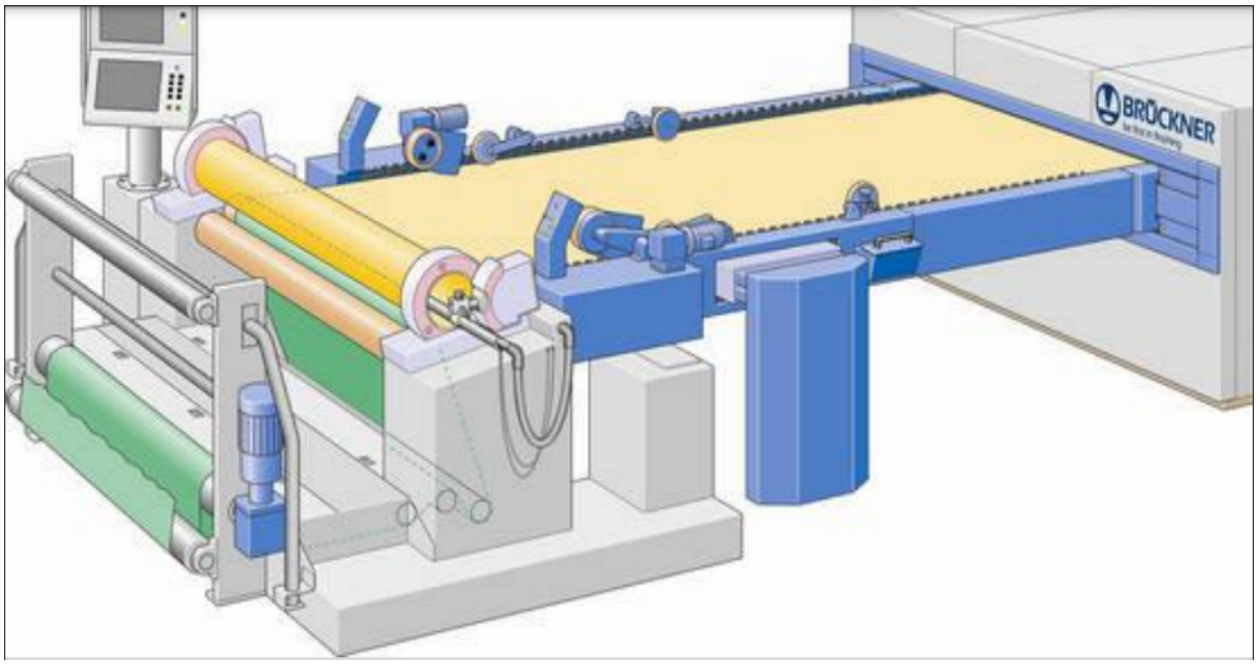
Textile Processing Technology

Level-II

Based on June 2022, Curriculum Version 1



Module Title: - Perform final finishing operations

Module code: IND TPT2 M06 0222

Nominal duration: 91Hour

Prepared by: Ministry of Labour and Skill

August 2022

Addis Ababa, Ethiopia

Table of Content

Acknowledgment

Ministry of Labor and Skills and Ministry of Health wish to extend thanks and appreciation to the many representatives of TVET instructors and respective industry experts who donated their time and expertise to the development of this Teaching, Training and Learning Materials (TTLM).

Acronym

SOP: Standard operating procedure

WHS: Work health and safety

PPE: Using personal protective equipment

PPE: Personal Protective Equipment

VOC: Volatile Organic Compounds

RPE: Respiratory Protective Equipment

Introduction to the Module

In Textile Processing Technology filed; to determine job requirements; what mean finishing processes; to know the set up and load finishing machine or equipment, how to operate and monitor of finishing machines or equipment; how to remove product and complete records.

This module is designed to meet the industry requirement under the textile processing technology occupational standard, particularly for the unit of competency: **Perform final finishing operations.**

This module covers the units:

- Job requirements
- Finishing processes
- Finishing machine or equipment adjustment
- Finishing machines or equipment Operation and monitoring
- Finishing machines
- Product dispatching
- Records Completion

Learning Objective of the Module

- Determine job requirements
- Understand Finishing processes
- Set up and load finishing machine or equipment
- Operate and monitor finishing machines or equipment
- Remove product and dispatch
- Finishing machines
- Complete records

Module Instruction

For effective use this modules trainees are expected to follow the following module instruction:

1. Read the information written in each unit
2. Accomplish the Self-checks at the end of each unit
3. Perform Operation Sheets which were provided at the end of units
4. Do the "LAP test" giver at the end of each unit and
5. Read the identified reference book for Examples and exercise

Unit one: Job requirements

This unit is developed to provide you the necessary information regarding the following content coverage and topics:

- Standard operating procedures (SOPs)
- Complying with work health and safety (WHS) requirements
- Using personal protective equipment (PPE)
- Identifying job requirements

This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Follow standard operating procedures (SOPs)
- Comply with work health and safety (WHS) requirements at all times
- Use appropriate personal protective equipment (PPE) in accordance with SOPs
- Identify job requirements from specifications, drawings, job sheets or work instructions

1.1. Standard operating procedures (SOPs)

1.1.1. OHS practices

• **Standard operating procedure**

For processes involving hazardous substances, hot liquids, pressurized equipment, and any other processes that may incur risks to safety and health, hazard information and risk control measures should be stated clearly in the respective standard operating procedures and made known to the employees concerned.

• PPE

• Safe material handling

• Hazard control measures

• Housekeeping

• **Containers** - use robust containers with a closable lid for storage. However, repeated removal and replacement of container lids and opening and closing of bags can also generate more dust. Plan to dispose of containers safely. Bags especially can cause problems and are best placed into disposal sacks at the workstation. Also plan how you will deal with damaged containers and how to dispose of unwanted dyes.

• Areas where dyes are handled should be easy to clean, with walls and floors that are sound and smooth. Rounded corners are easier to clean. Shelving and workbenches should be easy to clean too or else covered with impervious, disposable covering. They should have a lip to retain spills.

• Cleaning and dealing with spillages - dry vacuum cleaning, using a piped system or a type H industrial vacuum cleaner, is best for larger dry spillages and most cleaning tasks. Wet vacuuming or other wet cleaning methods may be appropriate in some situations or for smaller spillages. Don't use brushes or brooms or compressed air, as these will simply spread the dust into the air

• Ergonomic arrangements of workplace

• Reporting accidents and incidents

1.2. Complying with work health and safety (WHS) requirements

The major safety and health issues in the textile industry can be stated as under:

1) Exposure to cotton dust: The workers engaged in the processing and spinning of cotton are exposed to significant amounts of cotton dust. They are also exposed to particles of pesticides and soil. Exposure to cotton dust and other particles leads to respiratory disorders among the textile workers. The fatal disease of byssinosis, commonly known as brown lung, is caused among people working in the textile industry on account of excessive exposure to

cotton dust. The symptoms of this disease include tightening of the chest, coughing, wheezing and shortness of breath.

2) Exposure to chemicals: Workers in the textile industry are also exposed to a number of chemicals, especially those engaged in the activities of dyeing, printing and finishing. Chemicals based on benzidine, optical brighteners, solvents and fixatives, crease-resistance agents releasing formaldehyde, flame retardants that include organ phosphorus and organ bromine compounds and antimicrobial agents are used in textile operations.

3) Exposure to noise: High levels of noise have been observed in most of the units engaged in the textile industry, particularly those in developing countries. In the long run, exposure to high noise levels has been known to damage the eardrum and cause hearing loss. Other problems like

fatigue, absenteeism, annoyance, anxiety, reduction in efficiency, changes in pulse rate and blood pressure as well as sleep disorders have also been noted on account of continuous exposure to noise. Lack of efficient maintenance of machinery is one of the major reasons behind the noise pollution in a majority of the units. Though it causes serious health effects, exposure to noise is often ignored by textile units because its effects are not immediately visible and there is an absence of pain.

4) Ergonomic issues: Ergonomic issues are observed in a majority of the units engaged in textile-related activities. Most of these units have a working environment that is unsafe and unhealthy for the workers. Workers in these units face a number of problems such as unsuitable furniture, improper ventilation and lighting, and lack of efficient safety measures in case of emergencies. The workers in such units are at risk for developing various occupational diseases. Musculoskeletal disorders like carpal tunnel syndrome, forearm tendinitis, bicapital tendinitis, lower back pain, epicondylitis, neck pain, shoulder pain, and osteoarthritis of the knees are some of the occupational diseases that have been observed among the workers on account of poor ergonomic conditions. These issues are more common in developing nations as compared to developed ones.

Hazard identification and control

The hazards and risks involved in the textiles industry are comparable to other industries, with minimal emphasis on textile industry. Many accidents do not come to the legal

formalities. Many people are not aware that health and safety workers are unemployed; management has not given importance to promoting safety devices in the textile industry. The main risks are physical, chemical, ergonomics and physiologically, working hours, incorrect ventilation, dust chemical and noise are some of the things that can cause harm.
Big risks are physical, electrical, chemical ergonomics and physiological hazards. Some of these complications produce more work time, noise, dust, chemical and improper ventilation. These problems are controlled by using checklists, give recommendation and suggestions also give proper remedial measures. The proper design of human body capabilities and equipment only works in accordance with the environment. With the aim of continuous improvement, the workforce will focus on realizing their health and safety in the workplace.

1. Chemical Hazards

Respiratory & Dermal contact hazards

Dust: Exposure to fine particulates is mainly associated with natural fibers and yarn manufacturing processes. Cotton dust is generated during the handling or processing of cotton and contains cotton fibers and other potential chemical and microbiological contaminants (e.g.

bacteria, fungi, pesticides, and herbicides). Exposure to cotton dust can generate respiratory hazards (e.g. byssinosis in cotton manufacturing, chronic bronchitis, asthma, and emphysema).

Prevention and control of occupational health and safety hazards relevant to natural fiber dust include the following

- Installation of dust extraction, recycling and ventilation systems to remove dust from work areas, especially in cotton mills;
- Use of vacuum cleaning of surfaces instead of compressed air “sweeping” techniques;
- Implementation of regular housekeeping procedures, especially in the “flocking” area;
- Use of mechanical methods to handle cotton and cotton waste;
- Use of personal protective equipment (PPE) for exposed workers, such as masks and respirators, as necessary.
- Workplace exposure to asbestos dust during fiber production represents a known risk of lung cancer (mesothelioma) and injury to the bronchial tubes. The use of asbestos fiber is prohibited. Appropriate dust extraction systems in facilities where inorganic natural fibers are processed should be implemented (e.g. filters using nano-whiskers).

Volatile Organic Compounds (VOC):

Exposure to VOC emissions is related to the use of solvents in textile printing processes, fabric cleaning, and heat treatments (e.g. thermo fixation, drying, and curing). Worker exposure can cause skin and respiratory impacts. Exposure to certain compounds (e.g. carbon disulphide in rayon manufacturing) may have significant toxic effects, including nervous system and heart diseases.

Prevention and control techniques to reduce VOC exposure hazards include the following:

- Use of hoods and enclosed equipment;
- Use of well-ventilated rooms, with a slight positive pressure, for process control operators, and as worker rest stations;
- Use of shift and task rotation strategies for workers to minimize VOC exposure;
- Installation of extraction and air recycling systems to remove VOCs from the work area with
- Use of appropriate abatement technologies (e.g. scrubbers employing activated carbon absorbers) or routing the extracted vapors to the combustion system;
- Use of personal protective equipment (PPE), such as respirators, as necessary.

Chromium: is a major cause of allergic contact dermatitis among dye house workers and workers who perform dyeing operations and handle dyestuffs containing chromium.

Prevention and control of this potential hazard include reduction in the proportion of soluble chromium in dyestuffs and the use of adequate PPE to prevent dermal contact, as described in the General EHS Guidelines.

Explosion

Organic dusts, including cotton dust, are combustible and present a potential explosion hazard. This hazard is most effectively controlled through the measures for prevention of dust accumulation as above. In addition, all possible sources of ignition where organic dusts may form clouds or accumulate should be removed. VOC use, such as solvents, may form potentially explosive mixtures in air. Electrical equipment in these areas should be rated for ignition prevention.

2. Physical Hazards

Activities related to the maintenance operations of industry specific equipment (e.g. cards, spinning machinery, looms, and stenters) may expose workers to physical impacts,

particularly with reference to hot surfaces and moving equipment. Prevention and control of these impacts include the implementation of general protection measures (e.g. machine guarding and lock-out-tag-out systems and procedures), as described in the General EHS Guidelines.

Heat

The most significant risk of exposure to heat and high humidity occurs during wet processing and dry finishing operations and is caused by the use of steam and hot fluids in these processes.

Noise

The main sources of noise in textile plants are associated with yarn processing (e.g. texturizing and twisting and doubling) and woven fabric production. Noise management, including the use of personal hearing protection.

Ionizing and Non-Ionizing Radiation

X-ray stations are sometimes used for continuous monitoring of the foam thickness in continuous foam dyeing and for tank level control systems. Operators of this equipment should be protected through the use of ionizing radiation protection measures to limit exposure doses.

Risk assessment

Risk assessment is the risk hazard assessment or safety evaluation. The purpose is ensuring the enterprise economic interests' security for export enterprises which use quantitative analysis or qualitative analysis. Controlling the possibility for risk and damage degree will develop appropriate management decisions. Currently, the commonly used risk assessment methods are qualitative evaluation, quantitative assessment methods, probabilistic risk assessment methods, risk assessment software and soon.

Qualitative assessment method is the ability to assess based on the experience and technology of production systems, equipment, environment, personnel, management and other aspects of qualitative evaluation. Included in this type of assessment method are Safety Checklist, Preliminary Hazard Analysis, fault type and hazard analysis and other research methods that affect operability.

What is characteristic of this method is being simple and yielding intuitive results. Quantitative assessment method means assessing the risk on the basis of quantization which mainly relies on historical statistics, and mathematical method of constructing mathematical models for evaluation. Quantitative evaluation methods include probabilistic assessment method, mathematical model calculations and relative valuation method. Probabilistic Risk

Assessment Act is based on the probability of calculating the risk accidents. Risk assessment software b through software to help people find out the cause of the accident, understanding the severity of the potential risks and identifying risk mitigation approaches. There are four main types such as hazard identification software, consequences of accidents modeling software, accident frequency analysis software and comprehensive quantitative risk analysis software.

