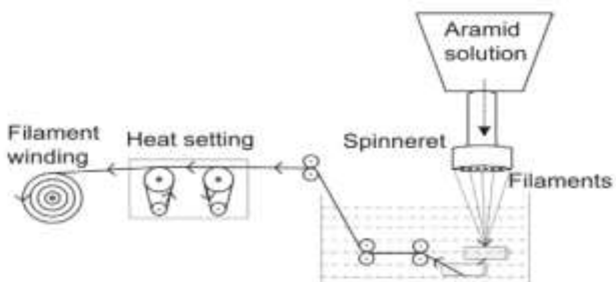


(Figure 7.12 Para-aramid)

Meta-aramid fiber is produced by the solution spinning process, also known as wet spinning, as shown in Figure 7.13. The polymerized meta-aramid is dissolved in 100% sulfuric acid to form an aramid mixture. The polymer slurry is forced through a nozzle immersed in a spinning bath containing water to form fibers. The sulfuric acid solvent in the pulp is removed in a water bath, and the formed fiber is drawn and thermally dried. Para-aramid fiber is made by drying. The wet spinning process is shown in Figure 7.14. The para-aramid polymer is immersed in 100% sulfuric acid to form a liquid crystal state, and only part of the liquid remains to hold the polymer chains together. The polymer paste is pressurized through a nozzle at 100°C. The fibers are strongly oriented in the air gap before entering the water-containing spinning tank. The sulfuric acid solvent in the pulp is removed in a water bath, and the fibers are thermally quenched to produce highly oriented fibers.



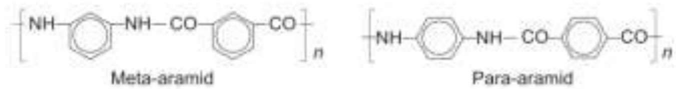
(Figure 7.13 Meta-aramid spinning process)



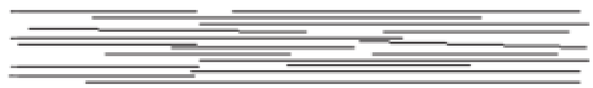
(**Figure 7.14 Para-aramid spinning process)**

7.3.2 The chemical properties of aramid:

Meta-aramid and para-aramid fibers have similar chemical compositions, But the aromatics are different from the benzene ring, as shown in Figure 7.15. Meta-aramid is a partially crystalline fiber with a partially oriented and partially crystalline structure similar to polyester and nylon. The presence of amide bonds in meta-aramid polymers limits the complete extension of the molecular chain, so high orientation and high crystallinity cannot be achieved in meta-aramid fibers. In para-aramid fiber, the presence of amide bonds in the polymer chain promotes the elongated chain configuration, thereby promoting the formation of liquid crystals. Therefore, the resulting para-aramid fiber structure is composed of fully elongated chains, which have very high crystallinity. And very high orientation. As shown in Figure 7.16. Because of the different crystallinity. The density of para-aramid fiber is 1.44 g/cm, the density of meta-aramid fiber is 1.38 g/cm



(Figure 7.15. The chemical composition of meta- and para-aramid fiber)



(The structure of para-aramid fiber) The aramid fiber in Figure 7.16 is composed of fully stretched chains)

The most important characteristics of aramid fiber are:
1. Very strong.
2. Excellent heat resistance, abrasion resistance, and chemical resistance.
3. They are not conductive.
4. They will not melt, but begin to decompose more than 500%.
5.In particular, the tensile strength of meta-aramid is about 0.5 nanometers, which is comparable to high-strength synthetic nylon and polyester fibers.
6. Meta-aramid fiber is unique in its ability to withstand tension, force, abrasion, and chemical resistance when exposed to flame and high temperatures up to 400°C. The moisture recovery rate of meta-aramid fiber is 5%, and the elongation at break is 15%.

para-aramid fiber has high tensile strength and high modulus. The latter describes the tendency of a material to deform elastically when a force is applied. Para-aramid fibers are available in low modulus, high modulus, and ultra-high-modulus versions. 2 p/tex, modulus 490 p/tex, and 3.6% elongation at break. The tensile strength of high modulus para-aramid fiber is 2.1 n/tex, and the modulus is 780 n/tex

Application: Meta-aramid fiber, due to its excellent heat resistance, flame-proof properties, chemical resistance, electric non-conductance, and abrasion resistance, is set up for application involving protective apparel, mainly for fire-proof, cut-proof, and abrasion-resistant garb for automobile drivers. Meta-aramid fibers also are used for electric insulation purposes. Para-aramids due to their excessive tenacity, excellent heat resistance, and abrasion resistance properties, are the desired fibers for ballistic safety put on such as bullet-proof armor vests and helmets. Para-aramids have massive applications as fiber reinforcement for composite materials and may be utilized in technical fabric applications such as automobile clutch plate, brake lining, plane parts, boat nulls, and sporting goods, they're additionally extensively used for ropes, cables, optical cable systems, sailcloth, excessive- temperature filtration fabrics, drum-heads and speakers diaphragms.

7.4 THE STRUCTURE AND PROPERTIES OF GLASS FIBER

Glass fibers are composed mainly of silica (SIO2), like window glasses, and feature diameters in the range of about 3-25 mm. glass fibers are normally used for reinforcement of polymers. Glass wool is every other form of glass fiber about 10-50 mm lengthy and entangled in the balky cotton-like shape, whilst is used for thermal and acoustical insulation. Glass fiber has a decrease production price than carbon fibers, that is of advantage; carbon fibers are black, highly an-isotropic and electrically conductive, while glass fibers are transparent, isotropic and electric insulators.

7.4.1 Manufacture:

Glass fibers are produced by melt spinning various raw materials are mixed and melted at a temperature above 1300`C. the molten glass is extruded thru many orifices and wound up on a drum. Glass fibers are provided in various forms, as shown below, and processed into composite materials.

filaments: a fiber whose length is long enough so that it can not be determined precisely.
Strand: a bundle of filaments.
Roving: a set of several strands wound on a cylinder.
Yarn: one or numerous strands twisted together.
Cloth: a woven material of roving and yarns.
Chopped strand: quick fibers produced by cutting continuous strand into the period of about 3-50 mm.
Milled fibers: quick fibers produced by grinding continuous strands into lengths of about 08-3 mm.

7.4.2 structure:

Glass, as an amorphous solid, lacks lengthy-variety order of shape instead of crystalline structures. The glass transition temperature is the temperature at which discontinues adjustments in thermal properties, just like the thermal enlargement coefficient, take place, whilst the glass transition temperature is reached for the duration of the cooling technique, viscosity appreciably will increase so that the fabric will become rigid. The glass implies the kingdom of fabric beneath the glass transition temperature that techniques each the shape of a liquid and the tension of a solid.

7.4.3 Properties:

Properties of glass vary widely with composition. the principal factor of all glass fiber is SIO_2. a glass fiber of natural SIO_2 proven superior properties. consisting of high thermal and chemical resistance, low thermal enlargement, and excessive transparency. It is, however, the most effective used in which its superior properties are required, consisting of optical fibers. Since an excessive temperature manufactures technique is costly. at present glass fibers are known as e-glass are widely used for reinforcement in polymers.

7.4.4. Application:

Glass fibers are used without matrix as filters and fibrous blankets for thermal and acoustical insulation. Glass fibers are used as reinforcement of polymers in various fields consisting of aerospace, automobile marine wearing, and leisure goods, and production and civil engineering one of the principal advantages of the usage of glass fibers for reinforcement of polymers in their excessive enforcement according to price ratio. An instance of the application of glass fiber in the form of a membrane made of poly-coated glass fiber for ceilings of stadiums and airports.

CHECK YOUR PROGRESS

1. Describe the various application of PP fiber.

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2. Describe the different processes used for producing PP fiber.

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3. What are the properties of glass fibers?

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4. What are the properties of aramid fibers?

____
____
____
____

5. describe the application of glass fibers?

Multiple Choice Questions

1. Polymer is made up of small units called?
(a) Layers
(b) Molecules
(c) Cells
(d) Monomers

2. PET is a?
(a) Polyester
(b) Polymide
(c) Nylon
(d) Glass

3. Which term is used for polymers made up of a large number of glucose units?
(a) Protein
(b) Fructose
(c) Cellulose
(d) Polyester

4. ________ is short for aromatic polyamide.
(a) Cotton
(b) Silk
(c) Aramid
(d) Wool

5. The word '______' was introduced to signify the fineness of the filament.
(a) Fiber
(b) Aramid
(c) Nylon
(d) Viscose

7.5 LET US SUM UP

In this unit, we learned that Synthetic fiber is the largest type of textile fiber produced and consumed in the world. Polyester fiber is the main type of synthetic fiber and is widely used in clothing and industry. Both nylon and polyester fibers are melt-spun, and both have similar semi-crystalline morphological structures. Acrylic fibers have many solutions. Although acrylic fibers are widely used in fabrics and outdoor software, they are rarely seen in today's clothing and furniture.

7.6 KEYWORDS

Ester	a sweet-smelling substance that is produced by a reaction between an acid and an alcohol
Poly-condensation	is the term used to describe polymers formed as a result of reactions involving the condensation of organic materials in which small molecules are split out.
Dicarboxylic:	containing two carboxyl groups in the molecule.
Diols	a compound containing two hydroxyl groups.
Thermoplastic	capable of softening or fusing when heated and of hardening again when cooled.
Thermostat	an automatic device for regulating temperature (as by controlling the supply of gas or electricity to a heating apparatus).
Reinforce	to strengthen by additional assistance, material, or support
Terephthalate	a salt or ester of terephthalic acid.
Terephthalic	a p-dicarboxylic acid $C_8H_6O_4$ that is obtained especially by oxidation of xylene and is used chiefly in the synthesis of polyesters.
.Monomer	a molecule that can be bonded to other identical molecules to form a polymer
Diethylene	(in combination) a substance that has a chemical structure containing two ethylene groups
Polymerization	a chemical reaction in which two or more molecules combine to form larger molecules that contain repeating structural units.
Hooper	old-fashioned term for cooper.
Extrusion	the process of forming something by forcing or pushing it out, especially through a small opening
Tensile	capable of being drawn out or stretched.
Molecular	of, relating to, consisting of, or produced by molecules molecular oxygen.
Hydrophobic	molecules and surfaces repel water.
Negligible	so small or unimportant or of so little consequence as to warrant little or no attention.

Mildews a superficial usually whitish growth produced especially on organic matter or living plants by fungi.

Tyre chords are high tensile-strength cords that are used as reinforcing material to bolster the strength of the final product.

Adipic acid a crystalline fatty acid obtained from natural fats and used especially in the manufacture of nylon

Caprolactam Caprolactam (CPL) is an organic compound with the formula $(CH_2)_5C(O)NH$. This colorless solid is a lactam (a cyclic amide) of caproic acid. Global demand for this compound is approximately five million tons per year, and the vast majority is used to make Nylon 6 filament, FIBER, and plastics.

e-aminocaproic Epsilon-amino caproic acid (EACA) is a synthetic inhibitor of the plasmin-plasminogen system.

Polyurethane a synthetic resin in which the polymer units are linked by urethane groups, used chiefly as constituents of paints, varnishes, adhesives, and foams.

Meta-aramid Meta-aramid—commonly known as Nomex™—are temperature, chemical degradation, and abrasion-resistant.

Benzene a colorless volatile liquid hydrocarbon present in coal tar and petroleum, and used in chemical synthesis. Its use as a solvent has been reduced because of its carcinogenic properties.

m-phenylene any of three bivalent radicals C_6H_4 derived from benzene by removal of two hydrogen atoms from the ortho, meta, or para positions.

Dichloride: a compound in which two atoms of chlorine are combined with another atom or group.

n-methyl pyrrolidone *N-Methyl*-2-*pyrrolidone* (*NMP*) is an organic compound consisting of a 5-membered lactam. It is a colorless liquid, although impure samples can appear yellow. It is miscible with water and with the most common organic solvents.

Hexamethylene a crystalline base H2N(CH2)6NH2 made by hydrogenation of adiponitrile and used in the manufacture of nylon; 1,6-hexane-diamine.

31. tex: Grams per 1,000 meters of yarn. Tex is a direct measure of linear density. den (denier): Grams per 9,000 meters of yarn. Den is a direct measure of linear density. dtex (deci-tex): Grams per 10,000 metres of yarn.

.7 SOME USEFUL BOOKS

1. Introduction to textile fibers by H.V.Sreenivasa mutrhy
2. Textile yarn by B.G.Goswami
3. Man-made fibers by Robert wighton moncrieff
4. Textile and fashion
5. Identification of textile fibers

SOURCES OF IMAGES

All images are from reference books and the internet.

Answer

1. Application: Polyester fiber has excellent tensile properties, tensile strength, drip resistance, and easy maintenance, and is widely used in sewing and industry. Cotton and wool. In addition to clothing, polyester is also used in home textiles, such as curtains, carpets, curtains, bedsheets, pillowcases, and upholstery. Polyester is commonly used in technical textiles in tire cords, belts, ropes, nets, and hoses. , Canvas and car interiors, as well as fiber fillers for pillows and furniture and other products, to name a few.

2. PET manufacturing polyester:
PET uses two processes for commercial manufacturing, one is called the stereo terephthalate (DMT) process, and the other is called the terephthalic acid (PTA) process. Method
DMT: This method involves the use of DMT, in the presence of a catalyst (usually a metal oxide), at 150-200°C, DMT reacts with mono ethylene glycol (MEG) to produce the monomer diethylene terephthalate Alcohol ester (DGT). Then polycondensation. In the presence of a catalyst (usually a metal acetate), the PET polymer is polymerized at a temperature of 265 to 285°C and a pressure of 1 mm Hg. Method
PTA. In this process, terephthalic acid and ethylene glycol are reacted at a temperature of 250-290°C in the presence of a metal oxide catalyst to obtain a BHET monomer. DGT undergoes polycondensation polymerization to produce PET polymer.

3.The characteristics of glass vary greatly depending on the composition. The main component of all glass fibers is SIO2. The glass fiber made of pure SIO2 shows excellent performance. For example, high heat resistance and chemical resistance, low thermal expansion, and high transparency.
4. The most important characteristics of aramid fiber are:
1. Very strong.
2. Excellent heat resistance, abrasion resistance, and chemical resistance.
3. They are not conductive.
4. They will not melt, but begin to decompose more than 500%.

5.In particular, the tensile strength of meta-aramid is about 0.5 nanometers, which is comparable to high-strength synthetic nylon and polyester fibers.
6. Meta-aramid fiber is unique in its ability to withstand tension, force, abrasion, and chemical resistance when exposed to flame and high temperatures up to 400°C. The moisture recovery rate of meta-aramid fiber is 5%, and the elongation at break is 15%.

Glass fibers are used without matrix as filters and fibrous blankets for thermal and acoustical insulation. Glass fibers are used as reinforcement of polymers in various fields consisting of aerospace, automobile marine wearing, and leisure goods, and production and civil engineering one of the principal advantages of the usage of glass fibers for reinforcement of polymers in their excessive enforcement according to price ratio. An instance of the application of glass fiber in the form of a membrane made of poly-coated glass fiber for ceilings of stadiums and airports

MCQ:

1. Monomers
2. Polyester
3. Cellulose
4. Aramid
5. Nylon

UNIT:8 YARN AND TYPES OF YARNS

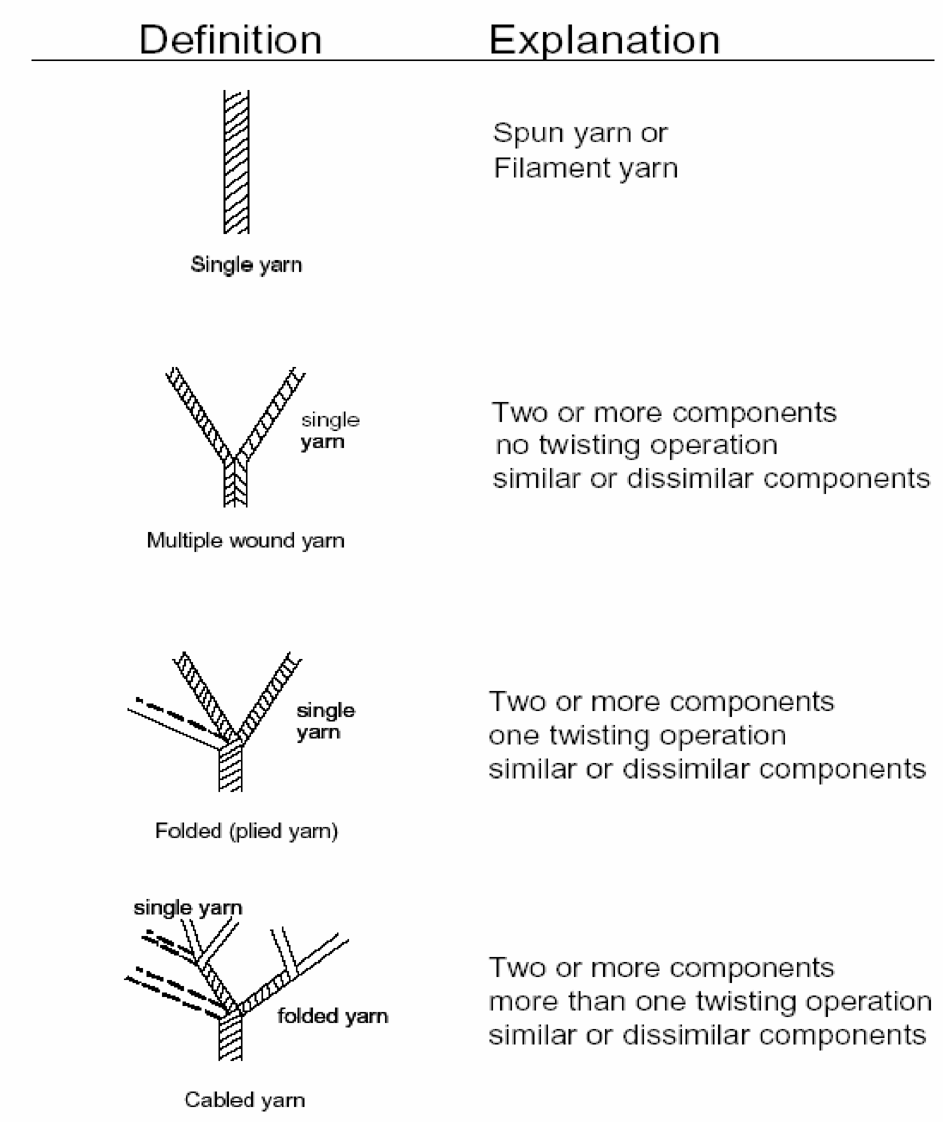
STRUCTURE:

8.0 OBJECTIVES

- To learn about yarn and types of yarns.
- To learn the structure and properties of yarns.
- To learn the classification of yarns.

8.1 INTRODUCTION

Yarn is a general term for "a bunch of continuous textile fibers, or filaments.Yarn plays an important role in fabric manufacturing because most textile materials are all made of thread. Thread is also used for sewing and embroidery thread, simple thread, rope, and other items. Yarn is produced in different sizes and textures, and other characteristics are also different. Performance, intended use, and fabric care-this fiber length It is used to roughly divide yarn into:-Twisted yarn (made of short fiber)-Filament yarn (made of continuous filament) The yarn processing method is very different from the filament processing method.

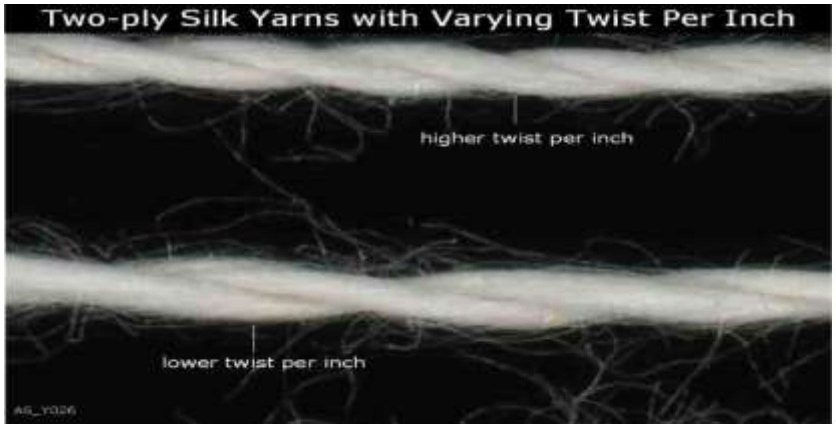


(Figure 8.1 yarn definition.)

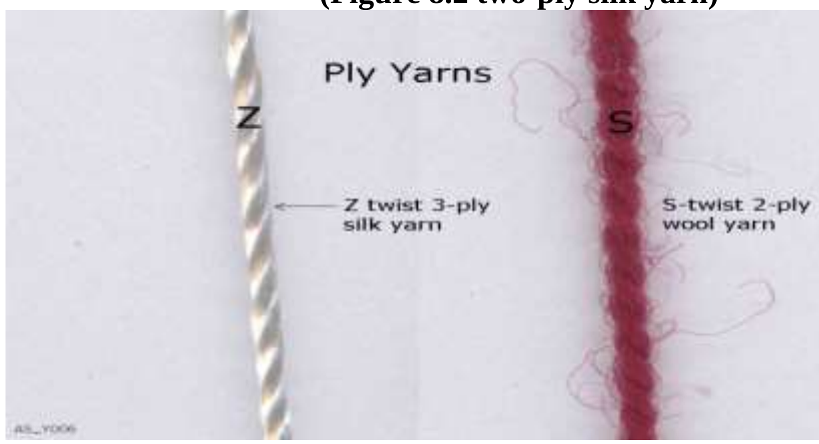
8.2 YARN TWIST, YARN COUNT and YARN STUCTURE

When spinning, two important factors will affect the fineness and strength of the fabric in the future.

1. Yarn twist: Threads (especially yarns) are twisted to hold the fibers together. The number of revolutions per unit length is used to measure the number of revolutions. The number of turns of the twine can be divided into several turns: zero or very low, low, medium, and high.



(Figure 8.2 two-ply silk yarn)



(Figure 8.3 ply yarn)

The following are some common uses of yarns are given below:

1. Filament yarns used in plain fabrics have a very little twist.
2. Most threads used in the weaving have a medium steepness.
3. Crepes used for plain weave and crepe fabrics have high steepness. The twist of the yarn affects the appearance, fineness, strength, and absorbency of the yarn.
4. Fineness and strength sometimes increase as the twist increases, but excessive twisting will reduce the strength of the yarn.
5. The absorption per revolution decreases; however, for hydrophobic fibers, even yarns with little or no twist may not have good absorption.
6. In crepe and other yarns with a high degree of steepness, twisting increases the elasticity of the yarn, thereby making the fabric flexible and vigorous.

The direction of a twist: Fibers can be woven into yarns together in a clockwise or counterclockwise direction. "S" twists the thread clockwise, and "Z" twists the thread counterclockwise. Z twist is used in most yarns used to make fabrics.

2. Yarncount: Yarncount, also known as Yarn number, is the number of Yarns required to make one pound of Yarn. This should not be confused

with the number of threads per inch. Fabric is called the number of threads. In the counting system, we calculate the length; it is called a strand, which weighs one pound. Therefore, if there are 10 strands of cotton yarn weighing a pound, it is 10 shillings of yarn. Each thread is 840 yards long, so the total length of yarn is 8,400 yards. This is a thicker yarn and requires fewer strands and a shorter length to produce a pound. On the other hand, the higher the number, the thinner the Yarn. It takes finer yarn to make a pound.

If the quantity of cotton is 1, the weight is 840 yards × 1 pound.
If the quantity of cotton is 2, the weight is 840 yards × 2 a pound. The length of
hanks depend on the spinning system:
cotton system: 1 hank = 840 yards
wool combing system: 1 hank = 560 yards
wool cutting system: 1 hank = 300 yards
Woollenrun system: 1 hank = 1600 yards

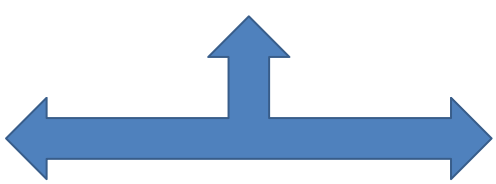
3. Yarn structure:

The appearance of the yarn structure is determined by the surrounding fiber layer. The second aspect is its internal structure. The thread structure is very diverse. For the intended use of the yarn, but to a large extent depends on the available resources. For example, it is difficult to produce ring-spun yarn with a novelty spinning process. Ring-spun yarn is still a standard yarn structure, which mainly depends on raw material characteristics, spinning technology and parameters, spinning station conditions, machine parameters, and yarn thickness. And twist, etc. The wire structure can be open or closed; small size; smooth, rough or hairy, soft or hard, round or flat; thin or thick

8.3 TYPES OF YARN

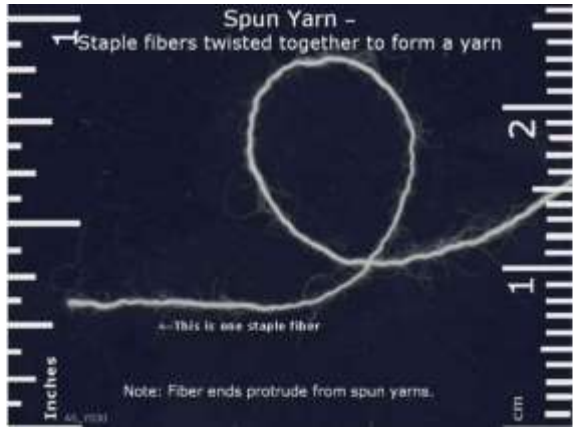
TYPES OF YARN

SPUN\STAPLE YARNS
FILAMENT YARNS



8.3.1. Spun Or Staple Yarn:

The yarn consists of short fibers or staples cut into short fibers. The yarn may contain the same type of fiber or a mixture of different fibers. The spinning process used to make the yarn affects properties such as uniformity and strength. The finest, softest, and highest quality cotton yarn, the so-called combed cotton yarn, is made by combing the fibers before spinning. A similar process is used to make High-quality worsted wool.



(Figure 8.4 spun/staple yarn).

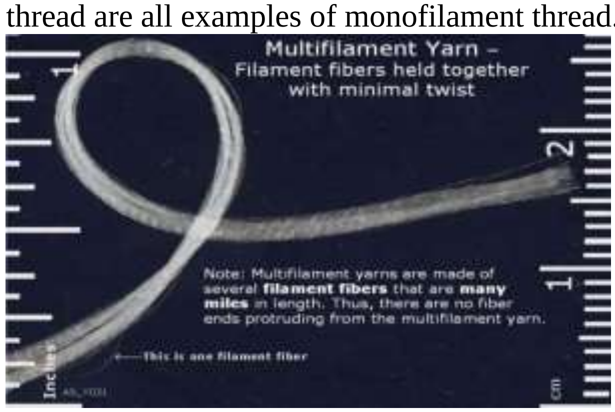
Spun yarn is a bunch of liner filaments, which are usually connected by inserting twisted yarns to form continuous filaments with a small cross-section but a certain predetermined length. It is used to make fabrics in weaving, sewing, and other processes. The strength or quality and appearance of the handle depending on the way the fibers are combined. Twisted yarns can be divided into short yarns or long yarns. The length of the short fiber is 10 to 500 mm. The maximum length of short grain is 60 mm. (Cotton fiber is a short fiber of about 2544 mm.) Long grains are more than 60 mm long. (Wool fiber is about 60-150mm long fiber).

