

### **LIST OF LABORATORY TASKS**

1. Desizing of cotton fabric
2. Scouring of cotton fabric
3. Bleaching of cotton fabric
4. Combined pretreatment process of cotton fabric
5. Pretreatment using different preparatory finishing machines
6. Pretreatment process for yarns
7. Mercerization of cotton
8. Preparation of wool
9. Degumming of silk
10. Preparation of polyester and polyester/cotton blends

### **GENERAL PROCEDURE OF LABORATORY WORK**

The task for every laboratory study includes the objective, the main data (description of instruments and test methods), the assignment for work, and instructions for preparation of work and on the report.

Prior to starting work a student must go through the laboratory manual and the recommended literature to acquaint him/her with the materials concerning the objective of the work. The preparedness of the student for carrying out the work is checked by the instructor or with technical means. After completing a laboratory work, the students make a report in the order indicated by "format for laboratory report writing ", return the instrument and tools to the laboratory assistant and put their work places in order.

In each case depending on the instruments available and the time allotted, an individual student or group of students does a laboratory work. To save time, in consultation with the instructor, the number and duration of measurements may be reduced as against the requirements of standards.

## **SAFETY INSTRUCTIONS**

- Use the equipment in the laboratory carefully and always leave it clean for the next student. Always report equipment problems immediately. Failure to do this may delay your progress or that of another student.
- Laboratory coats or aprons should be worn to all classes in which the use of chemical reagents is involved. Always remember to wear proper shoes when inside the laboratory.
- Safety goggles or glasses should be worn whenever any member of the class is working with chemicals. Use gloves as required.
- Only laboratory notebooks and textbooks should be left on top of the counter when working in the laboratory. Leave purses and other belongings in a safe place where they will not accidentally come with damaging chemicals.
- Use chemicals in the fume hood when they evolve strong odors or toxic vapors in the fume hood. When working with flammable chemicals, make sure all flames are extinguished and preferably use in the fume hood.
- Never work alone in the laboratory. Smoking is not permitted in the laboratory. Do not bring or consume food or drinks in the laboratory.
- Be careful not to bump into others when they are working with chemicals.
- When heating chemicals in a test tube, point the test tube mouth away from you and those near by. Matches, labels, pieces of fabrics etc. should be placed in the waste cans. Only those materials, which can be flushed down the drain, should be placed in the sinks.
- Remember that chemical reagents are corrosive to plumbing. Whenever concentrated chemicals are emptied into the sink, they should be flushed down with large quantities of water. Make sure that all chemical reagents and other supplies are replaced in their assigned positions.
- Avoid contamination of reagents, and consequently erroneous results, by taking care not to place stoppers on wrong bottle and by not returning unused portions of chemicals to the reagent bottles.
- Do not lean against the workbenches as their tops and sides may contain spilled chemicals and reagents, which may be harmful to you.

KNOW THE LOCATION OF THE FIRE EXTINGUISHERS, EMERGENCY DOORS, FIRST-AID SUPPLIES AND EMERGENCY EYEWASH STATIONS. BE PREPARED TO GIVE ASSISTANCE TO OTHERS AND TO CALL MEDICAL HELP.

***Fire Prevention:***

*Burning Reagents:* Extinguish all nearby burners and remove combustible materials. Use the fire extinguisher, directing the stream of carbon dioxide at the base of the flame, or smother with a fire blanket. Do not use water.

*Burning Clothing and Shoes:* Smother the flames by wrapping with a blanket or laboratory coat, by rolling on the floor, by placing or jumping into a sink of coldwater or use the fire extinguisher.

*Burns:* Do not attempt to remove clothing embedded in a burned area. If the burn is severe summon medical aid. If the burn is small, immerse the burned area in cold water or flood with water. After the cold-water treatment, cover the burned area with sterile gauze moistened with ozonol ointment, or magnesium oxide and glycerin burn paste.

