**Textile Terminology of Mechanical Operations**

**Report on IHKIB Views**

This report is prepared for the purpose of explaining the views of Istanbul Apparel Exporters Association (IHKIB) on how to incorporate the terminology of “mechanical operations” in the explanatory notes of Annex 1 of the Regional Convention of a textile product, which is a tool for classifying goods in trade.

IHKIB agrees on the definition of mechanical operations as prepared and sent to European Commission by Euratex as follows:

*“Definition of “Mechanical Operations”:*

*Mechanical operations are substantial processes that physically change the characteristics of the yarn to improve its look, performance, feel and properties. Mechanical operations include spinning, twisting, gimping and texturizing but are not limited to these processes. Chemical treatments as well as beaming are not assumed as “any mechanical operation”.”*

**The incorporation of the terminology of “mechanical operations” into the Explanatory Notes of the CN:**

To incorporate the terminology of “mechanical operations” in the explanatory notes of the CN, the following three factors should be considered:

1. *Type of energy in defining mechanical operations*

There are three types of energy used in textile production:

1. Physical/mechanical operations – mechanical (kinetic) energy

2. Thermodynamic operations – heat energy

3. Chemical operations – chemical energy

Accordingly, only those operations that depend solely on mechanical (kinetic) energy should be considered within the terminology of mechanical operations.

1. *The roles of machines in defining mechanical operations*

As textile production is based on machines, the general features of these machines and the type of energy that these machines use should be considered within the terminology of mechanical operations.

Any machine used in textile production may use only one type of energy or a combination of these three types of energies. Accordingly, selecting only one function based on mechanical energy of a single machine as a mechanical operation leads to wrong interpretations while defining the terminology of mechanical operations.

1. *The manufacturing processes in defining mechanical operations*

The integrity of the processes in production should be considered collectively while defining the terminology of mechanical operations. More than one machine may be used in any specific process and these processes may form sub-processes under the main processes.

Additionally, these sub-processes may substantially differ according to the features of the fiber and the material used.

Regardless of the fiber or the material used, in textile production, the whole production process may be divided into the following main processes:

1. Preparation of fiber or the material (fiber manufacturing)
2. Fiber Finishing
3. Spinning & Twisting – production of conventional single and multilayered yarn
4. Specialty yarn production
5. Yarn finishing
6. Weaving or knitting
7. Fabric Finishing

These processes and the machines, also the kind of energies used by these machines, differ according to the fiber and the material used.

In this report, the sub-processes of the following three types of fibers, which are used extensively in apparel production, excluding the technical textiles or other specific functional textiles, are examined:

1. Natural fibers: Those obtained fibers already in fiber form in nature like cotton.
2. Synthetic fibers: Those manufactured fibers obtained via extrusion of polymers like polyester.
3. Artificial fibers: Those manufactured fibers obtained through pulp of fibers, which are already existing in fiber form in nature but cannot be used as fiber without additional chemical operations.