8.3.2. Filament Yarn

Most filaments are extruded yarns made from extruded natural fibers or man-made fibers extruded through a nozzle.

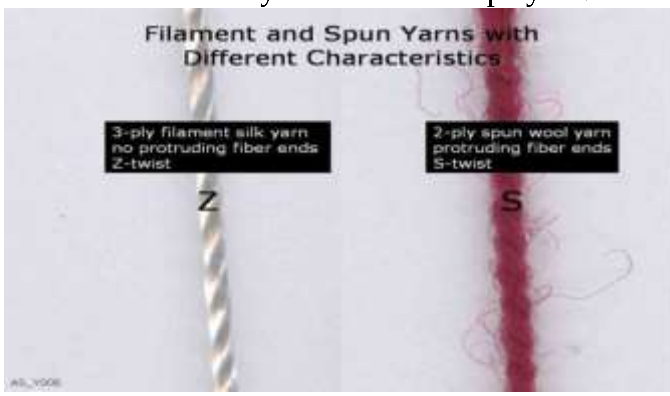
These yarn fibers can be roughly divided into:

1. Monofilament yarns are made of relatively thick filaments. Transparent sewing thread, metal thread, bare elastic band, and fishing thread are all examples of monofilament thread. Used as monofilament.



(Figure 8.5 Multifilament yarn)

2. Multifilament yarn is made of multiple layers of fibers. The length of the continuous filaments requires little or no twisting to hold the filaments together. Some filaments are made by cutting or separating sheets or films of metal or polymer-coated yarns. For example, metal-coated yarn is made by cutting metal sheets laminated between plastic sheets. It is the most commonly used fiber for tape yarn.



(Figure 8.6 The difference between thread and yarn)

8.4 YARN CLASSIFICATION

YARN CLASSIFICATION

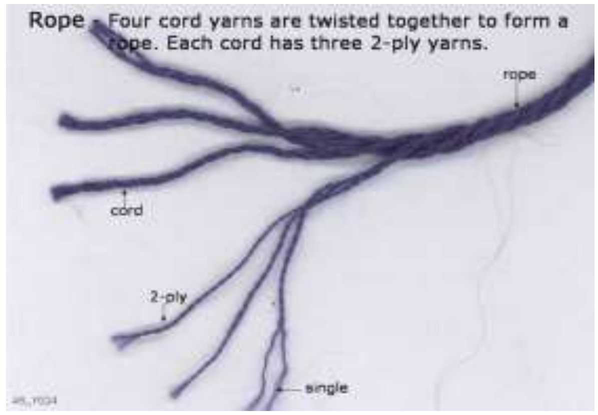
1. SIMPLE YARN	2. NOVELTY YARN	3.TEXTURED YARN	
1. Single yarn	1. Slub yarn	1. Sketch yarn /	2. Bulk yarn
2. Ply yarn	2. Flack yarn	1.Heat set	1.High bulk
3. Cord yarn	3. Flock yarn	2.Elastomeric	2.Air-jet yarn
4. Rope yarn	4. Bounce / loop yarn	3. Bi-component	
5. Spiral yarn	4. Bi- constituent		

8.4.1. Single yarn

Single yarn is characterized by uniform size and surface. Current.

1. Flat yarn is the simplest type of yarn, usually made of short fiber or filament fiber twisted.
2. Single yarn is formed by twisting two or more single yarns. Every single strand is called a layer. Therefore, four individual strands are twisted together to form a four-layer strand.
3. Rope yarn is made by twisting two or more layers of yarn.

4. A string is formed by twisting two or more strings.



(Figure 8.7 Rope texture.)

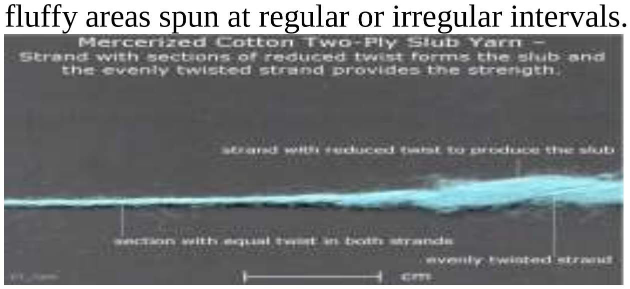
8.4.2 Novelty yarn

Novelty yarn, mainly composed of two or more threads, is produced to achieve decorative surface effects. Depending on the intended use, each thread is called a base/core, effect, or adhesive. The core provides structure and strength. The unique rope creates decorative details in the form of knots and loops. The yarn splicer is used to bind the fancy yarn with the ground yarn when binding is required. There are many novelty types of yarns made with different technologies and types of fibers and strands. The terminology and classification of novelty yarns vary greatly. This section contains some of the most popular novelty thread categories.

Novelty yarn, usually made of two or more threads, is used to create a decorative effect on the surface. Depending on the intended use, each thread is called a base/core, effect, or adhesive.

The base / Core provides structure and strength. The unique rope creates decorative details in the form of knots and loops. The yarn splicer is used to bind the fancy yarn with the ground yarn when binding is required. There are many novelty types of yarns made with different technologies and types of fibers and strands. The terminology and classification of novelty yarns vary greatly. This section contains some of the most popular novelty thread categories.

1. Slub yarn can be single or ply. This yarn is characterized by soft and fluffy areas spun at regular or irregular intervals.

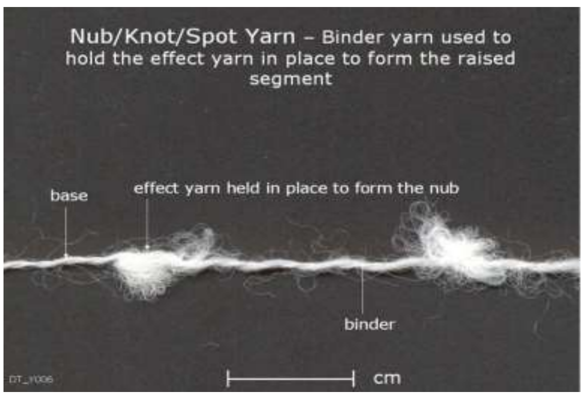


(Figure 8.8 slub yarn texture.)

2. Regularly add small tufts of different colors to the tufting/flocking yarn. These strands are easy to pull out. Tufted/flocked yarns are usually single yarns.

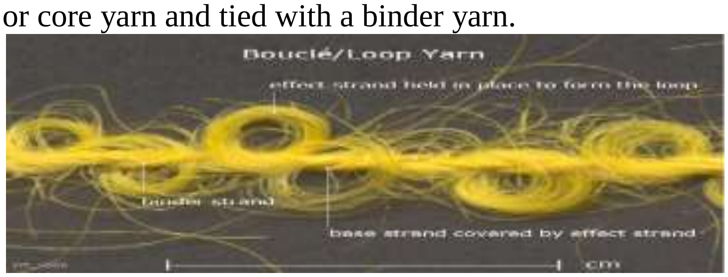
(Figure 8.9 The texture of flake/floke yarn.)

3.Knotted yarn, knotted yarn, and pointed yarn are layered yarns in which the prominent yarn is twisted around the base yarn to form a thicker surface or protrusion.



(Figure 8.9.Nub/knot/spot yarn texture.)

4..Boucle and loop yarns are ply yarns that use three sets of yarns – base or core yarn, effect yarn, and tie yarn. The effect yarn is looped around the base or core yarn and tied with a binder yarn.



. (Figure 8.10 boucle/loop yarn texture.)

5.. Spiral cord and the corkscrew cord is a multi-layer cord, one layer is soft and thick, and one layer is thin.

8.4.3. TEXTURE YARN

Textured yarns are made of fully drawn filament fibers with a changed surface, shape, and texture developed by using the new spinning techniques. Nylon and polyester are two main fibers that are textured. Textured yarns provide many variations in fabric properties. There are two main types of textured yarns: 1. Stretch yarns 2. Bulk yarns
Stretch Yarn & Bulk Yarn

Stretch yarn can be made by using any of the following methods:

1. By using special heat-setting treatment to thermoplastic filament fibers such as nylon and polyester.
2. From elastomeric fibers.
3. From bi-component fibers.
4. From bi-constituent fibers.
5. From chemically treated natural fibers. Bulk Yarns are softer and much pliable than tightly constructed twisted yarns. Bulky yarns also have a better cover.

They create a less transparent fabric and are of two types

: 1. High bulk yarns 2. Loop-bulk or air-jet yarns

CHECK YOUR PROGRESS

1. What is yarn?

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____
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____
____
____

2. How different types of yarns are classified based on their properties in general?

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3. Explain Yarn structure.

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4.Explain Yarn count.

____
____
____
____
____
____
____

5. Mention at least four types of fancy yarn and explain how they are made?

____

MULTIPLE CHOICE QUESTIONS

1. What is a generic term for a continuous strand of textile fibres?
(a) Chenille
(b) Yarn
(c) Novelty
(d) Simple

2.Yarns are twisted in the clockwise direction for?
(a) “Z” twist
(b) “A” twist
(c) "S" twist
(d) “Y” twist

3. Cotton system: 1 hank =?
(a) 84 yards
(b) 840 yards
(c) 550 yards
(d) 8400 yards

4.Yarns are twisted in a counterclockwise for?
(a)“Z” twist
(b)“A” twist
(c) "S" twist
(d) “Y” twist

5.Chenille yarns are pile yarns that are often made by slitting ______ weave.
(a) Plain
(b) Dobby
(c) Basket
(d) Leno

8.5 LET US SUM UP

In this unit, we learned about the detailed definitions and production principles of various yarn types. Special attention is paid to different types of fancy yarns, and their manufacturing processes are described with corresponding diagrams and detailed descriptions.

8.6 KEYWORDS

Strand	a single piece of cotton, wool, hair, etc.
Fineness	The quality or state of being fine.
Hydrophobic fibers	Fibres that cannot absorb water. The incapability of fiber to absorb water is known to be hydrophobic fiber.
Suppleness	bending readily without breaking or becoming deformed
Hanks	a measurement of the length per unit mass of cloth or yarn, which varies according to the type being measured. For example, it is equal to 840 yards for cotton yarn and 560 yards for worsted.
Coarser	rough or harsh in texture
Peripheral	of, relating to, involving, forming, or located near a periphery or surface part (as of the body)
Deliberately	consciously and intentionally; on purpose
Olefin	another term for alkenes
Elastomeric	an elastic substance occurring naturally, as natural rubber, or produced synthetically, as butyl rubber or neoprene
Bi-component	being a fiber made of two polymers having slightly different physical properties so that the fiber has a permanent crimp and fabrics made from it have inherent bulk and stretchability.
Bi-constituent	being a fiber made of two polymers having slightly different physical properties so that the fiber has a permanent crimp and fabrics made from it have inherent bulk and stretchability.
Tufts	bunch or collection of threads, grass, hair, etc., held or growing together at the base.
Corkscrew:	1. device for pulling corks from bottles, consisting of a spiral metal rod that is inserted into the cork, and a handle that extracts it.
Leno weave	*Leno weave* (also called gauze *weave* or cross *weave*) is a *weave* in which two warp yarns are twisted around the weft yarns to provide a strong yet sheer *fabric*. The standard warp yarn is paired with a skeleton or doup 'yarn; these twisted warp yarns grip tightly to the weft which causes the durability of the *fabric*

8.7 SOME USEFUL BOOKS

1.
2. Textile Fibres, Yarns, and Fabrics by Ernest R. Kaswell
3. A Complete Technology Book on Textile spinning, weaving, finishing and printing 2nd revised edition
4. Textile Yarn Technology Structure and Application by Goswami B.C.
5. Textile and Fashion

Sources of Images

All images are from reference books and internet.

ANSWER

1. Yarn is a general term for continuous strands of textile fibers, filaments, or materials, and its form is suitable for weaving, weaving, or otherwise weaving to form fabrics. Yarn plays an important role in fabric manufacturing because Most textile materials are composed of thread. Thread is also used to make a thread, thread, rope, and other items used for sewing and embroidery. Filament has various sizes, textures, and other characteristics. Performance, purpose, and substance. It depends on carefulness. Because of these characteristics of the yarn. Fiber length is used to roughly subdivide the yarn into:-Yarn (made of short fibers)-Filament (made of short fibers) and continuous fibers). Filament yarn

2. Yarns and filaments

Yarns consist of short fibers or long fibers cut into short fibers. Yarns can contain the same types of fibers or a mixture of different fibers. Yarn production affects properties such as uniformity and strength. The finest, softest, and highest quality cotton yarn, the so-called combed cotton yarn, is made by combing the fibers before spinning. A similar process is used to manufacture high-quality worsted yarn.

Discontinuous yarn is a liner collection of fibers, usually held together by twisting strands to form continuous strands with a small cross-section but a specific predetermined length d. It is used to make fabrics in processes such as weaving, weaving, and sewing. . It depends on how the fibers are constructed in the yarn system. The fiber can be natural, man-made, or man-made. Spun yarn is made of continuous staple fiber before spinning. Spun yarn can be subdivided and classified according to fiber length, spinning technology, and yarn structure. Each of these categories can be divided.

spun yarn can be divided into spun yarn or long yarn. The length of the short fiber is 10 to 500 mm. The maximum length of short fibers is 60 mm. (Cotton fiber is a short fiber about 2544 mm.) Long grains are more than 60 mm long. (Wool fiber is about 60-150mm long fiber).

FILAMENT YARN

Most filaments are extruded yarns made from extruded natural fibers or man-made fibers extruded through a nozzle. These yarn fibers can be roughly divided into:

1.Monofilament is made of relatively thick monofilament fiber. Transparent sewing thread, metal thread, bare elastic band, and fishing thread are all examples of monofilament thread. Silk is too thin to be used as a monofilament.

2. Multifilament yarn is made of multifilament fibers. The length of the continuous filament requires little or no twist to hold the multifilament together. Some filaments are made by cutting or splitting a net or film of metal or polymer-coated yarns. : Metal-coated yarn is made by cutting laminated metal plates between plastic plates. Ribbon filaments are made by cutting or separating polymer films. Olefin is the most commonly used fiber in ribbon yarns.

3. Yarn structure: The main aspect of the yarn structure is its appearance, which is determined by the outer position of the fiber. The second aspect is its internal structure. The structure of the yarn varies greatly. The difference is intentional and depends on the intended use of the yarn, but mainly depends on the available means. For example, it is difficult to produce Ring-spun yarn with similar properties, and the ring-spun yarn is still the benchmark for comparison. The structure of the yarn mainly depends on the nature of the raw material, the technology and parameters of the spinning station, the conditions of the spinning station, machine parameters, settings, and torque levels. The structure of the thread can be open or closed; small in size; smooth, rough or hairy, soft or hard, round or flat; thin or thick, etc.

4..Yarncount: Yarncount, also known as Yarn number, is the number of Yarns required to make one pound of Yarn. This should not be confused with the number of threads per inch. Fabric is called the number of threads. In the counting system, we calculate the length; it is called a strand, which weighs one pound. Therefore, if there are 10 strands of cotton yarn weighing a pound, it is 10 shillings of yarn. Each thread is 840 yards long, so the total length of yarn is 8,400 yards. This is a thicker yarn and requires fewer strands and a shorter length to produce a pound. On the other hand, the higher the number, the thinner the Yarn. It takes finer yarn to make a pound.

If the cotton count is 1, then 840 yards × 1 weighs one pound.

If the cotton count is 2, then 840 yards × 2 weighs one pound.

The length of a hank depends upon the spinning system:

Cotton system: 1 hank = 840 yards

Worsted wool system: 1 hank = 560 yards

Woolen cut system: 1 hank = 300 yards

Woolen run system: 1 hank =1600 yards

5= 1. Slub yarn can be single or ply. This yarn is characterized by soft and fluffy areas spun at regular or irregular intervals.
2. Regularly add small tufts of different colors to the tufting/flocking yarn. These strands are easy to pull out. Tufted/flocked yarns are usually single yarns.
3.Knotted yarn, knotted yarn, and pointed yarn are layered yarns in which the prominent yarn is twisted around the base yarn to form a thicker surface or protrusion.
4..Boucle and loop yarns are ply yarns that use three sets of yarns – base or core yarn, effect yarn, and tie yarn. The effect yarn is looped around the base or core yarn and tied with a binder yarn.

MCQ ANSWERS
1. Yarn
2. “S” twist
3. 840 yards
4. “Z” twist
5. Leno

UNIT : 9 YARN CONSTRUCTION

STRUCTURE:

9.0 OBJECTIVES

- To understand the preparation of short and long staple fiber for spinning.
- To learn the process of yarn construction.
- To understand the properties and end-up of yarn produced by each method.

9.1 INTRODUCTION

Fibers can be classified as short fibers or filament fibers. Filament fibers are long, continuous fibers, usually synthetic. Although silk is an exception here; it is a natural filament fiber. Short fibers are the relatively short length of short fibers because of their short length; short fibers must be twisted to form a long and continuous yarn. Short fibers are usually natural fibers, but synthetic fibers can be cut into equal lengths and mixed with natural short fibers or used alone to make yarns from natural short fibers. Cotton, wool, or linen.

The natural short fibers used in the textile industry are classified according to their typical fiber length and are called "short fibers" or "long fibers".

9.2 SPINNING METHODS

There is a variety of spinning processes that can be used to produce yarn, including ring spinning, rotor spinning, non-twist spinning, winding, and rod spinning.

1. Ring-spun yarn: This is the most widely used method of making spun yarn. The fibers are twisted together to maintain the strength of the yarn.

2. Spinning yarn: similar to ring-spun yarn, mainly made of short fibers. Although weaker than ring-spun yarn, the yarn is smoother and more uniform.

3. Less Twist Yarn-The fiber is twisted with glue instead of twisting, usually placed on a continuous yarn core.

4. Rolled Yarn: This kind of yarn is made up of discontinuous fibers connected by another yarn, usually a continuous yarn made of synthetic fibers. The threads can be short fibers or long fibers.

5. Core-spun yarn: The core-spun yarn has a central core, which is wrapped with short fibers and is produced in one operation during the spinning process, such as an elastomer core.

9.2.1 operation in staple fiber spinning:

1. Mixing: "mixing" refers to connecting several types of the same basic fiber. For example, Egyptian cotton can be blended with American cotton, and the tail yarn is still 100% cotton.
2. Blending: Blending describes the combination of different types of fibers, such as wool and silk or cotton and polyester.
3. Fiber cleaning and separation: The raw fiber bag contains various impurities that must be removed. The first process separates and separates the bales into loose fiber bundles of reduced size to remove dust, seeds, and other debris. Some types of fibers are washed or degreased, while other types of fibers can be combed or combed to separate the fibers And clean them further.
4. Fiber alignment: This process is after carding and carding. Multiple silver wires or groups of combed or combed wires are combined and loosened to form a single straightened silver wire. This process is called stretching.
5. Drafting and Twisting: drafting is the process of gently stretching silver to reduce its density or linear thickness. The exact method and mechanism used will depend on the quality and quantity of yarn required. In a stream.

9.2.2 Polymer Spinning Process

Most synthetic fibers are extruded using polymers derived from petroleum and natural gas by-products, including polyethylene (PET) and nylon, as well as compounds such as acrylic, polyurethane, and polypropylene. Change from solid to a liquid by melting, dissolving, solvent, etc. The flowable polymer is then extruded through a nozzle to convert the solution into fibers. There are four main manufacturing processes for synthetic fibers: dry spinning, wet spinning, melt spinning, and gel spinning.

The spinneret is a metal component with one to hundreds of small holes. Flowable polymers are introduced through these small holes to form fibers from the polymer solution. This process of extruding and curing countless strands is called polymer spinning. There are two types of extrusion; single screw and twin-screw extrusion.

1. Single screw extrusion is one of the basic tasks of polymer processing. The single screw extrusion process puts pressure on the molten polymer. Most single screw extruders can plasticize, pick up solid particles in pellet or powder form and melt them under pressure.

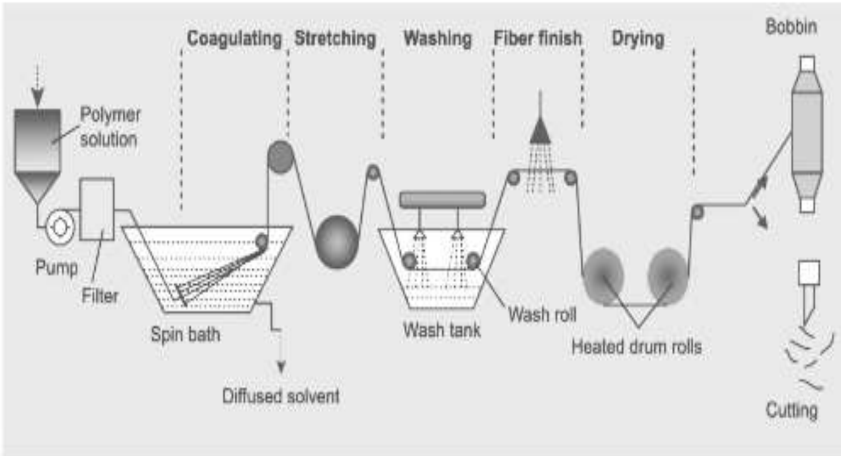
2. Twin-screw extrusion-usually used for mixing, compounding, or interacting with polymer materials. The flexibility of the twin-screw extrusion tool allows the operator to tailor it specifically to the recipe to be processed. For example, two screws can be turned or turned in opposite directions. , Interlaced or not interlaced. The design and configuration of the screw itself.

9.2.3 Polymer Spinning Process

These are different spinning processes.

9.2.3.1 Wet spinning:

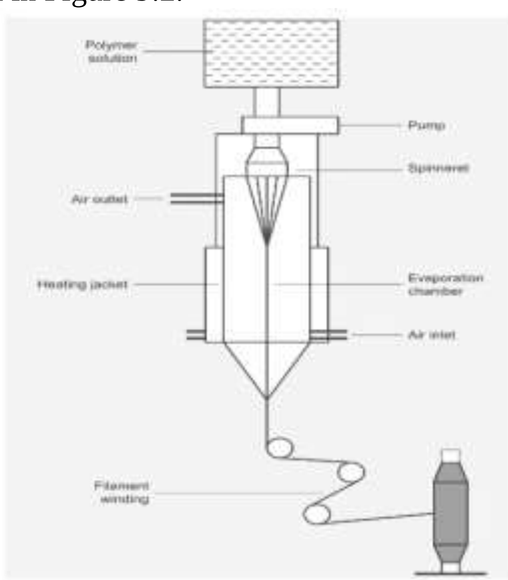
Of the four processes, wet spinning is the oldest, as shown in Figure 9.1. It is used for polymers that must be dissolved in a solvent before spinning. The row is still submerged in the chemical bath. Causes the polymer to precipitate and then solidify when it leaves the nozzle hole. (The name of the program comes from using this "wet" bath). Acrylic fiber, viscose fiber, aramid fiber, modified acrylic fiber, and elastic fiber are all produced by the wet spinning process.



(Figure 9.1 Wet spinning process)

9.2.3.2 Dry spinning:

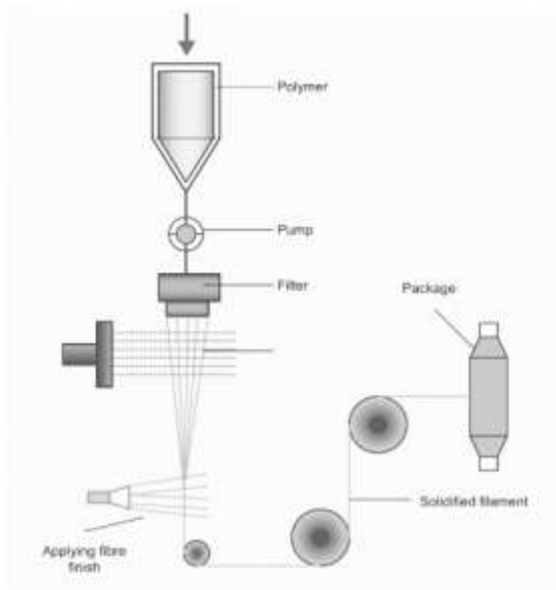
Dry spinning is used for polymers that need to be dissolved in a solvent, but solidified by solvent evaporation. The solution dissolved in the volatile solvent is pumped through the nozzle. When the fiber leaves the spinneret, air or inert gas is used to evaporate the solvent from the fiber. This causes the fiber to solidify, which can then be collected on a collection wheel. The fiber is stretched to provide the orientation of the polymer chains along the fiber axis. This technique is only suitable for polymers that cannot be melted. The latest safety and environmental indicators for handling solvents. Dry spinning can be used to manufacture acetate fiber, triacetate fiber, acrylic fiber, modified acrylic fiber, PBI, spandex, and ramie fiber; the schematic diagram of the dry spinning process is shown in Figure 9.2.



(Figure 9.2 Dry spinning process)

9.3.2.3 Melt spinning:

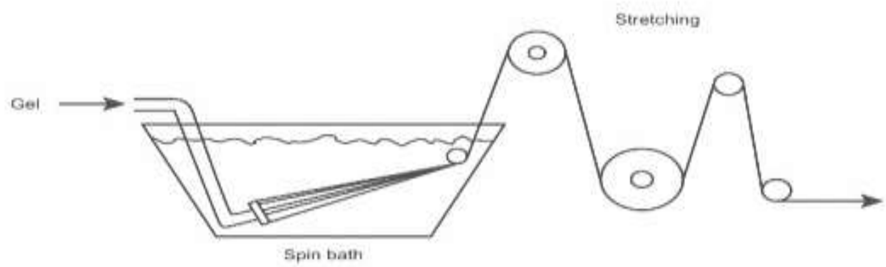
In this process, the polymer is melted and then extruded through a nozzle. The cooled and solidified molten fibers are collected on a collecting wheel. Melt stretching helps to orient the polymer chains along the fiber axis, and melt-spun fibers can be extruded through dies with various cross-sectional shapes including round, triangular, pentagonal, and octagonal. More light makes the fabric glow; pentagonal and hollow fibers have antifouling and antifouling functions and are used in carpets and carpets. The rectangular fiber produces a matte effect. Hollow fibers can trap air to form better insulating polymers, such as polyethylene terephthalate and nylon 66. High-capacity melt spinning. Nylon fibers, olefin fibers, polyester fibers, Saran fibers, etc. are also made by melt spinning.