***Injuries from Chemicals:***

1. Immediate application of an appropriate washing agent is necessary to prevent severe injury. Provide First Aid if injury is manageable, call medical aid immediately.
2. *Acid on the skin:* Wash at once with a large volume of water. If the acid is on the clothing or is flushed into the clothing, remove the clothing while repeatedly washing the area with water. After the water treatment, cover the affected area with sterile gauze moistened with magnesium oxide and glycerin burn paste.
3. *Alkali on the skin:* Wash thoroughly with water and then apply a suitable ointment.
4. *Reagents in the eye:* Wash at once with water over emergency eyewash stations. Keep the eye open so the water can run over the surface of the eyeball. Continue rinsing the eye for at least 10 minutes using water or the eyewash solution from the squeegee bottle.

## **FORMAT FOR LABORATORY REPORT WRITING**

### **Content of report**

1. Contents
2. Title of the Laboratory Work
3. Experimental Objectives
4. Theoretical Background
5. Apparatus and Material
6. Procedure
7. Experimental Observations and Results
8. Conclusion

### **COVER PAGE**

**NAME OF INSTITUTE & DEPARTMENT**

**Group Number and Title of Laboratory Work**

**Prepared by:** Student's Name

**Submitted to:** Instructor's Name

**Submission date:** xxxxxxxx

**LABORATORY TASK NO-1**  
**DESIZING OF COTTON FABRIC**

**1.1. Experimental Objectives**

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

**1. 2. Theoretical Background**

Desizing is the process in which size applied to the warp yarn during sizing process and/or other size additives in weaving are removed to enhance the wettability/absorbency of the fabric made. The basic mechanism of desizing involves degradation of the size material like starch to make it water-soluble (changed into glucose, maltose or oligosaccharides). The removal of size from a textile fabric is influenced by different factors. These are:

- Viscosity of size in solution
- Ease of dissolution of size film
- Amount of size applied
- Nature and amount of plasticizers
- Composition of desizing bath
- Desizing temperature
- Mechanical action & MLR
- Fabric construction
- Method of washing off
- Temperature of washing off

Different methods can be used for desizing fabrics. In general desizing of cotton fabrics can be accomplished by physical, chemical or combination of the two. The following methods are used in desizing cotton fabrics.

- Rot steeping
- Acid desizing
- Oxidative desizing
- Enzyme desizing

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

## 1.4 Desizing Recipes and Treatment Conditions

**Table 1.1** Recipe for acid desizing of cotton fabric

	MLR: 1:20 PH = 1 - 2 Temperature= 30 - 60 °C Time= 2-8 h
<b>Chemicals used</b>	<b>Concentration (% o. w. f)</b>
HCl	0.5-1
Wetting agent	0.3 [Optional]

**Table 1.2** Recipe for oxidative desizing of cotton fabric

	MLR: 1:20 PH= 8 - 9 Temperature = 90°C Time = 10 -15 min
<b>Chemicals used</b>	<b>Concentration (% o.w.f)</b>
Hydrogen peroxide (35%)	0.2 - 0.35
Caustic soda	2 - 6
Sodium silicate	0 - 1
Magnesium sulphate	0.005
DTPA * (40 %) or EDTA **	0.2
Wetting agent	0.2 - 0.5

DTPA \* - Diethylene triamine penta acetic acid

EDTA \*\* - Ethylene diamine tetra acetic acid

**Table 1.3** Recipe for enzymatic desizing of cotton fabric

	MLR: 1:20 PH= 6 - 7 Temperature= 70 - 80°c Time= 60 min
<b>Chemicals used</b>	<b>Concentration (gpl)</b>
Enzyme Biolase	2.5 - 10
Sodium chloride	5
Non ionic wetting agent	1.5

