BASIC TEXTILE OPERATIONS

NTQF Level - I

LEARNING GUIDE #64

Unit of Competence: Apply Pre-Treatment Processes to Textile Materials

Module Title: Applying Pretreatment Processes to Textile Materials

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Lo1 Set up and load pre-treatment equipment

Instruction Sheet	• **Set up and load pre-treatment equipment**

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics

- Set up and load pre-treatment equipment
- Operate and monitor pre-treatment equipment
- Remove product and dispatch

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to ;

- Set up and load pre-treatment equipment
- Operate and monitor pre-treatment equipment
- Remove product and dispatch

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below
3. Read the information written in the “Information Sheets”. Try to understand what are

   being discussed. Ask your teacher for assistance if you have hard time understanding

   them.
4. Accomplish the “Self-checks “in each information sheets.
5 Ask from your teacher the key to correction (key answers) or you can request your

teacher to correct your work. (You need to get the key answer only after you finished

answering the Self-checks).

1. If you earned a satisfactory evaluation proceed to “Operation sheets and LAP Tests if any”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity.

7 .After you accomplish Operation sheets and LAP Tests, ensure you have a formative

assessment and get a satisfactory result;Then proceed to the next information sheet.

Information Sheet-1	Set Up and Load Pre-Treatment Equipment LO1

A.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**

Wear personal protective materials such as **over coat**, **glove**, **eye glass** etc.

- **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 chemicals and other substances.

Areas where chemicals and other substances 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**

B.Introduction To Textile Product

I. Property of textile fiber

Fiber properties are determined by the nature of the physical structure, the chemical composition, and the molecular arrangement of their polymers.

Physical structures of fiber can be evaluated in terms of its

- ✓ **Length**; Staple, Filament
- ✓ **Diameter or Size**; Small, Large
- ✓ **Surface Contour**; Smooth, Rough, Serrated, Striated
- ✓ **Cross-Sectional Shape**; Round, Dog-bone, Triangular, Lobal, Bean-shaped, Flat, Straw like.
- ✓ **Crimp*;*** Waved, Bended, Twisted, Coiled, Curled
- ✓ **Fiber parts**; Outer covering, called a *cuticle or skin* /Inner area /Central core that may be hollow

➢ **Mechanical Properties**

- ✓ Directional bonding
- ✓ Tensile fracture
- ✓ Tensile modulus
- ✓ Shear
- ✓ Modulus
- ✓ Tensile
- ✓ Strength
- ✓ Compression

➢ **Thermal Properties**

- ✓ Melting Point
- ✓ Boiling Point
- ✓ Glass Transition Temperature
- ✓ Softening Temperature
- ✓ Sticking Point
- ✓ Safe Ironing Temperature

➢ **Chemical characteristics of Fiber**

- ✓ Effect of light.
- ✓ Mildew
- ✓ Heat
- ✓ Water
- ✓ Acids
- ✓ Chemical Solvents
- ✓ Alkalis
- ✓ Affinity to dyestuffs
- ✓ Dye Uptake

II. Property of yarn

Yarn- is a group of fibers or continuous filaments, either twisted or laid together of a conscious strand which is suitable while processing of weaving and/or knitting way of fabric production. As like as fibers, yarns have their own properties; strength, evenness, twist, count, hairiness, bulkiness.

- **Some important Properties of yarn**

➢ **Strength**: the ability of resistance to breakage of yarn when it is applied to some external force.

➢ **Evenness**: means yarn irregularity which tells us about a variation of a yarn along its length. This is classified as random variation and period variation.

- **Twist**: it is the number of turns in the yarn and it can affect the strength of the yarn. The number of turns can be classified as Z twist and S twist
  - **Leaner density (count):** it tells about how thick or how thin the given yarn is. It categorized as fine yarn and coarse

Property of fabric

INSPECTION OF GREY FABRIC:

After receiving the cloth from grey godown, it should be thoroughly checked and inspected before subjecting it to wet processing. The cloth is examined for the following:

FABRIC DEFECTS:

Oil, rust, stains, holes, damage selvedge and weaving faults like floats and read marks etc.

FABRIC SPECIFICATIONS:

Width, length, yarn count, ends and picks per inch and fabric composition.

A.Confirming Pretreatment Processes

- **Over view of chemical processing of textiles**

Textile chemical processing means that passing or treatment of textile products with chemicals or non-chemical agents such as pretreatment (cleaning operation), dyeing/printing (applying color) and finishing (imparting special property or function).

- ✓ **General Wet Processing Sequence for Cotton goods**

Singeing → De-sizing → Scouring → Bleaching → Mercerization (Optional) → Dyeing → Printing → Finishing

In wet - processing the typical sequence of processes followed for the preparation are:

1. **Singeing**: A process where loose fibers and protruding fibers are burned away to get a clear and clean fabric surface.

2. **De-sizing**: A process where warp size is removed.

3. **Scouring**: A process where mill and natural dirt, waxes and grease are removed.

4**. Bleaching**: A process where natural colors (yellowish grey) are destroyed and the fabric is whitened.

5. **Mercerizing**: Caustic treatment of cellulosic fabrics improving luster, water absorbance, dye yield and fiber strength with improvement in dimensional stability.

6. **Carbonizing*:*** Acid treatment of wool for removing vegetable matter.

7. **Heat Setting**: Heat treatment of fabrics containing thermoplastic Synthetic fibers. Stabilizing of fabric by reducing shrinkage and distortion (Improving dimensional stability of Synthetic fibers and its blends)

- ## Textile pre-treatment

Natural fibers and synthetic fibers contain primary impurities that are contained naturally, and secondary impurities that are added during spinning, knitting and weaving processes.

Textile pretreatment is the series of cleaning operations. All impurities which causes adverse effect during dyeing and printing is removed in pretreatment process.

This process include

singeing,

de-sizing,

scouring,

bleaching and

mercerization

which make subsequent dyeing and softening processes easy.

Uneven de-sizing, scouring, and bleaching in the pretreatment processes might cause drastic deterioration in the qualities of processed products, such as uneven dyeing and decrease in fastness.

Objective of Pretreatment:

- ✓ To convert fabric from hydrophobic to hydrophilic state.
- ✓ To remove dust and dirt from the fabric.

- ✓ To achieve the degree of desire whiteness.

- **Steps in Pretreatment Process of Cotton and Natural Fibers:**

Major steps involved in textile pretreatment are,

Singeing → De-sizing → Scouring → Bleaching → Mercerization

- **Steps in Pretreatments for Wool:**
  - ✓ Raw wool scouring; aqueous and/ or solvent washing
  - ✓ Carbonizing
  - ✓ Scouring/ (de-sizing)
  - ✓ Fuelling /crabbing/thermo fixing
  - ✓ Easy-care treatments
  - ✓ Anti-felting anti-shrinking treatments
  - ✓ Wool Bleaching
- **Steps in Pretreatment of Silk:**
- ✓ Degumming
- ✓ Scouring
- ✓ Bleaching
- **Pretreatment of Synthetic Textile Materials:**

Although most of the synthetics do not need to be given a very strong pretreatment however the possible steps in pretreatment of synthetics are

- ✓ De-sizing
- ✓ Heat setting
- ✓ Washing
- ✓ Bleaching if necessary.

• Pretreatment Processes

1. Singeing

The aim of singeing is to bum-off the protruding fibers and hairs from the fabric surface. The spinning process produces hairiness of the yam and lower the yarn counts greater is the degree of hairiness.

Reasons of why singeing:

- . Singeing improves the end use and wearing properties of textiles.
- The burning-off of protruding fibers results in a clean surface which allows the structure of the fabric more clear.
- Singeing reduces the fogginess caused by differing reflection of light by the projecting fiber and the dyed fabrics appear brighter
- Singeing is an effective means of reducing pilling in blended fabrics containing synthetic fibers
- Un-singed fabrics soil more easily than singed fabrics.
- A closely singed fabric is essential for printing fine intricate patterns.
- Singeing process facilitates and speeds up de-sizing, if the fabric is impregnated with de-sizing liquor immediately after singeing.

On the other hand there are **singeing faults** which are not visible and once occurred can no longer be repaired.

They are :

- ✓ Uneven singeing effect can cause streaks when the fabric is dyed, or bubbles when the fabric is finished.
- ✓ In the cotton system singeing is done on the grey cloth, but for blended fabrics containing synthetic fibers grey state singeing is not advisable be- cause small globules of melted synthetic fibers absorb dye preferentially, giving cloth a speckled appearance.
- ✓ There is a possibility of thermal damage to temperature sensitive fibers, for instance polyester..
- ✓ Stop-offs can cause heat bars on fabrics. Creasing produces streaks which are magnified when dyed.
- ✓ Protruding fibers are firmly bound by singeing on the surface by the sizing agent by hardening of the size and can lead to difficulties in de-sizing.
- ✓ When singeing is done after dyeing, heat can cause color loss from poly- ester portion of the blend because of sublimation of dye.
- ✓ There may be reduction of tear strength due to over singeing of the fabric.

Generally, singeing is done on both sides of the fabric. No chemical change occurs in the fabric during singeing and the reaction is basically one of oxidation. Singeing and de-sizing can be frequently combined by passing the singed cloth through the water bath which include enzymes. The enzymes digest the various sizing agents, making it easy to remove them during the scouring operation. The combined process also prevents possible latent damage to fabric from the singeing flame or heated plates.

Singeing different kinds of fibers fabrics

In singeing the short fibers are burnt off from the surface of the fabric by **direct** or **indirect heating** systems without damage to the cloth by scorching or burning. The thermal behaviors of different kinds of fibers are different and singeing at higher temperature is naturally associated with greater hazards on excessive contact period and may cause thermal degradation of the fabric.

In case of vegetable fibers,

GREY SINGEING

is necessary as it leads to slight yellowing which needs subsequent bleaching to get high degree of whiteness.

Grey singeing is also economical as singeing at any other stages of processing requires additional washing and drying.

- **Vegetable and regenerated fibers fabrics** can be singed very strongly with maximum burner intensity to obtain good results. Regenerated fibers normally bum to a little less easily than natural fibers.
- **Wool** has poor combustion properties and they are very sensitive to temperatures and hence woolen materials are not subjected to intense flame like cotton. In woolen fabric flame is not generally allowed to penetrate the material and this can be obtained **by blowing air through the fabric from the opposite side of the flame** so that the flame will be restricted only on the surface of the fabric. Alternatively, the fabric can be guided to water cooled

guide rollers allowing the flame to heat the cloth. When the flame strikes the fabric it is reflected by air/steam cushion created within the material.

