Chapter 2
Raw Materials of the Fashion Industry

Raw materials of fashion industry starts from the stage of fiber. The fibers are hence used to create yarns that either weave, knit or felt the fabric. The fabric further forms the basis to a garment. This process of garment generation from fiber has multitude levels addressed in this chapter.

2.1 Fibers

- A fiber is the basic and smallest unit of a fabric.
- It is a single, fine, hair-like substance.
- When fibers are united and twisted together they form a strand like structure called as Yarn.
- Yarns are then used to construct various textile materials like woven fabrics, knitted and lace fabrics.
- Felt and non woven are examples of fabrics constructed directly from fibers without the yarn stage.

Fig 24: Natural and Staple Camel Wool Fibers

2.1.1 Obtaining of Fibers

- Fibers are obtained directly from Nature or can be Man – made or Regenerated
- Natural Fibers are produced by plants, animals or minerals.
  1. Plant or vegetable fibers may come from the stem (flax, hemp, jute and ramie) from the seed (cotton and kapok), or from the leaves (sisal or abaca).
  2. Animal fibers are obtained from shearing the animal fleece (wool, cashmere, mohair and vicuna), which provide protection against the extreme cold climate and body injuries. Silk fiber comes from the cocoon of a silkworm and hence is considered as an animal fiber.
  3. A mineral fiber is obtained from the ground for e.g. asbestos which is found in rocks.
- Macro-molecules or polymers: Small monomers combine together to form a polymer. The process is called as polymerization - used for making man-made fibers in laboratories for example: Polyethylene, polyester, nylon, mod acrylic, acrylic, polyamide etc.
- Regenerated fibers: Textile fiber produced by dissolving a natural material (such as cellulose), then recreating it by the process of extrusion and precipitation are regenerated fibers, for example viscose.

2.1.2 Textile fiber categories with examples

- Natural Staple (smaller length) fibers- Cotton, jute, flax, wool
- Natural Filament (long length) Fiber: Silk
- Regenerated: (Raw material is natural fiber) eg Viscose, Modal, Acetate, Polynosic etc.
- Synthetic Fiber or Man-Made fibers: Polyester, Nylon, Acrylic, Polypropylene, Lycra, Viscose or Rayon, Cupramonium rayon, Polynosic Acetate, Triacetate, Nylon (polyamides), Aramid (aromatics) obtained from petroleum products. Polyester, acrylic/Modacrylic and Olefine (hydrocarbon), Polyethylene, Polypropylene, Polyurethane (spandex).
- Man-Made mineral fibers: Glass and Metal
- Other man-made fibers: Carbon and Boron

2.1.3 Fiber classification on the basis of length

- Staple Fibers: Fibers of short length (1cm or above), which can be measured.
- Filament Fibers: Fibers of continuous long length.

2.1.4 Yarn:

A set of fibers twisted or laid together to form a continuous strands suitable for use in weaving, knitting or braiding technique etc, to construct a fabric. It can consist of staple, filaments or combination of both fibers.

2.2 Yarn Classification

There are various kinds of yarns available for creating a fabric. They can vary due to their compositions of fibers used or textures given while constructing them from fibers.

2.2.1 Spun Yarns

Spun yarns are constructed from the short staple fibers, highly twisted together. Cotton, wool, flax are spun yarns.

2.2.2 Filament Yarns

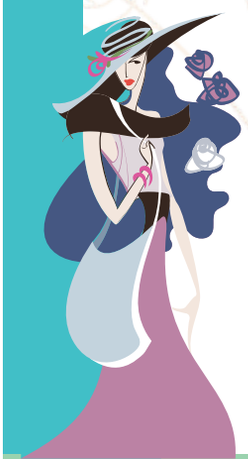
Filament yarns are constructed from low twist continuous strands of fiber. The length of the filament yarns may extend miles. Yarns made with man-made fibers are created from polymers which are extruded from the spinerret and cooled/ dried/ evaporated to produce these long length fibers which when used singularly forms a monofilament yarn.

Silk is the only filament yarn that exists in nature. The filament of silk is produced by the silk moth which creates a cocoon with its special serum. The silk yarn is hence extruded out of the cocoon by boiling it in water.