Generally, risk is composed of risk factors, risk accidents and losses. Risk factors increase opportunity for the risk accidents. Risk accidents are the direct reason for losses. Normally, risk losses refer to the economic losses or other additional losses. There are four types of risk control: first one is risk aversion which means designedly discarding the risk project; second is loss control which refers to trying to control losses to lowest degree even if something is unavoidable; third one is risk defection which needs to use insurance or contract toother participants. Last one is risk retention which refers to self–insurance with or without plan. Unplanned means bearing the loss by enterprise after risk occurrence. Planned means found compensation can be acquired through insurance or other methods before risk occurrence.

Risk assessment on textile finishing

Risk assessment on textile finishing requires knowledge of the properties of chemicals and the reactions involved in the concerned chemical processes. Due consideration should be given to the factors listed in the following paragraphs.

Physical form of the chemicals

The physical forms of the chemicals used in textile finishing have pronounced effects on the hazards of the chemicals. For those in the state of gases, vapours, fumes, aerosols, airborne particulates, the risk of entry into the human body as well as the risk of fire and explosion is increased. It should be noted that aerosol, particulate and powder forms of combustible materials can form explosive/flammable mixtures with oxidizing agents, including air.

Chemical changes

If chemical change is involved, the chemical reaction and the products should be studied. The hazards associated with the chemical reaction as well as hazardous properties of the reactants and products in textile finishing processes should be identified. Special attention should be paid to any possible side reactions and by-products.

Temperature and pressure changes

Many physical and chemical changes may evolve heat, causing a rise in temperature during the finishing processes. They may result in:

(a) Formation of hazardous gases, vapours or fumes;

(b) Pressure increase in the container causing explosion;

(c) Rapid bubbling causing splashing of hot hazardous fluids; or

(d) Increase in reaction rate generating even more heat.

These effects can be intensified if there is no effective means to dissipate the heat evolved which may result in localised heating and superheating of the reaction mixture. It should also be noted that some exothermic reaction initiated by a rise in temperature may auto-accelerate and the reaction rate may become out of control.

Scale of the process

The scale of the process determines the amount of hazardous chemicals involved. Change in the scale affects the heating effect of the operation as well as heat dissipation and pressure change in the system.

Extent of exposure

The extent of exposure to hazardous chemicals is affected by:

(a) Frequency, duration and mode of exposure;

(b) Rate of generation and concentration of the hazardous chemicals in the atmosphere; and

(c) Effectiveness of control and protective measures in minimizing the exposure.

Working environment

The working environment ranging from the containers holding the chemicals to the general conditions of the workplace is an important aspect in the risk assessment of textile finishing. The following factors should be considered:

a. Size and shape of the container where chemical or physical changes take place, especially the headspace in the container and passage for release of pressure; if the container cannot withstand or release the increase in pressure, explosion may occur;

b. Presence of nearby ignition source, if explosive/flammable mixtures are encountered;

c. Whether processes undertaken or chemicals stored or used are sensitive to air, moisture, temperature or light; and

d. Ventilation of the environment.

Implementation of risk reduction measures

The following points are some examples to reduce risk in textile operation:

- Identify the risks in the textile industry and provide the right solutions for it.
- Measure work environment issues such that noise, temperature lighting humidity.
- Detect unsafe working condition in the Textile industry.
- Develop a framework for understanding the risks textile workers were exposed to due to lack of health and safety standards in the industry.
- Identify areas in which the hazards are involved.
- Identify how to industry can made free from risk.
- Give suggestion for avoiding the hazards.

1.3. Using personal protective equipment (PPE)

Textile industry is one of labour intensive production and most technologically complex of all industries, and is a place of work where workers are exposed to different safety hazards, like cotton dust, excessive noise, accidents and diseases. As result of this, workers, employers and government lost direct and indirect costs related to workplace injuries and illnesses. The direct costs for employers include compensation and treatment costs that has to be paid to the disabled workers, and while the indirect costs include production disturbance costs, lost time of injured worker, time lost by supervisors or executive to follow the injured worker, training costs for new workers. The direct costs for workers include pain and suffering from the injury or illness, loss of income, loss of a job and health-care costs, and while the indirect costs include time lost by family members to care the disabled worker and utmost economic shock and social chaos.

Use of personal protective equipment (PPE) is one of the important measures to safeguard workers from exposure to occupational hazards, especially in developing countries where conventional occupational safety control principles remain a challenge to implement. Workers use of PPE is affected by socio-demographic, behavioral and work environment factors. In textile factory they use different protective devices at different production sections. For example, they need to wear respirator, gloves, goggle, boot shoes, overall, ear plugs and mask at spinning section, and while reflector and helmet are worn in addition at engineering section.

Policies or measures for delivering health and safety services to factory workers are limited in Ethiopia. This not only limits their access to information and training opportunities but also

places the workers at a greater risk to occupational injuries and diseases. Furthermore, different evidences show that factory workers lack the knowledge on proper use of protective measures and are least aware of health effects emanating from the activities and materials in their work environments

There are various protective Clothing/ equipment's are available for the workers involved in textile wet processing.

Hand and foot protection

Gloves protect the hands of the worker from contacting hazardous chemicals. They should be made of appropriate material that would not be corroded or damaged by the hazardous chemicals involved in the operation. If workers have to work on wet floors, they should also wear protective footwear, preferably of slip resistant type.

Face and eye protection

Where there is a risk of eye injury through splashing, suitable eye protectors or face shields should be worn. Safety spectacles can be fitted with prescription lenses if required, while safety goggles that completely enclose the eyes provides superior eye protection. If protection to the face, mouth and nose is required in addition to the eyes, face shield should be used).

Respiratory protective equipment (RPE)

Respiratory protective equipment (RPE) protects against exposure to dusts, gases, fumes and vapours, but exposure duration should be kept short.

The type of PPE required depends on the hazard, the way exposure affects the body and the exposure time. Examples of PPE include:

- Safety glasses
- Ear protectors
- Respirators with filters
- Dust masks
- Gloves
- Protective suits
- Safety shoes

1.4. Identifying job requirements

A job is defined as anything a person is expected or obliged to do, duty and responsibility he /she has or the process or requirements, details, etc., of working or the execution/completing or performance of a task.

- Job requirements may include the following:
- Job Specifications,
- Drawings,
- Job sheets or
- Work instructions

A job specification: is the list of recommended qualities for a person to qualify for and succeed in a position. While the job description includes the title position, responsibilities and summary, the specification identifies the skills, traits, education and experience a candidate might need to qualify for that job.

Drawings: are sketches that are used by designers such as architects, engineers and interior designers as a quick and simple way of exploring initial ideas for designs.

A job sheet: is a document that outlines all the relevant information about a job, task, or project. Technicians use the information on the sheet to start a job and add more information as the job's requirements change along the way.

Work Instructions: are documents that clearly and precisely describe the correct way to perform certain tasks that may cause inconvenience or damage if not done in the established manner.

The requirements for a job vary according to the nature of the job itself. However, a certain work ethic must be cultivated to succeed in any job and this is fundamental to an individual's sense of himself as a worker, as part of production relations and a fundamental economic being.

The basic requirements for a job remain the same no matter what the job is, where it is located or what professional and educational qualifications are required for it. These are listed as follows:

- Discipline
- Enthusiasm/interest
- Soft Skills
- Qualifications and each of them are discussed as below.

- Discipline:

Nothing is possible without discipline. Any job requires a fundamental core of discipline from the worker or the employee and this is a quality which is independent of age, stature/size, job and so on. Discipline is absolutely indispensable and provides the impetus/energy for work that can be repetitive, boring and even unsatisfactory at times.

Enthusiasm:

Enthusiasm/ interest for work are also a pre-requisite for any job. An innate love for the job, which in modern parlance/ phrasing is known as job satisfaction, is a core requirement for any job. The drive to succeed, to innovate, to do well and to make one's profession into one's livelihood is a critical drive which needs to be present in the employee or cultivated as soon as possible. Any job is difficult to perfectly carry out without interest.

Qualifications:

This is a more material, tactile need for a job which can be conveyed through degrees and certificates. However education is not limited to what is taught in colleges or vocational training courses.

It is the burning desire to learn more to reach the depths of knowledge about a particular field of interest; to complete the job and learn from it that marks the true enthusiast and the truly learned.

Soft Skills:

Soft skills include those skills which ensure that a job is executed well and the employee can carry himself in the proper manner too. For example: good and smooth communication, computer skills, proficiency in language if needed, presentable appearance, the ability to manage crises are all soft skills which are fundamentally important in any job and which must be cultivated consciously.

Thus, the requirements of a job, though specific to it, cover also a general spectrum. These make for better employees and better individuals.

Self-check-1

Instruction1: Select the correct answer for the given choice. You have given 1 Minute for each question. Each question carries 2 Point.

1. ---------- Exposure to fine particulates is mainly associated with natural fibers and yarn manufacturing processes.

A. Soil B. Dust

B. Yarn D. yarn E. all

2. ---------- is a document that outlines all the relevant information about a job, task, or project.

A. A job specification C. job sheet

B. Drawings D. Work Instructions E, all

3. The extent of exposure to hazardous chemicals is affected by----------

A. Frequency, duration and mode of exposure

B. Rate of generation and concentration of the hazardous chemicals in the atmosphere

C. Effectiveness of control and protective measures in minimizing the exposure

D. All of the above

E. None of the above

Instruction2: Write the answer for the given question. You are provided 3 minute for each question and each point has 4 Points.

1. Safe material handling means.
2. Safe material handling.
3. Volatile Organic Compounds (VOC).
4. Risk assessment.
5. Respiratory & Dermal contact hazards.
6. Explosion.

Note: Satisfactory rating – above 30% Unsatisfactory - below 30%

You can ask you teacher for the copy of the correct answers

Unit Two: Finishing processes

This unit to provide you the necessary information regarding the following content coverage and topics:

- Understanding finishing processes, technologies and its significance
- Understanding chemicals & auxiliaries interaction with each other and textiles
- Identifying finishing chemicals and auxiliaries properties & functions
- Identifying mechanical finishes properties & functions
- Selecting and using chemicals, auxiliaries & mechanical finishing types
- Preparing chemical recipe formulation and process parameters settings

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Understand finishing processes, technologies and its significance.
- Understand interaction of chemicals & auxiliaries with each other and textiles
- Identify properties & functions of Chemicals, auxiliaries and types of mechanical finishes
- Select and use chemicals, auxiliaries & other mechanical finishing
- Prepare chemical recipe formulation and settings of process parameters

2.1. Understanding finishing processes, technologies and its significance

Textile finishing processes

In textile manufacturing, finishing refers to the processes that convert the woven or knitted cloth into a usable material and more specifically to any process performed after dyeing the

yarn or fabric to improve the look, performance, or "hand" (feel) of the finish textile or clothing.

Fabric after leaving the loom or knitting machine is not readily useable. Called grey cloth at this stage, it contains natural and added impurities. Sometimes it is also processed at fiber or yarn stages of textile manufacturing. Grey fiber or yarn or fabric goes through a series of processes such as wet processing and finishing. Finishing is a broad range of physical and chemical treatments that complete one stage of textile manufacturing and may prepare for the next step, making the product more receptive to the next stage of manufacturing. Finishing adds value to the product and makes it more attractive, useful, and functional for the end-user. Improving surface feel, aesthetics, and addition of advanced chemical finishes are some examples of textile finishing.

Wet processing or finishing processes include the main processes of fabric preparation, namely desizing, bleaching, mercerizing, dyeing, printing, and other specific treatments. These phases treat fabrics with chemical and liquor baths and often require several washing, rinsing, and drying steps, generating significant wastewater effluents.

The recommended pollution prevention and control techniques for the finishing pretreatment steps include the following:

- Selection of water soluble and biodegradable lubricants for knitted fabrics instead of mineral oil and wash them with water;
- Use of organic solvent washing for non-water soluble lubricants;
- The thermo fixing step may be performed before the washing step. Air emissions generated from the stenter should be treated by dry electro filtration. The oil separated should be collected to limit effluent contamination;
- Residual liquor should be minimized through reduced application, reduced tank volumes and padding liquor recycling;
- Using mechanical dewatering equipment to reduce water content of the incoming fabric and reduce energy consumption in stenter frame.

The term finishing includes all the mechanical and chemical processes employed commercially to improve the acceptability of the product, except those procedures directly concerned with colouring. The objective of the various finishing processes is to make fabric from the loom or knitting frame more acceptable to the consumer. Finishing processes include preparatory treatments used before additional treatment, such as bleaching prior to

dyeing; treatments, such as glazing, to enhance appearance; sizing, affecting touch; and treatments adding properties to enhance performance, such as preshrinking. Newly formed cloth is generally dirty, harsh, and unattractive, requiring considerable skill for conversion into a desirable product. Before treatment, the unfinished fabrics are referred to as gray goods, or sometimes, in the case of silks, as greige goods.

Finishing formerly involved a limited number of comparatively simple operations evolved over the years from hand methods. The skill of English and Scottish finishers was widely recognized, and much British cloth owed its high reputation to the expertise of the finisher. More sophisticated modern finishing methods have been achieved through intense and imaginative research.

Preparatory treatments

It is frequently necessary to carry out some preparatory treatment before the application of other finishing processes to the newly constructed fabric. Any remaining impurities must be removed, and additives used to facilitate the manufacturing process must also be removed. Bleaching may be required to increase whiteness or to prepare for colour application. Some of the most frequently used preparatory processes are discussed below.

Burling and mending

Newly made goods, which frequently show imperfections, are carefully inspected, and defects are usually repaired by hand operations. The first inspection of woolen and worsted fabrics is called perching. Burling, mainly applied to woolen, worsted, spun rayon, and cotton fabrics, is the process of removing any remaining foreign matter, such as burrs and, also, any loose threads, knots, and undesired slubs. Mending, frequently necessary for woolens and worsteds, eliminates such defects as holes or tears, broken yarns, and missed warp or weft yarns.