- Amongst the **synthetic fibers** polyester has the greatest significance. It melts at 280-290^{0}c but does not burn till about 500^{0}cReflector' or 'refractory' singeing machines produce smears of fused polymer on the surface of the polyester cloth and therefore **unsuitable for polyester material**.
- **For blended fiber fabrics** singeing conditions are to be selected depending on the sensitiveness of the kinds of fibers to heat, blend composition, weight of fabric and fabric geometry. For example, singeing should be carefully conducted to avoid heat damage of the acetate component of the acetate/viscose blended fiber fabrics.

Though singeing improves the resistance to pilling of the polyester/wool blended fabrics, but should not be carried out on low weight fabrics because of risk of damage. In the case of 80/20 polyester/cotton blended fabrics or fabrics with dented pattern, sometimes, the cloth gets weakened only in the thinner or shadow portion. This is not detected until the material reaches to finish folding. If singeing is carried out after dyeing the sublimation fastness of disperse dyes used must be adequate to withstand the singeing conditions.

Singeing machineries are mainly based on direct and indirect singeing systems. The cloth is first passed over one or more steam-heated copper drying cylinders to remove the moisture and to raise the nap. The direct singeing may be done either on a hot plate, or on a rotary cylinder, or on a gas singeing machine or on a machine combining plates and gas burners.

The special features of indirect singeing systems are no flame contact, uniform singeing, heat retention zone and singeing by means of heat radiations. The indirect system produces fabrics which have a softer touch as compared to other methods. Gas singeing is more convenient, more economical and more effective than other methods and is well accepted commercially. The plate singeing and roller singeing machines are now out of date. Clean singeing of potentially troublesome synthetic

fibers can be achieved by using the scavenger tubes which are specifically designed to avoid thermoplastic melt (beading) problems

2. DE-SIZING

De-sizing is the process in which the size applied to the warp yarn before weaving is removed to facilitate the penetration of dyes and chemicals in the subsequent wet processing operations.

The purpose of sizing is to form coating of sufficiently strong and elastic film around the cotton warp yams so as to stand the tension during weaving and reduce the breakage. The surface coating of sizes is stiff, hard, smooth and less absorbent to

water. Apart from film forming materials, the size recipe many a time also contains other additions such as humectants, binders and lubricants

The removal of hydrophobic part of the sizes (the lubricants) is often especially problematic. These are not removed during de-sizing, but are expected to be stabilized or emulsified in the alkaline scouring. The total material present in the cotton fiber is up to 20% of the fiber weight including that of 4-12% natural impurities. In the process of de-sizing, not only sizing agents, but also some natural impurities are eliminated from fibers.

In de-sizing, the starches and polymers that are applied which are insoluble, are converted into water soluble compound to ease their removal. This is accomplished by transferring the starch into their simple sugars or simple water soluble polymers. The synthetic sizes used for man-made fibers are generally water soluble and they are removed during the scouring operation.

Objectives of De-sizing

- ✓ To eliminate the water repellent nature of sized cloth.
- ✓ To increase the absorbency.
- ✓ To reduce the consumption of chemicals in subsequent process.

Methods of De-sizing

De-sizing of cotton fabric can be accomplished by physical, chemical or combination of physical and chemical mechanism, namely **rot steeping**, **acid steeping**, **treatment with enzyme** and **oxidizing agents**.

A. Rot steeping

In this method grey cotton fabric is steeped in water in suitable box at a temperature of about 30-40^{0}c. During the storage micro-organisms are developed and they excreting enzymes which attack the starch. The swollen and hydrolyzed starch is thus partially converted into soluble state which is then removed from the fabric by normal washing with water. The main problems in this method are **low efficiency** due to longer treatment time and **degradation of cellulose** due to cross infections of mildew if the fermentation process is not properly controlled

B.Acid de-sizing

In this method cotton fabric is treated with dilute sulphuric acid with a concentration of 5-10 g/1 at a temperature of about 40^0c for 3-4 h. Dilute acid attacks the polymer chain of starch and due to chain cleavage of starch molecule short water soluble or dispersible chain segments are formed. With sulphuric acid higher than 10 g/1 and above 50 ^{0}c there is always the possibility of weakening the cloth or causing holes. The treated cloth must not be allowed to dry at all otherwise degradation of cotton will occur at the dried area. Rise in temperature increases the rate of reaction, but at the same time there is possibility of attacking the cellulose chain.

Generally, the rate of reaction doubles for each 10^0c rise in temperature. The acid-steeping method is particularly suitable for cotton varieties containing large metal contents as the mineral acid converts the metals to their corresponding sulphate which are water soluble. The degraded starch is removed from the fabric by normal washing treatment.

C.Enzymatic de-sizing

The word enzyme is from Greek words for 'in yeast' and was coined in 1876 by the German biochemist Willey Kuhne. Enzymes are organic biocatalysts highly specific both in the reaction catalyzed and their choice of reactants (substrate). Physically enzymes are colloidal nature and chemically they are of the nature of protein. Enzymes are complex and have high molecular weights. Today enzymes are produced by biotechnological processes in great amount of constant quality, and are therefore applicable to large-scale processes. Advances in the field of genetic engineering allow enzyme manufacturers to design specific enzymes for specific processes (with regard to temperature stability or an optimum pH, for ex- ample). Enzymes can originate from animal or vegetable sources. Around 1912 enzymes extracted from slaughter house wastes became available.

The main enzymatic development within starch de-sizing has so far been the introduction of amylase products (Diastafor) optimized to different temperature ranges. Malt amylases fall into two categories and are named the two (alpha) and (beta) species which are found to be present in the ratio of 1.5 to 1.6. Amylases are capable of hydrolyzing starch molecules at random present in the sizing preparation transform starch to dextrin, breaking them down to soluble sugars thus helping in eventual de-

sizing. Amylase attacks straight chains, cleaves the units and produces maltose, so that molecular chain of starch is shortened gradually. When an (x-amylase is applied to a starch solution, it is found that viscosity of the solution decreases rapidly, but for [3-amylase the viscosity drops slowly. Thus it is clear that the pr oportion of (x and [3-amylases in a de-sizing mixture determines the period (time) of effective de-sizing. It is also clear that the molecular structure of cotton is unaffected by amylases. The other size ingredients namely glue, gelatin etc. being protein in nature can be hydrolyzed using photolytic enzymes such as Gelatase, Trypsin etc.

Starch and lubricants (glycerides) are known to form insoluble complexes and the lipase is expected to help break these complexes thus making the removal of starch much easier.

The enzyme process of de-sizing is very easy to use and is adaptable to any type of equipment. In actual practice the grey cloth is first passed through hot water to approximately 100% pick-up and then padded with the de-sizing mixture containing 0.5-2% malt extract and non-ionic wetting agent at 60-70^{0}c. Wetting agent helps the enzyme to penetrate the size film.

Process	Concentration(g/l)	Timehour/PH	TemperatureO C
Rot-steeping		10-16h	30-40
H2SO4-steeping	5-10	3-4h	40
Malt Diastase	3-20	**PH** 4.5-5.5	50-60
Pancreative Diastase	1-3	6.8-7.5	50-60
Bacterial Diastase	0.5-1	6.5-7.5	60-70

The length of time for digestion will vary with the **concentration of enzyme** used, the ***t*emperature** of the de-sizing bath, the **types of goods** being de-sized and by the **methods** depending on the batch or continuous process. Compared to pan-creative enzyme, the malt enzyme has a lower action even with the addition of more amount of

enzyme. The use of greater amount of enzyme than the optimum will not itself convert the starch. When the goods are padded with de-sizing mixture, digestion of the starch is a matter of time and temperature. At lower temperature the de-sizing efficiency is also lower. Malt enzyme is more strongly dependent upon temperature than other enzymes. Even some enzymes are available which can now be worked at 100^0c so that high temperature de-sizing is a reality. Enzymes are quite specific in their response to pH and require close control.

a. De-sizing with oxidizing agents

Though the use of oxidants for de-sizing of cotton fabric is widely accepted but their large scale industrial application is yet to be exploited. The most important aspects of oxidizing agents are that they can be applicable to wide range of fabrics, the size content of which is often not known.

The Summary of the necessary conditions for de-sizing starch in presence of some important oxidizing agents

Oxidizing agent	Process	Additives (pad-bath)	pH	Time (min)	Temp
Hydrogen peroxide	Pad-steam	1-2 vol. H202, 7-15 g/1 NaOH	8-9	1-5	90
Sodium bromite	Pad-batch (cold)	1-3 g/1 active Br2, 20-30 g/1 Caustic soda, 5-10 g/1 Wetting agent	7.5-8.5	15	20-40
Persulphate	Pad-steam	3-6 g/1 Na-persulphate 8-10 g/1 Caustic soda, 5-10	10-10.5	1-3	95-100

		g/1 Wetting agent			
Persulphate + H202	Cold-batch	40 ml/1 H202 (25%) 10 g/1 Persulphate, 10 ml/1 Water glass, 10 ml/1 NaOH 5 g/1 Stabiliser, 5 g/1 Wetting agent.	10-10.5	6-20	20-40

The first oxidative de-sizing agent initially suggested is hydrogen peroxide. For continuous de-sizing, first the cotton fabric is impregnated with a 0.8% solution of H202 at 90^0c at near neutral pH; without intermediate rinsing, the fabric passes into the second bath which contains 0.5% caustic soda before final wash-off at minimum temperature of 70^0c. Alternatively, the cloth may be de-sized by pad steam and longer steaming time will have some bleaching effect in addition to de-sizing. Sodium chlorite, although an excellent bleaching agent, helps to 'fix' rather than remove size in single stage bleaching. Sodium bromite acts by the oxidation of starch in presence of cellulose. The sized cotton consumes bromite to a greater extent than that of unsized cotton. Sodium bromite does not act as a bleaching agent. In continuous processes, bromite treatment can be carried out hot using a dwell time of 20 min. Hypochlorite and chlorite have the added advantage of some fabric whitening which gives a saving in the oxidant concentration in subsequent bleaching.

Alkaline peroxycompounds have been found much more suitable for the effectiveness as de-sizing agent. Peroxymonosulphuric acid (H2SO5), sodium persulphate, peroxydisulphates [NazS208, K2S20 s and (NH4)2S208], acid hydrogen permonosulphates (KHSO 5 and NH4HSOs) and potassium peroxydiphosphate (K4P2Os) have been shown to be effective for desizing . Peroxymonosulphuric acid (2 g/l) is applied in a similar manner to that of mineral acid de-sizing. Persulphates are recommended for ambient temperature de-sizing containing 0.5% persulphate, 0.5% tetrasodium pyrophosphate and 0.5-3% caustic soda with 4-8 h treatment time.