**The terminology of mechanical operations according to flow chart of production**

The following flow chart shows main and sub-processes and further shows the type of operations according to the types of fibers used in textile production:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Main Processes of Textile Production** |  | **Types of Fibers** | | | | | |
| Natural Fiber: Cotton | **Type of operation** | Synthetic Fibers | Type of operation | Artificial Fiber: Viscose & Rayon | Type of operation |
| **Preparation of fiber & fiber finishing** | Cultivation | **Mechanical** | The production of polymers obtained generally from petro chemicals: Polymerization & Drying | **Chemical** | Steeping | **Chemical** |
| Blow Room (opening and cleaning) | **Mechanical** | Pressing | **Mechanical** |
| Shredding | **Mechanical** |
| Carding & Combing | **Mechanical** | Aging | **Heat** |
| Xanthation | **Mechanical, chemical heat** |
| Draw Frame | **Mechanical, heat** | Dissolving | **Chemical** |
| Ripening | **Mechanical, chemical heat** |
| Fiber finishing | **Mechanical, chemical, heat** | Filtration and deaeration | **Mechanical** |
| Degassing | **Mechanical** |
| **Spinning & Twisting – Production of single and multilayered yarn** | Roving Frame/Speed Frame/Simplex | **Mechanical** | Extrusion through melt, wet, dry or gel spinning & Texturing & Drawing (production of single yarn) | **Mechanical,**  **Heat, Chemical** | Wet Spinning & Drawing & Washing  (production of single yarn) & Texturing | **Mechanical, Chemical** |
|  |  | \*Texturing is an operation which is performed to give softness to the yarn to use in the production of certain types of apparel. | | | |
| Ring Frame (production of single yarn) | **Mechanical** | Cutting (staple fiber production) | | **Mechanical** | |
| \*This operation is performed to produce yarns having similar features to natural fiber to use in the production of certain types of apparel. Only man-made fibers are applied this process. | | | |
| Twisting (production of multi-layered yarn) | **Mechanical** | Twisting (production of multi-layered yarn) | **Mechanical** | Twisting (production of multi-layered yarn) | **Mechanical** |
| Cone Winding | **Mechanical** | Winding and stretching | **Mechanical** | Winding and stretching | **Mechanical** |
| **Specialty (Fancy) yarn production** | Fancy yarn effects are categorized in two: fiber or yarn, meaning the effect is either formed during the fiber or yarn production stage.  These yarns are mostly preferred in home textiles, and due to their disadvantages in terms of costs, fashion trends, etc., their usage is limited compared to commodity yarns. | | | **Mechanical, Heat** | | |
| **Yarn Finishing** | Yarn finishing may be categorized as preparatory finishing operations (scouring, bleaching, etc.) coloring (dying) and advanced finishing operations.  Texturing may not be categorized as a yarn finishing operation. | | | **Mechanical, Chemical, Heat** | | |
| **Weaving or knitting** | For weaving, there are three main steps of weaving preparatory process: Winding, Warping, Sizing.  For knitting, there are two basic machine types: weft (circular, double jersey, straight bar, flat bar) and warp (raschel, tricot).  Also, processes and machinery for knit-to-shape products like hosiery differs. | | | **Mechanical** | | |
| **Fabric Finishing-Embellishment** | Fabric finishing may be categorized as preparatory finishing operations (scouring, bleaching, etc.) coloring (dying and printing) and advanced finishing operations (calendaring, compacting, etc.)  These finishing operations are either mandatory operations to reach certain standards or advanced operations to design the function of the fabric. | | | **Mechanical, Chemical, Heat** | | |

**Eligible mechanical operations in terms of rules of origin**

From an industrial perspective, in line with the definition of mechanical operations, the following approach may be accepted in rules of origin:

1. Connected operations (either due to machinery used in production or the reference to sub-processes) should be accepted as a rule to convey origin.
2. Value addition should be decisive and those compulsory operations for packaging that have no value addition should not be evaluated as a rule to convey origin.
3. The flow chart of the processes from the industry perspective should be taken into account. In this sense, a specific function of a specific machine cannot be defined as a mechanical operation.

**Feasible applications to the rule: “Twisting combined with any mechanical operation”**

**Natural Fibers – cotton:**

*Twisting + Roving Frame/Speed Frame/Simplex*

Feasible combination

*Twisting + Ring Frame (production of single yarn)*

Feasible combination

**Synthetic & Artificial Fibers:**

*Twisting + Extrusion*

Feasible combination

*Twisting + Texturing*

Feasible combination

*Twisting + Cutting (staple fiber production)*

Feasible combination

**Common applications for both natural fibers (cotton) and man-made fibers (synthetic & artificial)**

*Twisting + Cone Winding (for natural fibers – cotton) or Winding and stretching (for man-made fibers)*

Un-feasible combination

This operation simply meaning the packaging of the produced yarn and has no value addition to the product.

*Twisting + Yarn Finishing*

Un-feasible combination

Although yarn finishing includes many mechanical operations, these operations mostly include chemical and heat operations, so it is difficult to select the mechanical operations separately among the flow of processes.