(Figure 9.3 Melt Spinning Process)

9.2.3.4 Gel spinning:

Gel spinning is also called dry spinning and wet spinning because the yarn is first passed through the air and then cooled in a liquid bath. Gel spinning produces very strong fibers with special properties. A liquid or "gel-like" state that holds polymer chains together at various points in the form of liquid crystals. This combination creates strong intermediate chains and tension in the fiber, thereby increasing its tensile strength. They are highly directional, which further increases their strength. By forming fibers that are highly oriented concerning each other, the strength is further increased. This process produces high-strength polyethylene and aramid fibers. The rotation of the gel is shown in Figure 9.4.



(**Figure 9.4 Gel Spinning process)**

No matter which extrusion process is used, the fiber will eventually be stretched to increase its strength and molecular orientation. This can be done while the polymer is still solidified or completely cooled. Due to the molecular chain and its arrangement along the fiber axis, which results in a significantly stronger yarn, chemical yarns can be divided into the following four sub-groups: smooth, deformed, bi-component and film.

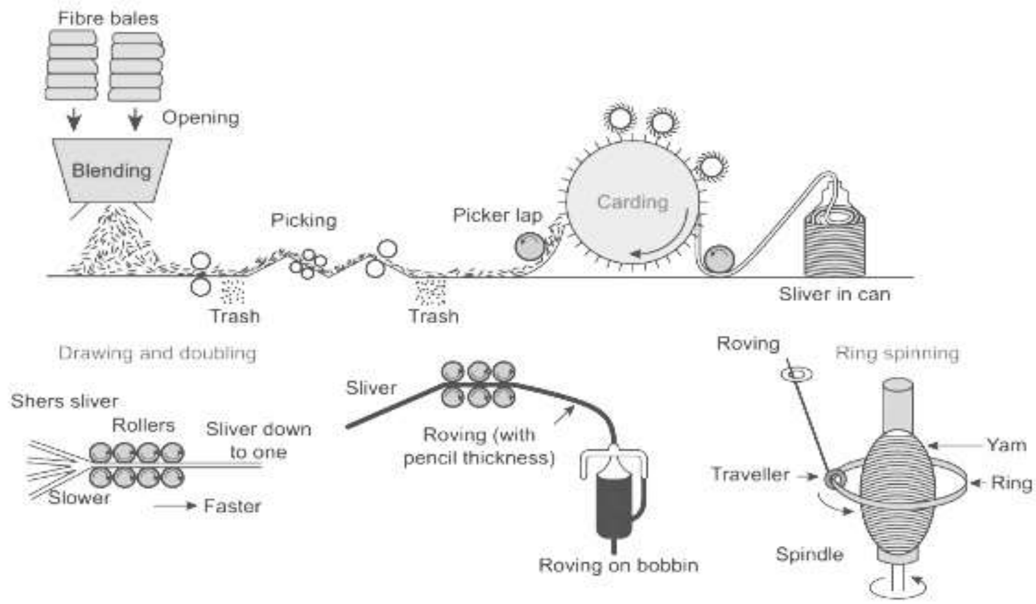
9.3 METHOD OF YARN MANUFACTURING

9.3.1 Ring spinning

Ring spinning is the process of spinning raw staple fibers into continuous yarns using a series of machines, as shown in Figure 9.5. A loop system for processing short fibers into cotton and wool yarn; opening, opening, opening, painting, carding, hiking, and turning.

1.Opening: This is the main spinning process of the original fiber. The opening is the process of reducing compressed cotton fibers from the bale into smaller fiber bundles. Use toothed rollers to remove dirt, dust, and other contaminants. After this process, the fiber is sent to another process.

2. Carding: After mixing and opening, transfer the loose fibers to the carding machine. Carding is done using opposing sets of teeth or small thread hooks called card stock fabrics, which cover part of the machine, including the glycerin, cylinder, and rotating plane. The cylinder and the plane can rotate in one direction or the opposite direction. But at different speeds, the fiber bundles are drawn into a thin, transparent fabric, which is then collected into a loose rope structure called silver, which is usually entangled. Combing further opens the fiber bundle and removes the fine particles trapped by the short fibers in the fiber aggregate. Go through this process.



(Figure 9.5 Carding, roving, blending, combing and ring spinning processes)

3.Combing: Combing is the process of removing short fibers from a cotton fiber (flake) sheet using a roller with fine-toothed elements, which is attached to the center of the flap. The number and length of recycled short fibers depend on the selected short fiber parameters. The fibers are straightened and arranged in parallel.

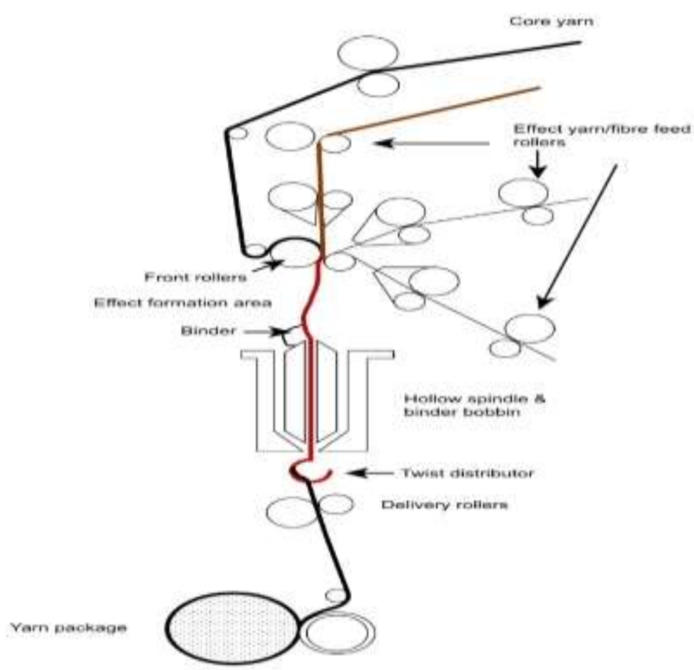
4. Roving: Roving uses three pairs of rollers rotating at different speeds to reduce the blade to about one-eighth of the original diameter while transmitting the required torque to ensure the stability of the roving. Low stretch due to wrinkles.

5. Ring spinning: The process of converting the wick into yarn is called the spinning process and is usually carried out in a roll drafting system with some fiber control (such as double aprons). To prevent slipping through the ring and track. The yarn is then wound on a suitable spool, a so-called loop, for further processing.

9.3.2 Hollow - Spindle Spinning

This process replaces yarn twisting by wrapping the yarn fabric around the material used (Figure 9.6). This leads to an amazing yarn structure in which most of the warp fibers/yarns are parallel to each other along the axis. Yarn and the adhesive provide the necessary cohesion. Although the surface is similar, the structure of the yarn made with the hollow spindle system is very different from the yarn made with the traditional ring spinning system. Their appearance and behavior during processing may also be different. They are mainly used for knitwear or fabrics, although plain weave yarn has many other uses, such as B.

Carpets and medical textiles. When is used for fancy yarns, the binder is added during the hollow spindle process, and the effect occurs immediately, instead of using a separate second step. The yarn produced on the hollow spindle has no twist to fix the fiber/core of the fancy yarn. Together with so that there is no cohesion other than the cohesion provided by the adhesive. If the connector breaks, the fibers in the core expand more freely and more suddenly than ring-spun fancy yarns. The schematic diagram of the hollow screw system is shown in Figure 9.6. In this particular example, there are four independent yarn feeders, three for fancy fibers and one for center yarn. The effect fiber is provided in the form of roving. Or silver. The fiber is then stretched using a roll stretching system similar to that used in ring frames. The spectacular fiber is combined with the core yarn and then fed through a rotating hollow spindle, on which a spool with a binder, usually a filament, is placed and rotated. The rotation of the hollow spindle wraps the adhesive around the pile strands and core. Then the binder fixes the effect and the inner cable in place. ; The shaft usually produces false twists in the staples, so the staples do not pass directly through the hollow shaft but are first wound on the torque adjuster, which is usually located at the lower end of the shaft.



(Figure 9.6 Hollow Spindle Process)

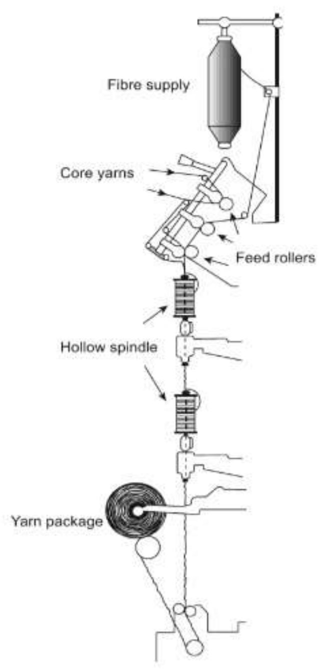
The hollow spindle system can achieve a variety of extraordinary effects. Many of these effects can be controlled by adjusting the speed of each feeder. The hollow spindle system can also be used to make fancy yarns, which can be made by controlling the final feeding speed of the yarns. Since the conspicuous fiber has no real twist, the hollow-spun yarn is different from the ring-spun yarn in appearance and performance. The former tend to be larger and have lower abrasion resistance.

9.3.3 Combined system

A combination system was developed to combine the advantages of ring spinning and hollow spindle system in one machine because single loop yarn has a more stable and reliable structure than single-loop yarn. It was later discovered that two hollow spindles could also be connected in series, which would result in different yarns and different advantages. This is shown in Figure 9.7, which shows two hollow spindles stacked on top of each other. , It wraps a strong thread with two opposite directions of adhesive.

This process produces fancy yarns with a more stable structure because the fancy fibers are captured by two binders instead of one.

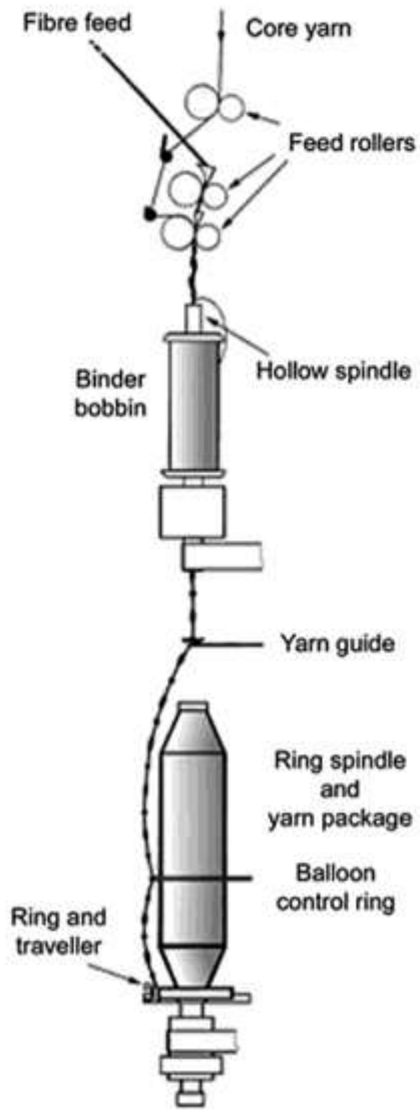
Figure 9.7 shows the original combination system, in which hollow spindles and ring spindles are combined on one machine, whereby the winding generates torque, and the ring spindles are located directly below the spindles. gap. The speed of the hollow spindle assembly is increased by the real torque generated by the ring spindle, so it is possible to manufacture a yarn that is cheaper than the real ring yarn while maintaining some of its characteristics.



(Figure 9.7 schematic two-spindle winding solution/combined system)

9.3.4. Doubling System

Backup system The traditional backup system is based on ring spinning. This design provides two or more wires, which can be fed independently at an adjustable speed. Depending on the requirements, these can include uniform, oscillating or intermittent supplies, which makes possible the simple production of spiral or clay yarns, and at the same time, they need to be supplied in the form of yarns. This process enables spinning mills to produce certain types of yarn. The simplest fancy yarn formula. Double borders can produce some interesting effects, especially when used to combine two exciting fantasy lines can also be made



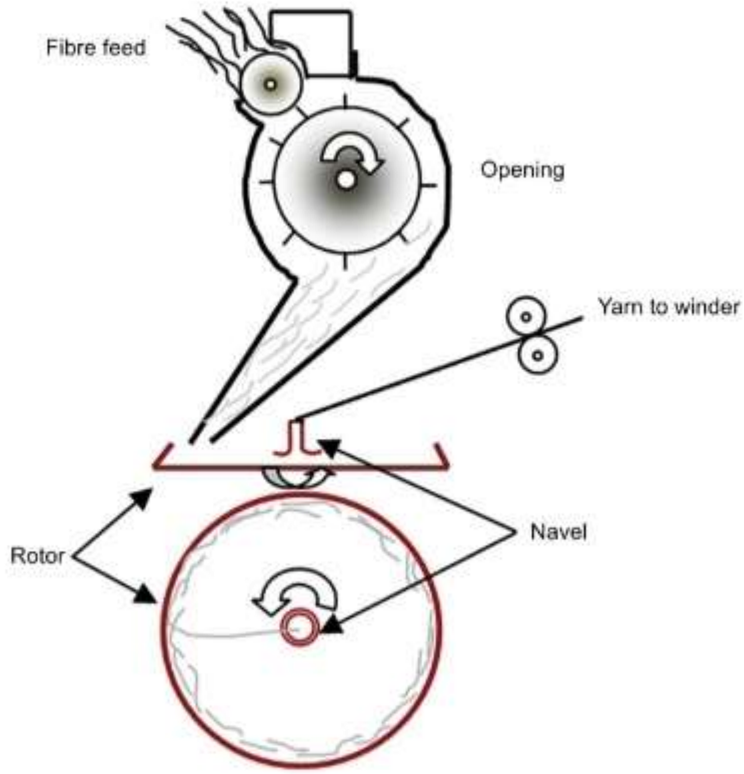
(Figure 9.8 Combination of the ring and hollow spindle)

9.3.5 Open-end spinning

These are two common yarn production methods based on the principle of open-end spinning: rotation and friction. The rotary system is mainly used to produce rovings to half yarns from short fibers. The friction system is mainly used to manufacture thicker industrial filaments. However, these two systems can also be used to produce some fancy yarns.

1. Rotary system

For open-end spinning, the twist of the yarn is separated from the winding, and the wire bundle should only rotate at a relatively low winding speed. The process can be divided into the following stages; opening, transportation, alignment, grinding, and twisting.

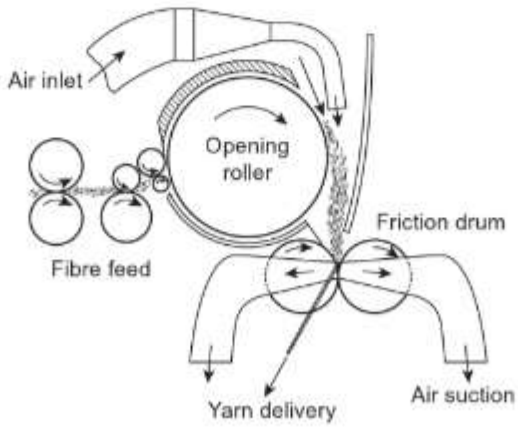


(Principle of Rotary Spinning in Figure 9.9)

In the process of rotating spinning, as shown in Figure 9.9, a single fiber is brought to the rotor by the airflow and contacts the collecting surface to form a fiber bundle. ... in the circumferential direction When the fiber is pulled, the rotor twists the yarn; rotary spinning is most suitable for spinning short fibers. The latest developments in electronic control have promoted the development of rotor spinning systems, which can also produce fired yarns. Sometimes they are used for denim. They are manufactured in connection with traditional open-end spinning equipment, which usually includes an electronic control device for briefly accelerating the draft roller. Due to the reverse bending effect in the rotor, it is impossible to obtain fiber bundles shorter than the circumference of the rotor, because any change in the fiber feed extends over the minimum circumference of the rotor. Attempts have been made to change the flow of fibers by injecting compressed air into the fiber delivery tube, thereby changing the appearance of the yarn. However, the effect of this method is very limited because the fiber flow in the transfer tube is very low. Therefore, the yarn change caused by the airflow change is small.

2. Friction system

Friction spinning is an open spinning process that is completely different from using a rotor. Two friction rollers clamp the exposed fibers and twist them into yarns. The principle of DREF2 is shown in Figure 9.10. Stretch to form the center component.

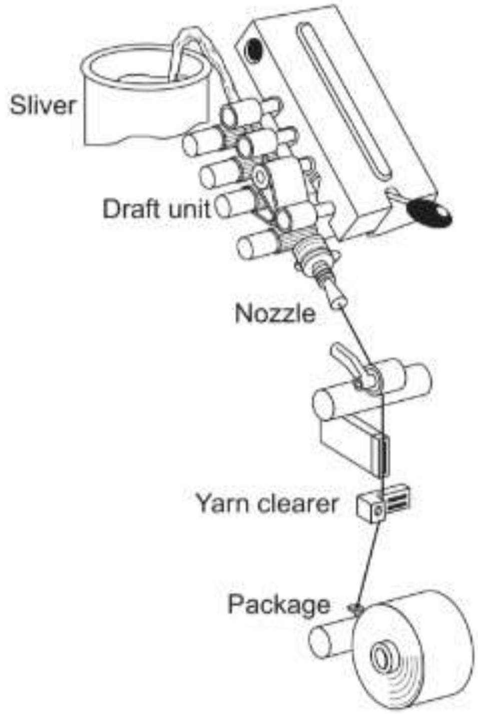


(figure 9.10 basic friction system)

Fiber is fed in the form of silver and spread with an opening roll. The exposed fibers are then forced out of the opening roller by the airflow and transported to the contact surface of the two friction fibers with holes. Torque is transmitted to the fiber line through friction with the surfaces of the two rollers... and supplied in a direction parallel to the axis of the friction roller and the forming unit. Since the diameter of the friction drum is much larger than the diameter of the yarn, a high twisting speed can also be achieved by using the relatively low rotation speed of the friction drum.

3. Vortex spinning

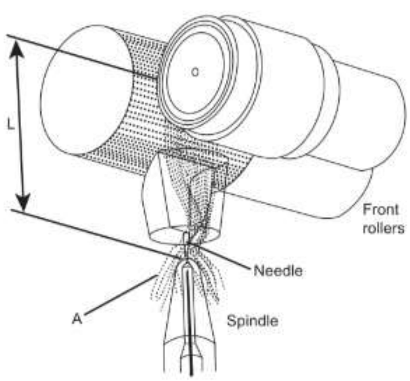
The open vortex spinning technology has recently completely changed the exciting yarn technology, but the previous poor printing quality and processability hindered the adoption of these technologies. Vortex spinning technology has become more and more important in the past ten years, as shown in Figure 9.11. Japan's Murata Machinery Co., Ltd. demonstrated vortex spinning on OTEMAS'97. This technology can best be explained as the development of air-jet spinning, which is specifically designed to overcome the fiber-type limitations of Murata air-jet spinning. The main feature of Murata Vortex Spinning (VMS) is that it can spin carded cotton yarn at a much faster speed than any other system currently in existence. The output of the ring-spinning machine is 20 times that of it.



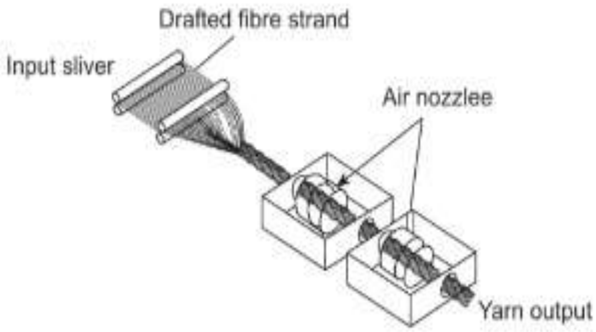
(Figure 9.11 Vortex spinning feed channel)

9.3.6 Air - jet spinning process

This is a pneumatic process, not a free-end spinning process. The stretched filaments pass through one or two of the leading filaments The nozzle feed is closed and the winding system is rolled, as shown in Figure 9.13. The roll drawing system draws the incoming silver into parallel fiber ribbons. High-pressure air is injected into the nozzle, generating a vortex airflow in the nozzle, thereby introducing a false twist into the elongated fiber bundle. The edge fibers are wound on the surface of the center strand and form yarns.



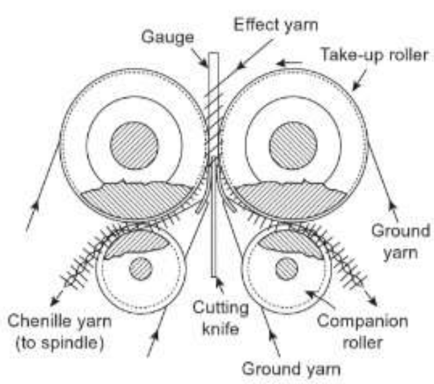
(Figure 9.12 due to the expansion of the fiber edge due to the vortex force of the airflow)



(Figure 9.13 Main air-jet spinning device)

9.3.7 Chenille yarn system

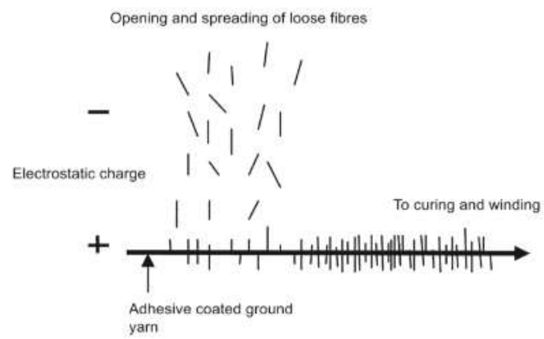
Forms two chenille yarn process units, as shown in Figure 9.13 Show. The eye-catching yarn is wrapped around the size or template with a triangle at the top and tapers toward the bottom to make the yarn. The width of the bottom of the gauge determines the length of the effect while maintaining the depth of the last strand of hair or beard. The cutting knife is straight as shown in Figure 9.14, and modern machines use a round cutting knife. There are two ground wires on each side of the cutting knife, which can be single or double: one ground wire is fed in by the take-up roller, and the other ground wire is fed in by the auxiliary roller. The roller is pressed on the special-shaped guide and meshes with the relevant roller, so that the two ground wires can clamp the pole formed by the movable wire between them, and are at right angles to the axis of the ground wire. Two ground wires are twisted together, usually with the ring-shaped main shaft at the bottom of the machine, to form the last wire.



(Figure 9.14. Chenille yarn production process)

9.3.8 Flocking

The effect of the chenille can also be achieved through the flocking process, in which the glued ground wire is statically lost, as shown in Figure 9.15. These are ground wires with opposite electrostatic charges. This will pull loose fibers from the ground wire and stick them to it. The loose fibers have the same electrostatic charge and repel each other, which makes the fibers separate well and also makes them "stand on the ground" instead of lying on their surface. The manufacturing cost is very low, but the yarn has low wear resistance, so the anchoring of the loose fibers in the grounding cable is weak, so it is easy to wear and leave the grounding cable here.



(Figure 9.15 Use the flocking method to make chenille yarn)

9.3.9 Mock Chenille

Simulated Chenille can be used in wire mesh, terry, or loops with dense effects (two lines have many small loops)) Copy two lines to make. However, when it becomes a fabric, many small loops in the fabric will produce a chenille-like effect on the surface of the fabric.

CHECK YOUR PROGRESS

1. What are the different methods available to manufacture yarn from staple fiber?

____
____
____
____
____
____

2.Explain the Polymer spinning process.

____
____
____
____
____
____

3.Write a short note on hollow-spindle spinning.

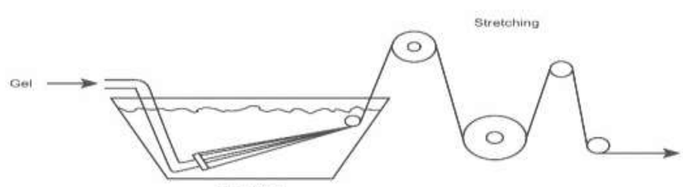
4. Explain rotor spinning.

5. Write about the chenille yarn system.

MULTIPLE CHOICE QUESTIONS

1. Which is the most widely used method of staple fiber yarn production?
(a) Ring spun
(b) Rotor spun
(c) Twist less yarn
(d) Core spun yarn

2. Which spinning process is this?



(a) Melt
(b) Air-jet
(c) Gel
(d) Dry

3. In which process, the twist in a yarn is replaced by wrapping a filament binder around the materials used?
(a) Ring
(b) Hollow-spindle
(c) Flocking
(d) Mock

4. Which chenille effect can be manufactured by playing two gimps, boucle, or loop yarn with dense effects?
(a) Flocking
(b) Mock
(c) Roving
(d) Combined

9.4 LET US SUM UP

This unit explains the manufacturing processes of melt spinning, wet spinning, dry spinning, and gel spinning, and explains the manufacturing technologies of hollow spinning, ring spinning, rotor spinning, air-jet spinning, and vortex spinning, as well as the types of yarn structures obtained. Related technologies and their end-use.

9.5 KEYWORDS

Adhesive	also known as glue, cement, mucilage, or paste, is any non-metallic substance applied to one or both surfaces of two separate items that binds them together and resists their separation
Cotton sheath	In fashion, a sheath dress is a fitted, straight cut dress, often nipped at the waistline with no waist seam.
Attenuated	having been reduced in force, effect, or value.
Polyurethane	1. : a synthetic resin in which the polymer units are linked by urethane groups, used chiefly as constituents of paints, varnishes, adhesives, and foams.
Polypropylene	a synthetic resin that is a polymer of propylene, used chiefly for films, fibers, or molding materials.
Precipitate	cause (a substance) to be deposited in solid form from a solution.
Evaporation	the process by which an element or compound transitions from its liquid state to its gaseous state below the temperature at which it boils.
Doffer	a small roller usually covered with wire teeth used to strip material from another roller or cylinder on textile machinery
Aggregates	a whole formed by combining several separate elements.
Cohesion	action or fact of forming a united whole. The
Volatile	(of a substance) easily evaporated at normal temperatures
Friction	the resistance that one surface or object encounters when moving over another.
Momentum	the quantity of motion of a moving body, measured as a product of its mass and velocity.

Pneumatic containing or operated by air or gas under pressure

Chenille yarn chenille is the name for both the type of yarn and the fabric that makes the soft material.

9.6 SOME USEFUL BOOKS

1. Textile fibers, yarns, and fabrics by Ernest R. Kaswell
2. A Complete Technology Book on Textile spinning, weaving, finishing and printing 2nd revised edition
3. Textile Yarn Technology Structure and Application by Goswami B.C.
4.Textile and Fashion

Sources of Images

All images are from reference books and the internet.

ANSWER

1.=. There are many spinning processes for yarn production, including ring spinning, rotor spinning, ply spinning, winding spinning, and core spinning.