Scouring

When applied to gray goods, scouring removes substances that have adhered to the fibers during production of the yarn or fabric, such as dirt, oils, and any sizing or lint applied to warp yarns to facilitate weaving.

Bleaching

Bleaching, a process of whitening fabric by removal of natural colour, such as the tan of linen, is usually carried out by means of chemicals selected according to the chemical composition of the fibre. Chemical bleaching is usually accomplished by oxidation, destroying colour by the application of oxygen, or by reduction, removing colour by hydrogenation. Cotton and other cellulosic fibres are usually treated with heated alkaline hydrogen peroxide; wool and other animal fibres are subjected to such acidic reducing agents as gaseous sulfur dioxide or to such mildly alkaline oxidizing agents as hydrogen peroxide. Synthetic fibres, when they require bleaching, may be treated with either oxidizing or reducing agents, depending upon their chemical composition. Cottons are frequently scoured and bleached by a continuous system.

Mercerization

Mercerization is a process applied to cotton and sometimes to cotton blends to increase lustre (thus also enhancing appearance), to improve strength, and to improve their affinity for dyes. The process, which may be applied at the yarn or fabric stage, involves immersion under tension in a caustic soda (sodium hydroxide) solution, which is later neutralized in acid. The treatment produces permanent swelling of the fibre.

Drying

Water, used in various phases of textile processing, accumulates in fabrics, and the excess moisture must eventually be removed. Because evaporative heating is costly, the first stage of drying uses mechanical methods to remove as much moisture as possible. Such methods include the use of centrifuges and a continuous method employing vacuum suction rolls. Any remaining moisture is then removed by evaporation in heated dryers. Various types of dryers operate by conveying the relaxed fabric through the chamber while festooned in loops, using a frame to hold the selvages taut while the fabric travels through the chamber, and passing the fabric over a series of hot cylinders. Because overdrying may produce a harsh hand, temperature, humidity, and drying time require careful control.

Finishes enhancing appearance

Treatments enhancing appearance include such processes as napping and shearing, brushing, singeing, beetling, decating, tentering, calendering or pressing, moiréing, embossing, creping, glazing, polishing, and optical brightening.

Napping and shearing

Napping is a process that may be applied to woollens, cottons, spun silks, and spun rayons, including both woven and knitted types, to raise a velvety, soft surface. The process involves passing the fabric over revolving cylinders covered with fine wires that lift the short, loose fibres, usually from the weft yarns, to the surface, forming a nap. The process, which increases warmth, is frequently applied to woollens and worsteds and also to blankets.

Shearing cuts the raised nap to a uniform height and is used for the same purpose on pile fabrics. Shearing machines operate much like rotary lawn mowers, and the amount of shearing depends upon the desired height of the nap or pile, with such fabrics as gabardine receiving very close shearing. Shearing may also be applied to create stripes and other patterns by varying surface height.

Brushing

This process, applied to a wide variety of fabrics, is usually accomplished by bristle-covered rollers. The process is used to remove loose threads and short fibre ends from smooth-surfaced fabrics and is also used to raise a nap on knits and woven fabrics. Brushing is frequently applied to fabrics after shearing, removing the cut fibres that have fallen into the nap.

Singeing

Also called gassing, singeing is a process applied to both yarns and fabrics to produce an even surface by burning off projecting fibres, yarn ends, and fuzz. This is accomplished by passing the fibre or yarn over a gas flame or heated copper plates at a speed sufficient to burn away the protruding material without scorching or burning the yarn or fabric. Singeing is usually followed by passing the treated material over a wet surface to assure that any smoldering is halted.

Beetling

Beetling is a process applied to linen fabrics and to cotton fabrics made to resemble linen to produce a hard, flat surface with high lustre and also to make texture less porous. In this

process, the fabric, dampened and wound around an iron cylinder, is passed through a machine in which it is pounded with heavy wooden mallets.

Decating

Decating is a process applied to woollens and worsteds, synthetic and blended fibre fabrics, and various types of knits. It involves the application of heat and pressure to set or develop lustre and softer hand and to even the set and grain of certain fabrics. When applied to double knits it imparts crisp hand and reduces shrinkage. In wet decating, which gives a subtle lustre, or bloom, fabric under tension is steamed by passing it over perforated cylinders.

Tentering, crabbing, and heat-setting

These are final processes applied to set the warp and weft of woven fabrics at right angles to each other, and to stretch and set the fabric to its final dimensions. Tentering stretches width under tension by the use of a tenter frame, consisting of chains fitted with pins or clips to hold the selvages of the fabric, and travelling on tracks. As the fabric passes through the heated chamber, creases and wrinkles are removed, the weave is straightened, and the fabric is dried to its final size. When the process is applied to wet wools it is called crabbing; when applied to synthetic fibres it is sometimes called heat-setting, a term also applied to the permanent setting of pleats, creases, and special surface effects.

Calendering

Calendering is a final process in which heat and pressure are applied to a fabric by passing it between heated rollers, imparting a flat, glossy, smooth surface. Lustre increases when the degree of heat and pressure is increased. Calendering is applied to fabrics in which a smooth, flat surface is desirable, such as most cottons, many linens and silks, and various synthetic fabrics. In such fabrics as velveteen, a flat surface is not desirable, and the cloth is steamed while in tension, without pressing. When applied to wool, the process is called pressing and employs heavy heated metal plates to steam and press the fabric. Calendering is not usually a permanent process.

Moiréing, embossing, glazing and ciréing, and polishing are all variations of the calendering process. Moiré is a wavy or “watered” effect imparted by engraved rollers that press the design into the fabric. The process, applied to cotton, acetate, rayon, and some ribbed synthetic fabrics, is only permanent for acetates and resin-treated rayons. Embossing imparts

a raised design that stands out from the background and is achieved by passing the fabric through heated rollers engraved with a design. Although embossing was formerly temporary, processes have now been developed to make this effect permanent.

Glazing imparts a smooth, stiff, highly polished surface to such fabrics as chintz. It is achieved by applying such stiffeners as starch, glue, shellac, or resin to the fabric and then passing it through smooth, hot rollers that generate friction. Resins are now widely employed to impart permanent glaze. Ciré (from the French word for waxed) is a similar process applied to rayons and silks by the application of wax followed by hot calendering, producing a metallic high gloss. Ciré finishes can be achieved without a sizing substance in acetates, which are thermoplastic (e.g., can be softened by heat), by the application of heat.

Polishing, used to impart sheen to cottons without making them as stiff as glazed types, is usually achieved by mercerizing the fabric and then passing it through friction rollers.

Creping

A crepe effect may be achieved by finishing. In one method, which is not permanent, the cloth is passed, in the presence of steam, between hot rollers filled with indentations, producing waved and puckered areas. In the more permanent caustic soda method, a caustic soda paste is rolled onto the fabric in a patterned form, or a resist paste may be applied to areas to remain unpuckered, and the entire fabric is then immersed in caustic soda. The treated areas shrink, and the untreated areas pucker. If the pattern is applied in the form of stripes, the effect is called plissé; an allover design produces blister crepe.

Optical brightening

Optical brightening, or optical bleaches, are finishes giving the effect of great whiteness and brightness because of the way in which they reflect light. These compounds contain fluorescent colourless dyes, causing more blue light to be reflected. Changes in colour may occur as the fluorescent material loses energy, but new optical whiteners can be applied during the laundering process.

Finishes enhancing tactile qualities

Finishes enhancing the feel and drape of fabrics involve the addition of sizing, weighting, fulling, and softening agents, which may be either temporary or permanent.

Sizing

Sizing, or dressing, agents are compounds that form a film around the yarn or individual fibres, increasing weight, crispness, and lustre. Sizing substances, including starches, gelatin, glue, casein, and clay, are frequently applied to cottons and are not permanent.

Weighting

Weighting, in the processing of silk, involves the application of metallic salts to add body and weight. The process is not permanent but can be repeated.

Fulling

Also called felting or milling, fulling is a process that increases the thickness and compactness of wool by subjecting it to moisture, heat, friction, and pressure until shrinkage of 10 to 25 percent is achieved. Shrinkage occurs in both the warp and weft, producing a smooth, tightly finished fabric that may be so compact that it resembles felt.

Softening

Making fabrics softer and sometimes also increasing absorbency involves the addition of such agents as dextrin, glycerin, sulfonated oils, sulfated tallow, and sulfated alcohols.

Technologies

Some finishing techniques such as bleaching and dyeing are applied to yarn before it is woven while others are applied to the grey cloth directly after it is woven or knitted. Some finishing techniques, such as fulling, became outdated with the industrial revolution while others, such as mercerization, are developments following the Industrial Revolution.

Significance

In order to impart the required functional properties to the fiber or fabric, it is customary to subject the material to different types of physical and chemical treatments. For example, wash and wear finish for a cotton fabric is necessary to make it crease-free or wrinkle-free. In a similar way, mercerising, singeing, flame retardant, water repellent, waterproof, anti-static and peach finishing achieve various fabric properties desired by consumers.

The use of 100% synthetic textiles has increased considerably since the development of textured yarns made of filaments and the growing production of knit goods. The use of open weave has enabled the production of lighter, breathable, fabrics to ensure better wearing comfort.

The properties of petroleum-based synthetic fibers, most important among them being polyamide, polyester and polyacrylonitrile, are essentially different from those of natural cellulosic and protein-based (wool) fibers. Hence the sequence of finishing operations is likely to be different. While cellulosic fabrics require a resin finishing treatment to impart easy-care properties, synthetic fibers already exhibit these easy-care criteria and require only a heat setting operation.

2.2. Understanding chemicals & auxiliaries interaction with each other and textiles

Management of chemicals

For the storage of chemicals, the installations refer to the instructions outlined as well as to the recommendations provided by the chemical suppliers (e.g. storage conditions, storage climate control, placement by storage classes according to compatibility). Furthermore, provisions are made to avoid spillage of chemicals, such as by using work instructions, secondary containments and catchment facilities. In addition, provisions for spillage control (spill kits with suitable absorption material) are in place to react to and clean up spillages and leakage. The companies surveyed record their respective inputs and outputs by documenting and recording recipes. It was found that, depending on the company, the process was carried out either fully electronically or manually.

Regarding chemical related data management, the installations collect and as well as technical data sheets as provided by their suppliers. The key source of information and reference, from which relevant data is being extracted as and when required. Technical data sheets were mentioned as an additional source of information. Use of extended safety data sheets and/or exposure scenarios were not indicated by any of the case study installations.

The selected installations are maintaining different types of chemical inventory systems. The establishment and use of an enhanced chemical inventory system, which could serve as a structured knowledge information system (in line with the format recommended.

The provision of such information in a more structured format would allow a better involvement of the different internal parties in an integrated process of chemicals management. This could be easily done in form of an in-house electronic database, with corresponding search filters (e.g. from waste water, compliance, safety & health or purchasing perspectives).

Guidance for Chemicals Management in the Textile Industry

Dosing and dispensing of chemicals

The installations use either semi- or fully-automatic dosing and dispensing systems which meter the exact amounts of chemicals and auxiliaries, delivering these directly to the various machines through pipework without human intervention. This approach also reduces the potential risk of accidental spillage and release into the environment, as this is often caused by inappropriate manual handling.

Systematic selection and use of chemicals

The operator of one installation reported the use of specific procedures referring to the consideration of hazard levels (including to environment as well as to safety & health aspects) for the selection of less hazardous chemicals as part of enhanced "responsible purchasing practices". For this purpose, Classification, Labeling and Packaging (CLP) ratings of chemicals and formulations are systematically taken into consideration. The installations in Poland and Sweden also indicated that for this purpose they are frequently seeking support by external service providers or online tools such as those provided by ECHA. However, according to the contact persons of the installations concerned, no textile-specific tools are used.

The guide focuses on sustainability aspects in areas like hazardous properties for human health and for the environment; mobility of a substance, greenhouse gas emissions and resource consumption as well as responsibility in the supply chains.

2.3. Identifying finishing chemicals and auxiliaries properties & functions

Chemicals in the textile finishing processes

The most intensive use of chemicals is required for wet finishing processes such as dyeing, washing, printing and finishing.

The guide can also be used for the identification of chemical substitutes. In the technical manual on hand, a table with an overview of chemical compounds applied in textile manufacturing, their technical effects and chemical composition is provided.

Most of the auxiliaries applied in textile finishing are used as aqueous solutions and dispersions. The amount of active ingredients in these solutions or dispersions varies widely.

Bulk chemicals like inorganic salts (for example sodium chloride or sodium sulphate) are primarily used as basic chemicals in textile finishing followed by lyes (for example sodium hydroxide), acids (acetic acid, formic acid, inorganic acids) and reducing and oxidizing agents (sodium dithionite, hydrogen peroxide).

Apart from a minor amount of water which is evaporated during drying in the textile production processes, the main part is discharged as aqueous effluent. The main environmental concern is therefore the amount of water discharged and the chemical load it carries.

The input of chemicals and auxiliaries added at the finishing mills can be up to 1 kilogramme per kilogramme of processed textiles. Among the products applied during the finishing processes, the highest environmental loads arise from salts, detergents and organic acids (in that order).

Some chemicals that may be used in textile finishing are worth mentioning for their potential negative environmental impact:

- Alkyl phenol ethoxylates (used as detergents, wetting agents, levelling agents and for other purposes): The metabolites octylphenol and nonylphenol are toxic to aquatic life and disturb the reproduction of aquatic species by disrupting the endocrine system.
- Polybrominated diphenyl ethers and chlorinated paraffins (flame retardants), halogenated phenols and benzenes (reagents in the production of flame retardants): Some compounds of these classes of substances (for example pentabromodiphenyl ether, C 10-13 chloroparaffins) have been identified as “Priority Hazardous Substances” for their toxicity, persistency and liability to bioaccumulate.
- Mothproofing agents based on permethrin and cyfluthrin (carpet sector) are toxic to aquatic life.
- Sequestering (complexing) agents such as EDTA, DTPA and NTA may form stable complexes with metals. EDTA and DTPA are also poorly biodegradable.
- Compounds that form chlorine such as sodium hypochlorite (bleaching agent) and sodium dichloroisocyanurate (wool anti-felting agent) may react with organic compounds in water to form adsorbable organic halogens (AOX).
- Chromate-containing substances such as potassium dichromate
- Organic compounds with carcinogenic potential such as some aromatic amines, formed by cleavage of azo dyes, or vinylcyclohexene and 1,3-butadiene that can be present in polymer dispersions due to incomplete polymerization.