Perphosphate requires a higher temperature for activation than persulphate, it is used more frequently in caustic saturator because of its stability at elevated temperatures. Perphosphate also exhibits a synergistic effect on the caustic treatment of the fabric as evidenced by the lower solvent extractibilities and the cleaner bottom. The inorganic persalts viz. sodium perborate (NaBO 3. 4H20) and sodium carbonate hydrogen peroxide (2Na2CO 3. 3H202) have been shown to be effective in foam de-sizing and bleaching of yarn and dyed fabric.

The main limitations of oxidative de-sizing agents are

- **increased pollution load**,
- **fiber damage**
- **inability to recover**
- and **re-use water soluble** sizes.

Recipe for acid de-sizing of cotton fabric

	MLR: 1:20 PH = 1 - 2 Temperature= 30 - 60 ^{0}C Time= 2-8 h
Chemicals used	**Concentration (% o. w. f)**
HCl	0.5-1
Wetting agent	0.3 [Optional]

Recipe for oxidative de-sizing of cotton

Recipe for enzymatic de-sizing of cotton fabric

	MLR: 1:20 PH= 6 - 7 Temperature= 70 - 80^{o}c Time= 60 min
Chemicals used	**Concentration (gpl)**
Enzyme Biolase	2.5 – 10
Sodium chloride	5
Non ionic wetting agent	1.5

fabric

De-sizing Efficiency

We can check how far our aim is fulfilled both quantitatively and qualitatively.

a) Quantitative method

$$\% \text{ Wt loss} = \frac{\text{wt of sized f/c} - \text{wt of de-sized f/c}}{\text{Wt of sized f/c}} \times 100$$

b) Qualitative method

For this method we take the de-sized fabric and put a drop of iodine on it, and check the results.

1) If the fabric turns blue or violet it confirms, the Presence of starch. Hence de-sizing has not been done properly and again de-sizing is required.
2) If the spot becomes brownish it confirms that, no more starch is present on the fabric and hence sizing is perfect and we can proceed to further processes.

% of reflectance

% of wet ability/ absorbency

3. SCOURING

The loom state cotton fabric contains about 8-12% natural impurities of total weight of the fiber. These impurities mainly consist of waxes, proteins, pectic substances and mineral matters. In addition to this, the mechanically held impurities called 'motes' are present containing seed-coat fragments, aborted seeds and leave etc. that clinge to the fiber. Apart from these, the loom-state fabric is also contaminated with adventitious oils such as machine oils, tars, greases etc.

Scouring is a purifying treatment of textiles. which is the process by which all natural and additive impurities such as oil, wax, fat, hand dust etc. are removed to produce hydrophilic and clean textile material. It is one of the vital processes of wet processing.

Even though these impurities are not soluble in water, they can be removed by **Extraction**, dissolving the impurities in organic solvents**, Emulsification**, forming stable suspensions of the impurities in water and **Saponification,** Converting the contaminates into water soluble components

Objects of Scouring

- To make the fabric highly hydrophilic.
- To remove impurities such as oils, waxes, gum, husks as nearly as possible.
- To increase absorbency of fabric or textile materials without physical and chemical damage.
- To produce a clean material by adding alkali. To make the fabric ready for next process. ¤To remove non-cellulosic substance in case of cotton.

Chemicals used in scouring process:

Main chemicals	Use
Caustic soda	Neutralize acidic materials, saponify glycerides (waxes and oil),solubili
Surfactants	Reduce surface tension & minimize interfacial tension.
Detergents	Emulsify oil, fats, waxes and remove oil-borne stains.
Chelating agent	Deactivate metal ions.
Sodium silicate	Penetrate & break drown lignin's.
Soda ash	Maintain p$^{H.}$
Solvent	Assist emulsification by dissolving oily materials.

A series of reaction takes place in the fabric. These are: -

1) NaOH **converts** all the saponifiable oils into soluble soap and soluble glycerine.
2) Proteins are all **degraded** into soluble amino acid
3) All types of mineral matters is **dissolved**

4) All dust dirt particles are **removed** by the detergents
5) Waxes are **emulsified** by the soluble soaps

The main actions, which take place during scouring, are

Saponification,

Emulsification

and Detergency

a. **Saponification:**

This is a process of **conversion** of insoluble and water immiscible oil into water-soluble product. The oils present in the size are all water insoluble. When these are treated with an alkali NaOH at high temperature the outcome is not sufficient, this is because of the high surface tension of water and avoids the wetting of the hydrophobic surface. For this problem we uses ***wetting agent*** which have tendency to reduce the surface tension of the water e.g. soap. In the presence of this the higher fatty acid are converted into fatty acid and glycerine, glycerine is water soluble and fatty acid formed is further reacted with alkali giving the soluble salt of alkali.

b. **Emulsification:**

When we saponify the fabric we get the oils removed but mineral oils are still present and are removed by this method. Emulsion is a stable mixture of two otherwise immiscible liquids. We use an emulsifying agent, which keeps the emulsion formed for a longer time. When the mineral oil or waxes are emulsified they can be easily removed by washing.

c. **Detergency:**

The dust and dirt particles are removed by using a good detergent. The detergent keeps the dirt and dust particles in a stable suspension in water and does not allow them to settle again.

The normal recipe for the scouring treatment on grey cotton fibre would be:

Sodium Hydroxide = 3% (owm),

Sodium carbonate = 2 % (owm),

Turkey red oil = 0.5-1.0% (owm),

Temperature, around 100oC,

Time, nearly 1 ½ to 3 hours,

Material Liquor Ratio, 1:10-20 (based on the type of machinery).

Recipe for scouring of cotton fabric with caustic soda

	MLR: 1:20 PH > 11 - 12 Temperature= 95 - 98^{o}c Time = 1 - 2h
Chemicals used	**Concentration (%)**
Caustic soda	3 – 4
Wetting agent	1
Sequestering agent	0.1 - 0.2

Scoured Fabric Property Evaluation

- ✓ Weight loss calculation
- ✓ Test for effective scouring(wet ability/absorbency)
- ✓ Measure reflectance
- ✓ Evaluate percentage shrinkage

Sensitivities to consider when scouring blends are:

- ✓ **Cotton**: Resistant to strong alkali. De-graded by acid
- ✓ **Rayon*:*** Sensitive to alkali. May be dissolved by hot alkali
- ✓ **Wool:** Degraded by alkali.
- ✓ **Acetate*:*** Hydrolyzed by alkali.
- ✓ **Polyester**: Hydrolyses under extreme conditions of alkali and heat.

4. BLEACHING

The process of de-sizing and scouring make the fabric more absorbent. But it still has the pale appearance due to the presence of the natural color material like pigments etc. These pigments cannot be removed. The only way to tackle these pigments is to decolorize those using suitable oxidizing agents. This process is known as ***Bleaching***. The process of bleaching gives a sparkling whiteness to the fabric and hence makes it suitable for further processing like dyeing.

The aim of bleaching can be described as following:

- Removal of colored impurities.
- Removal of the seed coats.
- Minimum tendering of fiber.
- Technically reliable & simple mode of operation.
- Low chemical & energy consumption.

- Increasing the degree of whiteness

A good bleaching agent should have following properties:

1. It should ensure a pure and permanent whiteness to the fabric
2. It should give level dyeing properties.
3. It should not cause any tendering of the fabric, which cause the loss in tensile strength of the fabric.

Bleaching Agent

A bleaching agent is a substance that can whiten or decolorize other substances. Bleaching agents essentially destroy chromophores (thereby removing the color), via the oxidation or reduction of these absorbing groups. Thus, bleaches can be classified as either **oxidizing agents** or **reducing agents**.

Bleaching Agents

Oxidation Bleaching Agents

Peroxide System	**Chlorine System**
1. Hydrogen peroxide	1. Bleaching powder
2. Sodium peroxide	2. Sodium hypochlorite
3. Sodium perborate	3. Lithium hypochlorite
4. Potassium permanganate	4. Sodium chlorite
5. Peracetic acid	5. Chloramine
6. Other peracids	6. Isocynual trichloride

Reductive Bleaching Agents

1. Sulphur dioxide
2. Sodium hydrosulphite
3. Sulphoxylates
4. Acidic sodium sulphite
5. Sodium bisulphites

- **Oxidative bleaching** – the bleaching agent is a chemical reagent which decomposes in alkali solution and produce active oxygen. The active oxygen is in fact the intrinsic bleaching agent as it will further destroy partly or completely the coloring matter present in the textile material.
- **Reductive bleaching** – the bleaching agent will destroy the coloring matter by reductive reaction of SO_2.

Sodium Hypochlorite Bleaching: Sodium Hypochlorite bleaching is done by using Sodium Hypo chlorite as a bleaching agent. This process is also known as *Chemicking.* Sodium Hypochlorite, NaOCl is a salt of Hypochlorous acid HOCl. NaOCl is a highly unstable compound at normal conditions of temperature and pH. It does not exist in the solid form and is present in aqueous solution. It have tendency to undergo self-decomposition.

$$3NaOCl \rightarrow 2NaCl + NaClO_3$$

At the same time one other reaction also proceeds that is

$$2NaOCl \rightarrow 2NaCl + O_2$$

This oxygen helps in the oxidation, which helps in the bleaching action.

Hence in order to keep the NaOCl solution in a stable form we require the following condition:

1) Temperature should be 0-5ºC
2) Concentration should be 2N
3) Store in a cool and dark place.

The pH of the solution highly influences the action of this bleaching agent. Take small amount of the NaOCl solution and titrate it against 1NHCl solution and observe the change in the pH.

It is observed that at 8.4 pH , even by the small addition of HCl there is sudden drop in the pH. Again the pH becomes regularly moving until it gets a similar change at pH 4.6. The two points of Inflexion are due to following reason: At pH 8.4 the NaOH present gets completely neutralized by the HCl and the HOCl is formed by the action of the NaOCl

$$NaOCl + HCl \rightarrow HOCl + NaCl$$

Hence the absence of the alkali causes the drop in that pH. Between 8.4 to 4.6 the NaOCl gets titrated against HCl and gives HOCl. At pH 4.6 NaOCl gets exhausted and HOCl gives Cl_2 on reaction with HCl

Hence the absence of any alkali at pH 4.6 causes a steep drop in the pH on the addition of even small amount of the HCl.