Fig 25: Yarn in form of a hank

2.2.3 Special Types of Yarn

Special types of yarns are the yarns with different physical appearances, surfaces or compositions, making them look visually different from each other. Some of its examples are Slub yarn, Novelty yarn, Boucle yarn etc.



(A)

(B)

(C)

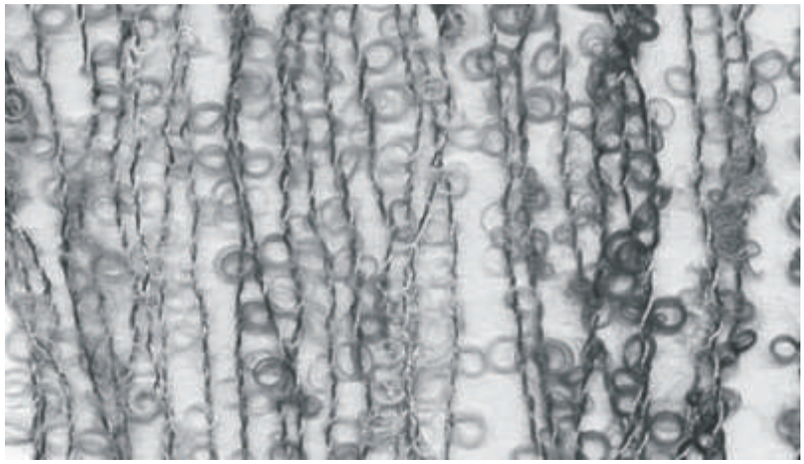


Fig 26: A. Novelty Yarns
B. Textured Yarn C. Boucle' Yarns

2.3 Fabric Development

Fabric can be prepared by three techniques: weaving, knitting and non-woven.

2.3.1 Introduction to woven fabric construction and its terminologies

Woven fabrics are made by interlacing vertical yarns called warp and horizontal yarns called weft. Yarns are bound on the warp beam of a loom and weft yarns are then fed by a shuttle. The alternate separation of warp yarns called shedding, interlaces with the weft to create the fabric.

2.3.1.1 Classifications of looms

Looms are of two types:

- Handloom or Powerloom
- Shuttle Loom or Shuttless Loom

Fig 27: Fabric Development on loom, Durrie from Jodhpur

Fig 28: Handloom for weaving fabrics

Fig 29: Closer view of Handloom

Fig 30: Fabric being woven on a powerloom

Handlooms are the looms on which fabrics are woven by hand.

The fabric made on power loom is also called as a mill-made fabric. This fabric can be made on various kinds of power looms for example air jet looms, rapier looms and water jet looms.

Looms can be shuttle looms or shuttle-less looms. In shuttle loom, a small instrument called shuttle is used to pass the weft yarn along the whole width of the loom. While in Airjet looms which is an example of a shuttle- less loom, the air pressure is used to pass the weft.

2.3.1.2 Terminologies of woven fabrics

- Ends: Single warp yarn is called as an End.
- Pick: Single weft yarn is called as a pick.
- Selvedge: It is the rim of the fabric running widthwise on both the sides of the fabric. It has double the number of ends than the body of the fabric.

Fig 31: Selvedge in a woven fabric

- **Straight Grain Line:** Grain line runs in the direction vertically parallel to the warp yarns.
- **Cross Grain Line:** Grain line runs in the direction horizontally parallel to the weft yarns.
- **Bias Grain Line:** Grain line runs in the direction at 45 degrees to the warp and the weft yarns.

2.3.1.3 Basic Woven fabrics

Plain Weave: The plain weave has one up and one down repeat pattern of the warp for one pick. It is the most stable and basic weave. Example of fabrics having this weave is Poplin, Voile, Canvas and Duck.