### **1.5 Desizing Procedure**

- 1) Take sample of gray fabric for each desizing method according to the material liquor ratio (MLR) provided.
- 2) Oven - dry (condition) the sample and weigh the dried up sample.
- 3) Mark 65x 65 mm size on each of the sample for shrinkage test.
- 4) Prepare the desizing liquor according to the respective recipes for the methods of desizing given in tables above (Table 1.1 - 1.3).
- 5) Check the solution pH.
- 6) The fabric sample for enzymatic desizing method is washed in hot water (80-95°C) to gelatinize the starch.
- 7) Put the fabric samples in the respective desizing liquor, and carry out desizing according to the time and temperature specified by the conditions for the respective desizing methods (Table 1.1 - 1.3).
- 8) Carry out aftertreatment - rinse with hot water [70 - 95 °C] and give a cold wash.
- 9) Oven - dry (condition) and weigh each sample.
- 10) Finally level the desized fabric samples.

## **1.6 Desized Fabric Property Evaluation**

### *1. Weight loss calculation*

Weigh the desized fabric sample, compare with the original gray fabric sample weight and calculate weight loss in percentage. The following equation is used to calculate the weight loss (Wt. %):

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

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

### *2. Test for starch*

Iodine test is used for starch detection. A drop of iodine solution placed on a test specimen resulting in a characteristic blue color is the universal test for identifying starch. It can be used as a qualitatively test to show whether all the starch was removed.

For the evaluation, the sample is stained with 25 µl of a solution containing potassium iodide (2.4 g/l) and iodine (1.3 g/l). The procedure followed is: applying the solution drop wise; rubbing it gently and assessment for color change. Accordingly, if no color is observed (colorless) it indicates the absence of starch, if the color is blue-violet it indicates the presence of starch and if brown indicates the starch has been modified. .

### *3. Measure for wettability/absorbency*

AATCC Test Method No. 79 can be used to measure fabric wetting. A drop of water is placed on the fabric and the time it takes for the drop to penetrate the fabric is recorded. The wettability is determined by counting the elapsed seconds between the contact of the water drop with the fabric and disappearance of the drop into the fabric. The faster the wetting time, the more absorbent is the fabric.

Capillarity test can also be used for wettability/absorbency determination. In this test each specimen is cut vertically into a 20 x 2cm strip, hung longways with the bottom end dipped in water in order to measure the length of fabric by which water is absorbed in 5 minutes.

Examination will be based on comparison of the length of the specimens by which water is absorbed.

#### *4. Measurement of reflectance*

Since yellow impurities adsorb blue light, AATCC Test Method 110 measures the amount of blue light reflected by the goods, against a white standard (usually a ceramic tile). This gives a measure of how well the yellow impurities were removed by bleaching. Whiteness is measured by reflectance of green light and by the removal of yellow impurities. The standard ceramic tile is measured and set to equal 100. The other specimens are rated against this standard. Unbleached fabrics will give values in the 50 to 60 ranges. Well-bleached fabrics will rank 95 or better.

#### *5. Evaluate percentage shrinkage and tensile strength*

#### *6. Observe hand value by feeling test*

### **1.7 Results**

Record the gray fabric parameters and the results for desired fabric property by using tables as shown below.

**Table 1.4** Gray fabric parameters

<b>S.No</b>	<b>Fabric Parameter</b>	<b>Characteristic Value</b>
1	Gsm	
2	Ends per inch	
3	Picks per inch	

**Table 1.5** Desizing results

<b>S.No.</b>	<b>Fabric Property</b>	<b>Gray Fabric</b>	<b>Desized Fabric</b>		
			<b>Acid Desized</b>	<b>Enzyme Desized</b>	<b>Oxidative Desized</b>
1	Weight loss (%)				
2	Starch presence (Color change by Iodine Test)				
3	Absorbency/Wettability				
4	Reflectance (%)				
5	Tensile strength				
6	Shrinkage (%)				
7	Handle				

**LABORATORY TASK NO.2**  
**SCOURING OF COTTON FABRIC**

**2.1. Experimental Objectives**

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

**2.2 Theoretical Background**

Natural fibers contain oils, fats, waxes, mineral matter, leafy matter and notes as impurities that interfere with dyeing and finishing. Synthetic fibers contain producer spin finishes, coning oils and/or knitting oils. Mill grease used to lubricate processing equipment mill dirt, temporary fabric markings and the like may contaminate fabrics as they are being produced.