Now we can divide the whole NaOCl bleaching in three zones:-

1) pH 12 to 8.4 (NaOH, NaOCl, NaCl)
2) pH 8.4 to 4.6 (NaOCl, NaCl, HOCl)
3) pH 4.6 to 1 (NaCl, HOCl, Cl_2)

The NaOCl is having a very strong bleaching action at pH 7, which causes the tendering of the fabric. At pH below 4.6 the free chlorine is liberated during bleaching action and may cause the undesirable effects. At pH more than 8.4 there is no such problem and hence generally the bleaching is carried out at 10-11 pH.

Taking the bleached fabric and treating it with N/25 NaOCl solution and the time in which the concentration of the NaOCl becomes half the original that is known as *time of half change* can also determine the effect of the pH on the action.

For the pH where NaOCl has strong oxidative action the time of half change is less and vice a versa. This indicates that the action of the Sodium Hypo chlorite is very strong between pH 8.4 to 4.6 and is strongest at pH 7.

Conditions for Hypo chlorite bleaching

a) Concentration of NaOCl: -

   The concentration used should be just enough to give 2-3 gm/l of the available chlorine

b) Temperature: -

   The bleaching should be carried out at *Room Temperature.* The NaOCl bleaching done at elevated temperature causes a rapid oxidation, which may even, causes tendering of the fabric itself.

c) pH: -

   The maintained PH is generally between, 10-11

Preparation of NaOCl

Commercially the NaOCl is prepared by passing free chlorine gas through a beaker containing NaOH solution. The reaction between the two gives NaOCl.

$$\mathbf{2NaOH + Cl_2 \rightarrow NaCl + NaOCl + H_2O}$$

This reaction is highly exothermic in nature and in order to prevent any accident the temperature of the set up should be maintained as low as 5-10ºC

Main Features Of NaOCl Bleaching: -

1) It gives after yellowing that is it gives temporary whiteness
2) It is suitable for cellulosic fibers but cannot be used for wool, silk etc.
3) It requires more water for washing
4) It is relatively unsafe
5) It cannot be used for bleaching the colored material as it may even bleach the color
6) It doesn't have any scouring action
7) It is relatively cheap process

B) **Hydrogen Peroxide Bleaching:**

The bleaching carried out by NaOCl is known as *Half Bleach.* Now using a further strong oxidizing agent that is H_2O_2 can also carry out the process of bleaching. This bleaching is known as Full Bleach. The use of H_2O_2 is preferred because it gives permanent and more whiteness to the material.

The reaction involved in the preparation of the H_2O_2 is: -

$$\mathbf{BaO_2 + 2HCl \rightarrow BaCl_2 + H_2O_2}$$

Properties of H_2O_2:

1) It is colorless and syrupy liquid
2) It is absolutely stable under acidic conditions
3) It is sensitive to sunlight
4) It decomposes if allowed to react with heavy metals
5) It is highly unstable under alkali condition

The decomposition of the H_2O_2 is given by the following reaction: –

$$\mathbf{2H_2O_2 \rightarrow 2H_2O + O_2}$$

Normally the concentration of the Hydrogen Peroxide is expressed in *volume.* It is the volume of oxygen in ml liberated by 1 ml of the H_2O_2 at NTP on complete decomposition.

Conditions for Hydrogen Peroxide Bleaching: -

pH : Since it is known that this chemical is stable under acidic conditions, hence we need alkaline pH for its decomposition. With increase in the pH the action of this becomes more prominent.

Temperature: The temperature is leading factor in this bleaching. The optimum temperature used is 80-85ºC. If the temperature is less than the optimum than the action of the H_2O_2 is very less known as **Under Bleaching.** If the temperature is more than the above mentioned, the action of H_2O_2 becomes very strong. known as ***Over Bleaching***. So the temperature should be controlled efficiently.

For this purpose we use **Stabilizer**, which works for the two purposes: -

1) It helps in the controlled oxidation of the Hydrogen Peroxide
2) It keeps the metal ions away thereby hindering the rapid decomposition of H_2O_2

The commonly used stabilizer is ***Sodium Silicate***. Now its use is avoided, as its removal from the fabric after the process is difficult. Dyeing carried out on a fabric containing the traces of this chemical shows the light spots on the dyed fabric. So now a day Non Silicate stabilizer is used such as Stabilizer NS.

Peroxide bleaching recipe for cotton fabric

	MLR: 1:20 Temperature = 90 - 100ºc PH = 10.5-11 Time= 60 - 90 min
Chemicals used	**Concentration (%)**
Hydrogen peroxide (35%)	3 - 5
Caustic soda	0.3 - 0.8
Sodium carbonate	0.6 - 0.1
Sodium silicate	2 - 3

Magnesium sulphate	0.5
Wetting agent + Sequestering agent (EDTA)	0.1 - 0.5

Note: Fabrics bleached with hypochlorite will develop a distinctive chlorine odor. This odor can easily be removed with an aftertreatment consisting of sodium bisulfite and acetic acid, known as antichlor treatment. Final rinsing follows the antichlor treatment before drying.

Bleached Fabric Property Evaluation

- ✓ Weight loss calculation
- ✓ Absorbency/wet ability
- ✓ Reflectance
- ✓ Percentage shrinkage

5. Mercerizing

Mercerization is one of the most important finishing processes of cotton with a strong ***caustic* alkaline solution** in order to improve the luster, hand and other properties. It imports gloss to the fiber, increases its hygroscopisity, strength and improves its dye affinity. Mercerizing improves the reactions with a variety of chemicals and elongation of the fibers and also improves the stability of form. Mercerizing process consists in treatment of cellulosic materials with concentrated solutions of caustic soda at a temperature of 15 to 18°C

Purpose of mercerizing

- To improve the luster
- To improve the strength.
- To improve the dye uptake and moisture regain.

Effect of Mercerization

- ✓ Improve Luster.
- ✓ Increase ability to absorb dye.
- ✓ Improve reaction with a verity of chemicals.
- ✓ Improve stability of form.
- ✓ Improve strength/elongation.
- ✓ Improve smoothness.
- ✓ It has been shown that the increase in the luster occurs because of an effect.
- ✓ The cotton fiber do convoluted.
- ✓ The cross-sectional shape changes.

Stages of the Mercerization: -

1) **Grey stage**

Here the mercerization is not optimum as grey fabric lacks in proper absorbency. So some wetting agent is added but they are also not stable under mercerization conditions. Also the recovery of the caustic is not easy as grey fabric is full of impurities and they go into the NaOH solution. But at the same time some de-sizing and scouring may also takes place.

2) **De-sized stage**

This stage of mercerization also have same problem as above but here the recovery of caustic is easier as level of impurities is less and the residual alkali can directly be used for scouring.

3) **Scouring / Bleaching stage**

This stage gives very good luster property and mercerization action as the degree of absorbency is high and is generally preferred.

The cotton fabric is generally mercerized in the under given *form*s: -

- ✓ Yarn form
- ✓ Fabric form
  - ➢ **Effects of Mercerization**

Swelling: During this process there occurs the lateral swelling of the fiber. This occurs due to preferential uptake of the NaOH, the cross-section of the fiber before mercerize action is elliptical and after the process becomes relatively circular.

Luster: Since the fiber cross-section becomes circular, the overall surface becomes more even and hence gives better reflection of light and so the luster increases.

Tensile Strength: The lumen or the hollow part of the fiber cross-section comes close to such extent that sometimes the lumen may even disappear due to the mercerization process. This is due to thickening of the fiber lumen and hence the tensile strength increases.

1. Cross section before mercerization
2→5. Swelling process in 18% NaOH
6. Rinsing process after swelling
7. Final state

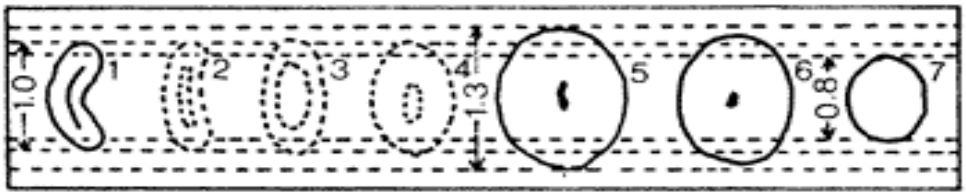


Fig Change in cross section of cotton

Change in the Cellulose Structure: By the X ray studies it was found that the dimension of the unit cell structure is altered in the mercerization process. The nature of cellulose structure is rhombus. So during the mercerization there is slight movement in the crystal lattice due to change in the angle. This movement exposes the –OH groups of the cellulose to the NaOH and hence the reactivity of the material increases and the Cellulose I is converted into Cellulose II. The complete conversion of the Cellulose I to Cellulose II is possible only under slack condition, when done under tension only partial conversion takes place.

Tests for Efficiency of Mercerization

- Barium activity number
- Luster

- Axial ratio
- De-convolution count

Barium Activity Number: depends upon the amount of Barium Hydroxide absorbed by the mercerized fabric. The absorption of the mercerized fabric is more than the un-mercerized one.

Making the light incident on the mercerized sample at the 45º and 90º and then the amount of the light reflected is then checked tests Luster. The angle of reflection will be 45º if the surface is smooth and the sample is properly mercerized.

Axial Ratio : decreases when the cotton fabric is mercerized and is checked by the microscope. This is so because the cotton fiber has elliptical cross section and it becomes relatively circular on mercerization.

De-convolution Count: is the counting of the fibers, which don't have any convolution. Convolution is the fold and twist, which are present in the cotton fiber. The number of the convolution free fibers per 100 fibers is termed as de-convolution count.

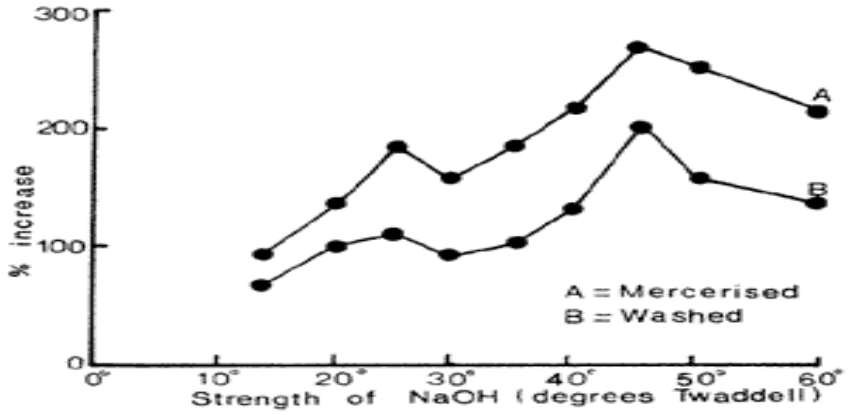


fig 5.