- ring spinning: This is the most widely used method of making spun yarn. The fibers are twisted together to maintain the strength of the yarn.
- Rotary Yarns: similar to ring-spun yarn, mainly made of short fibers. Although weaker than ring-spun yarn, the yarn is smoother and more uniform.
- Twist less Filaments-The fibers are glued together rather than crimped and are usually stacked on a continuous filament core.
- Twisted Yarns: These yarns are made of short fibers and are joined by another yarn, usually a continuous synthetic fiber yarn. The threads can be short fibers or long fibers.
- Core-spun yarn-The core-spun yarn has a center core, which is wrapped with short fibers and passed once during the spinning process, for example: or cotton on an elastic core.

2.= Polymer spinning process:

These are different spinning processes.

- WET SPIN: This is the oldest of the four. It is used for polymers that need to be dissolved in a solvent before molding. The mold is still submerged in the chemical bath, causing the polymer to precipitate, and the hardness drains from the holes in the mold. (The name of the program comes from using this "wet" bath). Acrylic, rayon, aramid, modified acrylic, and spandex fibers are made by wet spinning.
- DRY SPIN: Dry spinning is used for polymers that need to be dissolved in a solvent, but curing is done by evaporating the

solvent. After the polymer is dissolved in a volatile solvent, the solution is pumped through the series. If the fiber comes out of the spinneret, air or inert gas is used to evaporate the solvent from the fiber. This causes the fiber to solidify, which can then be collected on the take-up reel. The fiber is stretched to provide the orientation of the polymer chains along the fiber axis. This technique is only suitable for polymers that cannot be melted. Spin drying can be used. Used to produce acetate fiber, triacetate fiber, acrylic fiber, modified acrylic fiber, PBI, spandex fiber, and vinyl.

- MELT SPIN: In this process, the polymer is melted and then extruded through a nozzle. The cooled and solidified molten fiber is collected on the take-up wheel. The fibers are stretched in the molten and solid-state, which facilitates the orientation of the polymer chains along the fiber axis. The melt-spun fiber can be extruded through a die having a variety of cross-sectional shapes, including a circle, a triangle, a pentagon, and an octagon. Tribal can reflect more light and make the fabric glow. Hollow and pentagonal fibers have antifouling and antifouling functions and can be used to make carpets. The rectangular fiber produces a matte effect. Although hollow fibers can trap air and form better insulating polymers, such as polyethylene terephthalate and nylon 66, they are melt-spun in large quantities. Nylon fibers, Olefin fibers, polyester fibers, and sarong fibers are also made by melt spinning.
- GEL SPIN: also called dry jet wet yarn, because the fiber first passes through the air and then cools in a liquid bath. Gel spinning produces very strong fibers with special properties. A gel state in which polymer chains are held together at various points to some extent in the form of liquid crystals. This connection causes strong inter-chain tension in the fiber, thereby increasing its tensile strength. In addition, the fibers have a high degree of orientation, which further increases their strength. By forming fibers that are highly oriented concerning each other, the strength is further improved. This process produces high-strength polyethylene and aramid fibers.

3.= This process replaces the twisting of the yarn by wrapping the fabric of the yarn around the material used, resulting in an amazing yarn structure where most of the warp fibers/yarns are parallel to each other along the strand axis, and the adhesive is Responsible for the necessary cohesion. Although the surface is similar, the structure of the yarn made with hollow yarn is very different from the yarn made with the traditional ring spinning system, and the appearance and behavior during processing may also be different. Clothing or knitwear, although plain weave yarn has many other uses, such as carpets and medical textiles. In the manufacture of fancy yarns, the binder is added to the hollow spindle process, and the effect occurs immediately, instead of using a separate second step. Yarns produced with hollow spindles do not have the twist that holds the fibers/filaments of the fancy yarn core together and therefore has no adhesion. If the piecing breaks, the fiber in the core will spread more freely and more suddenly than the fancy yarn of the ring spinning system. There are four independent feeders, three for fancy fibers and one for middle yarn. The spectacular fiber uses intermittent or silver wicks. The fiber is then stretched using a roller tension system similar to an annular cage. The spectacular fibers are combined with the core yarn and then fed through a rotating hollow shaft, a spool containing a binder, usually a yarn. The hollow spindle rotates accordingly. The tie wire is pulled onto the hollow shaft. The rotation of the hollow shaft wraps the lace around the bracket and the central thread. The stapler then fixes the effect and inner strands in place. To avoid the possibility of the elongated staple fiber strands collapsing before winding the stapler, the rod usually produces false twists on the staple fiber strands. Torque regulator, usually located at the bottom of the shaft

4.=. In rotor spinning, the twisting effect of the yarn is separated from the winding effect, and the bundle should only rotate at a relatively low winding speed. The process can be divided into the following stages; opening, transportation, alignment, grinding, and twisting. In the rotor spinning process, a single fiber is transported to the rotor in the airflow and contacted with the collecting surface, thereby collecting the fiber bundles around the circumference. When the fiber is pulled, the rotor transmits torque. For yarn production, rotor spinning is most suitable for spinning short fibers. The latest developments in electronic control have promoted the development of rotor spinning systems, which can also produce fired yarns. These threads are used for furniture and curtains, not clothing fabrics, although they are sometimes used for denim fabrics. They are manufactured from traditional open-end spinning attachments and usually contain an electronic control device to briefly accelerate the traction roller. The rotor can't get a lead shorter than the circumference of the rotor because of any change. The fiber feed is spread along the smallest circumference of the rotor. Attempts have also been made to change the flow of fibers by injecting compressed air into the fiber delivery tube, thereby changing the appearance of the yarn. Those produced by this method are very limited because the fiber flow in the transfer tube is easy, so the yarn change caused by the airflow change is very small.

5.=. One way to make chenille yarns that form both ends in each block is to wind the yarn on a triangular gauge or template that tapers toward the bottom to create a rolling effect. The width at the bottom of the scale determines the length of the effect and maintains the depth of the last strand of hair or beard.

MCQ Answers

1. Ringspun
2. Gel
3. Hollow-spindle
4. Mock

UNIT: 10 WOVEN FABRICS

STRUCTURE:

10.0 OBJECTIVES

- To dress a loom.
- To understand draft plans and weaves structure.
- To learn weaving processes.

10.1 INTRODUCTION

Weaving is one of the oldest and most widely used weave-making methods. Weaving is the intersection of two sets of yarns; the warp threads extend vertically along with the weave, and the weft threads extend horizontally along the width of the weave. This section explains the basic information for starting weaving on a handloom. The term definition first explains the key terms used in weaving. Then there is a description of the type of loom used in hand weaving. It explains in detail the widely used loom manufacturing process, namely, Make the cover, wrap it on the loom and prepare to start weaving. The envelope diagram and the basic and derived structure of the weave illustrate how to form various patterns on the weave.

10.2 HISTORY OF WEAVING

Weaving may be as old as human civilization. One of the human needs is to cover one's body to protect oneself from external influences (heat/cold) and to appear "civilized" in the eyes. History is social status, religious requirements, etc. Clothing trends also vary by location.
Historical records indicate that the Egyptians made woven weaves about 6000 years ago; the Chinese made fine silk weaves more than 4000 years ago; it is believed that handlooms have undergone many changes in different civilizations.

Knitting started as a family art and went from house to house until the invention of the flying shuttle. The shuttle was invented by Kai in 1733 and was operated manually. In 1745, de Vaucanson manufactured a jacquard-designed loom to service every loom. In 1785, Cartwright invented an electric loom that could be operated at a single point. In the early 19th century, cast iron looms were driven by steam. These characteristics distinguish weaves from cheaper nonwoven and knitted weaves. Until recently, all weaves in the world were manufactured on single-phase looms, and technological advancements have been focused on accelerating the process of traditional weaving. For example, after centuries of measurements, the dam injection rate has increased from a few meters per minute to more than 2000 meters per minute. The textile machinery fair recorded significant growth. Three major textile machinery exhibitions in the world: ITMA held every four years in Europe, ATME held every four years in the United States and OTEMAS held in Japan. These exhibitions usually take place alternately. Additional output can only be achieved through new technologies, such as multi-phase looms.

10.3 LOOM AND TYPES OF LOOM

Various types of looms can be used for hand weaving. All looms perform the same basic function, which is to maintain the tension and tension of the warp when inserting and cutting the weft to form the weave. The loom has a device for making sheds, which can store weaves and make patterns. The main features common to all types of looms:

1. Frame: contains the components.
2. Crossbeam: to fix and store the wrapping cloth, located on the back of the loom. Some looms have more than one warp beam. If the loom has more than one back tree, it can be used to weave two different types of double-woven weaves. ...Or wrapped in different tensions. The front weave strip stores the finished weave. The width of each strip determines the latitude of the weave.

3.Shaft: Consists of upper and lower slats, fixed by fences, they control the rise and fall of the warp, thus forming a crown (only 2 arrows on the loom or up to 16 arrows or up to 24 shafts on the loom)...

4. Healds: Lean on the shaft or loom. The warp thread passes through the eyelet.

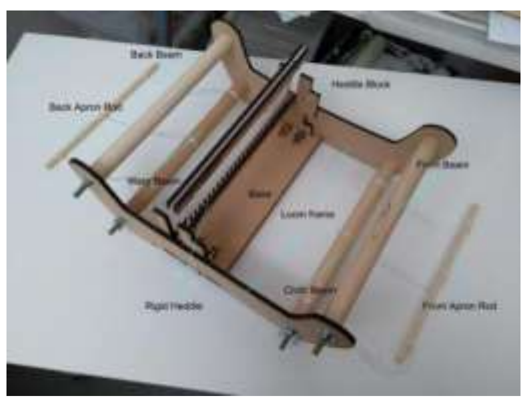
5. Batten: The rotating frame of the fixed rod. It can be hung (hang) on the top of the loom, or it can be rotated (hang) on the ground.

6. Reed: used to separate envelope and weft. Its size may vary, and it is best to be made of stainless steel to prevent rust.

7. Lever (desk loom) or pedal (floor loom): raise and lower the shaft. The lever is located on one or both sides of the frame. The pedal can be rotated from the front or the back.

10.3.1 Rigid Heddle Loom

The rigid loom is the easiest to use, but it is very limited because it can only be used for plain weaves. There is also a rigid panel and base at the back for fixing the package, the one at the front for fixing the package, and the one at the front for fixing the weave. Other techniques can be used to diversify the weave produced, such as tufting and space wrapping or the use of thick and thin yarns; in addition, the threads can be doubled or tripled to obtain a rib effect. (See Figure 10.1).



(Figure 10.1 Rigid loom)

10.3.2 Table loom

Looms can be up to 60 cm wide and have 2 to 16 axes. Each shaft has a lever, and each time the weft (cutter) is inserted into the neck, the shaft will be manually raised and lowered by the lever on the side of the loom. Two-axis looms can only be used for plain weaving machines, but four-axis or more-axis looms can make various desktop looms ideal for weaving patterns or small items (such as pillowcases and scarves) (see Figure 10.2)

(Figure10.2 Table loom)

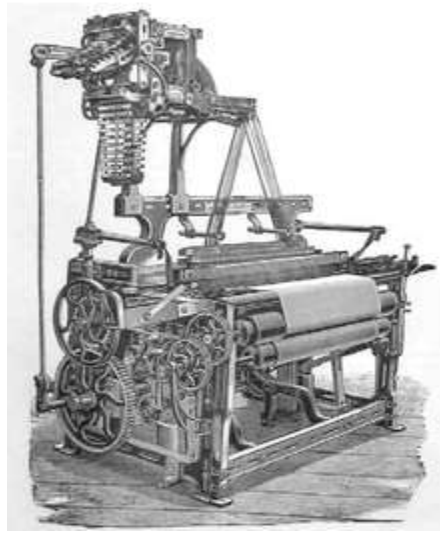
10.3. 3 Floor Weaving / Floor

Use floor looms or pedal looms to weave faster than desktop looms. The use of pedals allows the weaver to use his own hands to start the shuttle while using the power of his legs to shape the hat. On floor looms, the pedals can be connected to one, two, three, or four shafts for simultaneous lifting. They are not directly connected to the shaft, otherwise, they cannot be raised evenly. The shaft is connected with the sheet or gear located slightly below the shaft; center the hoist, except for the counterweight loom, the number of beams is equal to the number of shafts (see Figure 10.3)

(Figure 10.3 Floor/treadle loom)

10.3.4 DOBBY LOOM

A dobby loom is a floor-standing loom that uses a device called a dobby to control all warp threads. Dobby looms are an alternative to pedal looms. Both are floor-standing looms, in which each warp thread of the loom is connected to a single shaft through a device called ahead. The shaft is sometimes called a seat belt. Manage multiple threads. The simultaneous raising or lowering of multiple shafts will produce a large number of possible drops (holes), and the weft shuttle can be activated through these drops (holes). The dobby loom first appeared around 1843, about 40 years after Joseph Marie Jacquard invented the jacquard device, which can be installed on the loom to lift individual hedges and warps.

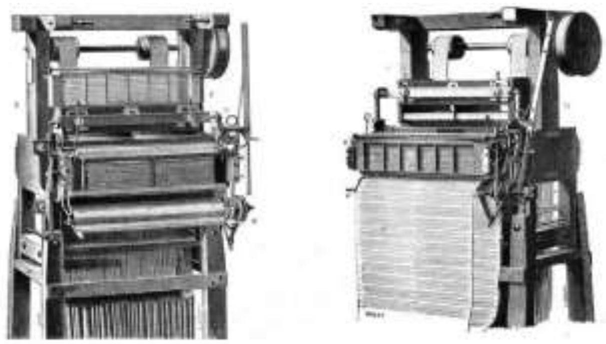


(Figure 10.4 Dobby loom (https://en.Wikipedia.org/wiki/Dobby_loom)

10.3.5 JACQUARD LOOM

Patterns such as brocade, brocade, and quilting. The resulting combination of loom and jacquard The loom used as a jacquard loom was invented in 1804 by Joseph Marie Jacquard , based on the early inventions of French Basil Bouchon (1725), Jean Baptiste Sokol (1728), and Jacques Vaucanson (1740). The car is driven by a "letter sequence"; several punch cards are connected in a continuous sequence. Each card has several rows of holes, and a complete card corresponds to a row of patterns.

The necessary accessories for jacquard technology and looms are named after their inventor. This mechanism is arguably one of the most important knitting inventions because the separation of the jacquard allows an unlimited number of knitting possibilities to be created automatically. The term "jacquard" is not specific, nor limited to a specific loom, but refers to an additional control mechanism that automates the pattern. The process can also be used for printed sweatshirts and woven textiles, such as sweaters.
The use of interchangeable punch cards for flow control is considered an important step in the history of computer hardware.



(Figure 10.5 of the jacquard loom)

10.4 UNDERSTANDING THE DRAFT PLAN AND WEAVING STRUCTURE

Weaving preparation

10.4.1 Winding:

Use yarn to better wrap the cone yarn... This repacking process is called wind. In this process, some yarns can be twisted heavier or combined with other single yarns to form double and multi-layer yarns. Yarn defects such as thick and thin areas are also removed. Increase the overall strength of the yarn and reduce yarn breakage during the weaving process.

(Figure 10.6: Winding machine)

10.4.2 Creeling:

yarn bundles are placed in a large metal frame called rounded corners. These fillets are equipped with a wire tension device to maintain a constant wire tension on the entire wire. When they go. They are wound around the base rod. Modern creel machines are equipped with automatic control, centralized tension change, and yarn brake control to increase warp yarn productivity.

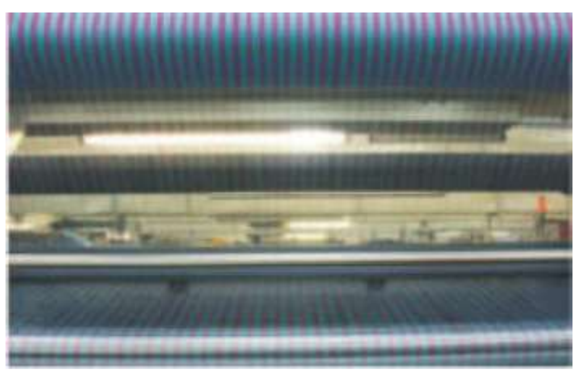
(Figure 10.7 Unwinding the yarn from the creel) (Figure 10.8: Rounding)

10.4.3 Warping:

transforms the yarn from a single-sided bundle to a uniform representing hundreds of ends (multiple ends) The process bundle of the yarn group is called the warp. Then wrap the end around the main beam. Warping can be carried out in two ways:

a) Straight warp thread In one operation, the thread ends are wound from the thread to the warp thread. Colorful or less complicated patterns should be woven.

b) Indirect warp yarn The yarn from the yarn bundle is wound into a ribbon on an intermediate drum called a template and then transferred to the warp bundle in a separate operation. Use this deformation method when fancy color deformation patterns are required. Or the coil capacity is limited.



(Figure 10.9: Direct warping Machine)

10.4.4 SIZING:

The size of the warp is important to reduce thread breakage, so that production on the loom stops. In the loom, the warp yarn is affected by various influences, such as wear of various parts of the loom, friction between the yarns, adhesion, the wear resistance of the yarn is improved, and the hairiness of the yarn is also reduced. Use a sizing machine to spread the paste on the warp yarns. After weaving, the weave is washed to remove the glue. Plugin.

(Figure 10.11: Sectional Warping Machine)

10.4.5 Drawing-in andDenting:

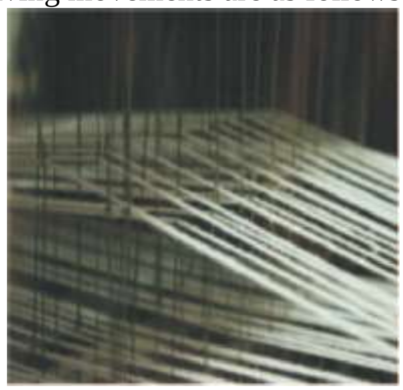
As shown in the figure, this is the process of pulling each end of the base through Herald's eyes, and then through the protruding reed. The warp threads are screwed onto Herold's bar, the so-called "drawing sequence". The order in which the warp thread passes through the tongue is called the "dent". The manual process of dragging and retracting is very time-consuming, so when mass-producing the same weave, each end of the new beam is simply connected to the corresponding end of the old beam, called TyingIn.

(Figure 10.12: Stretching) (Figure 10.13: Dent)

 Basic operation in weaving manufacturing

10.4.6 Shedding:

The weaving process consists of three basic operations, which form a hand or a simple continuous loop complex Of automatic operation looms. The main weaving movements are as follows:



(Figure 10.14: Shedding of warp sheet)

The warp threads of the top and bottom layers are separated to form a shed or tunnel, allowing the warp threads to run on the construction site.

10.4.7. Picking

(Figure 10.15 picking with a shuttle.)

The insertion of the weft thread, which traverses across the weave, through the shed.

10.4.8 Beating up

(Figure 10.16 Beating with the reed)

Push in the last notch or weft until the weave comes off. Regardless of the type of weave produced, the grasping and beating-up process will be recorded, but the separation movement is variable and can be called the core of the weave because it determines the type of weaving or weaving. Various separation movements will be introduced later in this chapter. In addition to the three main operations, several auxiliary actions are required for control. Some of them are mechanical devices related to the safety and continuity of the weaving operation, but the influence of certain actions can significantly change the appearance of the weave.

10.4.9. Warp Let Off

Determines the feed speed of the chain and warp tension. Tension largely determines the configuration of the warp ends in the weave. Two weaves with the same design but different tensions may look different and have different characteristics.

10.4.10 The Cloth Take-Up

Determine the removal rate of the weave, thereby determining the separation density of the weft stripes (that is, stripes per inch) on the **weave. Other mechanisms include:**

1. WarpProtector movement. If the shuttle is clamped between the top and bottom cap threads and the bar does not detour, this will stop the loom to prevent excessive damage to the warp threads, weave, and rod threads. ...
2. Warp yarn movement and weft yarn stop When one end of the warp or weft yarn is cut, the loom is stopped almost immediately, thereby avoiding weavedefects.The yarns from one warp bundle to another wool should be completely parallel and not intersecting; if they overlap, it may cause the warp to break and eventually weave the weave.

WEAVESTRUCTURE

The structure of the weave in the weave is determined by two factors: the sequence of the warp threads on the wave crest and the tongue bar; the combination of the heraldic shafts that are raised or lowered at the same time, and the shaft that is held is raised or lowered order of. Tissue density is defined as the number of spines and spines in a unit tissue. It is measured in cleats per inch and teeth per inch.

End per inch (EPI) is defined as the number of piece per inch of weave. In order to achieve the necessary density of the base, reeds made of various pearls are used.

Reed Counter: The reed counter is defined as the number of impressions in units of two inches. Two, three or more ends can pass through each indentation. For example, if you use a 32 reed counter, it means there are 16 indents in an inch, so there are 32 EPI indents at the 2 ends (16x2 = 32). There are different numbers of strips to make the weave thinner or thicker, or changing the number of ends of each indentation can help create open or closed weaves.

Picks per inch: defined as the number of rivets per inch of weave. The peak density can be changed by changing the recording speed.In high-speed winding, the number of teeth per inch is less, because when the weave is wound at a higher speed, the distance between the teeth is longer, and when the winding machine speed is slow, the gear ratio is now at a slower speed The wound weave is one inch faster.

Edge: The weave edge is a self-made weave edge.

Total warpends: defined as the total number of warp threads on the width of the weave. It is the product of the number of weave heads per inch and the width of the weave being woven. For example, if the PPE of the weave is 30 and 60 inches wide, the total chain of the weave will be 1800 (30 x 60)

SHEDDING MECHANISM

The Shedding mechanism is used to support the woven eyelet of the wire and raise or lower its thread depending on Do you want to lift the end on the weft or keep it under tension while grasping.
1. Tappet Shedding mechanism: With this mechanism, the clamped cable does not work alone, but is connected to the support frame, so it moves up and down with the movement of the shaft. Among them, due to the simplicity of the intermediate rope, only a few supporting shafts are needed, but this limits the length of the structure. For these reasons, the push rod separation principle is mainly used for the high-speed production of standard weaves. In this case, there are few structural changes and simplicity has some advantages.

2. Dobby separation device Here, the fixed cable is connected to the fixed shaft as a pusher separation device, but the system provides a larger image range and can usually control up to 24 fixed points.

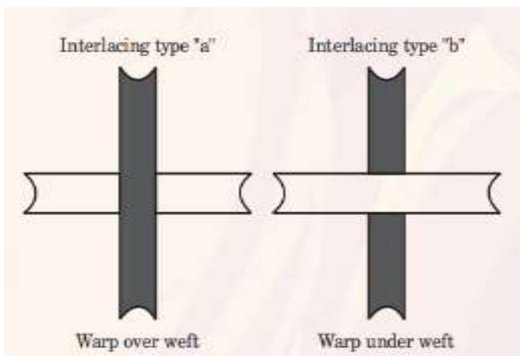
(Figure 10.17: Woven weave with jacquard mechanism)
These looms make it possible to weave cloth.

- METHOD OF weave REPRESENTATION

The weave consists of vertical threads called warp threads (crossing) and horizontal threads called weft threads (crossing). These strands are intertwined in different ways, and each type of structure shapes the design. Both ends and the weft are called barbs or fillers. Weaving designs are divided into two categories:

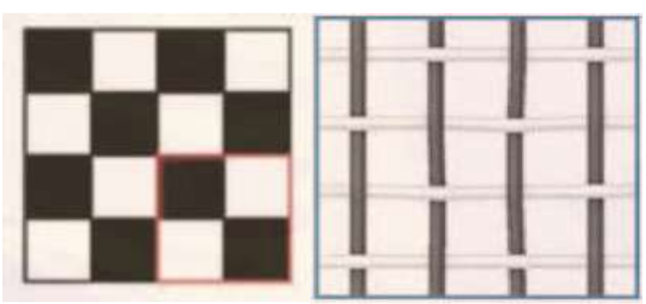
1. Simple structure: When the end and the tenon intersect at right angles and are therefore parallel to each other, this structure is called a simple structure. These structures have only one set of ends and one set of tips, which increase performance, practicality, and beauty to the same extent.

2. Composite structure: This structure has more than a series of ends and vertices, some of which are responsible for the execution, and some are only for decoration. They also cannot be parallel to each other. The weave unit is the intersection of warp and weft. There are two types of this type of intersection:



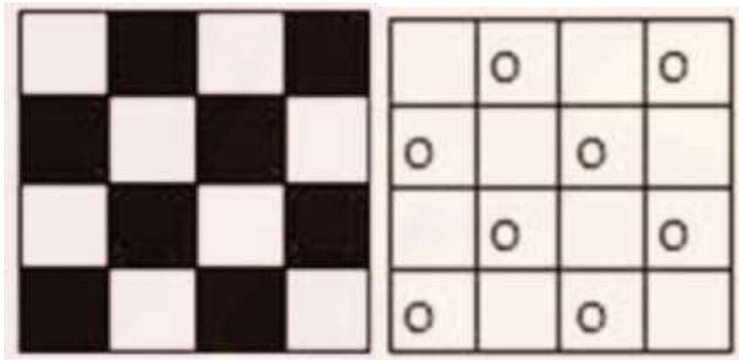
(Figure 10.18 Condition 1: Weft deflection / Condition 2: Weft deflection)

The end lifted by the pick should form an intersection. The lower end under the mandrel is used for crossing. Several different intersections are combined to form a design unit or a structure report. The simplest design that weave can make requires two ends and two tenons as repetitions of the same pattern. Since Figure 10.19 shows a design unit (shown in the red box), the adjacent unit is the same as the first unit, so it is usually sufficient to display a coherent design pattern as a repetition.

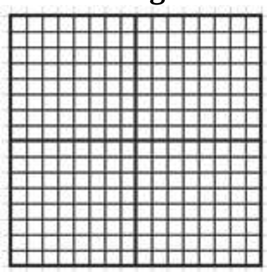


(Figure 10.19: Pattern unit)

Knitting pattern (red outline) Figure 10.19 shows warp thread 1, which passes through weft thread 1 and below weft thread 2, warp thread 2, running below weft thread 1 and above weft thread 2. This is called key mode. The preparation time is long, so it is not widely used, especially when creating large projects.

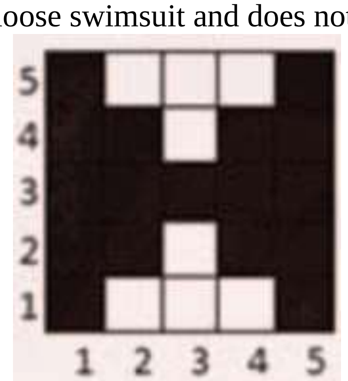


(Figure 10.20: Design on design paper/custom paper)

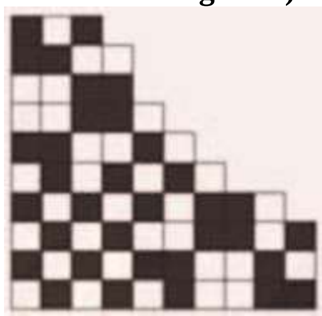


(Figure 10.21: Design paper/custom paper/square paper)

Indicates that the common method of design is drawing paper. The standard paper used for textile design is divided into 8 x 8 groups, separated by thick lines. Each vertical space represents the end of the warp and each horizontal space represents the end of the weft, so each stitch represents the intersection of the end and the cutter. The checkmark in this box indicates the weft chain, and space indicates the weft chain. Any type of mark (X, O, etc.) can be used, and sometimes multiple types of marks are used in the design at the same time to indicate different colors or line thicknesses. Regardless of the label, remember that dot paper is not a general representation of the pattern, but a specific level of the yarn weaving sequence, and each square is the intersection of the end of the warp and the top of the weft. To interweave, the lines must cross, so for a complete repetition of the pattern, each vertical space, and each horizontal space must have at least one notch and at least one space. It has no grip, it just forms a loose swimsuit and does not grab the weave.