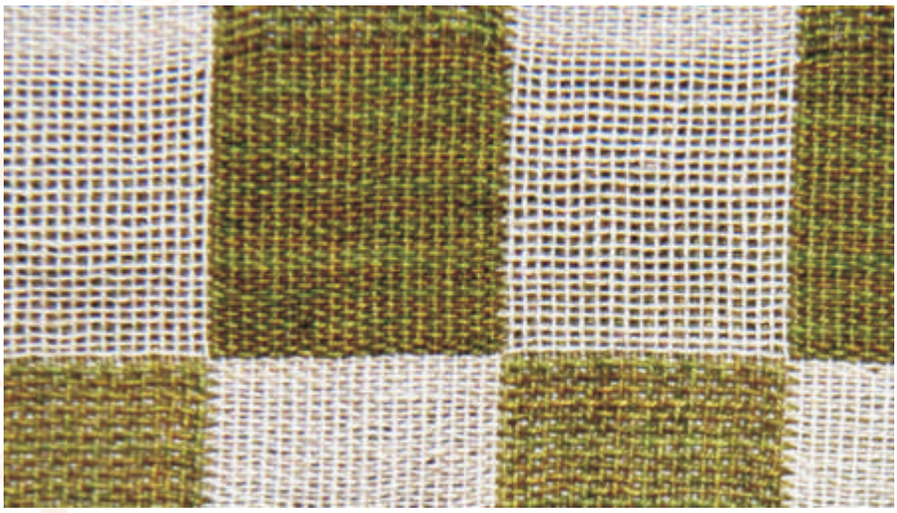


Fig 32: Plain Weave Fabric

Twill Weave: This weaving pattern will form diagonal lines in the fabric. If the diagonal lines are in left hand direction then it is called as Left Hand Twill, if they are in right hand direction then it is called as Right Hand Twill. Denim and Gabardine are few of its examples.

Satin Weave involves the crossing of one warp over several weft yarns creating floats on the right side of the fabric, thereby giving it smoothness and shine on the surface.

2.3.2 Knitted Fabric

Knitted fabric is formed by inter-looping of yarns. The fabric is formed either by hand or machine, and as per the technique used it is termed as hand-knitted or machine knitted fabric.

2.3.2.1 Terminologies of knitted fabrics.

Fig 33: Knitting Yarn and needles

- **Loops:** Loop is the smallest unit which an interlooping process creates to form the knitted fabric structure.
- **Wales:** As in weaving the warp represents yarn in vertical direction similarly in knitted fabric the stitches forming the loop in vertical direction is called as a wale.
- **Courses:** The stitches formed in horizontal direction are called as courses.
- **Cut and Gauge:** The number of needles per inch is called as Gauge or cut of the knitted fabric. The cut or gauge decides the density of the fabric like 8 Gauge fabric is denser than 4 Gauge fabric.

2.3.2.2 Basic stitches

- **Knit/Plain Stitch:** It is the basic stitch of a knitted fabric.
- **Purl Stitch:** The back of the plain stitch forms the purl stitch.