Graph showing the increase in volume of cotton fiber

Ways of Mercerization

1) Treating the material with NaOH and then stretching but this process doesn't gives luster and require more force for stretching

2) Stretching the material during treatment with NaOH and this requires less force in stretching and gives better luster.

Woven Fabric Mercerization

Mostly two methods are followed in the woven fabric mercerization. These are: -

1) The Chain Mercerization
2) The Chainless Mercerization

The Chain Mercerization

The fabric is dipped twice and squeezed in the padding mangle and then passed through air passage over the cylinder, which ensures the good absorption of the caustic. The fabric is maintained under tension by the series of clips and then the fabric passes under water spray to wash the alkali out again. The fabric may shrink if width of the selvedges were not gripped.

The Chainless Mercerization

In this the mangle is replaced with impregnation tanks through which the cloth passes in contact with he bowed rollers and these rollers are also used in the rinsing stage to maintain the tension. The curvature of the rollers is such that they pull the fabric in the direction of the selvedge but at the same time the cloth attempt to shrink in width as a result of the swelling action of the alkali. These outward and inward pull results in the tension in the fabric.

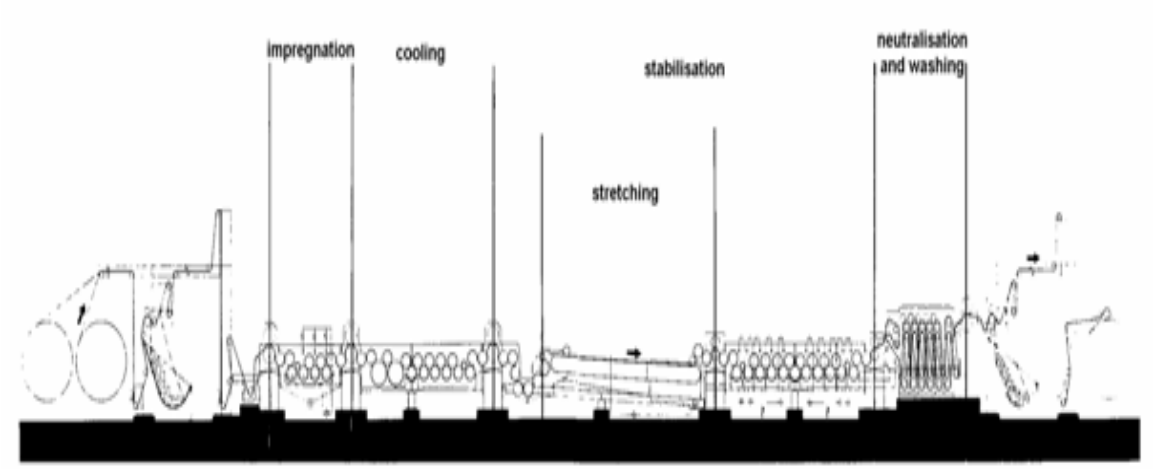


Diagram showing Chainless Mercerization

Knitted Fabric Mercerization

Since the mercerization take place in tension and this can be easily done in case of woven fabric but in the knitted ones it is very difficult to apply the tension as it can distort the fabric structure in serious and irrecoverable way. So the process would be carried out with the fabric in tubular form on machinery specially designed for the purpose and Sodium Hydroxide is used as above.

Yarn Mercerization

Using the Hank mercerization and Cone-to-Cone mercerization can do it.

In the **Hank mercerization** hanks are loaded on to the pairs of the tension rollers and then the rollers move in the vertical direction to apply tension on the hanks and at the same time the spray release the NaOH on the yarn and the squeeze rollers start squeezing the yarn and assist the absorption of the alkali. The tension rollers are also for, even impregnation of the alkali and in washing the wash water and the acid. The sprayer than sprays the hot water and then he cold water in order to remove the caustic and finally as tension is released then he acid is sprayed to neutralize the fabric.

In the **Continuous Yarn Mercerization** the continuous package is processed. Hank mercerization is batch operation and is the continuous one. The stretch wheel is a device which causes the yarn to be held back slightly and hence the take up package is therefore winding on the yarn somewhat faster than it is leaving the let off package. This creates the stretch that in turn provides the tension to the fabric. This process is more uniform and hence more economical also.

Recipe for mercerization and causticization

Chemicals used /Conditions	**Mercerization**	**Causticization**
Caustic soda	22 to 25%	10 to18%
Temperature	RT	RT
Time	2 min	2 min

Mercerized Cotton Analysis

1. Observe lustrate of the different samples
2. Test for degree of mercerization (Calculate barium number)

Check quality and conformity of textile products

If a product fulfils the customer's expectations, the customer will be pleased and consider that the product is of acceptable or even high quality.

If his or her expecta-tions are not fulfilled, the customer will consider that the product is of low quality.

This means that the quality of a product may be defined as "its ability to fulfil the customer's needs and expectations".

Quality needs to be defined firstly in terms of parameters or characteristics, which vary from product to product.

Load the textile product in to pretreatment machine

- Set machine properly
- Load textile substrate against to manufacture standards
- Operate safely

- Start production process

Report non-conforming materials

In order that no one should use unintentionally any defective or non-conforming product, the product must be placed for identification.

The control of defective products must be defined by authorized person.

Self-Check 1	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part one matching

Match columon A with column B

Column A	***Column B***
_____1. Scouring	**a**. removal of protrude fibers
_____2. Mercerization	**b**. removal of natural impurities
_____3. Desizing	**c**. improving fabric properties
_____4. Singeing	**d**. removal of natural coloring
_____5. Bleaching	**e**. removal of sizing materials

Give short answer and to the point (10 points)

1. Explain briefly the mechanism of all stages of pretreatment operation?
2. List the evaluation methods of desized fabric?

Answer Sheet

Score = _____

Rating: _____

Name: _____ ID NO_____

Match columon A with column B

1. _____
2. _____
3. _____
4. _____
5. _____

Give short answer and to the point (10 points)

1._____

_____

_____

_____

2._____

_____

_____

LAP Test 1	**Practical Demonstration**

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, workshop, tools and materials you are required to perform the following tasks within 2 hours.

Task 1: Select and prepare the given tools and equipment.

Task 2: Using the given equipment de-sizing the grey fabric by Controlling processes parameters.

Task 3: evaluate de-sizing efficiency

LAP Test 2	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, workshop, tools and materials you are required to perform the following tasks within 2 hours.

Task 1: Select and prepare the given tools and equipment

Task 2: Using the given equipment scouring the desized fabricby Controlling processes parameters.

Task 3: evaluate scouring efficiency?

LAP Test 3	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, workshop, tools and materials you are required to perform the following tasks within 2 hours.

Task 1: Select and prepare the given tools and equipment.

Task 2: Using the given equipment bleaching the scoured fabric by Controlling processes parameters.

Task 3: evaluate bleaching efficiency

BASIC TEXTILE OPERATIONS

NTQF Level - I

LEARNING GUIDE #65

Unit of Competence: Apply Pre-Treatment Processes to Textile Materials

Module Title: Applying Pretreatment Processes to Textile Materials

LG Code: IND BTO1M17LO2-LG65

TTLM Code: IND BTO1TTLM 170919 v1

LO2Operate and monitor pre-treatment equipment's and Machineries

Information Sheet 2	Operate and monitor pre-treatment equipment's and Machineries Lo2

A. Perform pretreatment process according to workplace OHs practices

1. Shearing Machine

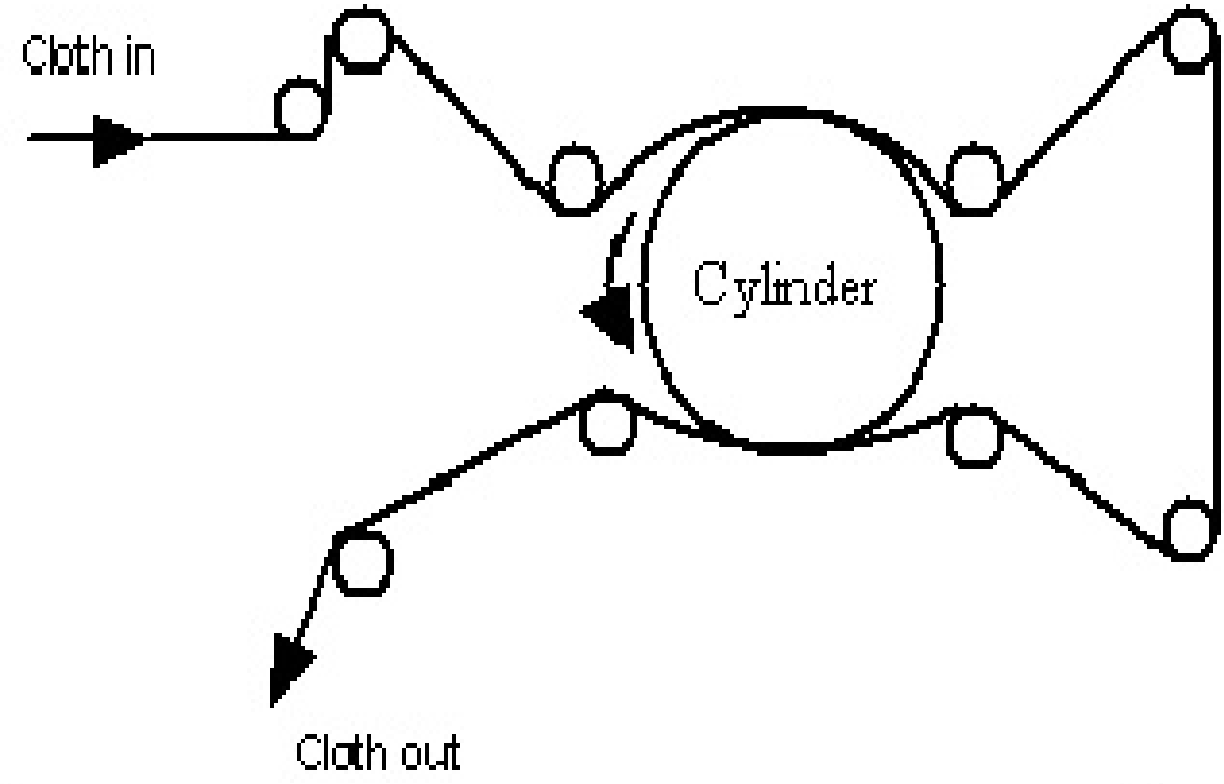
- ✓ Machine operated according to workplace procedures.
- ✓ Fabric is presented to the machine and threaded according to workplace procedures.
- ✓ Machine settings produce fabric cropped to product specification.
- ✓ Range feed rate, roller speeds, height of cut, fabric tension.
- ✓ Fabric is cropped without damage and cuts.
- ✓ Range edges feed flat without folds, fabric feeds without creases.
- ✓ Records are maintained according to workplace procedures.