*Twisting + Specialty (Fancy) Yarn Production, including gimping*

Feasible combination

**Flow Chart and Feasible Mechanical Operations to be combined with Twisting in Yarn Production**

|  |  |  |
| --- | --- | --- |
| **Feasbile** | Extrusion through melt, wet, dry or gel spinning & Drawing  =production of single yarn - filament  =Cannot be separated | **Mechanical,**  **Heat, Chemical** |
| **Feasbile** | Texturing  =Optional operation | **Mechanical, Heat** |
| **Feasbile** | Cutting (staple fiber production)  =Optional operation | **Mechanical** |
| **Feasbile** | Roving Frame/Speed Frame/Simplex (for natural fibers – cotton)  Ring Frame (spinning) (for natural fibers – cotton)  =Production of single yarn  =Cannot be separated | **Mechanical** |
|  | Twisting  =Production of multilayered yarn | **Mechanical** |
| **Un-feasible** | Cone Winding (for natural fibers – cotton) or Winding and stretching (for man-made fibers) | **Mechanical** |
| **Feasible** | Specialty (Fancy) yarn production | **Mechanical, Heat** |
| **Un-Feasible** | Yarn Finishing | **Mechanical, Chemical, Heat** |

**Terminologies for Natural Fiber: Cotton**

<https://textilelearner.net/cotton-yarn-spinning-process/>

**Cultivation of cotton**

The cotton is planted in the early spring. In around 60 days, the plants begin to blossom, producing whitish-yellow flowers. These flowers mature into circular walnut-like structures throughout time. Cotton balls are what they’re called. Cotton fibers sprout on these grains. Green cotton balls eventually become brown. Cotton bolls break open at maturation, revealing the white cotton fiber.

**Blow Room**

At this process the Fibers in Bale form will be loosen, opened and cleaned. This is the starting stage of Spinning Process.

**Carding**

Carding is one of the most important operations in the spinning process as it directly determines the final features of the yarn, above all as far as the content of neps and husks are concerned.

**Combing**

Combing is a process which is introduced into the spinning of finer and high quality yarns from cotton. The carded materials (sliver) contain certain amount of short fibers, neps, fine kitty and leaf particles. Short fibers are a hindrance to spinning of finer counts where the number of fiber in the cross section of the yarn is less. The short fibers cause thick and uneven places in the yarn length and the yarn looks hairy. Apart from this, very short fibers do not contribute anything to yarn strength. Short fibers below a certain pre-determined length can be easily separated out by using comber.

**Draw Frame**

This is the machine on which drafting and doubling are carried out. Carded sliver is that they are not even (uniform) enough to produce to good quality yarns. Therefore, usually all the carded slivers are subjected to Doubling and Drafting on a machine called “Draw Frame”.

**Roving Frame/Speed Frame/Simplex**

The product delivered by roving machines is called Roving. Roving is a Fiber strand of lesser count than that of a sliver. It is also has a small twist to keep Fibers together. It is wound on to a package which is suitable for feeding spinning machines.

**Ring Frame**

The ring spinning machine was first invented in 1828 by the American Thorp. In 1830, another American scientist, Jenk, contributed the traveler rotating on the ring. There have been many development has done in ring spinning machine for the last years but the basic concept remained unchanged.

**Cone Winding**

This is the final stage in Spinning and that is Cone Winding. As nowadays good winding is the mirror of spinning mills, it is necessary that this process is understood very well by all the personnel handling the department. Yarn winding can thus be viewed as simply being a packaging process, forming a link between the last few elements of yarn manufacturing and the first element of fabric manufacturing process. Improper utilization of the features of the winding machine can not only cost heavily to the spinning mills, but it can also lead to loss of good customers permanently.

**Terminologies for Synthetic Fibers**

[**https://textilelearner.net/synthetic-and-regenerated-fibers-manufacturing/**](https://textilelearner.net/synthetic-and-regenerated-fibers-manufacturing/)

[**https://textilelearner.net/polyester-fiber-properties-manufacturing/**](https://textilelearner.net/polyester-fiber-properties-manufacturing/)

[**https://textilelearner.net/different-types-of-man-made-fibers-with-their-application/**](https://textilelearner.net/different-types-of-man-made-fibers-with-their-application/)

**Polymers for Synthetic Fiber**

The term synthetic fiber relates to fibers formed from polymers constructed from chains grown via a controlled chemical process. These fiber forming polymers are obtained generally from petro chemicals.