The cotton fibre is a single biological cell with a multilayer structure. These layers are structurally and chemically different, and contain approximately 4 - 12 % by weight of the non-cellulosic substances. The composition of typical cotton is given below (Table 2.1). Apart from natural impurities, cotton also contains added impurities such as size; adventitious oil, such as machine oils, tars, grease etc. added for smooth operation in spinning and weaving/knitting.

**Table 2.1** Composition of raw cotton (% by weight)

<b>Component</b>	<b>% by weight</b>
$\alpha$ -Cellulose	88-96
Pectins	0.7-1.2
Proteins	1.1-1.9
Waxes, fats	0.4-1.0
Ash	0.7-1.6
Moisture	6-8
Others	1-4

Since the impurities' hydrophobic nature negatively affects the enhancement of the fabric's wettability and absorbency, they have to be removed from the fabric for smooth subsequent chemical processing. Scouring is a purifying treatment of textiles, which removes these impurities. The aim of scouring process is to reduce the amount of impurities sufficiently to provide adequate wettability and absorbency so as to obtain level and reproducible results in the subsequent dyeing and finishing operations.

The mechanism of scouring involves saponification of saponifiable oil and wax like impurities, melting and emulsification of unsaponifiable oils, hydrolysis of proteins in to corresponding amino acids, conversion of pectins into water soluble salts, dissolution and removal of mineral matters, hemicelluloses and size remnants.

Conventionally removal of these impurities is carried out by treating the textile with sodium hydroxide (NaOH). In addition other reagents can also be used in scouring of cotton fabrics. Generally scouring agents are classified into one of the following groups:

- Aqueous (Alkaline agents such as NaOH, KOH, Na<sub>2</sub>CO<sub>3</sub>, Liquid NH<sub>3</sub> etc)
- Surfactants
- Organic solvents (Dry cleaning)
- Enzymes (Bioscouring)

The appropriate type of scouring agent for specific scouring process generally depends on the kind of fiber, yarn and fabric type, extent of impurities and end-use requirement.

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

## 2.4 Scouring Recipes and Treatment Conditions

**Table 2.2** Recipe for scouring of cotton fabric with caustic soda

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

## 2.5 Scouring Procedure

- 1) Prepare desized fabric samples from previous experiment, dry (condition) and weigh.
- 2) Mark 65 x 65 mm on each of the samples for shrinkage test.
- 3) Prepare the scouring liquor based on given recipe (table above).
- 4) 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.
- 5) Carry out aftertreatment - rinse with hot water and give a cold wash.
- 6) Dry (condition) and weigh each sample.
- 7) Level the scoured fabric samples.

## 2.6 Scoured Fabric Property Evaluation

### 1. Weight loss calculation

Weigh the scoured fabric sample, compare with the desized fabric sample weight and calculate weight loss in percentage. The following equation is used to calculate the weight loss (Wt. %):

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

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

### *2. Test for effective scouring*

Properly scoured fabric should wet out faster and be more water absorbent. AATCC Test Method No. 79 can be used to measure fabric wetting. A drop of water is placed on the fabric and the time it takes for the drop to penetrate the fabric is recorded. The wettability is determined by counting the elapsed seconds between the contact of the water drop with the fabric and disappearance of the drop into the fabric. The faster the wetting time, the more absorbent is the fabric. Conduct also capillarity test to check for absorbency

### *3. Measure reflectance*

### *4. Evaluate percentage shrinkage and tensile strength of scoured fabric.*

### *5. Carry out silver nitrate test to check for fabric degradation.*

## **2.7 Results**

**Table 2.3** Scouring results

<b>S.No.</b>	<b>Fabric Parameters</b>	<b>Gray fabric</b>	<b>Desized fabric</b>	<b>Scoured fabric</b>
1	Weight loss (%)			
2	Starch presence (Color change by Iodine Test)			
3	Absorbency/Wettability			
4	Reflectance (%)			
5	Tensile strength			
6	Shrinkage (%)			
7	Fabric degradation (Silver nitrate test)			