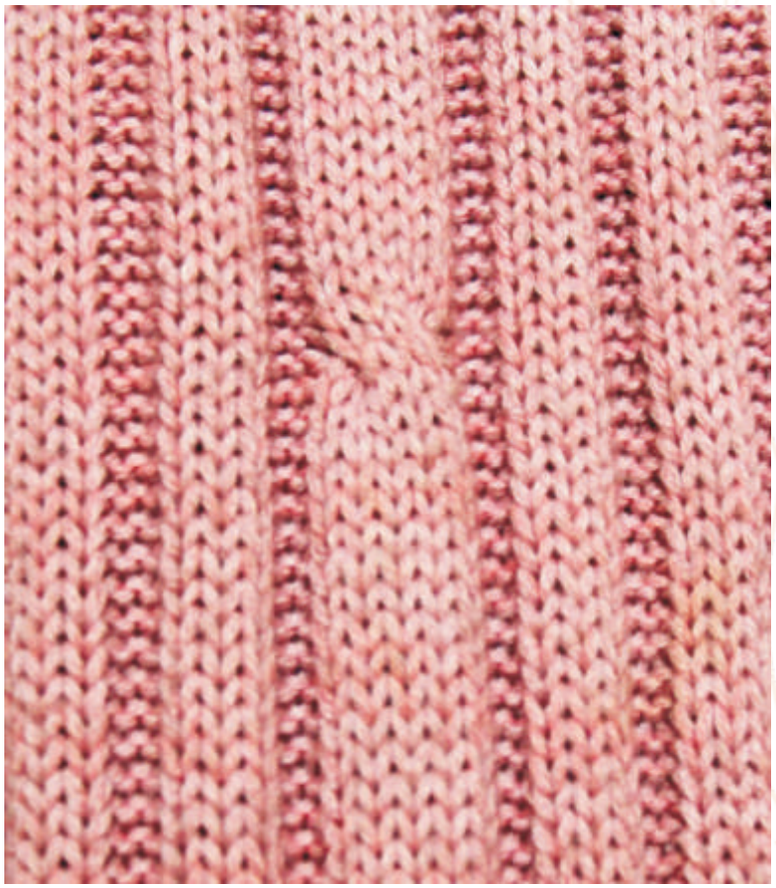


Fig 34: Plain and Purl Stitches in Knitted Fabric

Fig 35: Jersey Knit T-Shirt

Fig 36: Rib Knit in hem of a T-Shirt

- **Tuck Stitch:** A loop produced on the knitting needle is called as Tuck stitch when, there exists already a loop that has not been casted off by the previous process of knitting and the needle holds this current loop along with the previous one simultaneously.
- **Miss Stitch:** When any loop that exists in a course has not participated in the process of inter looping results in the formation of a hole, the stitch hence produced is called as a Miss stitch.

2.3.3 Weft Knitting

In weft knitting the fabric is formed by the interlooping of yarns to form loops in the horizontal direction of fabric, generating courses. Weft knitting is also called as commercial knitting as the fabrics for the sweaters, T shirts, undergarments fall under this category.

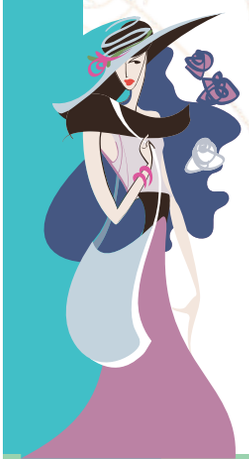
The basic weft knitted fabrics are single jersey, rib, purl and interlock.

2.3.4 Warp Knitting

In warp knitting multiple yarns are used simultaneously. The loops of one wale zigzags with its corresponding left and right wale to form the fabric. Wales are thus created in each column by the yarns fed from different cones at the same time.

2.3.5 Non-Woven Fabrics

These are the fabrics which are constructed by special techniques.



2.3.5.1 Bonded fabric

Bonded fabrics are made by adhering two layers of fabric together. The face of the fabric can be of any material while; the back of the fabric is generally acetate tricot or nylon.

2.3.5.2 Felt

Felt fabrics are made from wool or animal fibers like camel or goat hair. These animal fibers have scales which have a tendency to Cushion Designed by Amit Sharma interlock with each other on application of heat, moisture and agitation leading to the formation of felt fabrics.

Fig 37: Felt Fabric Cushion Designed by Amit Sharma

2.3.5.3 Lace Fabrics

Laces are made with needles and looping of threads either by hand or by machine. They are delicate, and can be an expensive material to decorate the garments or other products.