**Polymerization**

To form polyester, dimethyl terephthalate is first reacted with ethylene glycol in the presence of a catalyst at a temperature of 302-410°F (150-210°C).

The resulting chemical, a monomer (single, non-repeating molecule) alcohol, is combined with terephthalic acid and raised to a temperature of 472°F (280°C). Newly-formed polyester, which is clear and molten, is extruded through a slot to form long ribbons.

**Drying**

After the polyester emerges from polymerization, the long molten ribbons are allowed to cool until they become brittle. The material is cut into tiny chips and completely dried to prevent irregularities in consistency.

**Melt spinning:**

In melt spinning, The polymer chips are melted in a large hopper and passed through a metered pump before reaching the spinneret. The filaments then pass through cold air, which solidifies the filament before it is drawn and wound onto bobbins. Thermoplastic fibers are mainly produced with melt spinning. Nylon, polyester, and liquid crystalline aromatic polyester are all manufactured with melt spinning. They are first heated above their melting temperatures, then extruded through spinneret to form continuous fiber, followed by drawing, cooling, and winding.

**Wet spinning:**

Solution spinning is typically used when melt spinning is not possible for non-thermoplastic and temperature-sensitive polymers. In this processing arrangement, the polymeric chains are dissolved in an appropriate solvent to form a viscous fluid. Typical solution concentrations can vary from 1%–25% depending on the polymer chain length, solvent system, and spin pack design. Once dissolved in solution, the chains are typically free to entangle and disentangle and move relative to each other.

**Dry spinning:**

The polymer solution passes through a metered pump. Once through the spinneret, the filaments pass through warm air, which evaporates the solvent and dries the filament. The filament is then drawn and wound onto bobbins. Dry spinning is used to form polymeric fibers from solution. It is a direct process. Here a solvent and a solvent recovery plant are required. Washing is not done in this process. This process may be used for the production of Acetate, Tri-acetate, Acrylic, Modacrylic, PBI, Spandax and Vinyan.

**Gel spinning:**

Gel spinning is also known as dry-wet spinning because the filaments are cooled by passing through cold air first and then into a cooling liquid bath. This is a special process used to achieve high strength or special fiber properties. The polymer starts in a partially liquid or gel state, unlike the other three processes which causes the polymer chains to be bound together at intervals in liquid crystal form, which results in very strong, inter-chain forces. The polymer chains in the fibers have a high degree of orientation, which vastly increases their tensile strength. This process is used on aramid fiber and polyethylene.

**Terminologies for Artificial Fibers: Viscose & Rayon**

<https://textilelearner.net/viscose-rayon-manufacturing-process/>

**Steeping:**

It involves treating the pulp boards with caustic soda solution of mercerizing concentration (about 17.5%) to form alkali cellulose. The operation is carried out in a long rectangular tank in which a hydraulic ram is incorporated. Thus when mercerization is complete the excess of caustic liquor can be pressed by the ram, leaving the softened boards of alkali cellulose containing known quantities of caustic soda water. This takes nearly 14 hr. The dark brown colored caustic soda solution is then drained off and the sheets pressed by the movable plates to squeeze the caustic soda solution to a given moist mass of soda cellulose, which is then transferred to a shredding machine for the next operation.

**Pressing:**

The swollen alkali cellulose mass is pressed to a wet weight equivalent of 2.5 to 3.0 times the original pulp weight to obtain an accurate ratio of alkali to cellulose.

**Shredding:**

The pressed alkali cellulose is shredded mechanically to yield finely divided, fluffy particles called “crumbs”. This step provides increased surface area of the alkali cellulose, thereby increasing its ability to react in the steps that follow.

The disintegrating machine or shredder consists of two arms, bearing toothed wings, which work against other similar teeth on the bottom of the vessel. When the vessel rotates, the pulp sheets are cut into small bits called crumbs.