## LABORATORY TASK NO-3

### BLEACHING OF COTTON FABRIC USING DIFFERENT BLEACHES

#### 3.1. 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

#### 3.2 Theoretical Background

Natural fibers, i.e. cotton, wool, linen etc. are off-white in color due to color bodies present in the fiber. The coloring matter gives a yellowish brown color to the fibers, which is unwanted as far as aesthetic appearance and smooth subsequent finishing process is considered. The process of removal of unwanted color from substrates is known as bleaching. The purpose of bleaching is to destroy the colored material and confer a pure white appearance to the fibers. Bleaching should also decolorize or remove any residual impurities left by scouring.

Decoloration can occur by destroying one or more of the double bonds within the conjugated system or chromophore. Chemically the coloring matters can be destroyed by: oxidizing, reducing or combined oxidizing and reducing treatment.

Oxidizing agents used as textile bleaching agent are:

- Hydrogen peroxide ( $H_2O_2$ )
- Sodium chlorite ( $NaClO_2$ )
- Sodium hypochlorite ( $NaOCl$ )
- Peracetic acid ( $CH_3COO.OH$ )
- Perborates, percarbonates, and ozone

Reducing agents used as textile bleaching agents are:

- Sulphur dioxide ( $\text{SO}_2$ )
- Sodium hydrosulphite ( $\text{NaS}_2\text{O}_3$ )
- Derivatives of sulfinic acid ( $\text{H}_2\text{SO}_2$ )

Physical bleaching can also be carried out for enhancement of degree of whiteness as per end requirements. The agents used are known as Optical/Fluorescent brighteners (OBA/FBA). Optical brightening agents also called white dyes are organic compounds that fluoresce in a color that is complementary to that of the textiles and can be used to compensate the natural color. The brightening effect comes from the fluorescence, which depends on the property of certain organic compounds to convert short wavelength light into longer ranges.

About 80% of all optical brightening agents produced are derived from stilbene. Optical brighteners are applied to substrate as a separate after-treatment process or are incorporated into chemical bleaching and finishing baths. The fluorescent brightening agents behave like dyestuffs, and their effectiveness in bleaching is influenced by various factors that are important in application.

Other chemicals will be used in addition to the bleaching agent. These serve various functions such as to activate the bleaching system, to stabilize or control the rate of activation, to give wetting and detergent action, or to sequester metallic impurities.

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

### 3.4 Bleaching Recipes and Treatment Conditions

**Table 3.1** Peroxide bleaching recipe for cotton fabric

	MLR: 1:20 Temperature = 90 - 100°C PH = 10.5-11 Time= 60 - 90 min
<b>Chemicals used</b>	<b>Concentration (%)</b>
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 3.2** Chlorite bleaching recipe for cotton fabric

	MLR: 1:20 Temperature = 90 -100 °C PH = 3 - 4 Time= 60 - 90 min
<b>Chemicals used</b>	<b>Concentration (%)</b>
NaClO <sub>2</sub> (available chlorine)	1.2-2
Sodium dihydrophosphate	0.35
Formic acid	0.5
NaNO <sub>3</sub>	1.2

**Table 3.3** Hypochlorite bleaching recipe for cotton fabric

	MLR: 1:20 Temperature = 40 °C PH = 9 -11.5 Time = 1hr
<b>Chemicals used</b>	<b>Concentration (%)</b>
NaOCl (available chlorine)	2.5
Na <sub>2</sub> CO <sub>3</sub>	1.0