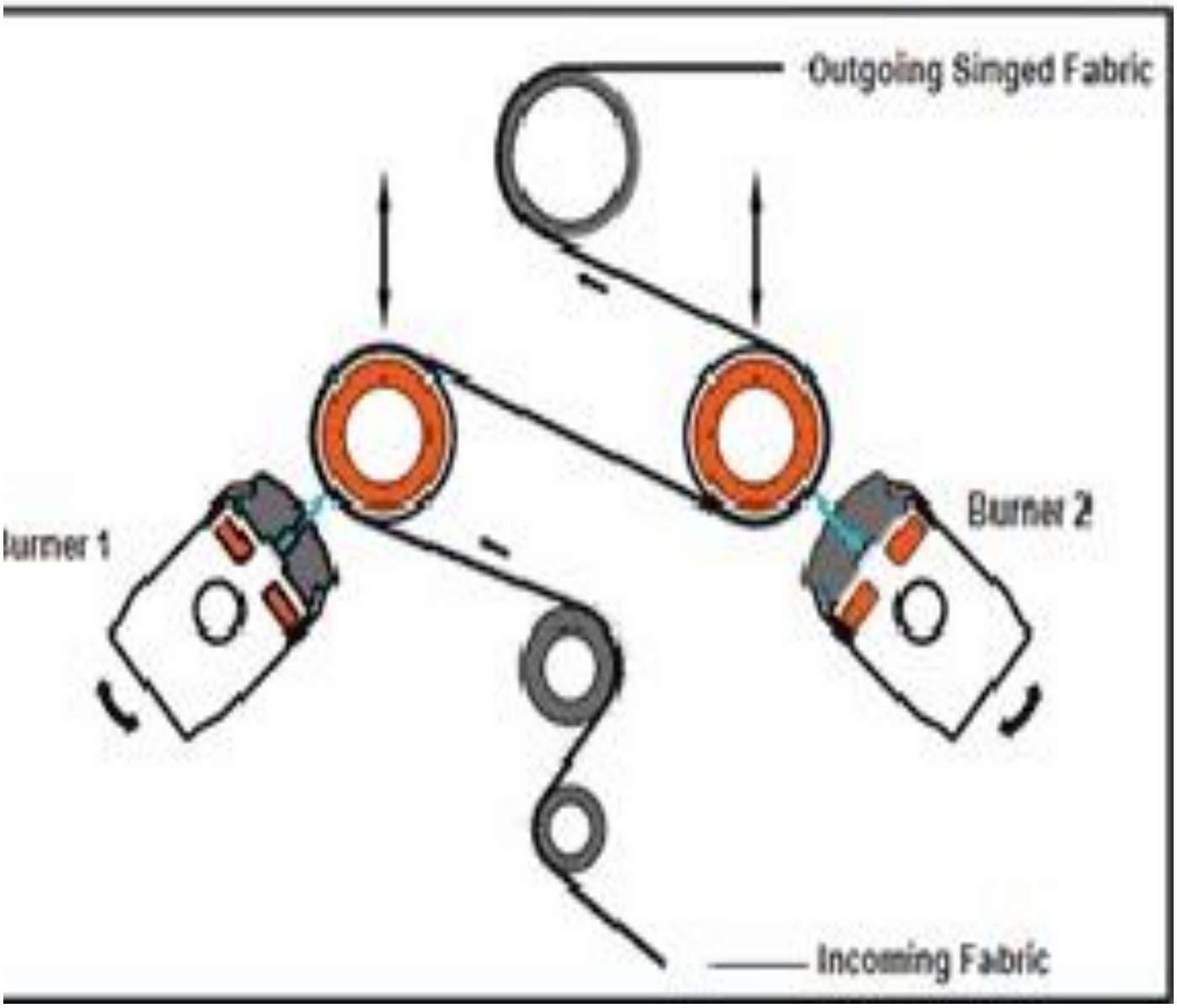
2. Singeing Machine

Singeing process is as follows:

- ✓ To produce a smooth surface finish on fabrics made from staple fibers first the fabric surfaces are brushed lightly to raise the unwanted fiber ends.
- ✓ Then the fabric is singed with or passed over heated copper plates or open gas flames. The fiber ends burn off.
- ✓ The fabric is moved very rapidly, and only the fiber ends are destroyed.

- ✓ As soon as the fabric leaves the singeing area, it enters a water bath or desizing bath.
- ✓ This stops any singeing afterglow or sparks that might damage the cloth.





Processes of operation

- ✓ End to End stitching of fabric pieces
- ✓ Operation of panel board
- ✓ Cleaning of the machine and the surroundings
- ✓ Oiling and greasing of the machine
- ✓ Feeding of the fabric to the machine
- ✓ Pouring of petrol to the tank

- ✓ Adjusting the flame length
- ✓ Maintaining cold water level in quenching machine.
- ✓ Practicing the work considering safety of man and machine
- ✓ Mock drill for fire fighting and first aid.
- ✓

3. De sizing Machine

- ✓ End to End stitching of fabric pieces
- ✓ Operation of panel board
- ✓ Cleaning of the machine and the surroundings
- ✓ Oiling and greasing of the machine
- ✓ Feeding of the fabric to the machine
- ✓ Preparation of desizing solution
- ✓ Temperature control and ph control
- ✓ Piling of desized fabric in bins.
- ✓ Practicing the work considering safety of man and machine
- ✓ Mock drill for fire fighting and first aid.

4. Batch, semi-continuous and continuous machines

- ✓ Cleaning of the machine and surroundings
- ✓ Cleaning of the machine and the surroundings
- ✓ Oiling and greasing of the machine
- ✓ Threading of the fabric in the machine
- ✓ End to end stitching of fabric
- ✓ Removing the crease and selvedge folds from cloth whilewinding the fabric
- ✓ Practicing the work considering safety of man and machine
- ✓ Mock drill for fire fighting and first aid

5. Washing And Drying Machines

- ✓ Operation of panel board
- ✓ Cleaning of the machine and the surroundings
- ✓ Oiling and greasing of the machine

- ✓ Threading the fabric to the machine
- ✓ Arranging the fabrics as per the requirement of soaping
- ✓ Preparing Soap water mixtures
- ✓ Adjusting time, temperature and tension in the ager
- ✓ Removing creases in printed cloth while soaping.
- ✓ Practicing the work considering safety of man and machine
- ✓ Mock drill for fire fighting and first aid.

6. Stenter, Stitching, Roller, Batch Puller, Forklift, Fiber, Yarn, Fabric

- ✓ Operation of panel board
- ✓ Cleaning of the machine and the surroundings and oiling and greasing of the machine
- ✓ Preparing finishing mix recipe
- ✓ Feeding of the fabric to the clips in the machine. Adjusting the required width of cloth.
- ✓ To open steam valve of damping box and that of steam pipe and coils underneath the Stenter
- ✓ To put the end of cloth from the Stenter through draw roller to the Plaiter or to wrap round the batching roll
- ✓ Adjusting and maintaining temperature, speed and mangle pressure
- ✓ Maintaining required moisture content in dried fabric
- ✓ Verifying the finish uniformity at the delivery.
- ✓ Practicing considering safety and health aspects.
- ✓ Mock drill for fire fighting and first aid.

7. Scouring and Bleaching Machines(Jigger ,Padding Mangle, Winch, Jambo Jigger etc)

- ✓ End to End stitching of fabric pieces
- ✓ Operation of panel board
- ✓ Cleaning of the machine and the surroundings
- ✓ Oiling and greasing of the machine
- ✓ Oiling and greasing of the Mounting the batch
- ✓ Monitoring the water, chemicals feeding.
- ✓ Temperature control of chemical bath
- ✓ Stocking solution batches properly
- ✓ Adjusting and maintaining speed of running and reversing
- ✓ Practicing the work considering safety of man and machine
- ✓ Mock drill for fire fighting and first aid.

a. Ensure product specifications and quality standards monitor process

- ➢ Conforming to specification is quality.
- ➢ Quality can also mean, meeting or exceeding, customer's expectation all the time.
- ➢ The customer's expectation can be of different types.
- ➢ The expectations of quality and the ability to distinguish various quality characteristics also vary from group to group of customers. E.g. more educated customer's requirements are very specific and less educated customer's requirements for quality are less.

Therefore, the quality is classified in four different classes, which are as follows.

1) Product based quality:

Product based definition of quality mainly depends on the quality.

Product based quality is more related to manufacture.

More the number of units in specified time more is product based quality.

From the user point of view more number of units in a specific cost is called product based quality.

2) **User based quality**:

The user based quality simply means the quality, whatever the customer says or wants. In short, meeting or exceeding customer's requirement and expectations

3) **Manufacturing based quality:**

The definition of this quality means, meeting specifications or conformance to requirements. It is nothing but manufacturing based quality. Any deviation from meeting the requirements means poor quality.

- Value based quality: In this type of quality,

there is more consideration of cost of a product or service.

- ✓ **Adjust the machines as per the requirement**
- ✓ **Operate the pretreatment machines safely**

Inspect machines/equipment prior to each operating shift to ensure that:

1. Points of operation and surrounding areas are clean of debris and other hazards.
2. Shields and guards are in place and controls and interlocks or other safety devices are accessible and operating properly (pay attention to the point of operation, as well as the area behind, to the side, and above the machine).
3. Machine components are in good working condition (do not use damaged equipment).
4. Labels and warnings are present and legible.

b. Operate and monitor the machine

- **Monitor and sustain equipment performance**

Overview: This standard is for those who monitor machinery and equipment during the production process and make adjustments to ensure it is operating to full capacity and meeting quality and quantity production requirements.