**Aging:**

The crumbs of soda cellulose are stored in small galvanized steel drums for about 48 hr at 23°C. The time and temperature depend on the nature of the pulp, degree of ageing (maturity) desired, spinning process to be employed, etc. In this step the average molecular weight of the original pulp is reduced by a factor of two to three. Reduction of the cellulose is done to get a viscose solution of right viscosity and cellulose concentration.

**Xanthation:**

This process is also called sulphidizing. After the ageing process, the crumbs of soda cellulose are transferred to rotating, air tight chambers. These are double-jacketed, so as to maintain the required temperature during churning. Carbon disulphide is added to the mixer and churned together for 3 h by rotating the mixer at slow speed. Colour of the product changes from white to light yellow, light yellow to deep yellow and finally to reddish orange. Sodium cellulose xanthate formed during this process should not be allowed to form hard lumps as they are difficult to dissolve in the subsequent process. After the churning is over, vacuum is applied for removing the ill-smelling vapours of carbon disulphide from the mixer.

**Dissolving:**

The yellow crumb is dissolved in aqueous caustic solution. The large xanthate substituents on the cellulose force the chains apart, reducing the interchain hydrogen bonds and allowing water molecules to solvate and separate the chains, leading to solution of the otherwise insoluble cellulose. Because of the blocks of un-xanthated cellulose in the crystalline regions, the yellow crumb is not completely soluble at this stage. Because the cellulose xanthate solution (or more accurately, suspension) has a very high viscosity, it has been termed “viscose”.

**Ripening:**

As the alkali cellulose needs ageing, this viscose solution requires to be ripened to give a solution having the best spinning qualities. Ripening is carried out by storing the viscose solution for 2 to 5 days at 10–18°C. During this period, a kind of coagulation or throwing down of sediment occurs and the viscosity decreases and then rises to the original value. The sediment necessitates filtration. Hence, the ripened solution is again filtered carefully and deaeratred. The solution is now ready for spinning to produce viscose rayon filaments by wet spinning method.

**Filtration and deaeration:**

This is necessary before the spinning stage is reached, since the rayon is to be formed by forcing the solution through the spinneret having very small holes, all bubbles and solid particles likely to choke the spinneret holes must be removed. Hence, the viscous solution is passed through a series of filter presses on its way to the large tanks in which it is ripened, and later the solution is again filtered several times in the same manner while being transferred from one container to another. Finally, deaeration is accomplished by maintaining a partial vacuum over the viscose solution in the air-tight tanks in which it is kept during the last part of the ripening periods.

**Degassing:**

Bubbles of air entrapped in the viscose must be removed prior to extrusion or they would cause voids, or weak spots, in the fine rayon filaments.

**Spinning – (Wet Spinning):**

Production of Viscose Rayon Filament: The viscose solution is metered through a spinnerette into a spin bath containing sulphuric acid (necessary to acidify the sodium cellulose xanthate), sodium sulphate (necessary to impart a high salt content to the bath which is useful in rapid coagulation of viscose), and zinc sulphate (exchange with sodium xanthate to form zinc xanthate, to cross link the cellulose molecules). Once the cellulose xanthate is neutralized and acidified, rapid coagulation of the rayon filaments occurs which is followed by simultaneous stretching and decomposition of cellulose xanthate to regenerated cellulose. Stretching and decomposition are vital for getting the desired tenacity and other properties of rayon. Slow regeneration of cellulose and stretching of rayon will lead to greater areas of crystallinity within the fiber, as is done with high-tenacity rayons.

The dilute sulphuric acid decomposes the xanthate and regenerates cellulose by the process of wet spinning. The outer portion of the xanthate is decomposed in the acid bath, forming a cellulose skin on the fiber. Sodium and zinc sulphates control the rate of decomposition (of cellulose xanthate to cellulose) and fiber formation.

(C6H9O4O-SC-SNa)n + (n/2)H2SO4 –> (C6H10O5)n + nCS2 + (n/2)Na2SO4

Elongation-at-break is seen to decrease with an increase in the degree of crystallinity and orientation of rayon.