Auxiliaries in the textile finishing processes

- **Surfactants**

Surfactants are widely used in the textile finishing industry. They are divided into the classes anionic, non-ionic, cationic and amphoteric substances, however, anionic and non-ionic substances dominate. The effects of surfactants are manifold. In the textile industry, they are used predominantly as detergents, wetting agents, de-aeration agents, levelling agents, dispersing agents, softening agents, emulsifying agents, spotting agents, anti-electrostatics, foaming and defoaming agents, after-treatment agents for fastness improvement, felting agents and fixing acceleration agents for continuous dyeing and printing.

In dyeing and pre-treatment processes, surfactants are generally used in a concentration of approximately 2 grams per litre. With a typical liquor ratio in exhaust processes of 1:10, 20 grams of surfactant are used per kilogramme of textile.

- **Biocides**

Biocides are applied on textiles either in exhaust or padding processes during textile finishing in order to avoid any problems with bacteria, fungi, mould, mildew and algae, and the associated deterioration, staining, odours and health effects that they may cause. However, less than 5 per cent of the textiles for the end-use are finished with biocides.

Particularly fabrics used outdoors (such as sportswear), sanitary products (for example hospital textiles) and carpets are treated with antimicrobial finishing [10]. The sensitivity of the textile fibres varies based on their classes, but generally textiles made from natural fibres are more susceptible to biodegradation than man-made fibres.

The following categories are characteristic for biocides applied in textile finishing:

- Antimicrobial finishing
- Moth proofing
- Preservation agents used to improve the storage stability of textile auxiliaries

Biocides are applied to the textiles in a similar way to other auxiliaries. Mainly continuous padding processes or discontinuous methods comparable to exhaust dyeing are common.

Preservation agents to increase the storage stability are contained in various auxiliaries such as liquid sizing agents, preparation agents, natural thickeners in printing pastes, bonding agents for pigment printing based on polymeric dispersion, coating agents based on polymers, softening agents (especially fatty acid condensation products), finishing agents containing silicone compounds and auxiliaries based on proteins.

Generally, the widely used substance permethrin and synthetic pyrethroids are reported to have low toxicity to humans but high aquatic toxicity. However, all biocides entail negative environmental impacts when they are discharged in wastewater, due to their toxicity to aquatic life.

2.4. Identifying mechanical finishes properties & functions

Mechanical finish refers to machine finishes such as embossing, heat setting, sanforizing, sheering, various, luster imparting, surface finishes, and glaze finishes.

By passing the fabric between heated rotating rollers, the surface of the fabrics is rendered smooth, flattening slubs, increasing the fabric luster, improving the fabric handle by making it softer. There are many finishing operations that have not been covered. These are included in the books cited in the References and Suggested Further Reading sections.

Mechanical finish refers to machine finishes such as embossing, heat setting, sanforizing, sheering, various, luster imparting, surface finishes, and glaze finishes.

• Raised surface finishes

Another finishing process is raising. During raising, the fabric surface is treated with sharp teeth to lift the surface fibres, thereby imparting hairiness, softness, and warmth, as in flannelette.

• Shearing

Shearing is a kind of mechanical finish in which the appearance of the fabric is enhanced by cutting the loops or raised surface to a uniform and even height. The machine may have a spiral blade similar to a grass cutting machine. A Shearing machine can cut the loop or the pile to a desired level.

• Peaching

Peaching is also a mechanical finish comparable to raising but very gentle. The peach effect on fabrics is obtained by sanding the fabrics slightly; it imparts a protruded surface and soft feel. The peaching finish is also possible with certain chemicals or laundry abrasion.

• Calendering

Calendering is the third important mechanical process, in which the fabric is passed between heated rollers to generate smooth, polished or embossed effects depending on roller surface properties and relative speeds.

2.5. Selecting and using chemicals, auxiliaries & mechanical finishing types

Chemical Finishing Processes are those processes which involve the application of chemicals to the fabric and these can lead to modification of handle or make the fabric water repellant, oil and soil repellant, moth and insect proof, anti-microbial, flame retardant, antistatic, etc.

Chemical finishes are normally applied in the form of an aqueous solution or emulsion and can be applied, for example, with the help of a pad mangle. The fabric passes through a trough of chemical finish. It is then squeezed by a pair of nip rolls to ensure the even application of a fixed amount of the finish on to the fabric. After padding, the fabric is dried to remove the water and the finish can then be fixed by subjecting the fabric to a relatively high temperature for a short period. This enables the applied chemicals to form a durable finish on the fabric.

Some of the chemical finish treatments will now be described:

- **Handle modification**

When a dilute solution of boiled starch is applied to a woven piece of cotton and the fabric dried, the dried starch film will stick the warp and weft threads firmly together to give a stiff product. A crisp, smooth finish for cotton goods results from use of modified starches.

The most common handle modifier used today is the softener which lubricates the warp and weft of woven fabrics allowing the fabric to bend more easily and this gives it a soft feel. Anionic compounds such as sulphated oils and sulphated alcohols are used as softeners. Other softening agents are oil fat and wax emulsions soaps and synthetic detergents and silicon compounds.

- **Water repellent and water proof finishes**

Waterproof finishes are those that coat or seal a fabric so water does not pass through the fabric. Water repellent finishes result in a fabric that resists wetting. In the earlier days, the method for waterproofing a fabric was to coat it with rubber. This did the job but the coated

fabric was heavy, bulky and uncomfortable. Silicon compounds have been found to be the most suitable.

- **Oil, stain and soil-resistant finish**

Silicones and fluoro chemical finishes are very effective. A drop of oil placed on an untreated fabric spreads rapidly and stains it. A fabric treated with fluoro chemical finish does not allow these to penetrate the fabric. Any treatments that encourage the wetting of the textile surface will act as soil release agents. Polymers containing hydrophilic groups (say acrylic acid groups) would be readily wetted by water and the wet surface will act as soil release agent.

Materials such as carboxy methyl cellulose (CMC) aid in preventing re-deposition of soil during laundering and are frequently included in detergents.

- **Moth and insect damage proofing finishes**

The older method of producing a mothproof finish by creating wool with an insecticide was popular. Environmental concerns have led to the use of more acceptable materials like the synthetic pyretheroids which have low animal toxicity.

- **Microbiocidal finishes**

These are becoming important for textile finishing. Bacteriostatic is a chemical which inhibits the growth of bacteria. Similarly Fungistatic is a chemical which inhibits the growth of fungi. Fabrics impregnated with these chemicals will be safe and guard against infection.

- **Flame retardant finishes for cotton**

A phosphorous containing material is reacted with urea. The reaction product is padded on to cotton fabric and dried. The fabric is then reacted with ammonia and finally oxidized with hydrogen peroxide. This renders the fabric flame retardant.

- **Anti-static finishes**

An antistatic finish dissipates an electrical charge and does not allow it to accumulate on a fabric. An interesting development in the field of anti-static treatments has been the development of the Permolose finishes by ICI which consists of block copolymers of ethylene oxide and polyester. When polyester fibers are treated with this, the polyester portion of the copolymers is adsorbed by the polyester fiber but, the polyethylene oxide

portion is incompatible with the polyester fibre and so remains on the surface, where it attracts water and forms a conductive surface on the polyester fiber.

Shrinking

Mechanical shrinking (sometimes referred to as sanforizing), whereby the fabric is forced to shrink width and/or lengthwise, creates a fabric in which any residual tendency to shrink after subsequent laundering is minimal. Fibers to fabric conversion lead to many mechanical tensions and forces during manufacturing, which includes following steps for fibre to yarn conversion with spinning then fabric with weaving, and knitting. When the products are immersed in water, the water acts as a relaxing medium and all stresses and strains get relaxed and try to come back to its original relaxed state. Even after finishing with sophisticated finishing machines, some residual shrinkage remains, which is carried forward to the garment stage. This residual shrinkage may cause deformity or de-shaping of the products after domestic laundry. There are certain acceptance limits of shrinkage levels for every product. Abnormal shrinkage levels are considered non-conformity to quality standards.

2.6. Preparing chemical recipe formulation and process parameters settings

The proper formulation of chemical finishes requires consideration of several important factors: the type of textile being treated (fibre and construction); the performance requirements of the finish (extent of effect and durability); the cost to benefit ratio; restrictions imposed on the process by availability of machinery, procedure requirements, environmental considerations; and compatibility of different formula components as well as the interaction of the finishing effects. To bring all these parameters to an acceptable compromise is not easy, even for a single purpose finish. But usually several types of finishes are combined for economical reasons mostly in one bath (only one application and drying process). This is often the hardest challenge of chemical finishing. First, all components of the finish bath must be compatible. Precipitations of anionic with cationic products have to be avoided. The emulsion stability of different products may be reduced by product interactions. More difficult is often the second hurdle, the compatibility of the primary and secondary effects of the different types of finishes that are being combined:

Some effects are similar or assist each other, for example silicone elastomers cause water repellency, softeners bring about antistatic effects and antistatic finishes can be softening. •

Some effects are obviously contradictory, for example hydrophobic finishes and hydrophilic antistatic finishes, or stiffening and elastomeric finishes, or stiffening and softening finishes.

Fabric goods must pass through various finishing processes to be suitable for their intended end use. “Finishing” encompasses a number of treatments that improve or modify fabrics, enhancing properties such as aesthetics, “hand,” performance, durability, and resistance to biologic agents, fire or heat, electric charge accumulation, etc. Finishing alternatives are extremely varied, ranging from mechanical to chemical treatments. In some cases, the same results can be achieved through both mechanical and chemical treatments.

Some finishing treatments are specific for one kind of fabric (e.g., easy care finish for cotton, antistatic finish for synthetics, moth proofing and superwash finish for wool).

A typical recipe for chemical finishing of cotton and cotton blends is a combination of:

- Easy-care agents,
- Softener, and
- Functional additives (e.g. water repellent, flame retardant).

Finishing treatments can be carried out in batch or continuous methods. Batch finishing procedures present the same problem for finishing as they do for dyeing: incomplete exhaustion of chemicals. After the finishing agents are applied, drying (at a temperature of approximately 120°C) and curing (by condensation at temperatures from 150°C to 180°C) are necessary.

Self-check-2

Instruction1: Select the correct answer for the given choice. You have given 1 Minute for each question. Each question carries 1 Point.

1. A typical recipe for chemical finishing of cotton and cotton blends is a combination of----
   ----
   A. Easy-care agents C. Functional additives (e.g. water repellent, flame retardant)
   B. Softener and D. All E. None
2. ----------finish dissipates an electrical charge and does not allow it to accumulate on a fabric.
   A. Anti-static finishes B. Flame retardant finishes
   B. Microbiocidal finishes D. Soil-resistant finish E. all

Instruction2: Write the answer for the given question. You are provided 3 minute for each question and each point has 3 Points.

1. List a typical recipe for chemical finishing of cotton and cotton blends.
2. Discuss in detail mechanical and chemical systems of finishing.
3. Discuss Chemicals and auxiliaries their functions to textile finishing processes.
4. Discuss Shrinking of textile finished product with advantage and disadvantage.
5. Explain recommended pollution prevention and control techniques for the finishing pretreatment
6. Describe calendering

Note: Satisfactory rating – above 20% Unsatisfactory - below 20%

You can ask you teacher for the copy of the correct answers

Unit Three: Finishing machine or equipment adjustment

This unit to provide you the necessary information regarding the following content coverage and topics:

- Identifying finishing machine types, properties and functions

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- understand and use Sanforizer finishing machine
- understand and use Stenter finishing machine
- understand and use Calendaring finishing machine
- Understand and use Compactor finishing machine
- Understand and use Loop steamer finishing machine
- understand and use Raising finishing machine
- Understand and use Shearing finishing machine

3.1. Identifying finishing machine types, properties and functions

Finishing machine type

- **Slitting Machine:**

Slitter machine is used for tubular knit fabric to make it in open form. In open form fabric finishing line; slitter machine is used after hydro- extractor, de-watering and drying machine. Slitting is a process that is applied for cutting the tubular fabric through the intended break Wales line on lengthwise direction prior to stenter processing. During slitting, it is required to be aware about the cutting line otherwise, fabric faults can be occurred there.

- **Stenter Machine:**

Objective of stenter- A machine or apparatus for stretching or stentering fabrics. The purpose of the stenter machine is to bringing the length and width to pre determine dimensions and also for heat setting and it is used for applying finishing chemicals and also shade variation is adjusted.

The main function of the stenter is to stretch the fabric widthwise and to recover the uniform width.

Function of stenter Machine

- Heat setting is done by the stenter for Lycra fabric, synthetic and blended fabric.
- Width of the fabric is controlled by the stenter.
- Finishing chemical apply on fabric by the stenter.
- Loop of the knit fabric is controlled.
- Moisture of the fabric is controlled by the stenter.
- Spirality controlled by the stenter.
- GSM of the fabric is controlled by stenter.
- Fabric is dried by the stentering process
- Shrnkage property of the fabric is controlled.
- Curing treatment for resin, water repellent fabric is done by the stenter.

- **Open width Compactor**

Open compactor is used for compacting the open form fabric. Here, slitting machine is used for open the fabric from the tubular form. Feature of Open Width Compactor: Perfect sanforising finishing of knit fabrics.

1. Ideally suitable for in-line with stenter machines.
2. Effective shrinkage control
3. A.C. Inverter drives, PLC with touch screen used.
4. Equipped with modem connectivity and online troubleshooting system.