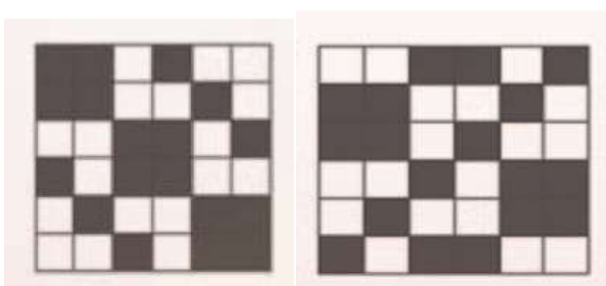


(Figure 10.22: Irregular pattern warp 1 and warp 5 form loose floating lines)



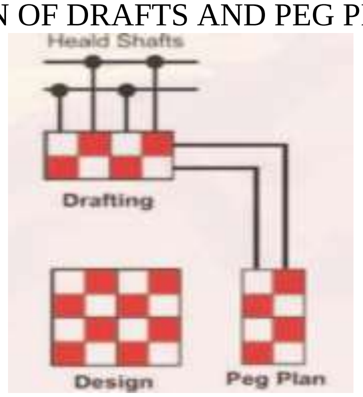
(Figure 10.23: Irregular repeating elements-complete repetition)

For rectangular shapes, each weave repeats at a certain number of ends and vertices. Usually, repeating units are displayed on the layout. The ends and teeth of the repeater unit can be the same or unequal, but the complete repeater must be rectangular because the wires are braided at right angles. If the repeating element extends to 8 ends and 8 ribs, each piece should extend to 8 ends and 8 ribs. Marks and cuts need to be connected correctly on all sides of the pattern because repeating the pattern to create the weave will result in continuous weaving. In the damaged weave design. However, weaving can start from a different position, as this will not affect the appearance of the weave, although the repetition may look different.



(The same weave in Figure 10.24 and Figure 10.25, but with different starting positions)

- CONSTRUCTION OF DRAFTS AND PEG PLANS



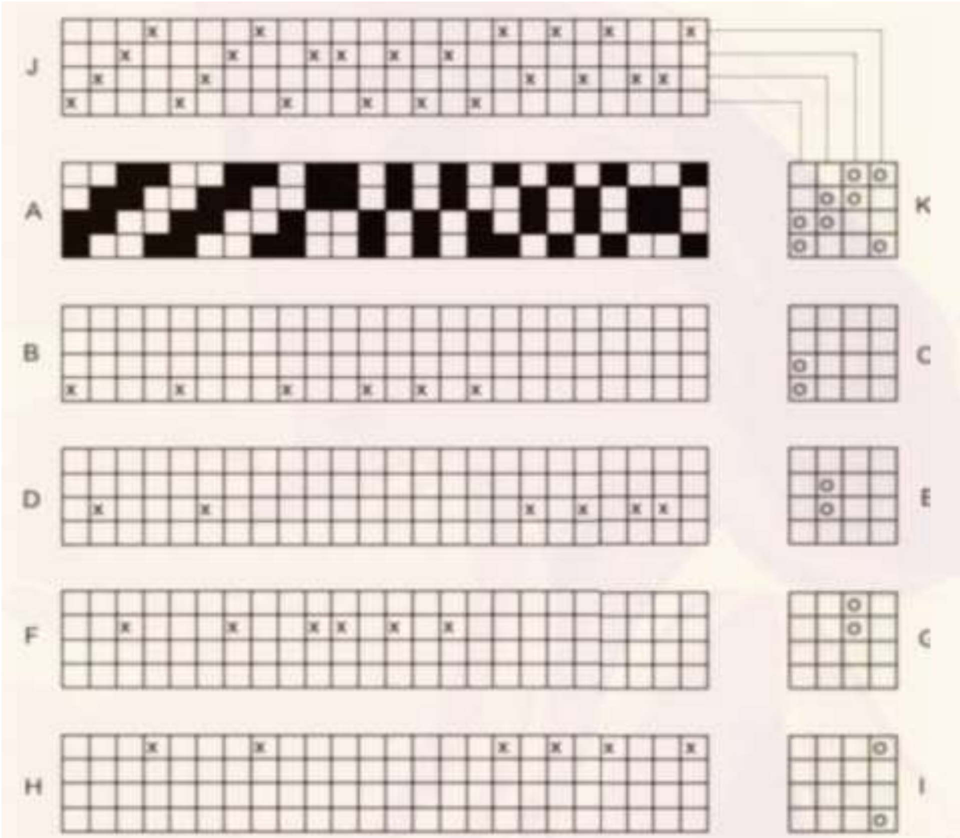
(Figure 10.26: Structure, sketch, and column installation plan)

This figure shows the number of support shafts used to make the structure and the sequence of pulling the end of the base through the fixing lugs on the pile bolts. Rescued. There are many ways to mark thrust, but the most common and convenient method is to use drawing paper. In this method, the inclined plane is drawn directly above the design, the horizontal gap represents the remaining part, and the vertical space represents each corresponding end of the base. The principle of pattern construction is that all ends working in different sequences need to fix the shaft separately. This means that all ends passing through a given support shaft work in the same way, because the support shaft is an object. This is not always the case, because sometimes for convenience and performance, ends with the same function are passed through different fasteners. It's important to note that the multiple choices in the repetition have nothing to do with the email template. This is considered in the amount. The lift plan or the pin plan determines the choice of the axis be maintained, and these axes are raised or lowered with each subsequent rack installation.

The plane of the brush is drawn in. The numbered vertical space in the pen plane corresponds to the numbering axis in the design, and the number of horizontal spaces corresponds to the protrusions in the design. The vertical space 1 in the pin plan indicates how the first bracket is operated; the number 2, the second is reserved, and so on. The plane also shows which axes move up and down on successive peaks. Therefore, the chart shows that at the first peak, the held 1 rise and 2 falls; on the second pin, 2 rises and 1 falls; the third hold option is 1 up and 2 down, The fourth option held is 2 up and 1 down.

10.5 WEAVES AND WEAVING METHODS

- METHOD OF CONSTRUCTION



(Figure 10.27: Step-by-step process for constructing the slope and plane of the

pin according to the given design)

builds the hood according to the following rules:

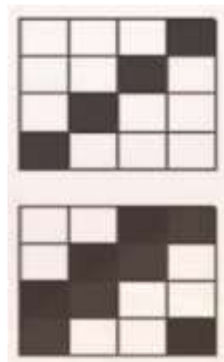
All ends of the same functional structure are pulled over. The same pin shaft. Content that works in different ways is drawn on different handles. Therefore, the number of shafts required for repeated design is equal to the number of threads with different functions in the design.

steps to draw and plan the pins for the structure: first give the first end, then first give all other ends that will serve as the first end. Copy the graphic to the first vertical interval of the view plane. The next extreme edge works differently from the first edge and is shown in the second arc. Endpoints that act in this way are then also shown in the second arc. The second record is copied from the project to the second vertical space in the view plane. This process continues until all ends of the structure are connected to the reserved manholes. Specify the final sketch or vertical plane of this structure.

The relationship between the design, project, and plan of PEG

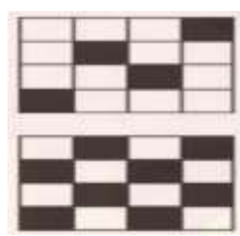
The three factors that weave construction depends on. Design, sketch, and fastening plans are closely related and interdependent. Therefore, it is very important to understand one of the two components, and the third is Can be built. ...For example, if someone knows the design and anchoring

plan, they can create a design. Once you know the layout and layout of the pins, you can create a design.
Drawing Types Various stretching systems are used in
wovenweaves, some of which are common and therefore very important to understand, while others are of course constructed based on architectural or elevation drawings of places such as herringbone or back pull. ... The common drawing systems are:
1. Straight Draft :



(Figure 10.28: Straight draft)

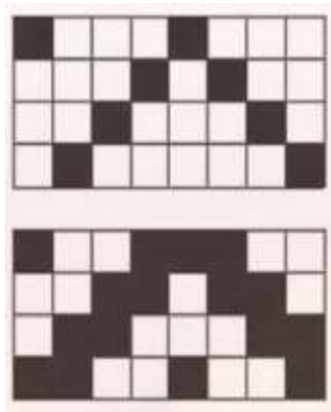
This is the most common and simplest drawing system. In this figure, the continuous end is drawn in the repeat of the pattern during the continuous holding time until the end of the repeat is reached, so in this system, the number of retained axes is equal to the number of repeats of the linear sketch design matching.
2. Skip Draft :



(Figure 10.29: Skip Draft)

Skip draft is used for very dense weaves; these weaves usually require very few rollers to fix, but to reduce friction and friction between the ends and prevent the pillars from climbing into the piled shaft The top is up. When the number of prints used exceeds the minimum required, the item will be used. Taking plain weave as an example, it only needs 2 axes, but it can be drawn on 4 or 6 axes.

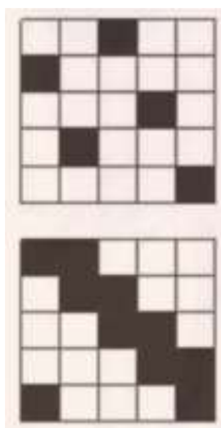
3. Point Draft :



(Figure 10.30: Point Draft)

Point Draft is used for symmetrical weaves, such as wavy or diamond weaves. Its advantage is that it can achieve very good results with half of the axis for straight-shooting.

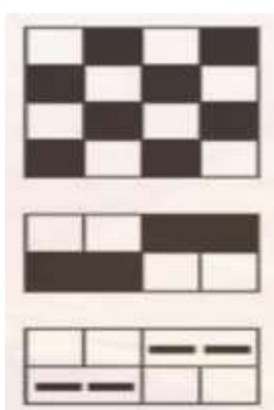
4. Satin Draft:



(Figure 10.31: Satin Draft)

The purpose of this draft is the same as that of a jumper, that is, to reduce friction and crowding between adjacent substrates.

5. Denting :



(Figure 10.32: Two ways of representing Denting pattern)

warps are distributed across the width of the loom. By choosing the correct tongue and different warp sequences, the required warp density (threads per inch) can be obtained. The sequence of dents is to pull the end through the gap between the two wires at the gap. The most common indentation order is one, two, three, or four endings for each indent. It can be conventional. Or equal to the width of the weave, sometimes the shape is irregular to highlight certain design features. The dimple pattern is usually displayed below the pattern.

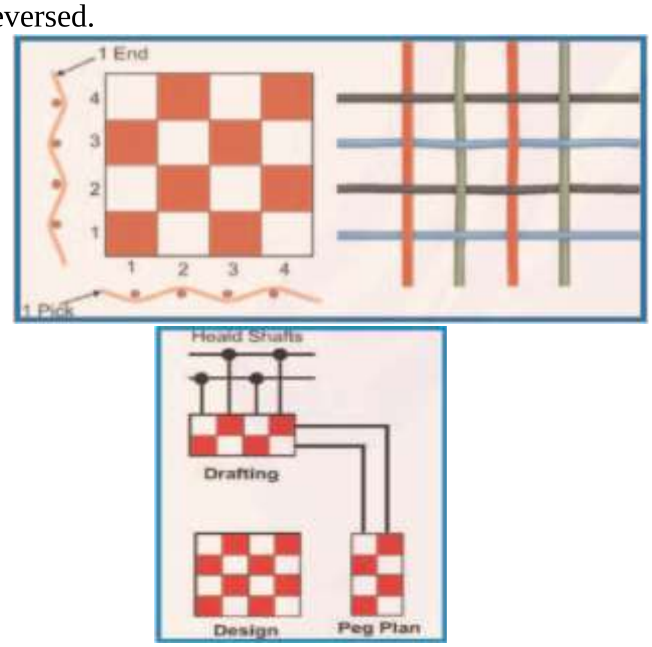
INTRODUCTION TO WEAVE

The weave is drawn on graph paper as described in the previous sections. Before making a weave recommendation, the type of weave used for the weave depends on the required factors, such as texture, gloss, strength, pattern, color, appearance, feel the effect, and manufacturing cost. There are three main weaves:
plain weave,
twill weave,
satin weave and satin weave. All other weaves are just permutations and combinations, whether they are made by hand, machine, or simple pedal loom. , On multi-pedal looms, trolley looms or jacquard articulated looms that use one or more weave designs.

- 1.PLAIN WEAVE

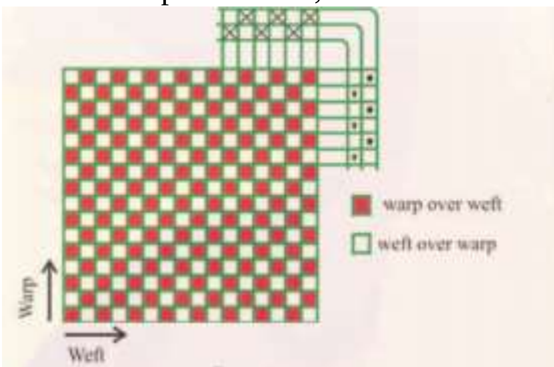
  Plain weave Features

This is the cheapest and easiest weave to make. For plain weave, each warp thread alternately passes through one weft thread and then under the second weft thread. You only need to connect two shafts or straps because the weave repeats every two ends and two points. When one connected axis is raised, the other is lowered, and then the order of the next stop is reversed.



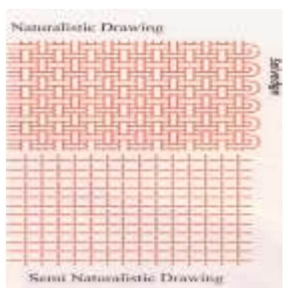
(Figure 10.33. Plain Weave Drafting, Peg plan)

The simplest and most basic combination of two rows of threads for textile weaves in plain weave, also known as a high-density weave.



(Figure 10.34 Warp and Weft weave)

Plain weave is the most common of all weave structures, with the simplest weave pattern, repeated at both ends and top. It also has the highest possible weaving frequency to form a tightly structured weave. The yarn in this kind of weaving is not easy to slip and is more slip-resistant. The warp and weft weave can be viewed in more detail in Figure 10.34, where the natural and semi-natural shapes of the pattern illustrate the warp and weft shown in the weave structure of the hem closure.



(Figure 10.35 Semi-natural pattern)

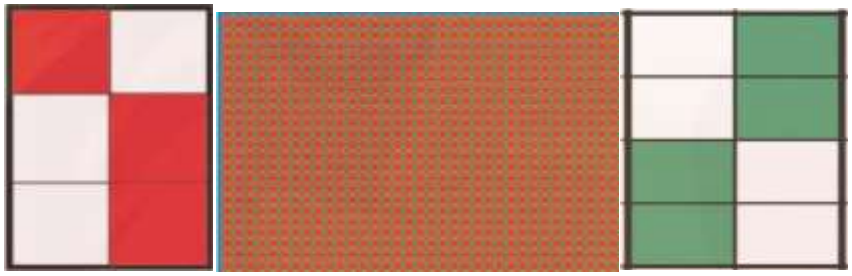
Traditional weaves:

plain weave has the simplest weave. Plain weaves can be expanded horizontally, vertically or both at the same time to make various weave variations. These are called derivatives. It is made of plain weave and can be further modified according to the warp and weft ratio introduced during the weaving process. Depending on the ratio between the selected warp and weft, they can be called normal warp or weft. Ribbed or uneven warp or weft ribs, matt or irregular matt weaves are also often selected for weave structure based on the warp and weft ratio.

2. RIB WEAVE

1. Warp Rib :

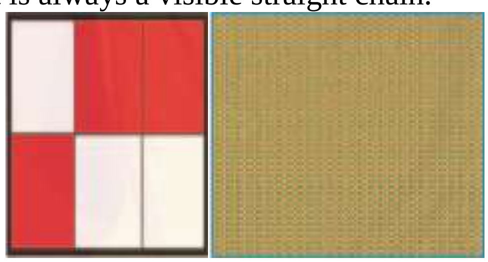
The main rib of the weave is composed of ribs, and each end of the ribs alternates up and down on two or more protrusions. The warp rib effect is visible on both sides of the weave. The warp rib is 2 x 1, and the rib effect occurs in the weft direction.



(Figure 10.36. The difference of warp and weft weaves)

When two picks are inserted between the shape of the shed (chain facing upwards), a 2 x 2 chain rib is formed (see Figure 10A). Insert 4 forks into the compartment, and then form 3 x 3 warp ribs or 4 x 4 warp ribs

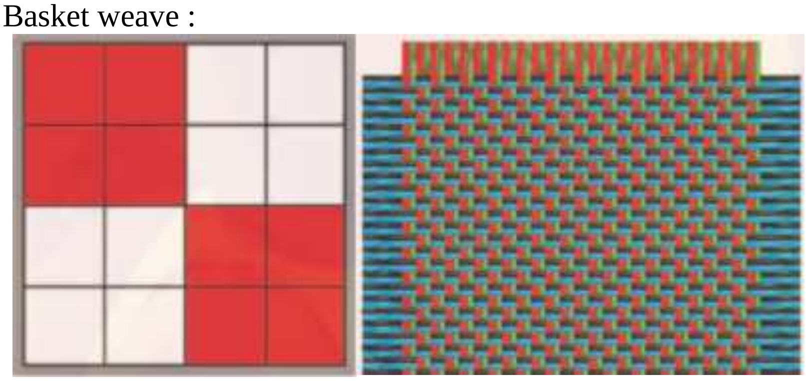
2. Weft Weave :Construct a weave with weft ribs, with two or more outer ribs on each end The above and below alternate. If the 2 ends are lifted alternately, the result is a 2 x 2 weft rib, which consists of 3 ends and 4 ends, resulting in 3 x 3 or 4 x 4 wefts. The weft can be identified by the fact that the weft is always a visible straight chain.



(Figure 10.37 Rib weave)

When weaving, a thick tenon or thick end can be used to replace two or more tenons at the throat or at both ends to combine in one eyelet, to achieve the effect of warp or weft ribs.

3. Basket weave :

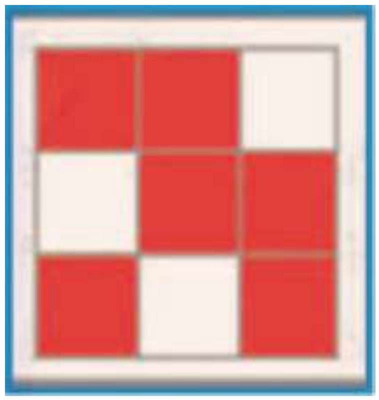


(Figure 10.38 Basket weave)

As one of the taffeta derivatives in the textile industry, matt weaving is the most popular weave.

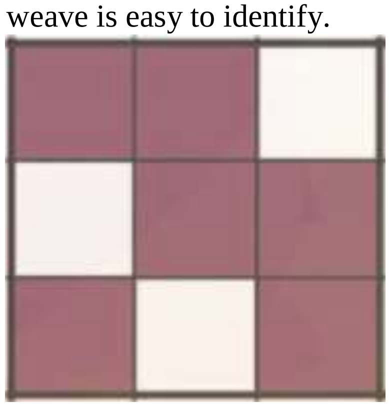
TWILL WEAVE

twillweave is easy to identify-more or less obvious diagonal lines in the warp or weft direction. The most famous twill weave is denim. Body weaves are easily identified by their general characteristics. Have a series of more or less distinct warp or weft diagonals, on equal parts or both sides of the weave. The smallest repetition of the twill weave is connected with 3 bars and 3 bars, with 1/2 or 2/1 twill lift. Twill lines can be made continuously from left to right in the / direction, called right-hand twill or Z-twill, and the twill extending from right to left is called left-hand twill or S-twill: right-hand twill: left-hand twill



(Figure 10.40 Twill weave)

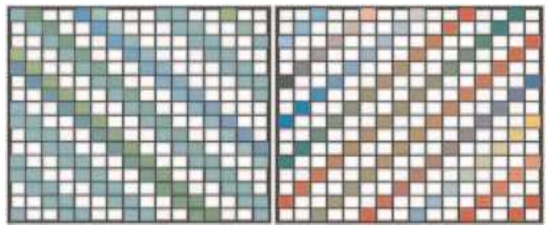
The basic principle of twill weave is that the liquid of each warp or weft can move upward or outward, sometimes in several vertical or weft directions, and can increase or leave to the right. Left, depending on the desired twill direction of the previous warp-up or weft-up. For example, the end of the 3½ twill weave moves to the right as shown in Figure 10.40, the first warp thread crosses the first weft thread, and then the second warp thread crosses the second weft thread. The latitude line, the third line is above the third line, and so on, meaning that each latitude line is the warp line to the right of the previous line. This continuous warp and weft weave forms a diagonal line. This type of twill is called top 1, bottom 2 (1/2 twill), which means that each claw must pass through two under a chain, and so on. Or, you can make another twill cloth, such as B. 2/1 and 3/1, where the chain is more visible on the right side of the weave. Twill strips can be seen on both sides of the weave. When the weave is turned over, the direction of the lines on one side is opposite to the direction of the lines on the other side. Basic twill, called ordinary twill, pure twill, flat twill, and long twill, combined twill, broken twill, pointed twill, wavy or zigzag twill, herringbone twill, and fancy twill weave, and its natural weave is easy to identify.



(Figure 10.41 Twill Weave)

Regular Twill

Regular Twill is the simplest form of twill, which can have the same or irregular diagonal warp and weft, alternating warp and weft. If the number of warp and weft threads increases uniformly, the dimensions of the warp and weft threads on the front and back sides of the weave are the same, but if the lines are uneven, the warp and weft threads on the front side can be the same or different on the front and back of the material. They can be called warp or weft, depending on the prevalence of warp or weft liquid on the surface of the weave.



(Figure 10.42 Ordinary twill weave)

SATIN WEAVE

Satin weave is mainly weft weave, and the satin weave is the main weave. Selection) depends on several factors for obtaining conventional atlas and atlas.

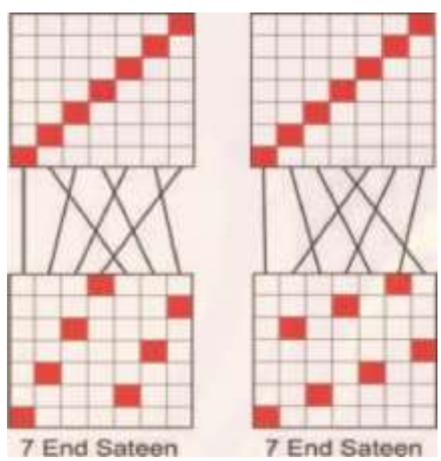
The principles of atlas and atlas construction are based on the following rules:

1. The number of sentences selected shall not be less than one of the repeated dimensions.

2..You cannot specify a sports number as a sport.

3. The number of moves cannot be evenly divided by the number of extremes and peaks in the repetition.

4. The number of mechanisms cannot correspond to the number of repetitions.



(Figure 10.42 Satin and satin weaves)

Rearranged satin weaves can be made from twill weaves, just as twill weaves can be rearranged and transformed into satin weaves. ... A simple system for rearranging traditional continuous twill weave weaves has produced a type of weave called satin or satin weave. The characteristic of these satin or satin weaves is that the warp or weft is uniform and smooth, which is caused by the completely regular crossing of these threads.

CHECK YOUR PROGRESS

1. What are jacquard looms?

2. Write a short note on the History of Textiles.

3. Classify the derivatives of plain weave?

MULTIPLE CHOICE QUESTIONS

1. Satin is a weave where...
(a) Warp is more dominant
(b) Both warp and weft is equal
(c) Weft is more dominant
(d) It produces diagonal lines

2. In warp rib the rib formation is in
(a) Warp direction
(b) Both warp and weft direction
(c) Weft direction
(d) None of the above

10.6 **LET US SUM UP**

In this unit, we learned that the weave consists of two sets of warp and weft. These threads have to withstand various deformations during the weaving process, so they have to go through a series of processes before entering the loom. These are referred to as preparing the organization process. These processes are carried out in the usual way and vary according to the different types of yarns or end weaves to be produced. This chapter introduces students to the preparation process of weaving, that is, all the processes that the yarn goes through before entering the loom. The actual weaving process is a complex process consisting of a series of operations. This chapter explains the Web mechanism by dividing it into simple functions. All parts of the loom are illustrated in linear graphs. The machine is divided into simple functions related to the solidification process. Special attention is paid to the functions that have the greatest impact on the structure and appearance of the weave.

10.7 **KEYWORDS**

Distinguish	manage to discern
Taut	stretched or pulled tight; not slack
Heddles	a looped wire or cord with an eye in the center through which a warp yarn is passed in a loom before going through the reed to control its movement and divide the threads.
Over slung	supported at a level above that of the wheel axles and over slung automobile opposed to underslung.
Underslung	suspended from the underside of something.
Rigid	unable to bend or be forced out of shape; not flexible
Depiction	a representation in words or images of someone or something. The book is fascinating in its depiction of the country's early history.

10.8 **SOME USEFUL BOOKS**

1. Handbook of Weaving
2. A Complete Technology Book of Textile Spinning, Weaving
3. Textile Yarn Technology Structure and Application by Goswami B.C.
4. Textile and Fashion

Sources of Images

All images are from reference books and the internet.

ANSWER

1. The jacquard machine is a device installed on the loom, which simplifies the production process of brocade, brocade, quilt, and other complex pattern textiles. The combination of a loom and a jacquard loom is called a jacquard loom. Joseph Marie Jacquard 1804 [4], based on the early inventions of French Basil Bouchon (1725), Jean Baptiste Falcon (1728) and Jacques Vaucanson (1740). The machine is powered by a "card chain"; a series of punched cards intertwined in a continuous sequence. Each card has several rows of holes, and a complete card corresponds to a row of patterns.

2. The necessary accessories for jacquard technology and looms are named after their inventor. This mechanism is arguably one of the most important knitting inventions because the separation of the jacquard allows an unlimited number of knitting possibilities to be created automatically. The term "jacquard" is not specific, nor limited to a specific loom, but refers to an additional control mechanism that automates the pattern. The process can also be used for printed sweatshirts and woven textiles, such as sweaters.
3. The use of interchangeable punch cards for flow control is considered an important step in the history of computer hardware.