**Drawing:**

The rayon filaments are stretched while the cellulose chains are still relatively mobile. This causes the chains to stretch out and orient along the fiber axis. As the chains become more parallel, interchain hydrogen bonds form, giving the filaments the properties necessary for use as textile fibers.

**Washing:**

The freshly regenerated rayon contains many salts and other water soluble impurities which need to be removed. Several different washing techniques may be used.

**Cutting:**

If the rayon is to be used as staple (i.e., discreet lengths of fiber), the group of filaments (termed “tow”) is passed through a rotary cutter to provide a fiber which can be processed in much the same way as cotton.

**Winding and stretching:**

Winding the stretching of the filaments is also done to orient the molecules in the direction of the fiber axis to improve the mechanical properties of the filaments. After that the filaments strands are wound and are further processed with following operations.

**Terminologies for Staple Fiber (Synthetic & Artificial)**

<https://textilelearner.net/polyester-fiber-properties-manufacturing/>

In making polyester staple fiber, polymerization, drying, and melt spinning (steps 1-4 above) are much the same as in the manufacture of filament yarn. However, in the melt spinning process, the spinneret has many more holes when the product is staple fiber. The rope-like bundles of polyester that emerge are called tow.

**Drawing tow**

Newly-formed tow is quickly cooled in cans that gather the thick fibers. Several lengths of tow are gathered and then drawn on heated rollers to three or four times their original length.

**Crimping**

Drawn tow is then fed into compression boxes, which force the fibers to fold like an accordion, at a rate of 9-15 crimps per inch (3-6 per cm). This process helps the fiber hold together during the later manufacturing stages.

**Setting**

After the tow is crimped, it is heated at 212-302°F (100-150°C) to completely dry the fibers and set the crimp. Some of the crimp will unavoidably be pulled out of the fibers during the following processes.

**Cutting**

Following heat setting, tow is cut into shorter lengths. Polyester that will be blended with cotton is cut in 1.25-1.50 inch (3.2-3.8 cm) pieces; for rayon blends, 2 inch (5 cm) lengths are cut. For heavier fabrics, such as carpet, polyester filaments are cut into 6 inch (15 cm) lengths.

**Spinning Process:**

The degree of polymerization of PET is controlled, depending on its end-uses. PET for industrial fibers has a higher degree of polymerization, higher molecular weight and higher viscosity. The normal molecular weight range lies between 15,000 and 20,000. With the normal extrusion temperature (280-290oC), it has a low shear viscosity is 1000-3000 poise. Low molecular weight PET is spun at 265oC, whereas ultrahigh molecular weigh PET is spun at 300oC or above. The degree of orientation is generally proportional to the wind-up speeds in the spinning process. Theoretically, the maximum orientation along with increase in productivity is obtained at a wind-up speed of 10,000m/min. Although due to a voided skin, adverse effects may appear at wind-up speeds above 7000m/min.

**Terminologies for Yarn Twisting**

<https://textilelearner.net/twist-directions-effect-of-twist/>

**Yarn Twist:**

The traditional staple yarns are strengthened by means of twisting the bundle of fibers. “Twist” could be elaborated as the spiral disposition of the components of a thread as a result of the relative rotation of the two ends. The presence of twist in a yarn binds the fibers together and helps to keep them in their corresponding positions. It provides coherence between the fibers and adequate strength to the yarn. Twist is also imparted to create different effects that are highly visible when fabric is manufactured from this yarn. The effects are attained by combining yarns with different twist levels and twist directions in the fabric. Twist is usually expressed as the number of turns per unit length of yarn, for example, turns per inch or turns per meter.

**Terminologies for Specialty (Fancy) Yarns**

<https://textilelearner.net/classification-and-uses-of-fancy-yarn/>

<https://textilelearner.net/different-types-of-fancy-yarns/>

**Specialty (Fancy) Yarn:**

Textile yarns are the basic elements of fabrics. For fabric design and production, yarns are mainly considered in terms of their colors, structures and material properties. Fancy yarn, sometimes known as novelty yarn is a yarn that is made with a distinctive irregular profile or a construction that differs from basic single and folded yarns, the objective of which is to enhance the aesthetics of the end product with respect to visual and textural properties. A fancy yarn has a complex microstructure due to the large number of constituent fibers with various properties such as fiber fineness, elasticity, etc. Most fancy yarns are produced by specialist fancy spinners, using machines modified or developed for the purpose. Fancy yarns produced by using hollow spindle machines have a similar look to yarns produced with ring twisting and the combined system, but their structure and properties are different.