5. Metal detector.

Working Procedure of Open Width Compactor: Open Width Compactor is suitable for open width knit fabrics to achieve exact dimensional stability and a soft feel. The machine generally consists of a feeding frame with centering device and driven scroll rollers, an equalizing stenter frame with over feed roller and brush pinning arrangement. The entry section of Pin Frame is provided with edge spreaders IR In-Feed device, an S.S. fabricated steaming unit for uniform moistening of the fabric. The Steaming Device has stainless steel sliding shutters that allow steam to flow only as per the width of the fabric. A low contact Glueing and Drying unit is provided with a stainless steel trough. Four selvedge drying units with infra-Red emitters are placed on either side of the machine. The delivery side section consists of edge dryer, Selvedge trimmer and a suction device, Exit roller, Width Adjustment device and the drive to the chain are housed in a exit box. The compacting unit consists of 2 felt compacting units, each of them consisting of a Nomex felt approx. 20 mm thick, a steam heated chrome-plated center roller of dia. 400 mm, a rubber covered roller driven by variable

- **Tubular Compactor:**

Tubular compactor is used after hydro-extractor, de-watering and dryer. By the compactor machine, compacting is done for control the shrinkage of the fabric. Here, different types of off line quality of the fabric are measured. Functions of Tubular Compactor: Following objectives are achieved by the tubular compactor. They are-

1. Shrinkage of the fabric is controlled by the compactor.
2. Fabric width is controlled by the compactor.
3. GSM of the fabric is adjusted by the compacting.
4. Fabric smoothness is achieved by the compactor.
5. Heat setting of fabric for Lycra is done by tubular compactor.

Working Procedure of Tubular Compactor:

The treatment of knit fabrics in tubular form on the Tubular compactor meets the exacting standards set by customers so that garment stitched from the fabric finished on this machine will yield the lowest residual shrinkage values. 1. Width control through a stepless adjustable special tubular fabric spreader driven by variable speed motor for distortion-free fabric guidance. 2. Steaming with a condensate-free steam box which is easily operated and completely made from stainless stell. 3. Compacting through two

Nomex felt belts. 4. Calendaring while passing between the felt belt and the heated shrinking rollers. 5. Precision plaiting with automatic platform level adjustment controlled by folded fabric height. Alternatively, a fabric rolling system can be provided. The fabric is fed through the guiding system and stretcher which then takes the fabric through the steam box onto the felt of the twin compacting units.

- **Sueding Machine**

  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. These improved aesthetics can increase the value of a fabric in the marketplace.

- **Combing Machine**

The basic operations in a combing machine are:

1. Feeding the uncombed sliver into the comb
2. Holding the fibres and combing the free end by pin treatment; any fibres which are not held will be combed away (the noil)
3. Holding the portion which has just been combed, and repeating the combing operation on the previously uncombed fibres, again removing noil
4. Forming an endless sliver of combed fibres from the tufts that have just been combed.

Heat-setting

Heat-setting is a heat treatment by which shape retention, crease resistance, resilience and elasticity are imparted to the fibers. It also brings changes in strength, stretch ability, softness, dye ability and sometimes on the color of the material. All these changes are connected with the structural and chemical modifications occurring in the fiber.

Heat setting is a heat treatment by which shape retention, Crease resistance, resilience and elasticity are imparted to the fibers. Change in strength, stretch ability, softness , dye ability and Sometimes in color. Changes occur due to structural and chemical modification of fibers.

Stages of Heat setting

Heat setting can be carried out at three different stages:

1. In grey condition
2. After scouring
3. After dyeing Heat setting at grey stage.

Heat setting after scouring:

1. Goods will shrink.

2. Cloth has developed stretch or other properties after scouring. Heat setting after dyeing these fabric shows considerable resistance to stripping Compared with dyeing on unset fabric.

Disadvantage of this are:

1. Yellow color developed cannot be removed.

2. Handle of cloth may get altered.

3. Risk of color to get fade. Effect of heat setting on various of synthetic fibers

1. Structural changes

2. Dimensional stability

3. Stiffness

4. Crease recovery

5. Dye ability

Heat Set Procedure

1. Knitting Machine wise Batch Prepare.

2. Dyeing Machine wise Batch Prepare.

3. In Batch Card should be write M/c Dia, Gauge, Stitch Length, Yarn count & Required GSM. 4. Sewing time follow Needle line

5. Slitting time need to be carefully follow slitting line.

6. Grey GSM & Width check also compare with standard.

7. Stenter M/c parameter set as a Standard parameter sheet.

8. Width, Temperature & Speed Fixed If needed then adjust only overfeed.

9. Follow Color wise after heat set GSM

10. After Heat set keep record Roll to roll & within roll GSM.

11. Color wise identify & some rolls need to be write then not mix-up with another Color.

Finishing machine properties and finishing machine functions

1. Friction calendar

This will be used to make sure that the fabric aesthetically looks good. Simply heating on a followed by a polish roller. So this calendaring machine sometimes can do some special, you know, roles it can play with a little bit of a smartness. So if you want to increase let us say the shining of a surface.

And what it means is one of the polished rollers surface can run faster. So if you run something faster, so these surface can become a little more shiny, the things can fall in place. The hairs can be put in a certain orientation order. And so it is like for example, if you press something like an iron, a very little bit of more pressure, you will see at some places the fabric become more shiner. That is the kind of principle that you have. So it is called the friction calendar.

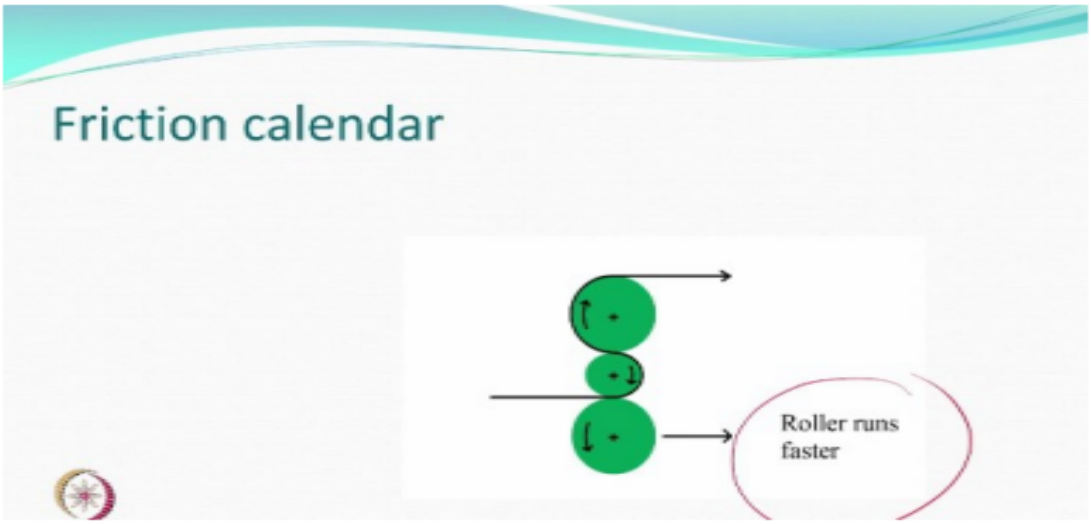


Figure 3.1: friction calendar

2. Chasing Calendar

Fabric comes in contact with the area, which is a polished surface in this whole sequence roller, all the balls number 3 and 6 are highly polished, and they are also hot. Okay, so that is one part, but the fabric is threaded in a manner that it goes from this side all along goes all the way comes on and then come so at some point there are 2 fabrics coming contact.

So when you have a hard surface versus the metallic surface on both side versus now you have a situation where one surface of the fabric is in contact with another fabric and fabric surface only. So it can highlight the, let us say at will material which can appear more the texture could be seen as the more highlighted its opposite of what the friction calendar was doing instead of making smooth it is making let us say more round this.

Because what is pressing is the yarn and yarn or one yarn is falling on the gap of the other yarn and it gives us very nice look which is nonreflecting it scatters the light more and softer

look can be obtained by this chasing calendar because fabric is the one which is coming in contact with the fabric and so, fabric itself it is chasing itself.

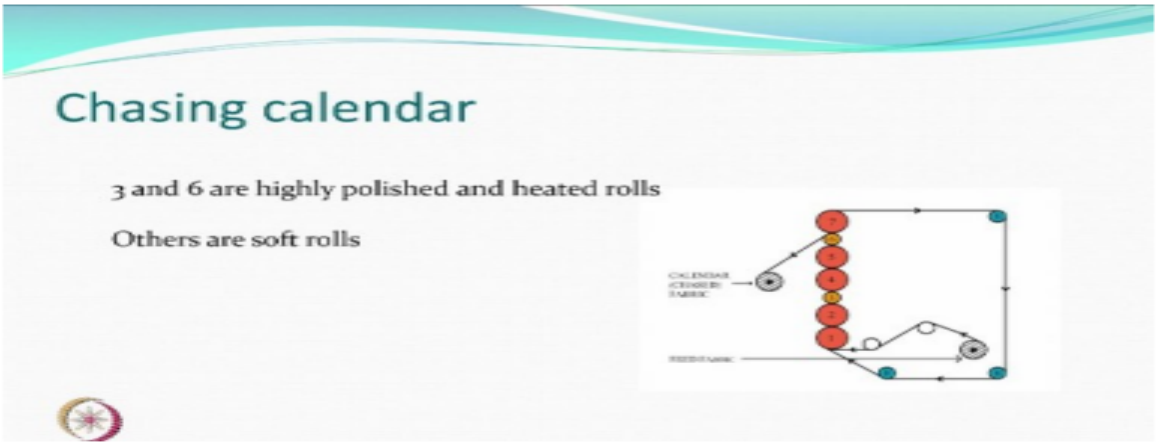


Figure 3.2: Chasing calendar

3. Embosing

Another type of calendar which is sometimes called embossing calendar that you actually want to have some type of a shape being seen design being formed. So, you have an embossing calendar, which is pressing against let us say, hot roll and you can get impressions. So, if the fabric is moving in this direction, you are creating some of the designs here. And this can be used for example; it could become a watermark or something.

It can give you an impression of some embedded design 3 dimensional effects is something which you will see at the end of embossing you must have seen upholstery and so and so forth material which gave you a different shape. So, based on the design of the embossing roller, you will get some design being seen or printed on the fabric as it moves through this calendaring system.

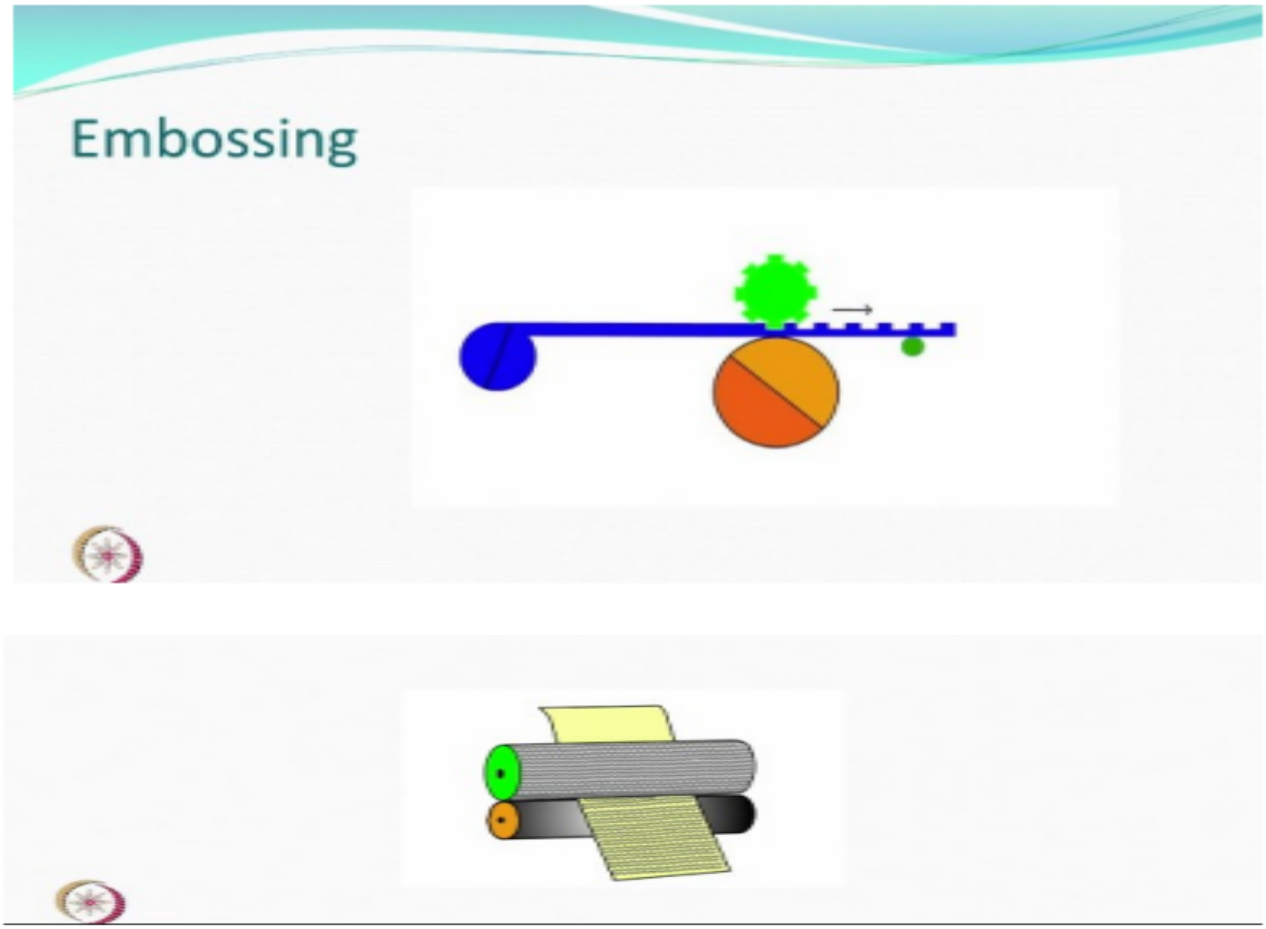


Figure 3.3: Embosing

4. Lamination and Embosing

For example, a system where you have a fabric and a polymer which is being excluded as a let us say a molten polymer is coming. This is a horizontal padder kind of a situation. Right. So, what happens is this fabric is coming from here. And the polymer is also coming here and they get in a way come in contact. So, if the fabric is touching the first roller, only one side of the fabric will come in contact with the molten polymer which will get deposited.