**Table 3.4** Recipe for fluorescent whitening

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

### 3.5 Bleaching Procedure

- 1) Prepare scoured fabric samples from previous experiment, dry (condition) and weigh.
- 2) Mark 65 x 65 mm on each of the samples for shrinkage test.
- 3) Prepare bleaching solutions separately for hypochlorite, chlorite and peroxide bleaching according to the recipe given in tables (Table 3.1 - 3.3).
- 4) Put the fabric samples in the respective bleaching liquor, and carry out bleaching according to the temperature and time specified by the same tables above.
- 5) Sour the bleached fabrics with HCl (1.5% o.w.f.) at room temperature (MLR: 1:20).
- 6) Rinse with hot water and then give a cold wash.
- 7) Cut out half of the sample from each bleaching process and treat the remaining half with OBAs according to the recipe and condition given in Table 3.4.
- 8) Carry out antichlor treatment for hypochlorite bleached fabric samples.

- 9) Then wash all the fabric samples with hot and then with cold water.
- 10) Dry (condition) and weigh each sample.
- 11) Level all the bleached fabric samples.

**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.

### **3.6 Bleached Fabric Property Evaluation**

Carry out the following analysis.

1. *Weight loss calculation*
2. *Absorbency/wettability*
3. *Reflectance*

Since yellow impurities adsorb blue light, AATCC Test Method 110 measures the amount of blue light reflected by the goods, against a white standard (usually a ceramic tile). This gives a measure of how well the yellow impurities were removed by bleaching. Whiteness is measured by reflectance of green light and by the removal of yellow impurities. The standard ceramic tile is measured and set to equal 100. The other specimens are rated against this standard. Unbleached fabrics will give values in the 50 to 60 ranges. Well-bleached fabrics will rank 95 or better

4. *Percentage shrinkage and tensile strength of bleached fabric*
5. *Fabric degradation (use silver nitrate test)*

### 3.7 Results

**Table 3.5a** Bleaching results

S.No.	Fabric Property	Scoured fabric	Bleached fabric		
			Hypochlorite bleached	Chlorite bleached	Peroxide bleached
1	Weight loss (%)				
2	Absorbency				
3	Reflectance (%)				
4	Degradation: a) Tensile strength (%) b) Sliver nitrate test (Color change)				
5	Shrinkage (%)				

**Table 3.5b** Fluorescent whitening results

S.No.	Fabric Property	Scoured fabric	Fluorescent whitening		
			Hypochlorite bleached	Chlorite bleached	Peroxide bleached
1	Absorbency				
2	Reflectance (%)				
3	Degradation (silver nitrate test)				
4	Shrinkage (%)				

## LABORATORY TASK NO- 4

### COMBINED PRETREATMENT PROCESS OF COTTON FABRIC

#### 4.1. Experimental Objectives

- ◆ To carry out combined pretreatment process of cotton fabric
- ◆ To compare conventional multistage pretreatment with combined pretreatment
- ◆ To study the properties of different multistage and combined pretreated fabrics

#### 4.2 Theoretical Background

In the conventional preparation, the desizing, scouring and bleaching processes are carried out separately at high temperatures requiring the use of large amount of thermal energy. In order to minimize energy consumption and material as well as to face the wastewater treatment and disposal regulations it has become necessary to combine several pretreatment stages by reducing the number of operations or by shortening the reaction time. The following combined pretreatment processes are widely used.

- ◆ (Desizing-Scouring) + Bleaching
- ◆ Desizing + (Scouring-Bleaching)
- ◆ (Desizing-Scouring-Bleaching)

**4.3 Materials/Equipments/Apparatus** – Gray cotton fabric, chemicals (as given by recipe) beakers, stoves, oven and other accessories.

#### 4.4 Pretreatment Recipes and Conditions

##### A. (Desizing - Scouring) + Bleaching

(I) Desizing - Scouring

**Table 4.1** Recipe for combined desizing/scouring

	MLR: 1:20 Temperature= 95 - 98°c Time= 2 - 3h
<b>Chemicals used</b>	<b>Concentration</b>
Caustic soda	4%
Persulphate	0.5-2g/l
Wetting agent	1-3g/l
Emulsifying agent	1-3g/l

(II) Bleaching: H<sub>2</sub>O<sub>2</sub> in place of persulphate is used with organic stabilizers.