There is a variety of fancy yarns, for example: nepp, slub, flake, marl, Spiral or corkscrew, gimp, eccentric, boucle, loop, stripe, cover, snarl, knop, Cloud or grandrelle, Eyelash or feather, chenille, pompom, diamond, fasciated, metallic, button, tape.

**Terminologies for Fabric Finishing & Embellishment**

<https://textilelearner.net/textile-finishing-beautification-process-of-fabric/>

<https://textilelearner.net/physical-and-chemical-means-of-textile-finishing/>

<https://textilelearner.net/fabric-embellishment-techniques/>

**Textile Finishing:**

Textile finishing is a term commonly applied to different process that the textile material under go after pretreatment, dyeing or printing for final embellishment to enhance their attractiveness and sale appeal as well as for comfort and usefulness.

**Preparatory finishing operations:**

Preparatory finishing operations are made to prepare the fabric ready for dyeing or printing. From textile surfaces, auxiliary materials such as sized, glue, etc. are removed. To give the desired color to the textile surfaces during the dyeing process, dyestuffs and substances that prevent the dye from penetrating the fibers are removed via these operations.

Important preparatory finishing processes include scouring, bleaching, caustication etc.

**Scouring:**

During the knitting process, the mesh surfaces become dirty. The mesh surfaces, which consist of synthetic yarns, contain oils that facilitate the knitting process. Dirt and oils are removed by washing in special washing machines used in the textile industry with degreasing agents.

**Bleaching:**

Bleaching is applied to all raw textiles that need to be white or painted or printed in light shades. By bleaching, natural dyestuffs, especially those in the structure of natural fibers, are broken down and made soluble in water and removed from the fibers by washing the fabric. Woven fabric, which is obtained by yarn from artificial fibers, is often not applied due to the fact that the fibers have the same standard.

**Caustic Soda:**

Caustication is the processing of cotton woven surfaces with Sud caustic. In this process, there is no stretching like in the mercerization process. The causticizing process causes the woven surface to pull and jam. So, the fabric can absorb the dyestuff more; however, this process does not give the woven surface a shine.

**Finishing – Coloring Operations (dying & printing)**

The coloring process in textile materials is carried out by dyeing or printing methods. The process of coloring in textiles is the treatment of dyes with textile material. With this process, the textile material not only changes color; at the same time this color becomes permanent on the material. Organic molecules used in the process of coloring textile materials by dyeing and printing are called dyestuffs. The process of dyeing a textile material into a single color is called plain dyeing or dyeing for short. The process of creating patterns with one or more colors in different places on the textile material is called printing.

**Advanced Finishing Operations**

Advanced finishing operations are for increasing the value of the final product through giving advanced features like softening, shining, technical specifications etc. Some examples to advanced finishing operations are summarized as below:

**Calendaring:**

Calendaring is defined as the modification of the surface of a fabric by the action of heat and pressure. The finish is obtained by passing the fabric between heated rotating rollers (Smooth or Engraved) when both speed of rotation and pressure applied are variable.

**Mercerization:**

The treatment of cellulosic textile in yarns or fabric form with a concentrated solution of caustic alkali whereby the fibers were swollen, the strength and dye affinity of the materials increased and their handle is modified. Usually, cotton goods treated with 15-25% w/v caustic soda solution (55-65 oTw) at a temperature of 15-25oC during mercerization.

**Compacting:**

Durable finish imparted on man-made fibres and knitted fabrics by employing heat and pressure to shrink them to produce a crêpey and bulky texture.

**Sanforizing or Pre Shrinking:**

Sanforizing is a process where by the fabric is run through a sanforizer; a machine that has drums filled with hot steam. This process is done to control the shrinkage of the fabric. The fabric is given an optimum dimensional stability by applying mechanic forces and water vapour.