So, as it comes out, so, there is polymer on this side fabric on the other side part of it may obviously diffuse also the polymer and so, you take and take it to this embossing area, whatever design that you have, if it is this one of the rollers is hot. So, this polymer if it is a thermo plastic or thermo set, but because we are talking about molten so it is a thermo plastic material. And so, it will get impression, and then it is cold by these rollers, ceiling rollers.

And then if you see the final product, it has got a layer of polymer deposited properly laminated on the textile surface and embossing has been done this will be more permanent

because the polymer is the one which is taking the impression textile is giving the strength alright. So, you must have seen various kinds of upholstery systems which may be using elimination embossing

type of sequence that is that is like calendaring.

So simple calendar with just irons to little more complex which can do this. The shape the 3d design 3 dimensional impressions can be created temporarily or permanently depending on what you do with them.

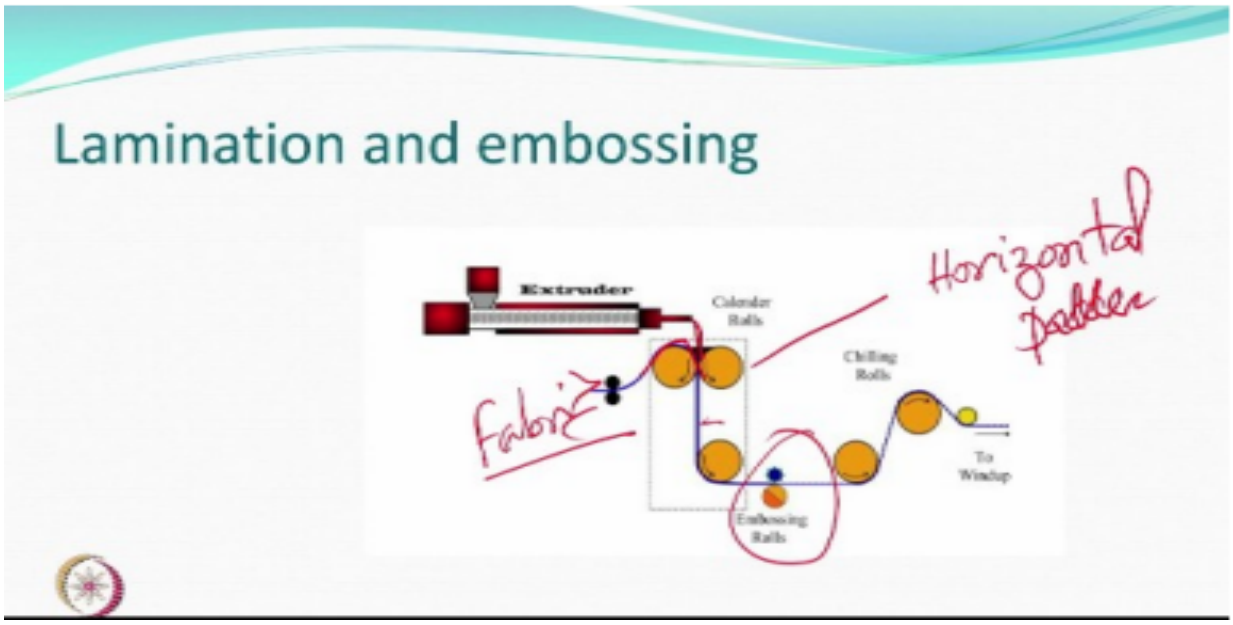


Figure 3.4: Lamination and embosing

5. Calendaring machine

One of the very simple machines, which we call it calendaring machine is part of almost the end of the process type everything when you say well, our finishing is over. Then before you let say sell anything to any client, you would make sure that there are no creases on the fabric. So you do calendaring it says like ironing, what do you do ironing? So you heat the iron and then remove the creases. So that is the best process a small garments can be done by that but it in the melt state it is just like ironing.

So, you have one hot roll or may be a little bit of moist fabric go through this and metallic systems and so it dry a little bit and like an ironing for example a moist fabric it will dry and the creases will be removed and then you can either roll or fold or make batches and then sell

so the simple calendaring machine which will be in every process house at the end of finishing process. This is will be used to make sure that the fabric aesthetically looks good.

Simply heating on a followed by a polish roller. That is one. So this calendaring machine sometimes can do some special, you know, roles it can play with a little bit of a smartness. So if you want to increase let us say the shining of a surface.

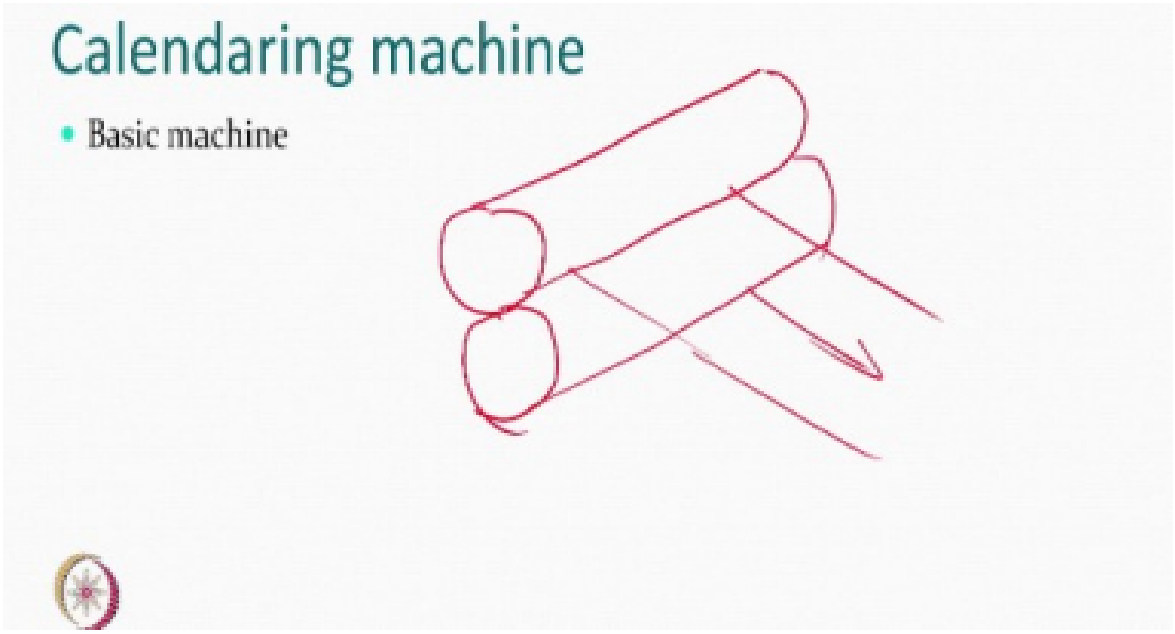


Figure 3.5: Calendaring machine

6. Raising and brushing

There is another interesting thing with textile people do normally you would remove all the protruding hair from the fabric by rinsing process or we talked about by polishing and so on, so forth. But sometimes people say well, I like some of the fiber if uniformly taken away out from the surface, then it will be a nice idea people like it that is called raising or brushing. So you have metallic brushes fitted on let us say a roller and if there is a fabric which is in contact moving either along this. Or it can have a situation where the fabric is coming in contact only in a specific area. So, when it moves, the hairs will be coming out. So, based on the length of the brush, the density of the brush the angle and the speed with which these things are going to moving the fabric on one direction the roller in the same direction or the other direction. One can get more or less of the hair coming out which will give you a bit of a

soft touch feel on the surface, because the hair is can be getting they can get compressed, okay.

So, there are several ways we talked about, they all would involve brushes, which could be metallic, plastic or sometimes other material also but they are this fabric, when lifts the fibers, then it gets the cushioning effect. And this hairiness can give you softness and warmth, if it is controlled, it looks good, if it is uncontrolled, it bad, right? But good amount of hair would come out and you can see them hairiness, normally you remove the hairiness where you actually want to do the areas but that is the desire.

So mechanical finish other is where you want very small little raising to be done not too much. Then instead of brushes use emery cloth which can upgrade the surface little bit okay.

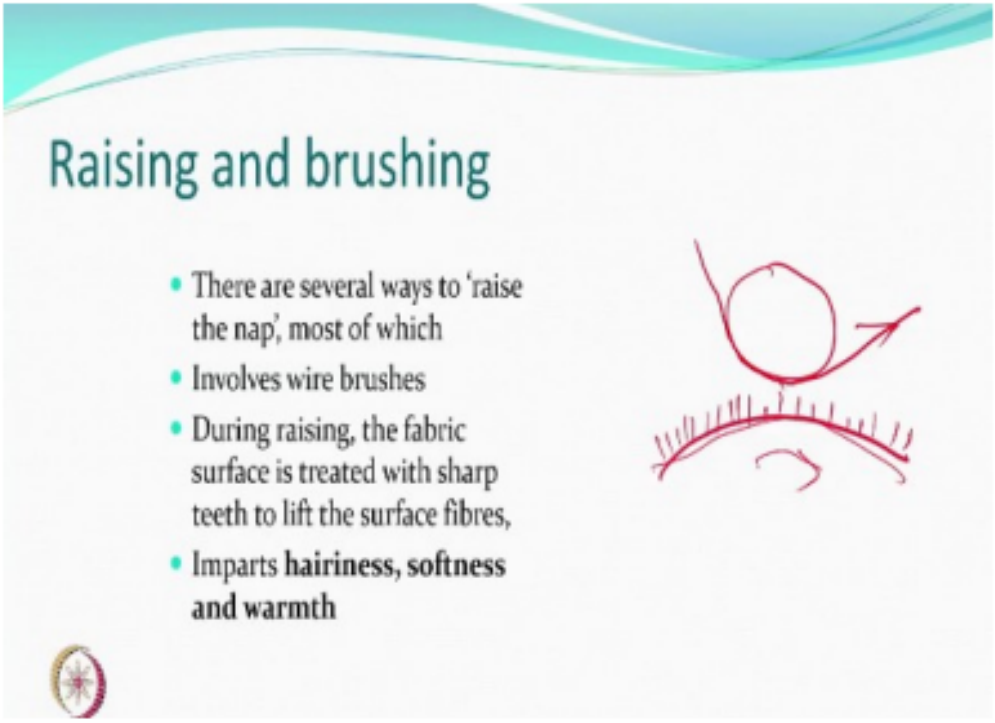


Figure 3.6: raising and brushing machines

7. Emerizing

So there can be a large number of rollers which have got emery there is a large number of roller each of them can independently move or rotate freely also and they are in a whole system the fabric can move all along and go out and this whole system will make sure that very mildly the surface is being touched. Now, the quality of abrasion that you may get depends on the grains, which are there on the emery paper or emery cloth. Now, emery cloth

now this therefore can give you very small little rays of little smaller very small hair and different kind of finish.

So you have series of rollers is shown here which have wrapped emery cloth or paper. So they produce very small even nap and therefore give luster also little bit because very small things that happening and gives a very soft and sometimes people are selling these kind of products they call it peach finish like you have seen the peach fruit. If you look at the surface, something like that. And textile by itself is very flexible. It looks pretty nice, soft to touch, but does not have long hair.

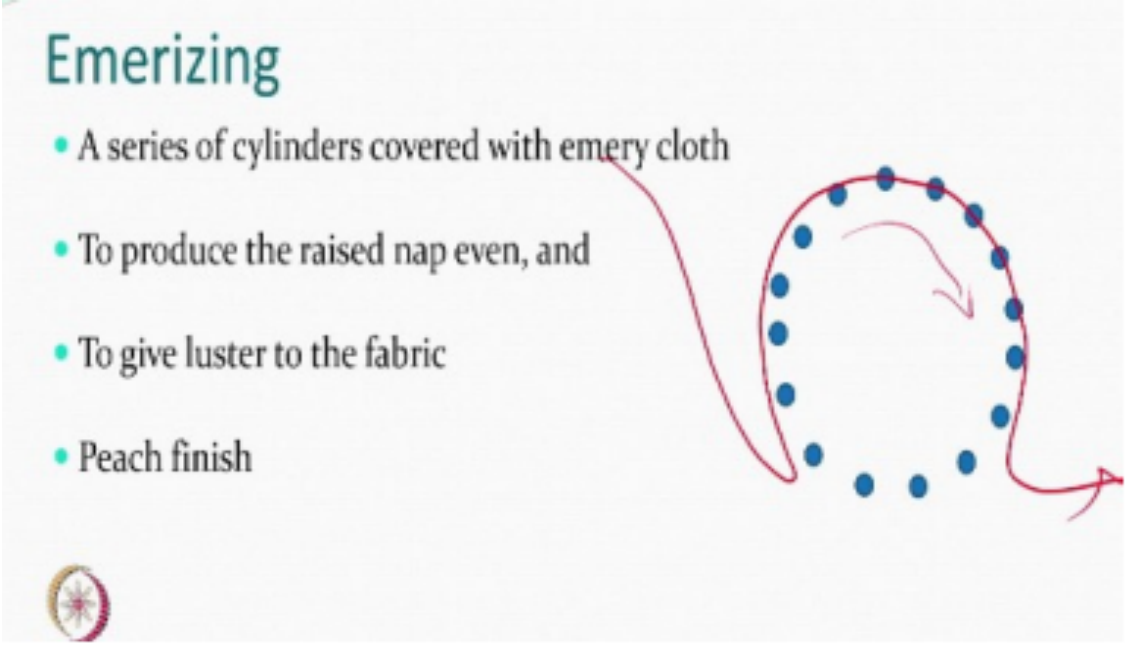


Figure 3.7: Emerizing

Self-check-3

Instruction1: Select the correct answer for the given choice. You have given 1 Minute for each question. Each question carries 2 Point.

1. ----------is a heat treatment by which shape retention, crease resistance, resilience and elasticity are imparted to the fibers.
   A. Heat-setting C. Open width Compactor
   B. Tubular Compactor D. Sueding E. all
2. ---------- is pressing against let us say, hot roll and you can get impressions.
   A. Friction calendar C. Embosing
   B. Chasing Calendar D. Raising and brushing E. all

Instruction2: Write the answer for the given question. You are provided 4 minute for each question and each point has 4 Points.