The job role may involve:

1. Monitoring production
2. Contributing to quality control requirements
3. Analyzing and rectifying faults in production
4. Producing and maintaining accurate records

Performance Criteria:

1. conform with written instructions
2. identify quality and quantity requirements
3. monitor production runs
4. check that quality standards are maintained during production
5. identify any irregularities in processing operations for irregularities
6. analyze faults and their causes using standard fault finding procedures
7. dealing with defective products following agreed procedures
8. making necessary adjustments to equipment within process control limits
9. ensure adjustments meet quality and quantity specifications
10. ensure adjustments are within process control limits and within the limits of own authority
11. return machinery and equipment to full production after rectifying faults and ensure that all appropriate people are informed
12. rectify faults and resolve problems with minimum disruption to production following agreed procedures
13. make recommendations on how to return process to requirements and inform appropriate people
14. report faults that are outside your area of responsibility to the appropriate person and make recommendations to prevent repetition of problems

15. complete and store accurate records and documentation

c. Check the product during and completion of pretreatment process against quality standard

d. correctly apply waste, pollution and recycling of materials at all stages of the process

1. Establish an on-site recycling program

Identify on-site recycling options for each textile process. Although on-site recycling is not source reduction, it can be a relatively easy way to reduce waste and costs simultaneously. On-site recycling reduces a company's overall waste stream.

A smaller waste stream can:

1. Require fewer garbage collections
2. enable the company to rent a smaller Dumpster□, and
3. Reduce the costs of the ultimate destruction or disposal of the waste.

Recycled materials may be:

1. purchased by a recycler
2. collected without charge
3. Collected for a charge.

This depends on the materials being recycled and the local market.

Implementing a recycling program involves four basic steps:

1. analyze your company's waste stream
2. identify recycling opportunities in your area
3. negotiate a contract with a recycler
4. Design a recyclables collection program.

First, analyze your company's waste stream. Identify the materials that you may want to separate for recycling, such as solvents, scrap metal, paper, or cardboard.

Second, identify recycling opportunities in your area. To be a candidate for recycling, a material must have a market. That is, someone must be able to use the old materials in new products.

Call recyclers to ask the following questions:

• What materials are recycled locally?

• How are materials collected and processed?

• How much is paid or charged for picking up different recyclables?

Third, negotiate a contract with a recycler. Traditionally, recycling markets have had frequent changes in the amount paid per pound of material. It is important to find a reliable company that will weather the market fluctuations. Ideally, a company will accept a wide range of materials so that you will have the option to expand the recycling program.

Fourth, design a recyclables collection program. For a company to obtain maximum value, it must separate a recycled material from the waste stream and, usually, from other recycled materials. For a collection program to be successful, employees must be able to easily participate in it.

• Place recycling containers in convenient locations.

• Clearly label containers.

• Place waste baskets near the recycling containers so that recyclables are not contaminated.

e. Identify and correct minor product process and machine faults

f. Report major machine or product faults

Such as:

- Tears and holes
- Creases and faults
- Marks, impressions
- Consistent coverage
- broken or pulled yarns

g. maintain and repair the machines

Good maintenance and repair procedures contribute significantly to the safety of the maintenance crew as well as that of machine operators.

The variety and complexity of machines to be serviced, the hazards associated with their power sources, the special dangers that may be present during machine breakdown, and the severe time constraints often placed on maintenance personnel all make safe maintenance and repair work difficult.

Self-Check 2	**Written Test**

Instructions*:* Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers. Write your answers in the sheet provided in the next page.

1. How to ensure product specifications and quality standards monitor process?
2. List all pretreatment machines?
3. List four basic steps of implementing a recycling program?
4. Write classification of quality?
5. Discuss an overview of monitor and sustain equipment performance

Answer Sheet

Score = _____

Rating: _____

Name: _____ ID NO_____

1.
2.
3.
4.
5.

BASIC TEXTILE OPERATIONS

NTQF Level - I

LEARNING GUIDE #66

Unit of Competence: Apply Pre-Treatment Processes to Textile Materials

Module Title: Applying Pretreatment Processes to Textile Materials

LG Code: IND BTO1M17LO3-LG66

TTLM Code: IND BTO1 TTLM 17 0919 v1

LO3 Remove product and dispatch

Information Sheet3	Remove product and dispatchLO3

a. Check the product against quality standards

- **Organization of the Manufacturing Textile Products Standards**

The Standards focus on three facts of textile product manufacturing on which its success depends:

1. Machinery and equipment set-up
2. The manufacture of textile products
3. Testing of textile products

- Manufacture textiles

This standard is for those who are responsible for the daily upkeep of machinery and equipment, preparing for production and carrying out the production process. They follow approved work methods and process materials safely to meet quality and quantity requirements.

It involves:

1. Preparing for processing
2. Manufacturing products to specification
3. Keeping the work area clean and safe

- **Produce textile products**

Overview: This standard is for those who produce textile products using different machinery, equipment and construction methods.

The job role may involve:

1. Assembling components to specification
2. Maintaining and controlling the work pattern
3. Maximizing production
4. Maintaining quality requirements

b. Unload or remove products from pretreatment area

Unloading of materials should occur at designated dispatch and receivable points. To provide consistency and continuity throughout the duration of the project, a standardized loading/shipping manifest will be used.

- Unload dyed fabric operate dyeing equipment and remove products from the dyeing machine by means of manual or automatically .

  Work is conducted according to defined procedures.
- Work may be conducted in small to large scale enterprises and may involve individual and team activities.
- The application of unload and operate dyeing equipment is according to OHS practices of the enterprise and workplace practices, which may include:

➢ requirements prescribed by legislation, awards, agreements and conditions of employment
➢ standard operating procedures
➢ work instructions
➢ quality practices, including responsibility for maintenance of own work quality and contribution to quality improvement of team or section output
➢ housekeeping
➢ tasks related to environmental protection, waste disposal, pollution control, and recycling

- Unload and operate dyeing equipment requires the application of skills associated with planning and organizing for the safe and efficient use of dyeing machines.

unload and operate dyeing equipment also requires the ability to check the quality of outcomes, identify and communicate inconsistencies or other problems and complete workplace documentation.

c. Dispatch the product to the next process

Check quality of products against to specification and transport products to dyeing section.

The following requirements are to be expected by during transport dyed products.

Unit weight marked on units (individual and collective).

Load center of gravity to be marked on each unit.

Decide on method of transport and unloading:

- Flat racks (where approved lifting equipment is available)
- Cradles (where approved lifting equipment is available)
- Pallets
- Crates
- Boxes
- Containers (where approved lifting equipment is available)
- Shrink-wrapping (boxes or pallets) making the small boxes into one unit

- Pre-slings for loading and remain attached as part of the load. They are tied down during transport and are later used to unload, thus eliminating the need for personnel to work at height to attach or remove slings. Pre-slings should be inspected before a lift.

Use of specialty transport options (such as tilt tray transport and container side loader).

Verify that the method for unloading identified is compatible with the equipment for unloading, which is at the unloading site

d. Clean And Maintain The Work Area

- Remove regularly accumulated dust and dirt on the dye bath.
- The yarn should be free from other impurities likes grease, oil stains etc.,.
- Transport the pretreatment chemical and other auxiliaries in a proper way and ensure that spillage do not occur
- Collect all the waste and dispose them in a systematic way as instructed by supervisor.
- Maintain cleanliness in the chemical bath surroundings.

e. Document And Record The Product

- ✓ Record all task against to specification
- ✓ Record accomplished time depend of weight of tasks
- ✓ List all safety precautions against to specification of task
- ✓ Record all necessary safety materials
- ✓ Record quality measurement of finished products
- ✓ Record specification of quality
- ✓ Record amount of products produce per day
- ✓ Record incidence and faults affecting productions
- ✓ Finally report for any appropriate personnel's

Self-Check 3	Written Test

Instructions: Perform the following tasks. Write your answers in the answer sheet provided:

1. List three facts of textile product manufacturing success?
2. Discuss an overview of produce textile products?

Answer Sheet

Score = _____

Rating: _____

Name: _____ ID NO_____

1. _____

_____

2. _____

_____

Short summary pretreatment

Introduction

The purpose of textile pretreatment is to remove natural and added impurities, to impart certain desirable properties:

Example:

- Improving water absorbency,
- Improving the appearance of fabric (whiteness),
- Making it suitable for subsequent processes like dyeing, printing & finishing

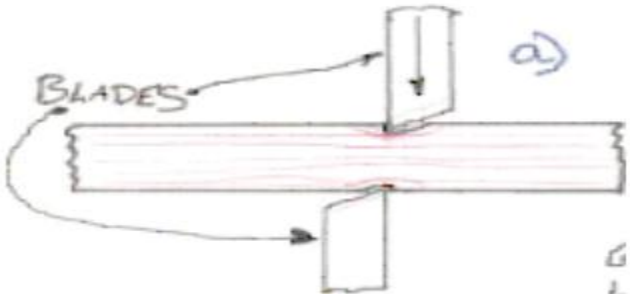
1. Set up and load pre-treatment equipment

Confirm pretreatment processes required for textile product based on the nature of the product and end user requirements.

1.1 Pre-treatment processes and Their equipment Tools and Equipment

1.1.1 Shearing / cropping process and its Machine

Shearing/cropping is cutting the loose threads attached to the fabric surface. It is achieved by raising the loose thread with the help of brush roller and cutting it close to thefabricsurfacewiththehelpofspiralblades.



1.1.2 Singeing process and its Machine

Singeing is burning the protruding fibers present on the fabric surface. It imparts smooth appearance to the fabric. It also improves the appearance of dyed and printed fabric.

The principle of singeing

Protruding fibers are burned by means of gas flame. This is carried out by passage of fabric at high speed (180 m/min) in contact with flame. Contact time with flame is in fraction of seconds and fabric is quenched immediately when it comes out of machine.

1.1.3 Batch pretreatment process and its machines

In this process the pretreatment is carried out in small batches. So the equipment is designed to accommodate small amount of textile product at a time.

1.1.4 Semi-continuous pretreatment process and its machines

In this process the fabric is impregnated with the pretreatment liquor by padding and it is wound on a roller known as batch roller.

1.1.5 Continuous pre-treatment process and its machines

This process is designed by putting different machinery into a sequence so that it can produce the pre-treated fabric in one pass.

The unprocessed cloth fed at one end of the machine comes out from other end in completely processed and dry condition

1.1.6 Washing process and its machines

Fabric will be washed to remove residual chemicals and impurities from the fabric by using water as removing agent.

1.1.7 Drying machines

Pre-treated fabric must be dried by removing water from the interior or surface of the fabric.

1.1.8 Stitching machine

Stitching machine is used when mass/bulky products of fabrics are pre-treated. This can be done by stitching different fabric batches together.