**Sueding:**

This process is carried out by means of a roller coated with abrasive material. Sueding is a mechanical finishing process in which a fabric is abraded on one or both sides to raise or create a fibrous surface. This fibrous surface improves the fabric appearance, gives the fabric a softer, fuller hand, and can mask fabric construction and subdue coloration. Special type of raised surface fabric is corduroy Sueding, sanding- creates softer hand of fabric.

**Raising or Napping:**

The raising of the fiber on the face of the goods by means of teasels or rollers covered with card clothing (steel wires) that are about one inch in height. Action by either method raises the protruding fibres and causes the finished fabric to provide greater warmth to the wearer, makes the cloth more compact, causes the fabric to become softer in hand or smoother in feel. Napped fabrics include blankets, flannel, unfinished worsted, and several types of coatings and some dress goods.

**Shearing:**

Shearing is an important preparatory stage in the processing of cotton cloth. The objective of “Shearing” is to remove fibers and loose threads from the surface of the fabric, thus improving surface finish.

**Softening:**

Softening treatment is one of the most important chemical after treatments in the textile industry. Softening is carried out when the softness characteristics of a certain fabric must be improved, always carefully considering the composition and properties of the substrate.

**Napping:**

Fabric surfaces are raised and plucked with needles on rotating drums to create a woolly or flannel surface.

**Elastomeric Finishes:**

Elastomeric finishes are also referred to as stretch or elastic finishes and are particularly important for knitwear. These finishes are currently achieved only with silicone-based products. The main effect is durable elasticity, because not only must extensibility be enhanced, but recovery from deformation is of crucial importance. After all stresses and disturbing forces have been released, the fabric should return to its original shape.

**Crease Resistant or Crease Proofing:**

Crease Resistant Finishes are applied to cellulose fibres (cotton, linen and rayon) that wrinkle easily. Permanent Press fabrics have crease resistant finishes that resist wrinkling and also help to maintain creases and pleats throughout wearing and cleaning.

**Anti-microbial finishes:**

With the increasing use synthetic fibbers for carpets and other materials in public places, anti-microbial finishes have assumed importance. Anti microbial finish Eco-friendly anti microbial finishing agent for cotton fabrics & Garments. Useful for eliminating bacterial growth due to sweat.

**Soil Release Finishes:**

Prevent soil and stains from being attracted to fabrics. Such finishes may be resistant to oil-boure or water-bourne soil and stains or both. These finishes attract water to the surface of fibres during cleaning and help remove soil. Soil release finish increases the hydrophilicity of the material and increases wetability.

**Peach finish:**

Subjecting the fabric (either cotton or its synthetic blends) to emery wheels, makes the surface velvet like. This is a special finish mostly used in garments.

**Anti Pilling:**

Anti pilling finish reduces the forming of pills on fabrics and products made considerable strength, flexibility and resistance to impact. Anti pilling finish is based on the use of chemical treatments which aim to suppress the ability of fibers to slacken and also to reduce the mechanical resistance of synthetic fiber.

**Flame Retardant Treatment:**

They are applied to combustible fabrics used in children’s sleepwear, carpets and curtains and prevent highly flammable textiles from bursting into flame. Polyester fabrics can be made flame resistant by treatment with an aqueous emulsion of xylene soluble 2,3-dibromopropyl phosphate in a pad-cure sequence.

**Oil and Water Proofing:**

Waterproof Finishes allows no water to penetrate, but tend to be uncomfortable because they trap moisture to the body. Recently, fabrics have been developed that are waterproof, yet are also breathable that is more comfortable.

**Water-Repellent Finishes:**

Water-repellent finishes resist wetting. If the fabric becomes very wet, water will eventually pass through. Applied to fabrics found in raincoats, all-weather coats, hats, capes, umbrellas and shower curtains.

**Heat setting:**

This is a final finish created by heating thermoplastic manmade fabrics (usually) to just below their melting point. This treatment stabilizes the fabric so that there will be no further change in its size or shape and therefore, improves the fabric’s resilience.