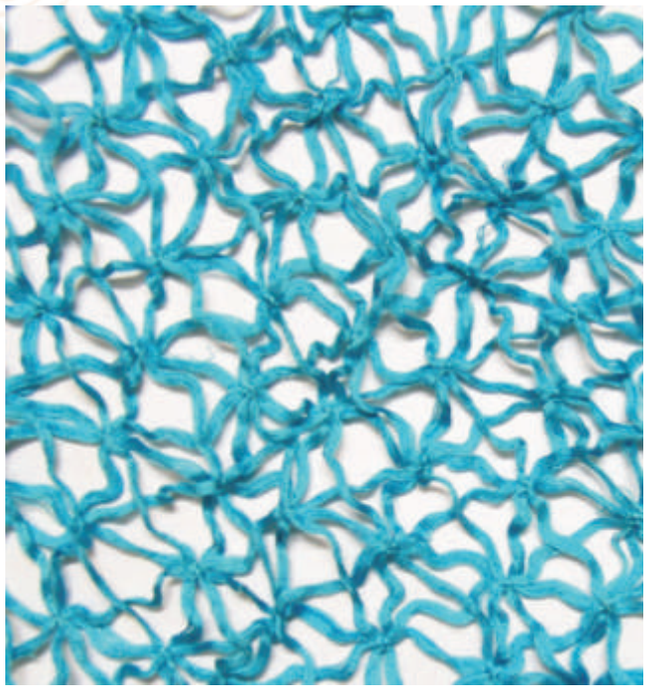


Fig 38: Handmade Lace; Non Woven Fabric

Fig 39: Handmade Crochet Lace

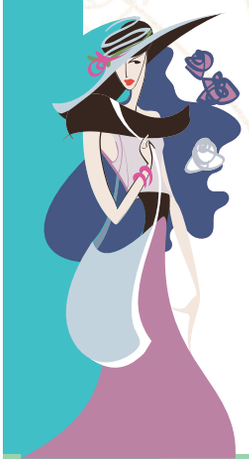
2.4 Dyeing

Dyeing is a process by which fabric, yarn or fiber can be imparted any desired color/s

2.4.1 Introduction to dyeing processes

When fabrics or yarns are left undyed in a raw state the resultant fabrics are called 'greige goods'. However, in terms of fashion, dyeing adds visual appeal to the fabric at any stage - i.e. fiber, yarn or fabric production. In India, while most of the larger production and export units utilize chemical dyes, there are some labels/ brands which use only eco-friendly and indigenous vegetable dyes.

Once the fabric is introduced in the dye bath, the dye penetrates in the fabric and bonds with the fiber, thus making it colorful. There are two ways of dyeing a fabric, namely Cross dyeing and Union dyeing.



2.4.2 Cross Dyeing

In this type of dyeing two different classes of dye colors can be dyed in one bath. This can also be used in a fabric which has two different fiber components like cotton and polyester, so one class of dyes can be used for cotton dyeing and one can be for polyester dyeing.

2.4.3 Union Dyeing

In this dyeing process the fabric is dyed in a single color but with a mixture of different classes of dyes.

Fig 40: Dyeing of yarn

2.4.4 Process of Dyeing

There are various methods of dyeing the fabrics, fibers and yarns. Following are the methods which are used in mills and textile laboratories to perform the dyeing process.

- Pad Dyeing
- Beam dyeing
- Winch / Box Dyeing
- Jig Dyeing

- Dip Dyeing
- Dope Dyeing
- Resist Dyeing

Fig 41 a: Resist Dyeing Process from Jodhpur

2.5 Printing

Printing is used to create colorful designs and patterns on a finished fabric. In printing as oppose to dyeing, the dye or the printing paste sticks on the front side/ surface of the fabric and does not penetrate through the back side of the fabric completely (except when the fabric is very sheer).

2.5.1 Printing Techniques

There are different kinds of techniques of printing as defined below:

2.5.1.1 Block Printing

This printing is achieved using wooden and metal engraved blocks. The pigment paste is applied on the blocks which are then pressed over the fabric to create a pattern or design on the fabric. All over, border or engineered prints can be developed through this technique. The size of the motif can vary from ½ inch to 16 inches.

Fig 41 b: Block Printing Process from Jodhpur

2.5.1.2 Roller Printing

This printing is achieved by a copper metal roller with engraving of design over it. The dye is applied on the fabric through these rollers. Printed fabric is then treated with steam and heat to set the colors. The diameter and length of the roller are factors to determine the repeat size of the pattern to be printed on the fabric.

2.5.1.3 Stencil Printing

The fabric is printed using stencil mostly in paper. To generate the stencil the desired design or pattern is cut out in paper. Then, on the application of the dye over the stencil, the color passes through the cut out areas and prints the fabric.

2.5.1.4 Screen Printing

This process is similar to stencil printing but is done on a larger scale. The screens used for printing are made of varied materials like silk threads, nylon, polyester, vinyon etc. This mesh is mounted on a wooden or a metal frame. The design on the screen is prepared with blocking the areas of the mesh which is not required to be printed. The paste is then applied on the screen kept over a fabric letting the color

pass only through the unblocked areas, thus printing the fabric. If the screens are flat then the process is called as Flat Screen Printing and if the screens are round then it is called as Rotary Screen Print.