2. Weaving may be as old as human civilization. One of one's needs is to cover the body to protect oneself from external influences (heat/cold) and to look at the eyes in a more "civilized" way. Other reasons for the development of different clothing in history are social status, religious requirements, etc. Clothing trends also vary by location Historical records show that the Egyptians made woven weaves about 6,000 years ago; the Chinese made fine silk weaves more than 4,000 years ago; it is believed that hand-looms have undergone many changes in different civilizations. Knitting started as a family art and went from house to house until the invention of the flying shuttle. The shuttle was invented by Kai in 1733 and was operated manually. In 1745, de Vaucanson made a loom to control each of them and then improved it with jacquard. In 1785, Cartwright invented a loom that could be operated from one point. In the early 19th century, cast iron looms were operated with steam. The loom required stronger winding threads, which led to the development of the first 1803 loom. In 1803, there were approximately 100,000 shuttle looms in operation in England. The processing principles of these looms roughly correspond to today's shuttle looms.In the early 20th century, yarn winding and warping were improved. Weaving machines have been improved, including warp knitting machines and warp knitting machines. After the end of World War II, the modern textile industry began to take shape. The invention of synthetic fibers greatly changed the scope of the textile industry. In 1930, engineer Rothman developed a prototype of the loom sent out. The production of rapier looms and air-jet looms started in

1972 and 1975, respectively, and has remained unchanged for centuries. Today's weaves are made by crossing lines at right angles above and below, just like in the past. For example, this type of textile production has many advantages. g. Stability and resistance to deformation under pressure and tension. These characteristics distinguish weaves from cheaper nonwovens and knitted weaves. Until recently, all weaves in the world were manufactured on single-phase looms, and technological advancements have been focused on accelerating the process of traditional weaving. For example, after centuries of measurements, the dam injection rate has increased from a few meters per minute to more than 2000 meters per minute. The textile machinery fair recorded significant growth. The world's three major textile machinery exhibitions: ITMA held every four years in Europe, ATME held every four years in the United States, and OTEMAS in Japan. These machine exhibitions are usually held alternately. The feed speed of modern single-phase knitting machines has reached its physical limit. Only the use of new technologies such as multi-phase looms can achieve additional output.

3. Plain weave is the easiest to weave. Simple plain weaves can be expanded horizontally, vertically, or bidirectionally to provide you with a variety of weaving options. They are called derivatives of single bonds. The plain weave can be further modified according to the warp-to-weft ratio introduced during the weaving process.

MCQ ANSWERS

(a) Warp is more dominant
(c) Weft direction

UNIT : 11 NON WOVEN FABRICS

STRUCTURE:

11.0 OBJECTIVES

After studying this unit, the student will be able to:

- To understand the basics of Non- Woven Fabrics.
- Gain knowledge regarding types of Non – Woven Fabrics along with the advantages and disadvantage of Non-Woven Fabric.
- To understand the Manufacturing process and Characteristics of Non- Woven Fabric.

11.1 INTRODUCTION

Nonwovens are known as designed textures or engineered fabrics. They are made with a targeted structure and properties. And also made by applying a set of scientific standards for different applications.

Nonwovens are produced by high speed and low-cost processes. As compared to the traditional woven knitting technology, a larger volume of materials can be produced at a lower cost by utilizing nonwoven technology

The manufacturing standards of nonwovens are showed in a special manner based on the technology of creation of textiles, papers, and plastics, the design and properties of nonwovens resemble, to a great extent, to those of materials.

Figure: 1 Non-Woven Fabric

Meanings of nonwovens

Nonwovens are characterized from numerous points of view by different associations and various norms. They are started below:
According to ISO 9092, nonwoven is characterized as "a manufactured sheet, web or batt of directionally or randomly arranged fibers, bonded by friction, or adhesion, excluding paper and products and products which are woven, knitted, tufted, stitch-bonded incorporating binding yarns or fibers or felted by wet-milling, whether or not additionally needled. The fibers might be of natural or man-made origin. They might be staple or continuous fibers or be shaped in the place.

Note: To recognize wet-laid nonwovens from wet-laid papers, a material will be viewed as a nonwoven if

(a) More than 50 % by mass of its sinewy substance is comprised of filaments (barring synthetically processed vegetable strands) with a length to width proportion more noteworthy than300; or, on the off chance that the conditions in a) don't make a difference,
(b) If the accompanying conditions are satisfied:

More than 30 % by mass of its sinewy substance is comprised of strands (barring artificially processed vegetable filaments) with a length to measurement proportion more noteworthy than 300 and its thickness is under 0.40 g/cm 3."

The previously mentioned meaning of nonwoven, given by ISO 9092, has been adjusted by CEN (EN 29092), and therefore by DIN, AFNOR, and all normalization workplaces in the EU.

However, ASTM likes to characterize nonwoven as "a material construction created by holding or interlocking of strands, or both, achieved by mechanical, synthetic, warm, or dissolvable methods, and blends thereof.

Note: the term does exclude paper, or textures which are woven, sewn, tufted, or those made by fleece or other felting measures."

This definition is accessible in numerous ASTM principles.

Today, there are two driving relationship of nonwovens on the planet, to be specific EDANA (The European Disposables and Nonwovens Association) and INDA (The North America's Association of the Nonwoven Fabrics Industry). They have been the voice of the nonwoven ventures in Europe and North America, separately. Nonwovens are characterized by them also. Despite the fact that EDANA has embraced the ISO 9092 or CEN 29092 meaning of nonwoven. In any case, INDA characterizes nonwovens in another way. As per INDA, "Nonwoven textures are comprehensively characterized as sheet or web structures reinforced together by entrapping fibers (and by puncturing films) precisely, thermally or artificially. They are level, permeable sheets that are made straightforwardly from isolated filaments or from liquid plastic or plastic film. They are not made by weaving or sewing and don't need changing the filaments over to yarn."

It is very fascinating to take note that these definitions incorporate crude materials, constructions, and assembling measures utilized to plan nonwovens. Be that as it may, there is no novel meaning of nonwovens found to exist on the planet.

11.2 TYPES OF NON-WOVEN FABRIC

Nonwoven fabric is a fabric like material produced using polymer chips, short fibers or filaments, boned together by assortment of web framing means and union advancements. It is another fiber product which includes super softness, incredible breathability and planar structure. It has the qualities of short process stream, high output, ease, quick assortment change, wide scope of raw material sources and more. The non-woven fabrics can be partitioned into 8 kinds as per different manufacturing professional

There are four primary types of non-woven:

1. **Spun bound / spun lace.**
2. **Air laid.**
3. **Dry laid.**
4. **Wet laid.**

1. **SPUN BOUND / SPUN LACE**

Spun bound fabrics are created by depositing extruded, spun fibers onto an assortment belt in a uniform random way followed by bonding the filaments. The strands are separated during the web laying process via air jets or electrostatic charges. The gathering service is generally perforated to prevent the air stream from redirecting and conveying the fibers in an uncontrolled way. Binding gives strength and trustworthiness to the web by applying heated rolls or hot needles to partially melt the polymer and break the filaments together. Since molecular direction increases the melting point, fibers that are not exceptionally drawn can be utilized as thermal binding filaments. Polyethylene or random ethylene-propylene copolymers are utilized as low melting bonding sites. Spun bound products are utilized in carpet backing, geotextiles, and disposable clinical / hygiene items, automotive items, civil engineering and packaging items. The cycle of Spun bound non-woven production will in general be more efficient as the fabric production is combined with the fiber production.

Figurer: 2 Spun bonded Non-woven fabric

2. **AIR LAID**

The cycle of air laying is a non-woven web shaping interaction that disperse into a quick moving and condenses them onto a moving screen by methods for pressing factor or vacuum. Air laid fabrics is basically made out of wood pulp and has a nature of well absorbing. It tends to be mixed in with a definite extent of SAP to improve its abilities of absorbing wet. Air laid non-woven is referred to as dry paper non-woven. The nonwoven is made through the air laying interaction. Transit the wood pulp into the bundle of air stream to make the fibers to disperse and agglomeration on the floating web. Air laid non-woven is built up of web. Air laid non-woven items are utilized in various products across a wide scope of industry's including; the interlining of garments, medical and hygiene products, embroidery material and filter material.

Figure: 3 Air-laid Non-woven Fabric

3. **DRYLAID**

Dry laid webs are mostly produced using staple fibers natural or manmade. Dry laid webs arrangement essentially consists of 4 stages:
Staple fiber preparation – > Opening, cleaning, blending and mixing – > Carding – > Web laying.

Benefits of Dry laid non-woven: The isotropic structure of the web, voluminous web can be produced. And a wide variety of process, capable filaments like; natural, synthetic, glass, steel and carbon. Dry laid non-woven items are utilized by many items ranging wipes and infant diapers to beverage filtration products.

Figure: 4 Dry laid Non-woven Fabric

4. **WET LAID**

Wet laid non-woven are non-woven made by a modified papermaking process. That is, the filaments to be utilized are suspended in water. A significant objective of wet laid nonwoven manufacturing is to deliver structures with textile fabric qualities, essentially flexibility and strength, at speeds moving toward those partner with papermaking.

Specific paper machines are utilized to separate the water from the filaments to frame a uniform sheet of material, which is then bonded and dried. In the roll good industry 5 – 10 % of nonwovens are made by utilizing the wet laid technology. Wet laid is utilized for a wide ranging amount of industries and items. Probably the common products that use wet laying non-woven technology incorporate; Tea bag paper, Face paper and cloths, shingling and Synthetic fiber paper. Some other normal kinds of non-woven include: Composite, Melt blown, Carded / Carding, Needle punch, Thermal bonded, Chemical bonded and Nanotechnology.

Figure: 5 Wet laid Non-woven Fabric

11.3 MANUFACTURING PROCESS OF NON-WOVEN FABRIC

At the point when it refers to non-woven fabric, really we are not a far away from it as there are different types of non-woven fabric product around us, like non-woven wallpaper, shopping packs, wet wipes, infant dispensable diapers, etc. It is broadly utilized in numerous fields like agriculture, medical industry, packaging, garments, home embellishment and etc. As its appearance and utilizations share a great deal for all intents and purpose with fabric, so it's also called non-woven material. In this chapter, we will learn the various types of non-woven fabrics and the nonwoven fabric producing process.

Applications

Non-woven fabrics are flat or tufted porous sheets that are made directly from separate fibers, liquid plastic or plastic film.

They are not made by weaving or knitting and don't need changing the fibers to yarn. Typically, a specific level of recycle fabrics and oil-based materials are utilized in nonwoven fabrics. The level of recycle fabrics varies depending on the strength of material required for the particular use. Also, some nonwoven fabrics can be reused after use, given the proper treatment and facilities. Hence, some think about non-woven a more environmental fabric for specific applications, particularly in fields and industries where dispensable or single use products are significant, like medical clinics, schools, nursing homes and luxury accommodations.

Nonwoven fabrics are designed fabrics that might be single-use, have a limited life, or be durable. Nonwoven fabrics give specific functions like absorbency, liquid repellence, flexibility, stretch, non-abrasiveness, strength, flame retardancy, wash ability, cushioning, thermal, acoustic protection, filtration, use as a bacterial obstruction and sterility. These properties are frequently combined to create fabrics appropriate for specific job, while accomplishing a good balance between product use-life and cost. They can copy the appearance, surface and strength of a woven fabric and can be as bulky as the thickest paddings. In combination with different materials they provide a range of products with diverse properties, and are utilized alone or as parts of apparel, home decorations, medical care, engineering, industrial and consumer goods.

Manufacturing processes

Nonwovens are typically manufactured by assembling small fibers together in the form of a sheet or web (like paper on a paper machine), and afterward binding them either mechanically (as in the case of felt, by interlocking them with serrated needles to such an extent that the inter fiber friction results in a stronger fabric), with an adhesive, or thermally (by applying binder (as powder, glue, or polymer liquefy) and melting the binder onto the web by expanding temperature).

Staple nonwovens

Staple nonwovens are made in 4 stages. Fibers are first spun, cut to a couple of centimeters length, and put into bundles. The staple filaments are then blended, "opened" in a multistep process, dispersed on a conveyor belt, and spread in a uniform web by a wet laid, air laid, or checking/cross lapping process. Wet laid tasks commonly utilize 0.25 to 0.75 in (0.64 to 1.91 cm) longfibers, however now and then more if the fiber is stiff or thick. Air laid preparing by and large uses 0.5 to 4.0 in (1.3

to 10.2 cm) fibers. Checking tasks ordinarily use ~1.5" (3.8 cm) long fibers. Rayon used to be a common fiber in nonwovens, greatly replaced by polyethylene terephthalate (PET) and polypropylene. Fiberglass is wet laid into mats for use in material and shingles. Synthetic fiber mixes are wet laid alongside cellulose for single-use fabrics. Staple nonwovens are bonded either thermally or by utilizing gum. Bonding can be all through the web by resin saturation or generally speaking thermal bonding or in an unmistakable example by means of resin printing or thermal spot holding. Adjusting with staple filaments for the most part alludes to a blend with melt blowing, frequently utilized in high end textile protections.

Melt-blown

A thermoplastic fiber-forming polymer is extruded through a straight pass on containing a few hundred little holes. Joined floods of hot air quickly weakened expelled polymer stream to shape very fine fiber (1-5 micro meter). The attenuated fibers subsequently blown by high viscosity air onto a collector conveyor.

The resultant web is gathered into rolls and therefore changed over to finished product. The incredibly fine fibers (regularly polypropylene) contrast from different expulsions, especially spun bond, in that they have low characteristic strength however a lot more modest size offering key properties. Frequently melt blown is added to spun bond to form SM or SMS networks, which are strong and offer the inborn advantages of fine fibers like fine filtration, low pressing factor drop as utilized in face covers or filters and actual advantages like acoustic protection as utilized in dishwashers. Probably the largest users of SM and SMS materials is the dispensable diaper and feminine care industry.

Spun laid nonwovens

Spun laid, likewise called spun bond, nonwovens are made in one continuous process. Fibers are spun and directly dispersed later into a web by diverters or can be coordinated with air streams. This method leads quicker belt speeds, and less expensive expenses. A few variations of this idea are accessible, for example, the REICOFIL machinery. PP spun bonds run quicker and at lower temperatures than PET spun bonds, for the most part because of the distinction in melting points

Spun bond has been combined with melt blown nonwovens, adjusting them into a layered item called SMS (spun-liquefy spun). Melt blown nonwovens have incredibly fine fiber diameters but are not solid fabrics. SMS fabrics, made totally from PP are water-repellent and fine enough to fill in as expendable fabrics. Melt blown is regularly utilized as filter media, being able to capture fine particles. Spun laid is built up by either tar or thermally. Regarding the bonding of Spun laid, Reiter has launched another age of nonwovens called Spun jet. In fact, Spun jet is the bonding of the Spun laid fibers because of the hydro entanglement.

Flash spun

Flash spun fabrics are made by spraying a resin into a chamber, where the solvent evaporates.

Air-laid paper

Air-laid paper is a textile like material arranged as a nonwoven fabric produced using wood pulp. Unlike the ordinary papermaking process, air-laid paper doesn't utilize water as the carrying medium for the fiber. Fibers are conveyed and formed to the design of paper via air.

Other

Nonwovens can likewise begin with films and fibrillate, serrate or vacuum-form pattern holes. Fiberglass nonwovens are of two fundamental types. Wet laid tangle or "glass tissue" utilize wet-hacked, heavy denier fiber in the 6 to 20 micrometer distance across range. Flame attenuated mats or "batts" utilize broken fine denier fibers in the 0.1 to 6 range. The last is comparative, however have at a lot higher fever, to melt blown thermoplastic nonwovens. Wet laid mat is quite often wet resin bonded with a curtain coater, while batts are typically spray bonded with wet or dry resin. An unordinary process produces polyethylene fibrils in a Freon-like liquid, forming them into a paper-like item and afterward calendaring them to make Tyvek.

Bonding

Both staple and spun laid nonwovens would have no mechanical resistance all by themselves, without the bonding step. A few techniques can be utilized:

- Thermal Bonding
- Use of a Heat sealer
- using a large oven curing
- calendaring through heated rollers (called spun bond when joined with spun laid webs), calendars can be smooth faced for a general bond or designed for a pattern, more tear safe bond
    - Hydro entanglement: mechanical interlacing of fibers by water jets (likewise called spun lace)
    - Ultrasonic pattern holding: utilized in high-space or fabric protection/quilts/bedding
    - Needle punching/Needle felting: mechanical interweaving of fibers by needles
    - Chemical holding (wet laid process): utilization of binders (like latex emulsion or arrangement polymers) to chemically join the fibers. A more costly route utilizes binder fibers or powders that melt and hold other non-melting fibers together
- one type of cotton staple nonwoven is treated with sodium hydroxide to shrink bond the mat, the burning causes the

cellulose-based fibers to twist and shrink around each other as the bonding method

- one irregular polyamide(Cerex) is self-bonded with gas-phase acid
    - Melt-blown: fiber is bonded as air attenuated fiber interchange with themselves during simultaneous fiber and web arrangement.

11.4 CHARACTERISTICS OF NON-WOVEN FABRIC

The specific arrangement of properties that a non-woven fabric may have is needy upon the combination of factors in its creation. The range of attributes is wide.

Some key qualities of non-woven fabrics that need attention are:

1. The appearance of non-woven fabric might be paper like, felt like, or like that of woven fabric.
2. They may have a delicate, versatile hand, or they might be hard, hardened, or broadly with little pliability.
3. They may be as thin as tissue paper or ordinarily thicker.
4. They likewise might be clear or opaque.
5. Their porosity may go from low tear and burst strength to very high tensile strength.
6. They might be created by gluing, heat bonding, or sewing.
7. The drape ability of this kind of fabrics changes from great to none at all
8. Some fabrics have great launder ability; others have none. Some might be dry-cleaned.

11.5 ADVANTAGE AND DISADVANTAGE OF NON-WOVEN FABRIC

The specific name of the non-woven fabric will be nonwoven. Because it is a type of form that doesn't need spinning weaving fabric, however the textile fiber for directional or random support, the development of the fiber network structure, and afterward the mechanical, thermal or substance techniques and strengthening into. Nonwovens get through the traditional textile standard, and have the qualities of short cycle stream, quick creation, high return, low cost, wide use and many source of raw materials,

Advantages:

1. Aeration Filtration
2. Good water Absorbency
3. Not scalable
4. They are light in weight and breathable
5. Elastic recovery without cloth direction
6. Compared with the creation of textile fabrics high production speed

7. The manufacturing value is low than other fabrics.
8. Can be produced in enormous amounts, etc.
9. It can be recycle.

Disadvantages:

1. Compared with the textile fabric, strength and durability is poor
2. Cannot be washed as other fabrics.
3. The filaments are arranged a specific way, so it is not difficult to part from the right angle. Thus, improvements in the production strategies have recently been made to prevent fragmentation.

11.6 CHECK YOUR PROGRESS

Q: 1What is Non-Woven Fabric?

Q: 2 Are Non-Woven Fabrics Durable?

Q: 3What are the advantages of Non –Woven Fabrics?

Q: 4Why are Non-Woven Fabrics mostly used in automobiles and motorcycles?

11.7 MULTIPLE CHOICE QUESTIONS

1. Basic Types of Non-Woven Fabrics are
(A) 2
(B) 3
(C) 4
(D) 5

2. Manufacturing value of Nonwoven Fabrics are __________ .
(A) Low
(B) Costly
(C) Very Costly
(D) None of above

3. Staple nonwovens are made in ______ stages
(A) 1
(B) 2
(C) 3
(D) 4

11.8 LET-US – SOME-UP

Nonwovens industry is developing exponentially and is finding a specialty in fashion apparel industry, offering a wide variety of items to so many diverse fields. Nonwoven materials offer numerous benefits over traditional fabrics, including cost savings. Nonwovens are widely utilized in the apparel business for interlining, garments, and glove protection. The new research exercises have brought about fabrics with better drape, hand, durability, and stretch and recovery, opening more opportunities for unconventional fabrics. The cost effectiveness of nonwoven fabrics and high speed of nonwoven process give substantial opportunities for nonwoven apparel industry.

11.9KEY WORDS

Drape ability	Mold Surface
Not Scalable	Unclimbable , Impassable
Aeration Filtration	Ventilation , Humidification , Temperature control
Pliability	Adaptable , Pliant , Twisted , Easily bent , Folded
Hydro entanglement	Interlocking , Intricate web
Flame Retardancy	Fireproof , Flame resistant , Unburnable , Noninflammable
Assembling	Manufacture , Construct , Build

11.10SOME USEFUL BOOKS

https://en.wikipedia.org/wiki/Nonwoven_fabric
https://www.carnegietextile.com/what-is-non-woven-fabric-characteristics-and-uses-of-non-woven-fabric/
https://nptel.ac.in/courses/116/102/116102014/
https://oneboxvision.com/news/types-of-non-woven/

Answers

Check Your Process

Ans: 1

Nonwoven fabrics are extensively defined as sheet or web structures bonded together by entangling fiber (and by performing films) mechanically, thermally, or chemically. Non-Woven fabrics are flat, porous sheets that are made directly from separate fiber or from molten plastic or plastic film.

Ans: 2

Non-woven fabrics are flexible, porous, products consisting of one or more fiber layers. They may be classified as either disposable or durable goods. Disposable or non-durable, nonwovens include such single time use products as diapers, medical dressings, household wipes, and disposable protective clothing.

Ans: 3

Non-woven fabrics are non-toxic and non-irritating fabrics. These kind of fabrics are good in water absorbency. They are light in weight, breathable, flexible and rich colors. Non-Woven fabrics are also with decompose. We can recycle Non-Woven fabrics.

Ans: 4

Non-woven fabric has good absorbency, breathable, and low price, etc. So, it is mostly used in replacement air filters for automobiles and motorcycles.

Answers – Multiple Choice Questions

1. **(C)** 4
2. **(A)** Low
3. **(D)** 4

References:

Fig.1 https://www.testextextile.com/wp-content/uploads/2017/04/non-woven-fabric.jpg
Fig.2 http://www.marutipolyfabs.in/images/pro-3.jpg
Fig.3 https://oneboxvision.com/wp-content/uploads/2020/03/spunbound_non-woven-1.jpg
Fif.4 https://oneboxvision.com/wp-content/uploads/2020/03/Airlaid_Non-woven-1.jpg
Fig.5 https://oneboxvision.com/wp-content/uploads/2020/03/drylaid_non-woven-1.jpg

UNIT: 12 FINISHING OF FABRICS

STRUCTURE:

12.0 OBJECTIVES

After studying this unit, the student will be able to:

- To understand the definition of textile finishing and gain basic knowledge regarding finishing process
- Gain knowledge about different types, and methods of finishing process.
- To understand the importance of finishing process in textile manufacturing.

12.1 INTRODUCTION

When fabrics are woven or knitted, freshly falling off the machine, we cannot use them to make garments because they are unrefined and coarse, they likewise shrink tremendously when we wash them. Fabrics at this stage are called grey products which should be treated in various ways to give them theimportant finishing touch. This finishing touch we call as “finish”.

This finishes we apply to fabrics are either for useful reasons or appearances. Today, we can use a wide range of finish on fabrics. Finishing of fabric is the last manufacturing step in the production of Textile fabrics. As a fundamental part of wet processing, Finishing is the operation or activity where the final and last properties are developed.

Textile finishing is an activity which is done out for improving the aesthetic and functional properties of the textile material depending of its end use. The ideal properties may include the fabric’s dimension, their stability, its softness, weight, & handle, just as any required practical properties such as protection from wrinkling, flames, soil, water, bacteria etc.

12.1.1 Definition of Textile finishing and Basic Knowledge of finishing process

Definition of Textile Finishing:

In textile manufacturing, finishing refers to the processes that convert the woven or knitted fabrics into a usable material and more specifically to any interaction performed after dyeing the yarn or fabric to improve the look, performance or "hand feel" of the finished textile product or garments.

In another manner we can define, "Textile finishing is the term for mechanical and chemical cycles utilized on textiles after they have been made".

Basic Knowledge of Finishing process:

In textile manufacturing, finishing refers to the cycles that convert the woven or knitted fabric into a usable material and more specifically to any interaction performed after dying the yarn or fabric to improve the appearance, performance, or "hand" (feel) of the finish material or clothing.

After leaving the Loom or Knitting machine fabric, is not readily useable. It is called grey cloth at this stage, it contains some natural and added impurities. Sometimes it is likewise processed at fiber or yarn phases of textile manufacturing. Grey fiber or yarn or fabric goes through a progression of cycles like wet processing and finishing. Finishing is an expansive range of physical and chemical processes that complete one phase of textile manufacturing and might be planning for the next stage. It makes the fabric more receptive to the next stage of manufacturing. Finishing enhances the product and makes it more attractive, helpful, and useful for the end-user. Improving surface feel, style, and addition of advance chemical finishes are a few examples of textile finishing.
Some finishing techniques, for example, bleaching and dyeing are applied to yarn before it is woven while others are applied to the grey material directly after it is woven or knitted. Some finishing methods, for example, fulling, became outdated with the modern technologies in textile industries, while others, like mercerization, are developments following the Industrial Revolution.

12.2 TYPES OF FABRIC FINISHING

There are many types of textile or fabric finishing. We can't cover them all, here are some important categories and some of the most common processes below.

- **Washing and Drying**

Washing cleans the fabric and removes dirt that may stay following the manufacturing process. It can also involve other finishing processes like bleaching which removes color shading and whitens fabric and scouring which utilizes high temperature and detergents to remove dirt, oil, and wax from manufacturing. During these stage of textile finishing the fabric might also go through special processes like mercerizing which is done to cotton. In mercerizing the cotton fabric is lowered in a sodium hydroxide solution for short periods and then rinsed (washed).This cycle makes cotton fabric stronger, gives it a lustrous or shiny surface and improves its capacity to take dyes and hold more clear colors.

- **Stabilizing**

Fabrics also need to be stabilized. Stabilizing processes are done after washing. Stabilizing process tend to reduce shrinkage, settle condition and rearrange surfaces that might have become stretched during fabric manufacturing. Fabric stabilizing includes processes like calendaring, which compacts textile fibers by pressing or squeezing them between two large heated rollers. Few types of calendaring using various rollers produce specific types of finishes. Some methods may be utilized on specific kinds of fabrics. Fulling is a process that uses heat, moisture and friction on wool fabrics, which can makes them smoother and more compact. It's similar to controlled shrinkage. Another process done specifically to wool is crabbing in which wool fabric is twisted on rollers at high pressure and exposed to hot or boiling baths. This process eliminates distortion and helps set the yarn fibers so they hold their shape.

- **Other finishes**

  Another component of textile finishing include applying chemical substances to fabrics in order to achieve certain outcomes. These might make fabrics resistant to static or help them stay wrinkle free. Substances can likewise be applied to make fabrics water repellent, fire resistant or anti - bacterial. Today there are so many variety of extremely specific finishing cycles to accomplish desired functional results.

12.3 METHODS OF FABRIC FINISHING

There are two main methods of fabric finishing process utilize in textile industries.