1.1.9 Roller

Roller is a device on which pre-treated fabrics are rolled over or wounded over.

1.1.10 Batch puller and Forklift

These two equipment's are used for load shifting during fabric pre-treatment is performed.

1.1.11 Desizing process and its Machine

Desizing is the process of removal of size chemicals from woven fabric. Protective layer of size chemicals though useful during weaving, it acts barrier for the penetration of chemicals in woven fabrics during chemical processing. So, it must be removed. Desizing facilitates penetration of chemicals and dyes applied during subsequent processing operations. Starch is the main ingredient for sizing of cotton warp.

Operation Sheet-1 Desizing of cotton fabric

Experimental Objectives

- To carry out desizing of cotton fabric by different methods
- To study the property of the desized cotton fabric

Materials/Equipments/Apparatus – Gray fabric, chemicals (as given in recipe), beakers, stoves, and other accessories.

Desizing Recipes and Treatment Conditions

Table Recipe for acid desizing of cotton fabric

	MLR: 1:20 PH = 1 - 2 Temperature= 30 - 60 ^{0}C Time= 2-8 h
Chemicals used	**Concentration (% o. w. f)**
HCl	0.5-1
Wetting agent	0.3 [Optional]

Desizing Procedure

a) Take sample of gray fabric according to the material liquor ratio (MLR) provided.
b) Oven - dry (condition) the sample and weigh the dried up sample.
c) Mark 65x 65 mm size on each of the sample for shrinkage test.
d) Prepare the desizing liquor according to the respective recipes given in tables above.
e) Check the solution pH.
f) Put the fabric samples in the desizing liquor and carry out desizing according to the time and temperature specified.
g) Carry out after treatment - rinse with hot water [70 - 95 ^{0}C] and give a cold wash.
h) Oven - dry (condition) and weigh each sample.
i) Finally level the desized fabric samples.

$$\text{Wt\%} = \frac{W_1 - W_2}{W_1} \times 100$$

Where: W1 and W2 are the weights of the fabric before and after treatment, respectively.

1.1.12 yarn scouring process and its machine

Scouring is the treatment of cotton with alkaline solution.

The purpose of scouring is:

- Remove natural impurities : fats and waxes,
- Pectin substances, proteins
- Remove added impurity : oil stains
- Seed coat fragments (kitty's)
- Improve water absorbency for uniform dyeing, printing and finishing.

Experimental Objectives

- To carry out scouring of cotton fabric using alkaline scouring agent (NaOH)
- To study the property of the scoured cotton fabric

Materials/Equipment/Apparatus – Cotton fabric (desized), chemicals (as given by recipe), beakers, stoves, oven and other accessories.

Scouring Recipes and Treatment Conditions

Table Recipe for scouring of cotton fabric with caustic soda

	MLR: 1:20 PH > 11 - 12 Temperature= 95 - 98^{o}c Time = 1 - 2h
Chemicals used	**Concentration (% O.w.f)**
Caustic soda	3 – 4
Wetting agent	1
Sequestering agent	0.1 - 0.2

Scouring Procedure

a) Prepare desized fabric samples from previous experiment, dry (condition) and weigh.
b) Mark 65 x 65 mm on each of the samples for shrinkage test.
c) Prepare the scouring liquor based on given recipe (table above).
d) Put the desized fabric sample in the scouring liquor and carry out scouring according to the time and temperature specified by the same table above.
e) Carry out after treatment - rinse with hot water and give a cold wash.
f) Dry (condition) and weigh each sample.
g) Level the scoured fabric samples.

1.1.13 Yarn bleaching process and its machine

Climate and soil cause various degree of yellowness in the fiber. Leaves coming in contact with moist cotton boll also cause yellow spots. Discoloration due to dirt/dust, insects', oil stains from harvesting machinery.

Bleaching is the process of removing natural coloring impurities from cotton. Its purpose is to produce white fabric by destroying coloring matter with minimum fiber degradation.

Further, improvement of whiteness is carried out by treatment with optical brightening agents when the fabric is to be marketed as white. It also improves the brightness of color after dyeing.

Operation Sheet-3 Bleaching of cotton fabric using different bleaches

Experimental Objectives

- To carry out bleaching of cotton fabric using different bleaches
- To study the property of the bleached cotton fabric
- To compare bleaching effect of different bleaching agents

Materials/Equipments/Apparatus - Cotton fabric (scoured) chemicals (as given by recipe), beakers, stoves, oven, and other accessories.

Bleaching Recipes and Treatment Conditions

Table*:* Peroxide bleaching recipe for cotton fabric

	MLR: 1:20 Temperature = 90 - 100^{o}c PH = 10.5-11 Time= 60 - 90 min
Chemicals used	**Concentration (%)**
Hydrogen peroxide (35%)	3 - 5

Caustic soda	0.3 - 0.8
Sodium carbonate	0.6 - 0.1
Sodium silicate	2 - 3
Magnesium sulphate	0.5
Wetting agent + Sequestering agent (EDTA)	0.1 - 0.5

Table: Recipe for fluorescent whitening

	MLR: 1:10 - 20 PH = Neutral Temperature= 40 - 60°C Time= 1hr
Chemicals used	**Concentration (%)**
Fluorescent whitening agent	0.5 – 1
Glauber's salt	1.0

Bleaching Procedure

a) Prepare scoured fabric samples from previous experiment, dry (condition) and weigh.
b) Mark 65 x 65 mm on each of the samples for shrinkage test.
c) Prepare bleaching solutions according to the recipe given in tables above.
d) Put the fabric samples in the bleaching liquor and carry out bleaching according to the temperature and time specified by the same tables above.
e) Sour the bleached fabrics with HCl (1.5% o.w.f.) at room temperature (MLR: 1:20).

f) Rinse with hot water and then give a cold wash.

g) Cut out half of the sample and treat the remaining half with OBAs according to the recipe and condition given in Table above.

h) Dry (condition) and weigh each sample.

i) Level all the bleached fabric samples.

1.1.14 Mercerizing process and heat setting process

Mercerization process:

Mercerization is the treatment of cotton (yarn/fabric) with caustic soda solution to improve the properties of cotton as: increased dye adsorption, increase in tensile strength, increase in lusture.

Mercerization process includes:

- ❖ Yarn mercerization
- ❖ Hank mercerization
- ❖ Fabric mercerization (Open width only)

Operation Sheet-4 MERCERIZATION OF COTTON

Experimental Objectives

- ❖ To carry out mercerization and causticization of cotton fabric/yarn samples
- ❖ To study tension and slack mercerization methods
- ❖ To compare mercerization effects by different methods

Materials/Equipments/Apparatus: Gray fabric, scoured fabric and bleached fabric, chemicals (as per given recipe), beakers, oven, apparatus for mercerization, and other accessories

Recipes and Conditions for Mercerization

Table: Recipe for mercerization/causticization

Chemicals used /Conditions	Mercerization
Caustic soda	22 to 25%
Temperature	RT
Time	2 min

Mercerization Procedure

a) Prepare a set of gray, scoured and bleached cotton fabric and yarn samples.
b) Prepare the mercerizing solution in a suitable bath based on the recipe given above.
c) For slack mercerization, put the fabric in slack (tensionless) form in the bath and carry out mercerization for 2min at room temperature.
d) For tension mercerization, apply tension on both sides of the fabric on a support by means of a clip and carry out mercerization at RT for 2min.
e) Carry out mercerization of the cotton yarn samples as per given recipe and condition.
f) Rinse all the treated samples.
g) Dry all the treated fabric and yarn samples.
h) Carry out dyeing of half of all the treated samples.

Heat setting process:

The purpose of heat setting is to dimensionally stabilize fabrics containing thermoplastic fibers.

1.1.15 carbonizing and degumming process

Carbonizing process*:*

Carbonizing is done to remove the cellulosic impurities from wool by treatment with acid or acid producing salts. Carbonizing may be carried out in loose wool or on piece goods after scouring.

The treated wool substance is dried at low temperature (60-70^{0}C) very quickly to minimize degradation by sulphuric acid of intermediate critical concentration.

Degumming process*:*

Degumming or boiling-off is the process employed to remove the silk gum (sericin) enveloping the two raw silk threads (fibrion). The gum content of silk varies according to quality and origin.

Carried out by soap Marseille soap (olive oil soap) & proteiase enzymes can break the peptide/amide linkages and convert them into simple amino acids.

2. **Operate and monitoring pre-treatment equipment**

2.1 OH&S practices------ is already explained in previous class / unit of competences

2.2 Undertaking pretreatment process.

It carrying out the specified pretreatment process to the specimen selected.

2.3 Monitoring pretreatment process.

Under this task, the selected pretreatment process is controlled to meet the pre-determined standard.

2.4. Product faults

During pretreatment of textile products different faults may be encountered while checking them.

It may include:

a) Tears
b) Holes
c) Creases and folds
d) Marks, impressions
e) Inconsistent coverage
f) Broken or pulled yarns

3. Remove product and dispatching

Unload or remove product from pretreatment area first. Then Check their product against quality standards and Dispatch/distribute it to the next processes. Finally complete cleaning of area to ensure work environment is maintained in a safe and

productive manner & accurately complete production records and other documentation.

Self-check

I. Choose the correct answer

1. Which of the following is pre-treatment of cotton, wool & silk respectively?

A. Degumming, carbonizing & mercerization B. mercerization, carbonization & degumming

B. Carbonizing, degumming & mercerization D. All

2. _____ is the burning of protruding fiber from fabric surface

A. Shearing/cropping B. singeing C. desizing D. scouring E. Bleaching F. All

3. The process of removing cellulosic matter from wool fibers is_____

A. Degumming B. De sizing C. carbonizing D. Bleaching

II. Mach the following

A	B
1. Shearing	a. process of removing colouring mutter
2. Bleaching	b. cut loose threads from surface of fabric
3. Scouring	c. burn protrude fibers from surface of fabric
4. Degumming	d. remove gum from silk fibers
5. Mercerization	e. remove natural impurity as fat, wax, from cotton fibers
	f. Threat cellulosic fibers with NaOH to improve strength & absorbency

III. write the correct answer

1. write the objective of a) singeing b) scouring c) bleaching d) mercerization e. degumming

Revisions

Impurities Removed During Pre-Treatment

Short fiber ----------singeing

Applied impurities----------size materials----------Desizing

Artificial Impurities----------oil, strains ,dust, dirt-----scouring

Natural impurities----------oil, wax, pectin's, proteins----scouring

Colour pigments----------naturally present in cotton----Bleaching

REFERANCE

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