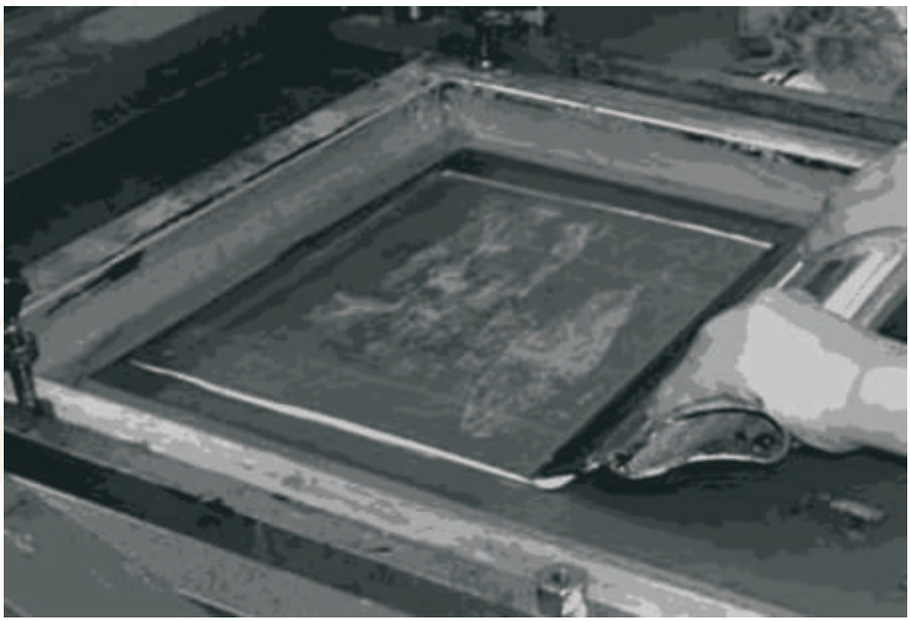


Fig 42: Screen Printing Process

2.5.1.5 Transfer Printing

Transfer printing is commonly seen on T- Shirts where the chest prints are transferred on the fabric through the application of heat. The design is first drawn on a computer and then print is taken on a paper which, transfers the print onto the fabric through heat application.

Fig 43: Transfer Printing on T Shirt

2.5.1.6 Batik Dyeing

It is based on resist dye technique. Wherein the pattern is blocked by application of wax and the rest of the fabric is dyed. On the removal of the wax after wash, the pattern is achieved with undyed motifs on the dyed fabric base.

Fig 44: Batik Print Designed by Amit Sharma

2.5.1.7 Tie Dyeing

The process uses the resist dye technique. The fabric is knotted, clamped or tied and put in a dye bath. The dye is unable to penetrate through the blocked areas and hence, creates motifs and patterns. Ikats from the state of Andhra and Orissa are famous example of Tie and Dye where the warp and the weft yarns are space dyed as per the patterns before weaving. Other example of this technique is Bandhej from the states of Gujarat and Rajasthan.