1. **Chemical Finishing**
   - Anti – crease Treatment
   - Creping
   - Fire proofing
   - Shrink resistant
   - Mothproofing
   - Oil repellant
   - Water repellant

2. **Mechanical Finishing**
   - Beetling
   - Sanforizing
   - Embossing
   - Calendaring
   - Crinkling
   - Napping
   - Sueding (for better appearance)
   - Glazing
   - Creping

12.3.1Chemical Finishing

Chemical finishing is defined as and includes all cycles after coloration that give better properties and empower the qualified utilization of the treated textiles. Yet, dyers and printers are often responsible for finishes that improve color fastness. These day's colored textiles need to fulfil many requirements. Accordingly improvement in the color fastness is a kind of chemical finishing of specific practical interest and significance. Properties given by these finishes are for the most part improved wet fastness, for example washing, water, perspiration and ironing fastness, at that point better light fastness and only to a small extent improved crocking and rubbing fastness. For other type of color fastness, for example dry ironing, chlorine, peroxide and carbonization, there are no known possibilities for development by an after treatment. The market importance of these finishes depends on client preferences and economic production requests. For a better arrangement, each different fastness improvements will be managed separately.

- Anti – crease Treatment

This finish is given to fabrics (clothing) to take out crease or wrinkle after use.

Pre fix process (pre cure): It is generally used for fabrics which do not require pleats or creases and are to remain flat. All the steps (pad dry and cure) are performed at the factory level.

Post cure preparing: In the post cure process, the uniform distribution of chemical compounds is guaranteed, since sanitization' (use of all essential chemicals followed by a low temperature controlled drying) is done at the factory level in the fabric form.

Anti - crease finish, Wash-and-wear finishes, Durable Press finishes are further development of low maintenance finishes.

- **Fire Retardants**

The requirement for textiles that are nonflammable during their typical time of utilization has led to the development of number of durable fire retardants for cotton fabrics.

Fire retardants based on phosphor amide subordinates have been archived, and their suitability for the fire resistant treatment of cotton fabrics has been assessed. In recent surveys the more significant durable fire retardants utilized as added substances or co-reactants in fibers or in finishes for filaments were summarized.

- **Oil-repellent**

Oil-repellent fabric is generally like the waterproof fabric. This requires exceptionally low surface tension of the fabric. The utilization of fluoro chemical polymers brings about fabrics that are both highly water resistant and profoundly oil resistant by preventing the fibrous material from being wetted and dirtied, by repulsing watery and oily soil particles, and by preventing adhesion of dry soil through anti-adhesive properties

Stain resistant fabrics are treated with chemical blockers that depend on the kind of potential stain. For example, waterborne stains can be resisted utilizing silicon water anti-agents. Then again, oil-based stains can be repelled utilizing fluoro chemical polymers that can prevent oils and water from entering into the fabric and soils from sticking to the fiber surface. This is especially significant for textile products that are not regularly laundered like upholstery fabrics and carpets.

High quality upholstery fabrics are required to save their pleasant appearance for quite a while by being resistant to regular stains in daily life like espresso (coffee) on the upholstered chair or jam on the couch. It should be brought up, in any case, that a conventional fluoro chemical finish has its solidness restriction, especially relation to abrasion obstruction resistance. Abrasion impacts can occur even under mild conditions, for example, seating and arm resting causing abrasion of the micro fine fluoropolymer protection film that covers the fibrous material. This can result in a constant decrease in the stain-or soil-repellent effect.

12.3.2 Mechanical Finishing

Finishing is the last step in fabric manufacturing and is the point at which the final fabric properties are developed. Fabric finishing refers to any process, mechanical or chemical, post dyeing, which prompts an improvement in the look, handle, or performance of the fabric, be it a woven, knitted, or nonwoven material. Generally, these cycles are done on the textile in fabric structure, yet some can also be applied to filaments or yarns. Textile finishing gives a material its last commercial character concerning appearance, shine, handle, drape, fullness, usability, and so on.

Textile finishes generally fall into two classes:

The one is dry or mechanical finishes, for example; calendaring or mangling. And the second is wet or chemical finishes, for example; fluoro chemical or fire retardancy.There is room for crossover, however, with some finishing strategies including both mechanical and chemical finishes. Mechanical finishing or 'dry finishing' utilizes mainly physical (particularly mechanical) intends to change fabric properties and normally alters the fabric's appearance too. In this unit we will discuss the mechanical finishes of fabric.

Application of Mechanical Finishes in Textiles:

Mechanical finishes use heat, pressure, and rollers to grant a specific finish to the material, with the point of improving either its appearance or its handle.Mechanical finishes incorporate calendaring, embossing, and napping. A comprehensive overview of mechanical finishes is beyond the scope of this unit, yet key finishes are discussed.

- **Calendaring**

Calendaring utilizes high temperatures and pressing factors to change the nature of the fabric; this will clearly depend on the initial stage of the fabric. Delicate filaments, or open-weave fabrics, are obviously much more readily affected as compared with fabrics with a tight weave or those made out of hard strands.

Figure: 1Calendaring Machine

Frictional calendaring: In frictional calendaring, there is a speed differential between the pair of rollers, with the end goal that a smooth, shiny appearance is created on the material. One of the rollers is produced using smooth metal and might be heated; this rotates quicker than a second softer roller, which effectively finishes the fabric. In addition to the friction created, which creates a glossy finish to the fabric, the process reduce the gap between the warp and weft threads too.Utilizing this finishes process, for example, Chintz can be produced. For this situation, a padding machine applies the finishing solution for the fabric, which is then partially dried and friction calendared. Use of a resin based solution leads a permanent finish, though with starch or wax, the impact is temporary.

- **Embossing:**

This strategy utilizes heat and pressure to impart an elegant aesthetic appeal to a fabric or article of clothing. The fabric is pressed between two rollers, one is an engraved heated roller and a second softer roller, which makes the embossed image to be raised when compared to the background. In a material setting, embossing is normally utilized in nonwovens like nappies, napkins, and tissue papers, where one may wish to make a logo or a pattern.

Figure: 2 Embossing Machine

Also, embossing can be seen on home furnishing, for example, cushion covers and curtains. It might likewise be utilized on fashionable outfits (evening gown) worn by celebrities.

- **Sanforizing:**

This is a process whereby the fabric is run through a sanforizer; a machine that has drums loaded up with hot steam. In sanforizing process, the fabric and baking blanket (wool or rubber) is taken care of between a feed roller and a curved baking shoe, with the blanket held under some tension.

Figure: 3 Sanforizing Machine

The tension on the blanket is released after passing the fabric and blanket between the roller and braking shoe. The net result is the compaction of the fabric. A particularly simple t method permits garment making with finished material merchandise to be without fear of excessive shrinkage on washing.

- **Raising or Napping:**

The napping cycle can be traced back to Roman times, when dried teasel pods were utilized as a component of the process, and indeed, for woolen garments this procedure persisted until recently.

Napping includes raising the ends of filaments out of the fabric and is performed on both woolen and cotton fabrics, with flannelette being an example of the cotton fabric that has gone through this process.

Fig.: 4 Raising and Napping Machine

The nap is normally brushed one way (one direction) in fabrics, for example, corduroy and velvet to such an extent that light will reflect off the surface with a specific way. Hence, when making articles of clothing from pieces of napped fabric, it is significant that they are completely laid in the same direction; in any case, the finished garment will seem as though it is made of fabrics of different colors. Raising finishing process to successfully raise the nap in woolen fabrics, they should be damped and afterward subsequently dried. Modern strategies utilize metal needles with 45-degree hooks on the end to pull the end of the yarn from the fabric. The rollers generally alternate with one roller, with hooks coordinated toward the fabric feed direction, followed by one with hooks directed to the fabric feed direction. Rotating brushes counter to the rollers clean the napped filaments from the hooks.

- **Sueding:**

Figure: 5 Sueding Machine

This cycle is done by methods for a roller covered with abrasive material. The fabric has a much softer hand and an improved protecting effect because of the fiber end pulled out of the fabric surface.

12.4 IMPORTANCE OF TEXTILE FINISHING

- Finishing process helps to improve the appearance of the fabric and enhance the look of fabric.
- Improve the touch or feel of fabric.
- We can produce variety in fabrics through dyeing and printing.
- Improve the draping ability of light weight fabrics by finishing process.
- Finished fabrics looks attractive, lustrous, and available in different prints and different shades of colors.
- It becomes smooth and wrinkle free fabric, there is no defect on the surface, even width, and free from stains and many more, after finishing fabric.

Improve the value of fabric after finishing, which depends upon the type of the fiber and number and type of finishes applied. And make fabric suitable for specific use.

Check Your Progress

Q: 1 Give the definition of fabric finishing.

Q: 2What is mechanical finishing in textile?

Q: 3Mention the name of different types of mechanical and chemical finishing process use in textile.

Q: 4 Why finishing of fabric is important?

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Multiple Choice Questions

1. **When there is no finish applied on a fabric's surface, it is known as _______________.**
   (A) Dye fabric
   (B) Grey cloth
   (C) Printed
   (D) None of above

2. **Which finishing process produce variety in fabric?**
   (A) Washing
   (B) Printing
   (C) Dyeing
   (D) Dyeing and Printing
3. **The treatment given to fabric to enhance their appearance, performance and handling is known as ______________.**
   (A) Finish
   (B) Heat
   (C) Weaving
   (D) None of above
4. **Which finishing process is not part of chemical finishing method?**
   (A) Napping
   (B) Embossing
   (C) Calendaring
   (D) All of above

12.5 LET US SUM UP

The aim of the textile finishing is to improve the outward appearance and the nature or quality of the fabric, and confer its particular properties.

The entire cycle of finishing consists of mechanical and chemical cycles, which are utilized depending upon the kind and end use of the fabric. Furthermore, it is liable to change different physical and chemical properties of textile materials per client or consumer needs. Textile materials are made with a wide assortment of fiber compositions, yarns and fabric structures.

12.6 KEY WORDS

Mangling	Disfigure , Damage , Injure
Sanforizing	Pre-shrinking
Intends	Appropriate , Proper , Fitting , Suitable
Aesthetic	Creative , Artistic , Inventive , Attractive
Indeed	In fact , Certainly , Perhaps , Surely , Absolutely
Persisted	Endure , Continue , Abide
Flannelette	Cotton flannel , Cloth , Cambric, Muslin

12.7 SOME USEFUL BOOKS

- http://textilesinformation.blogspot.com/2017/05/finishinh-0f-textile-definition-objectives.html
- https://en.wikipedia.org/wiki/Finishing_(textiles)#:~:text=In%20textile%20manufacturing%2C%20finishing%20refers,the%20finish%20textile%20or%20clothing

- https://www.onlineclothingstudy.com/2015/11/different-types-of-chemical-finishes.html
- https://www.sciencedirect.com/topics/engineering/repellent-fabric
- https://textileapex.blogspot.com/2019/01/textile-finishing-types.html
- https://www.dacollege.org/smat/Seri-Sem4-Unit5-TEXTILE-TECHNOLOGY.pdf
- https://nios.ac.in/media/documents/SecHmscicour/english/Home%20Science%20(Eng)%20Ch-11.pdf

Answer

Check Your Progress

Ans: 1

Functional or Performance finishes are treatments or process that are applied to woven or knitted or other fabrics to enhance their appearance, performance and modify their mechanical or chemical properties, is called as Finish.

Fabrics can be made to resist wrinkling, shrinking, soiling, and fading after finishing.

Ans: 2

Mechanical finishing refers to any process performed on fabric or filaments to improve their appearance, performance or 'hand' of the clothing. These kind of processes are designed either to change the dimensions of the fabric, or to alter properties like surface appearance or handle.

Ans: 3

There are many type of chemical and mechanical finishes applied on fabric in textile. Some Mechanical and Chemical finishing process used in textile are mention below:

Mechanical Finishes

- Calendaring
- Embossing:
- Sanforizing:
- Raising or Napping:
- Sueding:

Chemical Finishes

- Anti – crease Treatment
- Creping
- Fire proofing
- Shrink resistant
- Mothproofing
- Oil repellant
- Water repellant

Ans: 4

Finishing is the last or final manufacturing step applied on fabric in production of textile fabrics, which is very important. Finishing process help to improve the appearance of the fabric and enhance the look of fabric. It improve the touch or feel of fabric. We can produce variety in fabrics through dyeing and printing which is part of finishing process. Finishes improve the draping ability of light weight fabrics. Fabrics becomes smooth and wrinkle free, there is no defects on the surface, even width, and free from stains. There are a many more benefits after finishing fabric. Improve the value of fabric after finishing, which depends upon the type of the fiber and number and type of finishes applied. And renders the fabric suitable for specific use.

Answers: Multiple Choice Questions

1 (B)
2 (D)
3 (A)
4 (D)

Reference:

Fig.1 https://image.slidesharecdn.com/textilefinishes-140824224956-phpapp01/95/textile-finishes-13-638.jpg?cb=1408921725

Fig.2 https://image.ec21.com/image/wsmachinery/oimg_GC10736972_CA10759083/3D-Fabric-Embossing-Machine--Garment-Embossing-Machine.jpg

Fig.3 https://www.cibitex.it/wp-content/uploads/2018/06/Shrinktex-W-elenco-e-main.jpg?x58115
Fif.4
https://lh3.googleusercontent.com/proxy/kJXY56IRDRvwj5Vl21Fzss4dHhX6SOu72VCjJeMrjRdGoIw40ocjR2aDH93n1Zgc09dy7wV4w0NIChtWaFf7iD8T5-Gl0_5fJBgEy11qosxbCfZ15fjalogJN9QoSGtk
Fig.5 http://1.bp.blogspot.com/-FVLNRtHUbOI/UPw6ykm9hvI/AAAAAAAAGAg/gkiZzBSO6rA/s1600/Untiytled.jpg

UNIT:13 CHEMICAL FINISHE FOR FABRICS

STRUCTURE:

13.0 OBJECTIVES

After studying this unit, the student will be able to:

- To understand the basic idea of chemical finishes.
- Gain knowledge about different types, and agents of chemical finishing process.
- To understand the students importance of chemical finishing process in textile manufacturing.

13.1 INTRODUCTION

When fabrics are woven or knitted, freshly falling off the machine, we cannot use them as they are to make garments because they are unrefined and coarse, they likewise shrink tremendously when we wash them. Fabrics at this stage are called grey products which should be treated in various ways to give them theimportant finishing touch. This finishing touch we call as “finish”.

Chemical Finishing

Chemical finishing is defined as “wet” finishing, and includes all processes after dyeing that give better properties and empower the qualified utilization of the treated textiles. Yet, dyers and printers are often responsible for finishes that improve colour fastness. These day’s coloured textiles need to fulfil many requirements. Accordingly improvement in the colour fastness is a kind of chemical finishing of specific practical interest and significance. Properties given by these finishes are mostly improved wet fastness, for example; washing, water perspiration and ironing fastness. And also at that point better light fastness and only to a small extent improved crocking and rubbing fastness. For other type of colour fastness, for example dry ironing, chlorine, peroxide and carbonization, there are no known possibilities for development by an after treatment. The market importance of these finishes depends on client preferences and economic production requests. For a better arrangement, each one of these three quite different fastness improvements will be managed separately.

13.2 DIFFERENT TYPES OF CHEMICAL FINISHES FOR TEXTILES

1. **Anti – crease Treatment**

This finish is given to fabrics (clothing) to take out crease or wrinkle after use.

Pre fix process (pre cure): It is generally used for fabrics which do not require pleats or creases and are to remain flat. All the steps (pad dry and cure) are performed at the factory level.

Post cure preparing: In the post cure process, the uniform distribution of chemical compounds is guaranteed, since sanitization’ (use of all essential chemicals followed by a low temperature controlled drying) is done at the factory level in the fabric form.

Anti - crease finish, wash-and-wear finishes, durable press finishes are further development of low maintenance finishes.

2. **Fire Retardants**

The requirement for textiles that are nonflammable during their typical time of utilization has led to the development of number of durable fire retardants for cotton fabrics.

Fire retardants based on phosphor amide subordinates have been archived, and their suitability for the fire resistant treatment of cotton fabrics has been assessed. In recent surveys the more significant durable fire retardants utilized as added substances or co-reactants in fibers or in finishes for filaments were summarized.

3. Oil-repellent

Oil-repellent fabric is generally like the waterproof fabric. This requires exceptionally low surface tension of the fabric. The utilization of fluorochemical polymers brings about fabrics that are both highly water resistant and profoundly oil resistant by preventing the fibrous material from being wetted and dirtied, by repulsing watery and oily soil particles, and by preventing adhesion of dry soil through antiadhesive properties.

Stain resistant fabrics are treated with chemical blockers that depend on the kind of potential stain. For example, waterborne stains can be resisted utilizing silicon water anti-agents. Then again, oil-based stains can be repelled utilizing fluorochemical polymers that can prevent oils and water from entering into the fabric and soils from sticking to the fiber surface. This is especially significant for textile products that are not regularly laundered like upholstery fabrics and carpets.

High quality upholstery fabrics are required to save their pleasant appearance for quite a while by being resistant to regular stains in daily life like espresso (coffee) on the upholstered chair or jam on the couch. It should be brought up, in any case, that a conventional fluorochemical finish has its solidness restriction, especially relation to abrasion obstruction resistance. Abrasion impacts can occur even under mild conditions, for example, seating and arm resting causing abrasion of the microfine fluoropolymer protection film that covers the fibrous material. This can result in a constant decrease in the stain-or soil-repellent effect.

4. Parchmentising

Cellulosic fabrics, when treated with concentrated sulphuric acid under exceptional (special) conditions produce the surprising organdie finish. This cycle is known as parchmentising.

A thin closely woven cotton fabric is transferred into a wonderful transparent fabric with slight stiffness, the impact is permanent. Activity of sulphuric acid is described by three unique effect depending on its solidarity.

5. MOTH PROOFING

"Moth proofing is a finishing which is given to prevent the development or growth of moth." It is one kind of uncommon finishing process of textile. Moth proof finish is a chemical and property giving finish.

- **Purpose of Moth Proofing:**

It is for the most part completed on wool fabrics as the keratin molecules are consumed by moths as food. Since woolen fabrics are costlier, they must be protected from moth. Moth is a small insect that benefits from substances like keratin and fibroin thus animal fibers are more susceptible to the attack of moth. Moth proof finished bag woolen and worsted materials are attacked by moth and immediately eaten away and the housewives must be careful in preserving such garments.

- **Requirements:**
  The finish should not influence the strength, drape, handle, softness, fastness property of dyed fabric and it should not reason any bothering or irritation to the human skin. The finish should be fast to wash, light and washing.
- **Process of Moth Proofing:**
-

Moth proofing should be done in the following ways:

1. By exposing the material to daylight or sulfur-di-oxide.
2. Utilizing Naphthalene balls and para dichloro benzene.
3. Using a few substances containing fluorine like Sodium fluoride, Aluminum fluoride, Potassium fluoride, and Sodium antimony fluoride.
4. Using soluble solvents like Dichlorobenzene, Sulphomethylamid and DichloroTrichloro ethane.
5. Evlan-BL and Mittin FF also produce moth proofing.

These are the bet mothicides (insecticide or fungicide).

The Process Sequence: 1. Pad-dry-fix 2.Concentration-20% on the weight of the material.

13.3 WET FINISHING PROCESS

Basic Knowledge about Wet Processing:

Textile wet processing is the process which can be used in any finishing treatment. Where, this process is applied on textile material in type of liquid with includes some for chemical activity on the textile material.

This is the most widely used wet preparing flowchart in the contemporary textile industry. Be that as it may, some of the time on certain production lines or factories the scouring and bleaching are done all the while.

The principle objective of wet processing in cotton is to take a gray cloth and make it a finished fabric. It can make garments by bringing them into too many techniques of wet process. The wet processing cycle makes the fabric more useable, all the more fine, and more attractive to the buyer. Wet processing is two single words yet means a one thing but if it describes, and it will be a vast process. A wet process is a process that begins with a cycle and gets the end by step by step process. One uncompleted process can demolish the following cycle so each process is equally significant.

Wet processing is a very important process in the fabric manufacturing industry, particularly for natural fiber, cotton is one of them. Wet processing is a stage to turn a fiber into appropriate yarn or fabric. Cotton fibers have impurities and they contain the unusable material into the yarning so that it's impervious to utilize that fiber. Some of the time wet processing makes the cotton more smooth and usable.

Most extreme check of yarning also depends on good quality wet processing. Cotton is regarded as a highly valuable natural fiber so taking extra care of cotton is significant.

Wet handling is a phase to take to make a fiber suitable to make it yarn.

Fabric wet processing techniques

Different wet processing procedures are utilized after weaving and knitting of fabrics for example, Singeing, Desizing, Scouring, Bleaching, Mercerizing and so forth.

The wet processing is a term that includes the mechanical and chemical treatment to improve the aesthetic value of the fabric, yarn, fiber.

The wet processing sector can be divided into three particular areas.

- **Preparation process or preliminary process.**
- **Coloration process.**
- **Finishing process.**

The overall process sequence followed for the fabric wet processing is shown underneath:

- Grey Stitching
- Shearing and Cropping
- Singeing
- Desizing
- Scouring
- Bleaching
- Mercerization
- Dyeing and Printing
- Printing

In this unit we will discuss about only bleaching process, which is a part of fabric finishing process.

- Bleaching:

Figure: 1, Bleaching process machine

Bleaching is a chemical process that disposes of undesirable coloured matter from filaments, yarns, or fabric. Bleaching decolorizes coloured impurities that are not taken out by scouring and prepares the fabric for additional finishing cycles like dyeing or printing. A few different kinds of chemicals are utilized as blanching agents, and determination relies upon the type of fiber present in the yarn, cloth, or finished product and the ensuing finishing that the product will get.

Importance of Bleaching

The purpose of bleaching is to remove any undesirable colour from the filaments and to bring whiteness to fabric. Accordingly it improves the absorbency of the material for dyeing and printing. The most well-known bleaching agents are hydrogen peroxide and hypochlorite.

The most well-known bleaching agents incorporate hydrogen peroxide, sodium hypochlorite, sodium chlorite, and sulfur dioxide gas. Hydrogen peroxide is by a far the most commonly utilized bleaching agents for cotton and cotton blends, accounting more than 90% of the bleach utilized in textile operations, and is typically utilized with caustic solutions. Bleaching contributes under 5% of the total textile factory BOD load (NC DEHNR, 1986).

The bleaching process generally includes the following steps

- The fabric is saturated with the bleaching agents, activator, stabilizer, and other fundamental chemicals;
- The temperature is raised to the suggested level for that specific fiber or blend and held for the amount of time expected to complete the bleaching activity; and the fabric is thoroughly washed and dried.

Finishing of nonwovens in the wet state includes treating fabrics with liquid formulations including watery solutions or dispersions.

Wet processing incorporates

(1) Applying chemicals substances to the fabric;
(2) Fixing the chemicals to the filaments;
(3) Scouring and washing to eliminate unbonded chemicals; and
(4) Drying and curing.

In addition to significant water consumption and the burden of wastewater treatment, most wet finishing treatments likewise include thermal processes to dry and cross-connect the applied chemistry on the fabric. For most of nonwoven fabric applications in the industry, there is as of now no requirement for dyeing processes because of the nature of eventual outcomes. Traditionally, some nonwoven fabrics, for example, shoe linings are dyed utilizing strategies like those utilized by the textile industry, however in many applications, fabric colouration depends on mass colouration and printing methods including computerized stream (digital jet) procedures.

Some of the essential wet finishing cycles will currently be considered.

Washing is probably the easiest wet finishing technique and is utilized to remove undesirable substances from fabrics and to soften them.

Chemical Finishing includes applying chemical to the fabric that might be dissolved or suspended in a liquid medium like water. Frequently utilized chemical finishing agents are as below.

1. **Antistatic agents ('antistats'):** These chemicals can be either durable or nondurable once applied to the textile material or fabric. The determination is partly dependent on the intended life of the product. Examples - durable antistats incorporate vapor deposit metals, conductive carbon or metallic particles applied related to binders, polyamines, polyethoxylated amine, ammonium salts and carboxylic salts. Instances of nondurable antistats incorporate cationic (quaternary ammonium salts, imidazoles and fatty amides), anionic (phosphates, phosphate esters, sulfonates, sulfates and phosphonates) and nonionic antistats (glycols, ethoxylated unsaturated fats, ethoxylated fatty alcohols and sorbitan unsaturated fat esters).
2. **Antimicrobials:** The anticipation and control of the growth of bacteria, fungi, algae and viruses on fabrics is significant in numerous applications, especially those proposed for use in clinical and hygiene products, where infection control is significant.

   Antimicrobials might be solid or leachable. Mechanically used antimicrobials incorporate alcohols like isopropanol or propylene glycol, halogens such as chlorine, hypochlorite, iodine, N-chloramine and hexachlorophene, polyhexamethylene biguanide, metals like silver nitrate, mercuric chloride and tin chloride, different peroxides, aldehydes, phenols quaternary ammonium compounds, phosphoric acid esters and pine oil derivatives.

- **Necessity of Antimicrobial Finishes**

Antimicrobial treatment for textile materials is important to fulfill the accompanying objectives:

1. To avoid cross infection by pathogenic microorganisms.
2. To control the infestation by microorganisms.
3. To arrest metabolism in organisms (microbes) to decrease the formation smell.
4. To defend the textile product from staining, discolouration and quality deterioration.

- **Requirements for Antimicrobial Finish:**

Textile materials, specifically the garments are more susceptible to wear and tear. It is important to consider the effect of stress strain, thermal and mechanical effect for the finished substrates.

The accompanying requirements should be fulfilled to acquire maximum benefits out of the finish:

1. Strength to washing, dry-cleaning and hot pressing.
2. Particular activity to undesirable microorganisms.

3. Should not produce harmful effect to the maker (manufacturer), user and the environment.
4. Should consent to the legal necessities of directing organizations.
5. Similarity with the chemical processes.
6. Simple technique for application. No deterioration of fabric quality.
7. Resistant to body fluids; and resistant to sanitizations/sterilization.

- **Benefits Of Antimicrobial Textiles**

A wide range textile material is currently accessible to help the buyer. At first, the primary objective of the finish was to protect textiles from being influenced by microorganisms especially fungi. Tents, uniforms, defense textile materials and specialized materials, for example, geo-textile materials all are finished utilizing antimicrobial agents. Afterward, the home textiles, for example, curtains covering, and bath mats accompanied antimicrobial finish. The use of the finish is presently extended to textiles utilized for outdoor, healthcare area, sports and relaxation. Novel technologies in antimicrobial finishing are successfully utilized in nonwoven sector particularly in medical textiles. Textile filaments with built in antimicrobial properties will also serve the need alone or in mixes with different fibers.

Bioactive fiber is a modified type of the finish, which incorporates chemotherapeutics in their structure, i.e., manufactured medications of bactericidal and fungicidal characteristics. These filaments are not just utilized in medication and health prophylaxis applications yet in addition for manufacturing textile products of day by day use and technical materials. The field of utilization of the bioactive filaments incorporates sanitary materials, dressing materials, surgical threads, materials for filtration of gases and liquid, air conditioning and ventilation, constructional materials, special materials for food industry, automobile industry, pharmaceutical industry, garments industry, footwear industry, etc.