1. List heat set procedure
2. Discuss finishing machines and their applicable textile product in each machine and why?
3. Compare open width compactor and tubular Compactor
4. Describe Emerizing

Note: Satisfactory rating – above 20% Unsatisfactory - below 20%

You can ask you teacher for the copy of the correct answers

Unit Four: Finishing machines or equipment Operation and monitoring

This unit to provide you the necessary information regarding the following content coverage and topics:

- Confirming textile product finishing processes
- Confirming textile products
- Loading textile product and finishing chemicals
- Checking finishing quality
- Reporting non-conforming materials

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Confirm Finishing processes required for textile product
- Check Textile product quality and conformity to specifications
- Report non-conforming materials
- Load Textile product into finishing machine or prepare for final finishing

4.1. Confirming textile product finishing processes

Easy-Care Treatment

Easy-care finishing results in cellulose fabrics that

(a) Are easy to wash,

(b) Resist creasing during wash and wear and

(c) require no ironing or a minimum of ironing. These requirements now exist because cellulose fabric characteristics must compete with polyamide and polyester, which both have a higher in-built stability.

Water-Repellent Treatments (Hydrophobic Treatment)

Water-repellent treatment consists of eliminating or reducing the space among the threads, by which water (and air) may penetrate the fabric. It is generally done on cellulose fabrics.

Water-repellent treatment of a garment must assure its resistance to water but not to air and humidity. This may be achieved in two ways:

- Precipitation of hydrophobic substances on the fiber, such as paraffin emulsions and aluminum salts
- Chemical transformation of the fiber surface, that is, adding a hydrophobic group to the fiber molecule (substances used are silicones and fluorocarbons).

Softening Treatment

Especially for cotton or cellulose fibers, softening is a primary finishing treatment. Softening treatment consists of applying specific chemicals that make the fibers soft and comfortable; it is often done in the last rinsing bath after the dyeing process or in connection with a drying process. With continuous and semi-continuous dyeing processes, the fabric is soaked into a bath containing the softening agents, and then excess chemicals are squeezed by two cylinders and recovered. Impregnated fabric is then dried in a tentering machine, whereby softening agents are fixed.

Flame-Retardant Treatment

Flame-retardant finishing has become increasingly important and in several countries, it has become compulsory for some items. Many natural and synthetic fibers (except those designed for flame-retardant purposes) are flammable. Flame-retardant agents should protect fabric from burning, without modifying the hand, color, and look of the fabric. Many substances may be used to obtain flame-retardant properties.

A different approach to obtain fire-retardant properties of textiles is to create flame-retardant fibers by adding certain chemicals to existing fiber spinning solutions. This approach has become more acceptable to the textile industry because it represents a more stable situation and to consumers because the health hazard is removed.

The third approach to flame retarding is the development of special flame retardant fibers that are produced in specific generic classes. These fibers generally are more expensive than the modified flame-retardant fibers. They also have technical limitations with aesthetic qualities, finishing, and dyeing.

Antistatic Treatment

When two surfaces are rubbed, they may get charged with electrostatic energy. For textiles, this may be uncomfortable. Moreover, charged fabrics attract dust and dirt. Thus, in many cases antistatic treatment is necessary. The process consists of treating the fabric with hygroscopic substances (antistatic agents) to increase the electrical conductivity so that it is impossible to accumulate electrostatic charge. It is important that antistatic agents keep their properties for a long time and are not removed by washing.

Antistatic treatment is very important for synthetic fibers because they accumulate electrostatic energy very easily, compared to natural fibers. Some antistatic agents also have anti-pilling effects.

Treatment with Hand Builders

Handle modifiers, or "builders" are added to the finishing recipe to add body or stiffness to fabrics and to modify their handle from soft to firm. Builders include natural polymers (starches, modified starches, alginates), crosslinking agents (trimethylol melamine, urea, formaldehyde), and synthetic polymers (PVA, polyacrylates). Generally, builders are film-forming agents that can react with the fabric or not. Unless used in conjunction with polymeric or crosslinking reactants, the stiffening effect is not durable.

Soil-Release Treatment

Finishes can be applied to impart stain and soil/oil repellence to apparel fabrics (usually work wear), military and automotive fabrics, carpets, and primary upholstery. Such finishes increase washing or dry-clean efficiency in case of stains derived from food, motor oil, alcoholic and non-alcoholic beverages, ink and mud.

The finishes are applied by pad-dry processes and are generally effective through many cleanings; some are durable for the life of the garment.

Bactericidal and Fungicidal Finish

Biocides are used in textile processing to prevent biological growth, and as a finish to

A. impart biocidal or fungicidal properties to apparel fabrics or fabrics for hospitals and floor coverings, and

B. act as odor suppressants for socks/ hosiery.

Shrink-Resistant Treatment

Fibers spun into yarn are under constant tension during the weaving process. Their physical condition is changed, but not permanently fixed; the fibers tend to revert to their natural state, causing shrinkage. The yarns are made to assume a final condition by shrinking the fabric in a preparatory finishing process that minimizes subsequent shrinkage such as immersion in cold water, followed by hot water, steaming, or a chemical treatment. Even when textile fabrics are preshrunk, they are liable to further shrinkage when washed. The amount of additional shrinkage that may occur after washing must be clearly stated on the label.

Shrinkage is a very important matter in case of wool and wool-rich fabrics, because wool may felt, thus reducing dimensions of the fabric. In order to avoid this, anti-felting treatments aim to make wool fabrics shrink-resistant during usage and washing, and may include treatment with the following chemicals:

- Chlorine gas followed by washing with sodium bisulfite (NaHSO3)
- Hydrochloric acid (HCl) and sodium hypochlorite (NaClO) in bath
- Dichloroisocyanuric acid
- Enzymes
- Resins

<u>Wool Super wash Treatment</u>

Super wash finishing treatment aims to increase wool's anti-felting properties and consists of applying resins to the wool tops or to the wool fabric. Several products and methods are used, but the most popular is the chlorine-Hercosett process. Hercosett resin cannot be applied directly onto wool because undernormal conditions it does not distribute itself uniformly on the surface of the fibers. In order to avoid such a problem, wool is treated with chlorine, which increases the superficial tension of wool, so that Hercosett resin can easily distribute itself on the surface, thus obtaining a thin and homogeneous film.

Mothproofing Treatment

Mothproofing of wool and wool-blend textiles is largely restricted to textile floor coverings. In the case of apparel textiles, mothproofing agents may be applied to protect articles that will be stored for extended periods of time between uses -

- Military uniforms, for example. Three active compounds used are: permethrin, sulcofuron and a hexahydropyrimidine derivative (together with permethrin). Adequate fastness to washing and dry cleaning is achieved by applying the treatment in the dyeing process.

4.2. Confirming textile products

Methods for quality testing

Washing procedure

The laundering and drying procedure were done according to company policy. Domestic washing machines were used to perform the washing process and the textile were washed with a normal program at 40° C, the program length was approximately 1, 5 hours.

Tear Strength

Tear strength was tested with the Elmendorf method, Tear properties of fabrics. Determination of tear force using ballistic pendulum method. Specimens were randomly taken form the garment and torn in the testing apparatus. The mean tear force across warp and weft were calculated. **Abrasion Resistance**

Determination of abrasion resistance of fabrics by the Martindale method. Determination of specimen breakdown, and judged according to the company's quality requirements. After the end of each series the specimen was evaluated to determine if it yet had reached its breakdown limit. The colour change and appearance of the specimens was also evaluated. The shade change was assessed after every test interval.

Colour Fastness To Rubbing

The colour fastness to rubbing was evaluated . Tests for colour fastness fastness to rubbing . Two specimens, of each warp and weft direction measuring a minimum of 50 mm x 140 mm, were cut from testing sample. The tests were made with both wet and dry rubbing cloths.

Dimension Stability

The dimensional stability was tested according to two standards, Preparation, marking and measuring of fabric specimens and garments in tests for determination of dimensional change

, considering the fabric and Determination of dimensional change in washing and drying considering the garment.

Before laundering, the areas on the denim jeans were marked length wise and width wise with three parallel benchmarks. After the first and the third laundering, the dimensional change in percentage were determined and calculated with the formula $\frac{X_0-X_t}{}$ X 100

Where x_o is the original measurement and x_t is the measurements after the wash and dry cycle.

4.3. Loading textile product and finishing chemicals

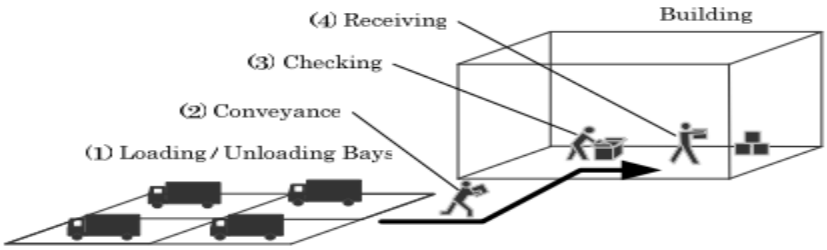


Figure 4.1: loading and unloading systems

4.4. Checking finishing quality

Testing and quality management

Quality management (QM) is the portion or section of the overall management function that determines and implements the quality policy. Quality is the collective features and characteristics of a product or service that reflects on its ability to satisfy stated or implied needs of the client.

Quality is fitness for purpose for the intended end use or customer.

Quality management requires a system of evaluations that may or may not require product testing to be carried out. In most cases involving textile products, some form of physical or chemical testing and evaluation will be required to determine conformance or noncompliance.

What does testing involve?

There is a wide range of test types available so you must be aware of the reason you are testing and for what purpose the test results will be used. The testing method must be

determined before beginning the sampling and testing to ensure that the results are useable for all parties concerned. The test method or work instructions need to be documented.

Selecting the most appropriate test method It is important to know exactly what you are trying to measure or verify and the reason why you are measuring it.

Testing may be carried out for one of the following purposes:

Quality control – for example, testing raw materials, finished product, appraisal testing

Quality assurance – testing samples on the run to allow changes to be made to improve the quality or confirm conformance of the product during or prior to production

Conformance – testing to show compliance with a specification or performance criteria.

Types of tests

- **Physical testing**

Physical tests involve such processes as breaking, stretching, abrading and flexing All of the physical attributes of fibers, yarn or fabrics may be tested, including the parameters of the manufacturing process.

- **Chemical testing**

Chemical tests involve fibre identification and dissolving or removing substances from fibres, yarns or fabrics and testing the composition or make-up of items. Chemical tests include testing the performance of additives such as dyes or surface finishes and their reaction to certain reagents, such as sunlight or water.

- **Performance testing**

Performance tests normally measure the attributes of the fibre or fabric, such as flammability, electrostatic propensity, moisture and thermal resistance.

- **Appearance testing**

Appearance tests involve subjectively determining the change in appearance of a fabric after use; that is, creasing, wrinkling, frosting and puckering.

Trouble shooting and dispute resolution testing

These tests all arise from the above test types but are usually a combination of tests used to diagnose the source of the problem.

4.5. Reporting non-conforming materials

This standard is for those who work with processes and are involved in producing a finished sample prior to bulk production.

The job role may involve:

1. Producing a pre-production finish sample
2. Testing processing methods against customer requirements
3. Establishing quality requirements
4. Making adjustments to formulations
5. Contributing to the production specification

Self-Check-4

Instruction1: Write the answer for the given question. You are provided 4 minute for each question and each point has 5 Points.

1. How to confirm textile product finishing processes
2. Discuss types of tests to check the quality of finished product
3. Discuss the difference of Quality control, Quality assurance, Conformance and Quality standard.

Note: Satisfactory rating – above 15% Unsatisfactory - below 15%

You can ask you teacher for the copy of the correct answers

Operation sheet

Operation: Check quality of finished fabric according to the standard

Purpose: to handle the finished product accurately

Instruction: perform finished fabric evaluation according to the standard

Equipment, Tools & Fabric:

Package of product, loader of the product and finished check instruments as required

Operation procedures:

- Clean and check package and storage equipment
- Determine Package content requirements
- Configure Packs according to the standard and procedure
- Wrap requirements Specifications
- Assess and before finish
- Record and document according to requirements

- Determine Protective covering requirements for products
- load products into transport equipment
- use safe manual handling techniques
- Ready and order the final finished products for next process inspection

LAP test

1. Check the results and identify the product quality.
2. Evaluate the quality of the finished product according to the requirement.

Unit Five: Finishing machines

This unit to provide you the necessary information regarding the following content coverage and topics:

- Undertaking finishing process operations
- Identifying & monitoring processes and products faults
- Identifying and correcting minor product process and machine faults
- Reporting major machine or product faults

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Undertake Finishing process operations according to workplace and work health and safety (WHS) requirements
- Monitor & identify processes, products and faults to ensure product specifications and achieve quality standards
- Identify and correct minor product process and machine faults to meet specified requirements
- Report major machine or product faults

5.1. Undertaking finishing process operations

In order to achieve specific properties or effects, the pre-treated and/or coloured/printed textiles (in the form of yarn, fibres or fabrics) are subjected to one or several functional finishing steps. These processes may involve a chemical treatment (for example with stiffening, softening, water repellent, antimicrobial, moth-proofing and fire-proofing agents) and a mechanical treatment to improve smoothness or roughness. In chemical processes, the chemicals are generally applied to the textiles in a watery solution/dispersion by padding machines ("foulards"). Following this, the solution is dried at approximately 120°C. In addition to padding machines, spraying, knife coating and printing as well as exhaustion processes may also be applied.

The most intensive use of chemicals is required for wet finishing processes such as dyeing, washing, printing and finishing.

Most of the auxiliaries applied in textile finishing are used as aqueous solutions and dispersions. The amount of active ingredients in these solutions or dispersions varies widely.

Bulk chemicals like inorganic salts (for example sodium chloride or sodium sulphate) are primarily used as basic chemicals in textile finishing followed by lyes (for example sodium hydroxide), acids (acetic acid, formic acid, inorganic acids) and reducing and oxidizing agents (sodium dithionite, hydrogen peroxide).