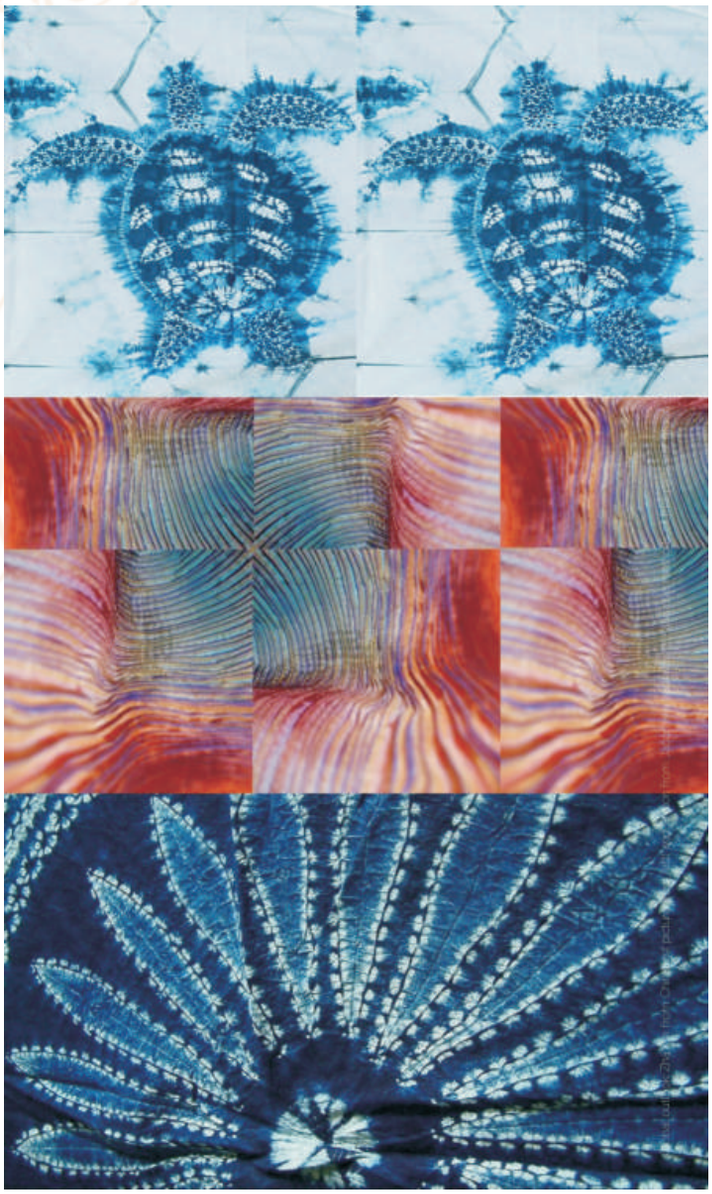


Fig 46: Tie - Dye from Jodhpur

2.5.1.8 Digital printing

It is the most popular printing processes now-a-days. The pattern is developed on computers through Computer Aided designs and is printed on the fabric through an inkjet print head. The printer has a system which interprets the data and controls the dye placement on the fabric. As this requires high computer skills and also is a new technology, this printing is expensive and is experimental. One can achieve as many colors as one wants on a fabric through digital printing as compared to any other techniques of printing.

Fig 45: Digital Print Designed by Amit Sharma

2.6 Finishing processes

Finishing is the final set of processes that are utilized to enhance a fabric after dyeing or printing, to achieve the final desired look, texture, feel or finish. This includes physical processes such as heat setting and shearing, or chemical processes like bleaching, starching, mercerizing, and water-repellence.

Other finishing processes can make fabrics flame-retardant, U.V. resistant, bacteria and stain resistant through various applications, depending on the requirements of the finished garment.

Fig 47: Fabric Calendering rollers

2.7 Textile Industry - Today

It is important to realize that both natural fabrics and man-made fabrics play an important role in fashion. There are differences between natural and man-made fiber industries that have resulted in different operational and organizational structures. While man-made fabrics have certain qualities that lend themselves well to certain kinds of designs, the manufacturers of natural fabrics like cotton and wool have adopted a more pro- active role in promotional activities and enhancing these properties in the context of textiles and fashion.

2.8 Transformation of Fabric into Garment

The garment is the finished product. It is the culmination of creative and technical process that is ready for the presentation to the customer. It is, as we have seen, a complex process, beginning with the perception of the customer needs and the coming together of a multitude of efforts from pattern-making, to fabric and trim selection, color choices and the manufacturing process. This brings together the elements of design in a harmonious balance to produce a garment that attempts to meet the physical, social, psychological and aesthetic needs of the customer and hence the society at large.

Summary:

The starting point of the fashion industry is from its raw material stage. Fibre forms the basic unit of fabric formation. Fibre when twisted together forms a yarn. Spun yarns, filament yarns or any other special yarn is used to create a fabric. Fabric can be produced through the process of weaving, knitting or felting. Each fabric created, has its inherent characteristics. The process of dyeing is used to impart colour to fabric. Dyed fabric can be printed with various printing techniques in order to add value and visual interest. Finishing the fabric ensures that the fabric is ready for its ultimate use.

This ready fabric can be used in home furnishings, draped as a yardage or can be cut and sewn into desired garments.