3. Water repellents (anti-agents): Chemical finishes can be applied to fabrics to

Increase the water contact angle on the fabric surface to such an extent that it is greater than 90° and to give the least possible basic surface tension. Water repellent agents generally incorporate substances that have low surface tension, for example, waxes, wax dispersions, melamine wax extenders, chrome complexes, silicones and fluorochemical.

Other finishes that are regularly applied to nonwoven fabrics for specific applications include UV absorbers, polymer stabilizers, fire retardants, conditioners, re-wetter’s, fragrances, adhesive binders, cross-connecting agents, soil release chemicals, whiteners and fluorescent agents. Note that solid particles, for example - microcapsules, abrasives and fillers may likewise be applied to fabrics related to binders that cling them to fiber surfaces.

13.4 IMPORTANCE OF CHEMICAL FINISHES IN TEXTILE

Chemical finishing is always a significant component of textile processing because it makes textile material attractive and easy to understand, which is user friendly. In last few years there has been a growing trend towards 'innovative' and 'high-tech' textile items. As the utilization of high-tech textile materials has grown, the requirement for chemical finishes to give the fabric properties needed in these special applications has grown accordingly.

One strong future trend is the continuing incorporation of an easy to use PC control into textile finishing equipment. Touchscreen controls with straightforward symbols have been introduced on numerous machines, and more versatile microprocessors are being used, not only to screen machine and process parameters, yet in addition to control the process through close feed-back loops. A feed-back loop is the way by which a portion of the output of a circuit, system, or device is returned back to the input.

Moreover, production information are being recorded and stored so they can be recalled for some time in the future use. A significant trend is to give improved and more consistent quality in finishes yarns, fabrics, and garments. Machinery manufacturers perceive the requirement for continuous competitiveness, and they are supplying their clients with the way to increase productivity while reducing overhead expenses. The developing fame of short manufacturing runs requires finishing machinery that can give the ideal fabric properties over a more extensive scope of fabrics.

Check Your Progress

Q: 1What are the different chemical finishes used in fabric?

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Q: 2What are the necessity of Antimicrobial finishes?

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Q: 3Why chemical finishes important for fabrics?

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Q: 4What is the meaning and purpose of Moth Proofing finish?

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Q: 5Which processes are included in Wet processing Finish?

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Multiple Choice Questions

Q: 1 Moth Proofing is part of _______________________.

(A) Mechanical Finish
(B) Dyeing and Printing
(C) Chemical Finish
(D) None of above

Q: 2 Anti - crease finish, Wash-and-wear finishes, Durable Press finishes are further development of ______________________finishes.

(A) Low maintenance
(B) High maintenance
(C) None of above
(D) Both A and B

Q: 3Which step is not a part of Wet Processing?

(A) Bleaching
(B) Napping
(C) Scouring
(D) All of above

13.6 LET US SUM UP

Chemical finishing is always a significant component of textile processing because it makes textile material attractive and easy to understand, which is user friendly. In last few years there has been a growing trend towards 'innovative' and ‘high-tech’ textile items. As the utilization of high-tech textile materials has grown, the requirement for chemical finishes to give the fabric properties needed in these special applications has grown.

13.7 KEY WORDS

Perspiration	Sweating, Sudation
Solidarity	Strength, Harmony
Co-Reactants	Reaction partner, Reacting agent
Deterioration	**D**ecline, Degradation, Depreciation
Repulsing	Awful, Appalling
Disposes	Eliminates
Determination	Selection
Relies	Depends
Upholstery Fabrics	Covering, Cushioning
Dispersions	Deterioration, Decline
Ensuing	Subsequent
Substances	Support, Aid

13.8 SOME USEFUL BOOK

- **https://www.onlineclothingstudy.com/2015/11/different-types-of-chemical-finishes.html**
- **https://www.textileflowchart.com/2014/12/flow-chart-of-wet-processing-process.html**
- **https://www.textileschool.com/343/fabric-wet-processing-techniques/**
- **https://gcwgandhinagar.com/econtent/document/1587449364FINISHES_IN_FABRICS.pdf**
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Answer
Check your progress

Ans: 1

There are various types of finishing process included in chemical finish. Here are some finishes mansion below;

- Anti – crease Treatment
- Creping
- Fire proofing
- Shrink resistant
- Mothproofing
- Oil repellant
- Water repellant

Ans: 2

Necessity of Antimicrobial Finishes

Antimicrobial treatment for textile materials is important to fulfill the accompanying objectives:

1. To avoid cross infection by pathogenic microorganisms.
2. To control the infestation by microorganisms.
3. To arrest metabolism in organisms (microbes) to decrease the formation smell.
4. To defend the textile product from staining, discolouration and quality deterioration.

Ans: 3

Chemical finishing is always a significant component of textile processing because it makes textile material attractive and easy to understand, which is user friendly. In last few years there has been a growing trend towards 'innovative' and ‘high-tech’ textile items. As the utilization of high-tech textile materials has grown, the requirement for chemical finishes to give the fabric properties needed in these special applications has grown accordingly like.

Ans: 4

"Moth proofing is a finishing which is given to prevent the development or growth of moth." It is one kind of uncommon finishing process of textile. Moth proof finish is a chemical and property giving finish. Moth Proofing finishes mainly carried out on wool fabrics.

Purpose of Moth Proofing:

Moth Proof finish is for the most part completed on wool fabrics as the keratin molecules are consumed by moths as food. Since woolen fabrics are costlier, they must be protected from moth. Moth is a small insect that benefits from substances like keratin and fibroin thus animal fibers are more susceptible to the attack of moth. Moth proof finished bag woolen and worsted materials are attacked by moth and immediately eaten away and the housewives must be careful in preserving such garments.

Ans: 5

Finishing of nonwovens in the wet state includes treating fabrics with liquid formulations including watery solutions or dispersions.

Wet processing finish include some step by step processes, which are as following;

(1) Applying chemicals substances to the fabric;
(2) Fixing the chemicals to the filaments;
(3) Scouring and washing to eliminate unboned chemicals; and
(4) Drying and curing.

Multiple Choice Questions

Ans: 1 (C)
Ans: 2 (A),
Ans:3(B)

References:

Figure:1https://www.erbatech.com/files/erbatech/products/Bleaching/SCOUT%20%28Pad-steam%20bleaching%29%20-%201.jpg

UNIT: 14

PRACTICAL EXERCISE OF IDENTIFICATION FOR

STRUCTURE:

14.0 OBJECTIVES

After studying this unit students will understand,

- Fabric or Fiber lab test, identify and differentiate natural fabrics like cotton, silk, wool from synthetic fabrics such as polyester and nylon
- Identifying and classifying fibers used in fabrics and give manufacturers valuable information on the quality and authenticity of materials used in production.

14.1 INTRODUCTION

There are many types of textile fibers used in apparels. Furthermore the types and numbering of yarns. Therefore it is important to learn the various methods used to identify different textile filaments or fabrics.

The information on recognizing the fabrics or fibers helps a maker of garments to distinguish the type of fiber and the attention to be given in maintaining the fabrics made out of a particular fiber. This is a significant factor for labeling of cloths, which incorporates determining the fiber content in the garment.

There are various tests which could be utilized for the identification of the textile fabrics and fibers like burning test, microscopic test, solubility test, optical test, fabric or fiber density test and so on. This chapter discusses the basic knowledge of the essential tests like burning, touching, feeling, microscopic and chemical test of recognizing the fabric and textile filaments.

14.2 DIFFERENT TECHNIQUES OF FABRIC IDENTIFICATION

14.2.1 Touch/Feel

There are numerous things you can measure about a fabric just by looking at it. You can determine the finish of fabric effectively enough. You can determine the smoothness, stiffness and the overall feel of the fabric by running your hand over the fabric.

At the point when you attempt to crease the fabric, you will find cotton and linen fabric wrinkles and may even hold the crease, while wool and silk will spring back.

Figure: 1 Touch and feel test

The information about different parts of fabrics like the type of fabric filaments regularly seen, kind of fabric weaving utilized, fabric patterns , fabric types, fabric finishes utilized, thread count of fabric, denier of fabric, recognizing the fabric by it texture etc. creates a difference in the fabrics.

Here are a few of the attributes you will find when touching different fabrics:

- Cotton

One approach to do this isn't to utilize your hands. Rub the material gently across your cheek and perceive how the material feels against such delicate skin. Cotton should feel gentler (softer) than different materials in addition to have more texture than polyester.
A polyester cotton texture will be smoother and slicker than 100% cotton. At that point an all poly clothing item will have a more artificial feel about it. It could be difficult to advise when you are attempting to sort out since the manufacturing of fabrics has been updated over the years.
In some cases the best way to tell is by perusing the mark. 100% cotton ought to have a different feel in comparison to different fabrics including natural ones yet that may not always be the case. Cotton comes in countless various styles and textures, like canvas or light to heavyweight materials, that it will have an alternate feel in any event, when comparing different 100% cotton items.

Do not be disturbed in case you are tricked when you do the touch test. It is difficult to differentiate just by touch alone. Manufacturers make synthetic items just to feel and act like cotton.

- **Silk** –.Simply touch silk and it feels very smooth, the fabric has a bright and luster look with soft and waxy feeling. And if you scrunchit up a bit in your hand, you should hear a crunching noise – that sound should tell you that it’s the real silk
- **Wool** - is coarse to the touch and you should feel distending (protruding) filaments from the fabric.
- **Polyester and Rayon** - smooth to the touch, have a gloss or luster to their look.
- **Twill** - coarse to the touch and there ought to be a diagonal vibe to the material.
- **Nap materials like Velvet and Pile** - smooth when touched yet comes with circles and hairy structure.
- **Nylon and Satin** – It feels very tricky and the surface reflect light.

That gives you an idea of the differences between the fabrics when you touch or feel them.

14.2.2 Burning test

Natural fabric
Fabric Identification – The burn test

Alert. Caution. BE CAREFUL! This should just be done by skilled burners! Ensure there is a bucket of water nearby and that you burn in a metal bucket or non-plastic sink.

To distinguish (identify) fabric that is unknown, a basic burn test should be performed to decide whether the fabric is a natural fiber, man-made fiber, or a blend of natural and man-made filaments. The burn test is utilized by many fabric stores and designers and takes practice to decide the specific fiber content. In any case, an inexperienced person can still decide the difference between many fibers to "narrow" the decisions down to natural or man-made fibers. This elimination cycle will give information necessary to choose the care of the fabric.

Warning: All filaments will burn! Asbestos treated filaments are, generally flame resistant. The burning test ought to be finished with alert. Use a small piece of fabric in particular. Hold the fabric with tweezers, not your fingers. Burn over a metal dish with soft drink (soda) in the bottom or even water in the lower part of the dish. A few fabrics will igniteand melt. The result is burning dribbles which can hold fast to fabric or skin and cause a serious burn.

There are some very important things to keep in mind before you attempt burning.

Wear non-inflammable garments when using the test. In the event that you are a child ensure an adult knows about this and comes to supervise the activity. Utilize these tests on flammable materials with most extreme alert. Keep damp woolen material nearby to put out a fire. Keep hair out of flame and don't allow the burning material to touch skin.

The result of fabric burning test may raise questions now and when the various filaments are twisted together. Different finishes utilized on the fabric also may result in varying results.

Fabric Identification – Natural Fibers

Natural Fibers are a class of hair-like materials that are persistent fibers or are in discrete lengthened pieces, like pieces of thread. They can be spun into fibers, threads, or rope. They can be utilized as a part of composite materials. They can likewise be matted into sheets to make products like paper or felt. Fibers are of three kinds: Natural fiber, Cellulose fiber, and Synthetic fiber. The earliest proof for people utilizing filaments is the disclosure of wool and dyed flax fibers.

- **Cotton:**

Figure: 2 Burning test

Cotton is a plant fiber. When ignited it burns with a steady flame and smells like burning leaves. The ash left is effortlessly crumbled. Small samples of burning cotton can be extinguished as you would a candle.

- **Linen:**

Linen is likewise a plant fiber however not the same as cotton in that the individual plant fiber which make up the yarn are long where cotton filaments are short. Linen takes more time to ignite. The fabric nearest to the ash is exceptionally fragile. Linen is effortlessly extinguished by blowing on it as you would a candle.

- **Silk:**

Silk is a protein fiber and generally burns promptly, not really with a steady flame. Silk smells like burning hair. The ash is effortlessly disintegrated (crumbled). Silk tests are not as easily smothered as cotton or linen.

- **Wool:**

Wool is also a protein fiber yet is easier to ignite than silk as the individual "hair" filaments are shorter than silk and the weave of the fabrics is for the most part looser than with silk. The flame is consistent (steady) however more hard to continue to burning. The smell of burning wool resembles burning hair.

Man Made fibers

Fabric Identification – The Burn test

Man Made Fibers, frequently referred to as man-made filaments, are the result of broad research by researchers to improve naturally occurring animal and plant fibers. When normally synthetic fibers are made by forcing, ordinarily through extrusion, fiber forming materials through openings (called spinnerets) into the air, shaping a thread. Before synthetic filaments were grown, artificially produced fibers were produced using cellulose, which comes from plants. These filaments are called cellulose fibers.

Synthetic Fibers

Synthetic fibers represent about half of all fiber use, with applications in each field of fiber and textile technology. Although numerous classes of fiber dependent on synthetic polymers have been assessed as possibly valuable commercial products, four of them – nylon, polyester, acrylic and polyolefin – rule the market. These four account for roughly 98 % by volume of synthetic fiber production, with polyester alone representing around 60 %.

- **Acetate**

Acetate is produced using cellulose (wood fibers), in fact cellulose acetate. Acetate burns promptly with a flickering flame that can't be easily stifled. The burning cellulose drips and leaves a hard ash. The smell is like burning wood chips.

- **Acrylic**

Acrylic technically acrylonitrile is produced using flammable gas (natural gas) and petroleum. Acrylics burn promptly because of the fiber content and the lofty, air filled pockets. A match or cigarette dropped on an acrylic blanket can light the fabric which will burn quickly except if extinguished. The ash is hard. The smell of acrylic fabric is acrid or harsh.

- **Nylon**

Nylon is a polyamide produced using petroleum. Nylon melts and then burns quickly if the fire stays on the melted fiber. In the event that you can keep the flame on the melting nylon, it smells like burning plastic.

- **Polyester**

Polyester is a polymer produced from coal, air, water, and petroleum based commodities. Polyester melts and burns at the same time. The melting, burning ash can bond rapidly to any surface it trickles on including skin. The smoke from polyester is black with a sweetish smell. The doused ash is hard.

- **Rayon**

Rayon is a regenerated cellulose fiber which is practicallyunadulterated cellulose. Rayon burns quickly and leaves just a slight ash. The burning smell is like burning leaves.

- **Blends**

Blends consist of at least two fibers and, ideally, are supposed to take on the characteristics of every fiber in the blend. The burning test can be utilized yet the fabric content will be an assumption for fabric recognizable proof or identification.

❖ Fabric Burn Test – Chart of Natural and Synthetic Fabrics

Types of fabric	Reaction to flame	Burning behavior	Odour of flame	After the flame is over	Type of Ash
Cotton, Hemp, Ramie	Does not shrink away from flame; Ignites easily on contact with flame	Burns rapidly with a yellow flame and light grey smoke.	Burning paper.	Continues to burn, there is an after glow.	Soft Grey powdery smooth ash
Linen	Does not shrink away from flame; Ignites easily on contact with flame	Burns rapidly with a bright yellow flame and light grey smoke.	Burning paper.	Continues to burn, there is an after glow.	Soft Grey powdery smooth ash
Rayon, Tencel	Does not shrink away from flame; Ignites easily on contact with flame	Burns rapidly with a yellow flame and light grey smoke.	Burning wood or paper.	Burns slowly without flame with slight melting	No ash
Wool	Shrinks away from flame.	Burns slowly with an orange colour but does not melt; small flickering flame	Strong odour of Burning hair or feather	May self-extinguish i.e. it burns itself out	Crushable black bead that turns to ash.
Silk	Shrinks away from flame.	Burns slowly sizzles but does not melt	Burning hair.	May self-extinguish	Crushable black bead that turns to ash.
Acrylic, Olefin	Melts and pulls away from the flame.	Melts and burn rapidly with hot sputtering black flame	Acrid Chemical odour (Fishy odour)	Continues to burn and melt.	Forms irregular small beads in black / tan
Modacrylic	Melts and pulls away from the flame.	Difficult to ignite; Melts and burn	Chemical odour	Self-extinguishes with white	Forms small hard beads in

Types of fabric	Reaction to flame	Burning behavior	Odour of flame	After the flame is over	Type of Ash
				smoke.	black
Spandex	Melts but does not pull away from the flame.	Melts and burn	Musty Chemical odour	Continues to burn and melt.	Soft sticky black ash.
Polyester	Melts and pulls away from the flame.	Melts and burn with black smoke	Sweet chemical odour	Continues to burn and melt.	Forms small hard beads in cream and later tan colour
Acetate	Melts and pulls away from the flame.	Melts and burn with yellow flame	Acrid, harsh, sharp odor.	Continues to burn and melt.	Forms small beads
Nylon	Melts and pulls away from the flame.	Melts ; bubbles as it burns	Acrid, harsh, sharp odor.	Continues to burn and melt.	Forms small beads

14.2.3 Microscopic Test

Close assessment of the texture filaments

You can take a look at the fabric through a microscope and identify the fiber effectively as a result of its particular properties. To do this pull a yarn in the lengthwise direction. Open up its fibers. Keep the fibers on a slide with a drop of refined water. Examine under a magnifying lens. Compare to a known fiber.

Cotton – The finished cotton fiber will be swollen, straight, smooth and round with a shining surface. On the off chance that the fabric has a nap, when you run a moistened finger on cotton filaments, the filaments will down.

Linen – the fiber will have nodes at intervals like a piece of bamboo with numerous joints. At the point when you look at linen and cotton filaments, cotton fiber will be whiter in shading, soft and dull while linen fiber will be stiffer and creamy in colour.

Figure: 3 Microscopic test

Silk – the fiber will be straight, extremely fine and smooth.
Nylon –the fiber will have a shiny appearance
Wool– the fiber will be springly and tough and lustrous. If the fabric has a nap, when you run a moistened finger on the filaments, the fibers will jump up
Rayon – the fiber will be extremely fine and delicate. It can take after silk fibers however rayon fiber isn't as soft or fine as silk.

14.2.4 Other Industrial Fabric Test

- **Chemical Solubility Tests**

These are tests that help to decide the fiber content of a fabric. Here solvents are utilized to distinguish (identify) one fiber from another. Reactions of fibers to common and alkaline solutions are utilized in these tests. Acetate fabric dissolve in acetone nail polish remover.

Stain tests to identify synthetic fibers

These are tests used to identify filaments utilizing stains and dyes. Fibers are colored or stained with reagents.

- **Specialized machines**

An infrared spectrophotometer is utilized to independently identify man-made fibers in a blended fabric.

- **Tensile strength tests**

Figure: 4 Chemical test

These are tests done during fabric development and manufacturing – strip tensile test, wide width elastic test, and grab tensile test are the various tests utilized. In the strip tensile test, the fabric is pulled from ends and an elastic burden is applied to test its strength Grab tensile test and wide width tensile tests are utilized for modern industrial fabrics.

- **Fabric Bow and Skew**

There are machines to test the manner in which filling yarns in a fabric lie in a circular segment. In the fabric, warp yarns are typically straighter than filling yarns since filling yarns may have more tendency for bow and skewness. The selvage of the fabric runs corresponding to the warp direction.

- **Standard fabric tests**

Here are the significant standard fabric tests utilized by American Association for Textile Chemists and Colorists to recognize different characteristics.

Tear resistance tests – Tongue test and Elmendorf test are the two tests used to test the resistance of fabric's Fabric count of the woven fabric.

The width of woven fabric

Climate resistance

Test technique for flammability of fabrics

Colorfastness testing

Wrinkle or Creasing in fabrics

The resistance of Apparel fabrics to pilling

Stretch properties of fabrics woven from stretch yarns

Abrasion resistance of fabrics

Thickness of fabrics

Water repellency and resistance

Identification of finishes in Fabrics

Standard determination for knitted fabrics

Insect pest deterrents on fabrics

Wrinkle recovery of fabrics

Protection from yarn slippage at the sewn seam in Upholstery fabrics; The stiffness of fabric by the circular bend methodology; Bursting strength and lengthening of sewn seams of knit or woven stretch textile fabrics; Grayscale for staining; Grayscale for colour shading change; Bond strength of bonded fabrics; Light blocking effect of curtain fabrics; Smoothness of seam.

Electrostatic sticking of fabrics; Color measurements of textile; Antifungal and Antibacterial finishes in textile; Oil repellency; Evaluation of wetting specialists.

Check Your Progress

Q: 1How can you Identify Fabrics?

Q: 2What are the Natural Fibers, give example?

Q: 3How can you tell if a fabric is cotton by touching?

Q: 4What is Chemical Solubility tests?

Q: 5What is the burning characteristics of Spandex?

Q: 6What is the burning characteristics of Linen fabric?

Multiple Choice Questions

Q: 1Which fiber is man-made fiber?
(A) Cotton
(B) Polyester
(C) Wool
(D) Silk

Q: 2Which fiber will have shiny appearance in Microscopic test?
(A) Wool
(B) Nylon
(C) Cotton
(D) All of above

Q: 3Which kind of fiber gives the smell of burning hair?
(A) Cotton
(B) Silk
(C) Wool
(D) Both (B) and (C)

Q: 4Which fiber is most flam-resistant?
(A) Cotton
(B) Silk
(C) Wool
(D) None of above

14.5 LET US SUM UP

At the point when you go to purchase fabric in a shop, the last thing you have as a primary concern is to burn them – yet at this point and then that is actually what you need to do. The fabric burn test is one of the many strategies for fabric identification that is vouched by all the textile specialists

For design, wrap and visual effect you need to know precisely the thing you are making the piece of clothing with, which is the place where these texture testing methods come to be useful.

14.6 KEY WORDS

Scrunch	Crumple, Squeeze
Ignite	Light
Distinguish	Identify, Know, Discover
Dribbles	Drips, Trickle, Fumble
Persistent	Continues
Flickering	Flash, Shimmer
Extinguished	Blown
Fragile	Brittle, Breakable, Frangible
Quenched	Extinguished, Relieve, Satisfy, Put out
Unadulterated	Pure, Fine, Neat, Refined

14.7 SOME USEFUL BOOKS

- https://sewguide.com/fabric-testing-identification/
- https://sewingiscool.com/how-to-tell-if-fabric-is-100-cotton/
- https://info.fabrics.net/fabric-facts/fabric-identification/

Answer

Check Your Progress

Ans: 1

There are various types of textile fibers utilized in the apparels that are followed by the types and numbering of yarns. Therefore it is important to learn with the various methods to identify different textile filaments or fabrics.

There are various tests which could be utilized for the identification of the textile fabrics and fibers like touching and feeling, burning test, microscopic test, solubility test, optical test, fabric or fiber density test and so on.

Ans: 2

Natural fibers: Cotton, Silk, Wool, Linen, Hemp, Jute etc. These fibers are obtained from natural sources.

Ans: 3

One approach to do this isn't to utilize your hands. Rub the material gently across your cheek and perceive how the material feels against such delicate skin. Cotton is very soft, it has a natural feel to it and should have little texture to the overall fabric.

Ans: 4

Chemical Solubility Tests

These are tests that help to decide the fiber content of a fabric. Here solvents are utilized to distinguish (identify) one fiber from another.

Reactions of fibers to common and alkaline solutions are utilized in these tests. Acetate fabric dissolve in acetone nail polish remover.

Ans: 5
The burning Characteristic of Spandex is as following;

f	Reaction to flame	Burning behaviour	Odour of flame	After the flame is over	Type of Ash
	Melts but does not pull away from the flame.	Melts and burn	Musty Chemical odour	Continues to burn and melt.	Soft sticky black ash.

Ans: 6
The burning Characteristic of Linen is as following;

Reaction to flame	Burning behaviour	Odour of flame	After the flame is over	Type of Ash
Does not shrink away from flame; Ignites easily on contact with flame	Burns rapidly with a bright yellow flame and light grey smoke.	Burning paper.	Continues to burn, there is an after glow.	Soft Grey powdery smooth ash

Multiple Choice Questions
Ans: 1 (B)
Ans: 2 (B)
Ans: 3 (D)
Ans: 4 (C)

References:
Figure: 1
https://www.intertek.com.hk/uploadedImages/wwwintertekcomhk/_sandbox/FTT.jpg
Figure: 2
https://i.ytimg.com/vi/xmKKvepQujo/mqdefault.jpg
Figure: 3
https://1.bp.blogspot.com/-HBoxxsJskf8/WjF3dzfHx4I/AAAAAAAAG2k/flxk_OOJe2ci5RRnC93pST55X4bZWnUuACLcBGAs/s1600/microscopic%2Btest%2Bfor%2Bfibres.jpg
Figure: 4
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યુનિવર્સિટી ગીત

સ્વાધ્યાયઃ પરમં તપઃ
સ્વાધ્યાયઃ પરમં તપઃ
સ્વાધ્યાયઃ પરમં તપઃ

શિક્ષણ, સંસ્કૃતિ, સદ્ભાવ, દિવ્યબોધનું ધામ,
ડૉ. બાબાસાહેબ આંબેડકર ઓપન યુનિવર્સિટી નામ;
સૌને સૌની પાંખ મળે ને સૌને સૌનું આભ,
દશે દિશામાં સ્મિત વહે, હો દશે દિશે શુભ-લાભ.

અભણ રહી અજ્ઞાનના શાને, અંધકારને પીવો ?
કહે બુદ્ધ આંબેડકર કહે, તું થા તારો દીવો;
શારદીય અજવાળાં પહોંચ્યાં ગુર્જર ગામે ગામ
ધ્રુવતારકની જેમ ઝળહળે એકલવ્યની શાન.

સરસ્વતીના મયુર તમારે ફળિયે આવી ગહેકે
અંધકારને હડસેલીને ઉજાસનાં ફૂલ મહેંકે;
બંધન નહીં કો' સ્થાન સમયનાં જવું ન ઘરથી દૂર,
ઘર આવી મા હરે શારદા દૈન્યતિમિરનાં પૂર.

સંસ્કારોની સુગંધ મહેંકે,મન મંદિરને ધામે
સુખની ટપાલ પહોંચે સૌને પોતાને સરનામે;
સમાજ કેરે દરિયે હાંકી શિક્ષણ કેરું વહાણ,
આવો કરીએ આપણ સૌ
ભવ્ય રાષ્ટ્રનિર્માણ...
દિવ્ય રાષ્ટ્રનિર્માણ...
ભવ્ય રાષ્ટ્રનિર્માણ

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