Apart from a minor amount of water which is evaporated during drying in the textile production processes, the main part is discharged as aqueous effluent. The main environmental concern is therefore the amount of water discharged and the chemical load it carries.

The input of chemicals and auxiliaries added at the finishing mills can be up to 1 kilogramme per

kilogramme of processed textiles. Among the products applied during the finishing processes, the highest environmental loads arise from salts, detergents and organic acids (in that order).

5.2. Identifying & monitoring processes and products faults

Monitoring of a process leading to the detection of faults and determination of the root causes are essential for the production of consistent good quality end products with improved yield.

Complex raw materials and manufacturing processes mean the textile industry is particularly dependent on good process control to produce high and consistent product quality.

Monitoring and controlling process variables during the textile manufacturing process also minimises waste, costs and environmental impact. Process control in textile manufacturing provides an important overview of the fundamentals and applications of process control methods. Part one introduces key issues associated with process control and principles of control systems in textile manufacturing.

5.3. Identifying and correcting minor product process and machine faults

- Packaging and storage equipment is checked for cleanliness
- Package content requirements are determined
- Packs are configured according to the standard and procedure
- Packs are wrapped requirements and Specifications
- Final finish of theatre packs is assessed
- Packed product is recorded and documented according to requirements
- Protective covering requirements for products are determined
- Products are loaded into transport equipment
- using safe manual handling techniques
- Orders are assigned according to transport requirements

5.4. Reporting major machine or product faults

Quarantine

Minimum Standards Requirement

There must be a quarantine area for non-conforming products

Quarantine areas are where non-conforming products are separated from conforming products. These areas should be clearly marked, and even segregated from the rest of the factory to ensure poor quality; non-conforming products are not shipped to the customer. A system of positive release from the quarantine should be established to ensure products are not moved from the area unless there are specific instructions to do so. Quarantine areas should also be established at key points throughout the process with particular importance at the final inspection stage.

Self-Check-5

Instruction1: Write the answer for the given question. You are provided 4 minute for each question and each point has 5 Points.

1. Describe the purposes of quarantine
2. What is the monitoring of a process leading to the detection of faults and determination of the root causes?
3. Identifying and correcting minor product process and machine faults

Note: Satisfactory rating – above 15% Unsatisfactory - below 15%

You can ask you teacher for the copy of the correct answers

Unit six: Dispatching And Recording

This unit to provide you the necessary information regarding the following content coverage and topics:

- Checking product quality
- Unloading and dispatching product
- Completing production records and other documentation

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Check product against quality standards
- Unload or remove product from finishing area according to specifications
- Dispatching product
- Complete cleaning of area to ensure work environment and maintain in a safe and productive manner
- Complete production records and other documentation accurately

6.1. Checking product quality

Types of tests

- **Physical testing**

Physical tests involve such processes as breaking, stretching, abrading and flexing all of the physical attributes of fibres, yarn or fabrics may be tested, including the parameters of the manufacturing process.

- **Chemical testing**

Chemical tests involve fibre identification and dissolving or removing substances from fibres, yarns or fabrics and testing the composition or make-up of items. Chemical tests include testing the performance of additives such as dyes or surface finishes and their reaction to certain reagents, such as sunlight or water.

- **Performance testing**

Performance tests normally measure the attributes of the fibre or fabric, such as flammability, electrostatic propensity, moisture and thermal resistance.

- **Appearance testing**

Appearance tests involve subjectively determining the change in appearance of a fabric after use; that is, creasing, wrinkling, frosting and puckering.

- **Trouble shooting and dispute resolution testing**

These tests all arise from the above test types but are usually a combination of tests used to diagnose the source of the problem.

This can be related to the raw material, production, finishing, condition of use, or something the product has been subjected to after manufacture. These tests are usually carried out on the final product.

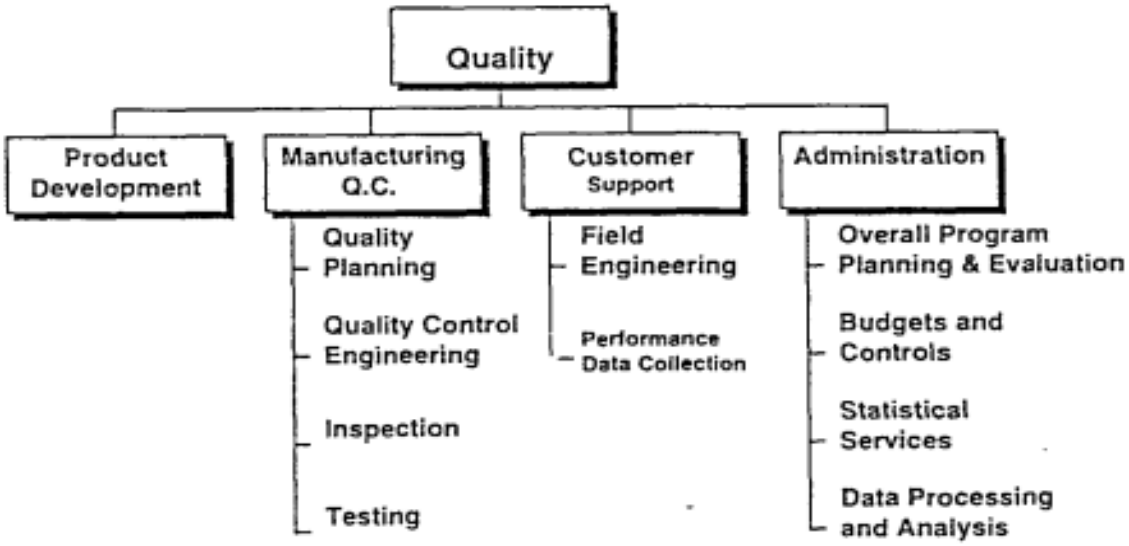


Figure 6.1: loading and unloading systems

6.2. Unloading and dispatching product

Unloading product

- Finished goods shall be received from the packing department along with the batch details.
- The document shall contain information about product name, product code, batch number, manufacturing date, expiry date, and packed quantity.
- Ensure that all the containers shall have labels and quantity details. On receipt of the batch in the finished goods store, batch details shall be verified against the documents received.
- Entry of material receipt shall be done in respective logs/ software.
- The goods shall be stored at appropriate storage conditions as per labeled storage conditions. The batch shall be stored in the quarantine area/ under test area.
- Location details shall be updated in the respective area log/ software.
- Finished goods shall be arranged in the storage area in such a manner to prevent contamination, cross-contamination, and mix-ups.
- Once QA releases the batch, it shall be transferred from the quarantine area to the approved area.

Dispatch of finished goods:

- Get the weight chart for the consignment with details of batch number, container number, gross, tare, and net weight and share it with the logistic department.
- Logistics shall arrange the container for the consignment at the plant.
- Before consignment, check the mode of transportation. For example, if the mode of transportation is by air, the finished goods store person shall wrap the pallet with a thermal blanket.
- Before shipment, the finished goods store person shall wrap pallets with stretch film.
- Finished goods store person shall ensure that the arranged transporter is approved by QA department and agreement with the transporter is valid.
- Dispatch of finished goods shall be done through only the Approved Transporter.
- Before transportation of finished goods, the vehicle shall be checked for the vehicle's condition and cleanliness.
- In case the customer is arranging their transportation, detailed information regarding the transporter should be ensured. List of such customers shall be maintained by finished goods store. As and when new customers and products are introduced, the list shall be updated.
- After the vehicle's arrival, the finished goods store person shall inform to QA department for vehicle inspection and consignment verification.
- Finished goods store person and QA person shall check the finished product and inspect the vehicle, loading platform, and rainproof status before loading of consignment.
- Finished goods store person shall load the goods in the container as per the shipping document.
- Finished goods store person shall do documentation of shipment loading.
- When shipment needs to send with the controlled condition, finished goods store person shall use calibrated temperature sending device to check the container's temperature and record it in the logbook.
- Before starting batch loading activity, ensure that the container's temperature complies with the required product storage condition mentioned on the shipping mark.
- Ensure that temperature controlling equipment is in ON condition while loading the finished goods.

- After completion of loading the finished goods, ensure that vehicle should maintain the required temperature.
- Finished goods store person shall ensure that material is not damaged during the loading.
- While loading, if required, use airbag or strapping tools to prevent goods tilting or damage during transportation.
- It is to be ensured that the protection of finished goods is done in such a way that the vehicle is protected from calamities conditions and rain showers.
- Before closing the shipment container, photographs shall be taken and attached with the documents for future reference.
- Once the shipping container is filled, fix the seal and hand over the vehicle to the transporter.
- Required commercial documents shall be handed over to the transporter.
- Acknowledgment for shipment handover shall be taken from the driver.
- Logistics department shall additional documents required to facilitate shipment, such as invoice, Weight Chart, Non-Hazardous declaration.
- Dispatch documents shall be retained for product expiry +1 year or 5 years, whichever is longer.

6.3. Completing production records and other documentation

Format for Checklist for Dispatch of Finished Goods

Record the observations

Product Name----------

Batch No. ----------

Date of shipment----------

Cleanliness of vehicle----------

Vehicle details----------

Temperature before loading the goods----------

Temperature after loading the goods----------

Temperature sensor Id. ----------

Pallet No.----------

Container numbers----------

Details entered By----------

Derails verified by----------

- Format for acknowledgment from vehicle driver (this can be in multiple languages for understanding of driver)

Product Name:

Date of dispatch:

Information for driver to note:

1. In case of any abnormality observed during the transportation, driver needs to immediately inform to company and transporter's main office.
2. Ensure that cooling of container is maintained as per storage condition.
3. If cooling unit malfunctions, alternate arrangement needs to be done immediately with the help of transporter's main office.

4. To inform immediately to transport company in case of any event with the vehicle during carrying the goods.

Explained by finished goods store person: Signature/ Date:

Acknowledged by driver: Signature/ Date:

The property of finished fabric to be recorded:

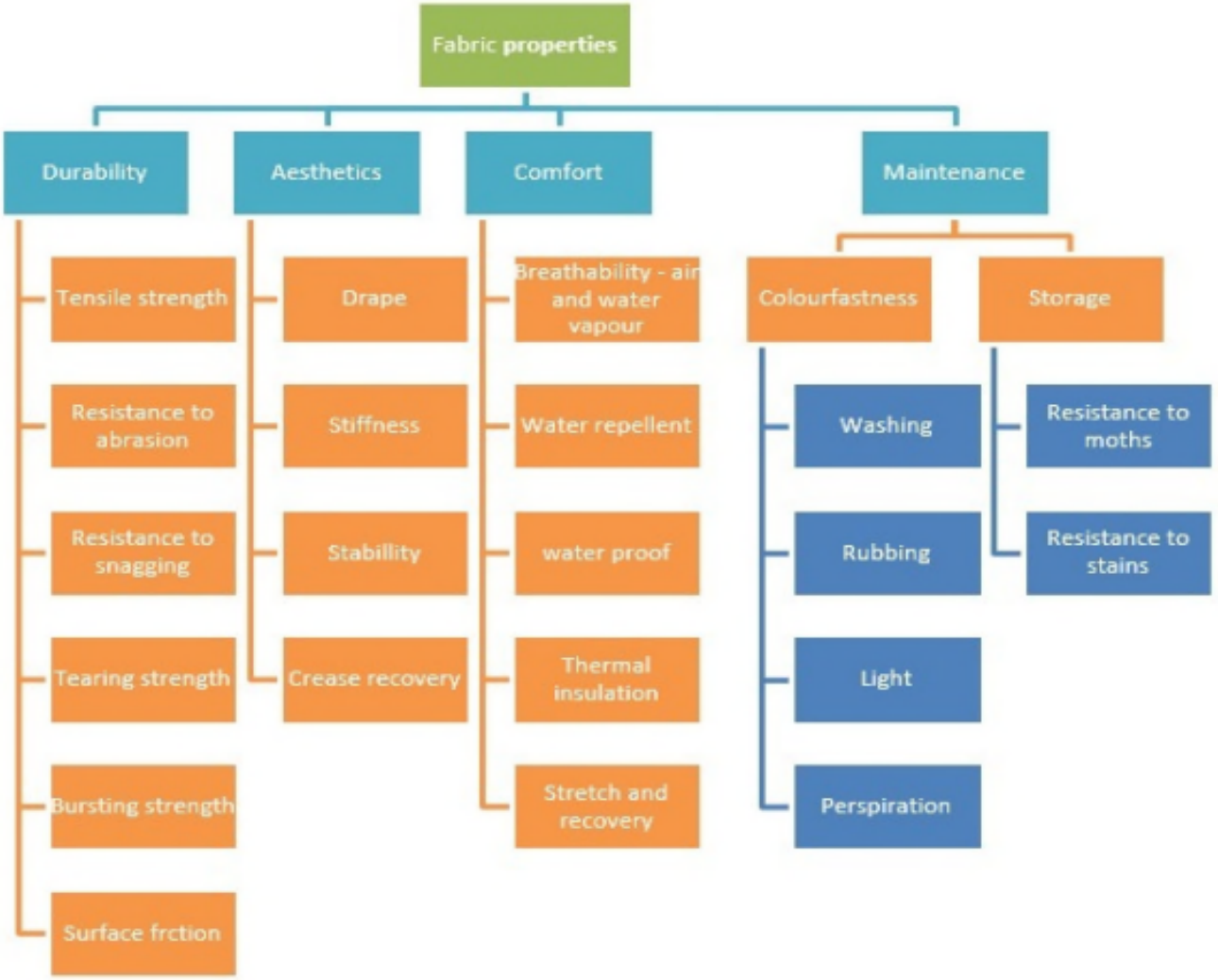


Figure 6.2: fabric properties to be recorded

Self-Check-6

Instruction1: Write the answer for the given question. You are provided 4 minute for each question and each point has 5 Points.

1. List and describe types of tests.
2. Explain shortly unloading product.
3. Describe shortly dispatch of finished goods.

Note: Satisfactory rating – above 15% Unsatisfactory - below 15%

You can ask you teacher for the copy of the correct answers