Glossary

- **Bacteria resistant:** A finish which makes fabric bacteria attack free.
- **Bleaching:** The application of bleach to make fabrics white.
- **Classes of Dye:** The terminology to specify that which dye is for which fiber, like polyester has different class of dye and cotton has different.
- **Computer Aided Design (CAD):** Pattern developed on computers.
- **Courses:** The stitches forming loops in horizontal direction in knits.
- **Cut or Gauge:** The number of needles per inch.

- **Denier:** The unit of fineness of a yarn.
- **Drapability:** The property of a fabric, which measures the fall of the fabric width-wise and lengthwise.
- **Dye Bath:** Acontainer in which the dyeing of a fabric / yarn is done.
- **Dyein:** The process is by which a fabric can be given any color.
- **Eco friendly dyes:** Dyes which does not harm the environment.
- **Elasticity:** The property of a fabric to come back to its original form after application of force on it.
- **End:** Single warp yarn.
- **Fiber:** The basic and smallest unit of a fabric.
- **Filament Fibers:** Long length fibers.
- **Filament Yarns:** Yarns made up of low twist continuous strands of fiber.
- **Finishing:** The final set of processes that are utilized to enhance a fabric after dyeing or printing.
- **Flame-Retardant fabric:** Fabric which do not catch fire.
- **Greige fabric:** Fabric created from undyed and unprocessed yarns.
- **Handlooms:** Looms on which fabrics are woven by hand.
- **Heat setting:** The application of heat to achieve a desired look of a fabric.
- **Knitted fabric:** Fabric formed by inter-looping of yarns.
- **Mercerizing:** The treatment for cotton fabric and thread that gives fabric or yarns a lustrous appearance and strengthens them.
- **Natural fibers:** Fibers produced by plants, animals or minerals
- **Non Wovens:** Fabrics constructed directly from fibers without the yarn stage.
- **Pick:** single weft yarn.
- **Polymerization:** Process of combining monomers to construct polymers for making man-made fibers in labs.
- **Powerlooms:** Looms which weave fabric by power.
- **Printing:** The process to create colorful designs and patterns on a finished fabric.
- **Regenerated fibers:** Composed of natural fiber as raw material.
- **Selvedge:** The rim of the woven fabric on both the sides widthwise.
- **Shearing:** Cutting of the raised nap of a pile fabric to a uniform height to enhance appearance.

- **Shedding:** The alternate separation of warp yarns to create a space for weft yarn insertion.
- **Shuttle less loom:** Loom in which air pressure or water pressure is used to pass the weft
- **Shuttle loom:** Loom in which shuttle is used to pass weft yarn.
- **Spinneret:** Finely perforated dispenser through which a viscous liquid is extruded in the production of synthetic fibers.
- **Spun Yarns:** Yarns made up of short staple fibers, highly twisted together.
- **Stain resistant:** A finish which does not let fabric stain easily.
- **Staple fiber:** Short length fibers (1cm or above).
- Starching is the application of starch to give strength to the fabric.
- **Synthetic fiber or man-made fibers:** Produced in laboratories by man through the polymerization process.
- **U.V. Resistant:** A finish which makes fabrics Ultraviolet rays protective.
- **Vegetable dyes:** Dyes obtained from vegetables and plants.
- **Wales:** The stitches forming loops in vertical direction in knits.
- Water-repellence is a finish which makes fabric water resistant, like in umbrella.
- **Woven fabric:** Fabric formed by the interlacement of warp and weft on looms.
- **Yarn:** Fibers are united and twisted together to form a strand like structure.

Question Bank:

Q1. What is the textile classification of natural fibers?

Q2. What is the difference between the man- made and natural fibers?

Q3. What is the difference between a Spun yarn and Filament Yarn?

Q4. Define Ends and Picks in a woven fabric?

Q5. What is the difference between a woven and a knitted fabric?

Q6. Define basic stitches of knitted fabric?

Q7. What is the difference between weft knitted and warp knitted fabrics give examples?

Q8. What is dyeing and define the various kinds of dyeing processes in textiles?

Q9. What is the difference between screen printing and roller printing?

Q10. What are the various finishes applied on a fabric or a garment?