**B. Desizing + (Scouring - Bleaching)**

(I) Desizing: Based on enzymatic method (refer to laboratory task -No.1)

(II) Scouring - Bleaching: Based on caustic soda, hydrogen peroxide and organic stabilizers.

**Table 4.2** Recipe for combined scouring/bleaching

	MLR: 1:20 PH = 11 Temperature= 70 -90°c & Time= 2h
<b>Chemicals used</b>	<b>Concentration (%)</b>
Caustic soda	1-2
Hydrogen peroxide (50%)	1-3
Sodium silicate	2
TSP*	2

\* (Tripoly) sodium phosphate

### C. Single stage Desizing/ Scouring/Bleaching

**Table 4.3** Recipe for single stage desizing/scouring/bleaching

	MLR: 1:20 PH = 11 Temperature= 95°c & Time = 90 min Temperature= 80°c & Time = 30 min [Steaming]
Chemicals used	Concentration (%)
H <sub>2</sub> O <sub>2</sub> (35 %)	5
Caustic soda	0.9
Sodium Silicate	2
Non ionic wetting agent	0.1
Sodium dipersulphate	0.3

#### 4.5 Pretreatment Procedure

- 1) Prepare three gray fabric samples, dry (condition) and weigh.
- 2) Mark 65 x 65 mm on each of the samples for shrinkage test.
- 3) Prepare the pretreatment solution for the different pretreatment processes according to recipe given for each pretreatment (Refer tables above).
- 4) Put the samples in the respective liquor and carry out each pretreatment process for the specified condition (Refer tables above).
- 5) Then rinse all the samples with hot and then with cold water.
- 6) Dry (condition) and weigh each sample.
- 7) Level all the treated fabric samples

#### 4.6 Property Analysis

Compare the different pretreated cotton fabric samples based on the following properties.

1. Weight loss
2. Starch presence
3. Wettability/absorbency
4. Reflectance (Degree of whiteness)

5. Handle
6. Tensile strength
7. Percentage shrinkage
8. Fabric degradation

#### 4.7 Results

**Table 4.4** Combined pretreatment results

S.N.	Fabric Property	Conventional Pretreatment			Combined Pretreatment		
		Desized	Scoured	Bleached	*DS + B	**D + SB	***DSB
1	Weight loss (%)						
2	Starch presence (Color change by Iodine Test)						
3	Absorbency/wettability						
4	Reflectance (%)						
5	Tensile strength						
6	Color-change (Degradation test)						
7	Shrinkage (%)						
8	Handle						

\* **DS + B** - (Desizing - Scouring) + Bleaching

\*\* **D + SB** - Desizing + (Scouring - Bleaching)

\*\*\* **DSB** - Single stage Desizing/Scouring/Bleaching

## LABORATORY TASK NO- 5

### PRETREATMENT USING DIFFERENT PREPARATORY FINISHING MACHINES

#### 5.1. Experimental Objectives

- ◆ To study the principle of operation and mechanism of laboratory sample dyer in processing of cotton fabric
- ◆ To study the principle of operation and mechanism of jigger and winch in processing of cotton fabric
- ◆ To carry out pretreatment process of cotton fabric using different preparatory finishing machines
- ◆ To evaluate the properties of pretreated cotton fabric treated with different preparatory finishing machines and compare the results

#### 5.2. Theoretical Background

Laboratory dyeing machine is a longer liquor ratio sample-dyeing machine used for processing of sample fabric/yarn. As integral part of the machine are the beakers, which are used to hold the solution and processing samples. For processing the samples are placed in the beaker containing the required solution. An oil heating system provides the energy required for processing according to the desired temperature and time. A program controls every process, which is set prior to processing.

Jigger and winch are used for preparatory finishing as well as in dyeing of textile fabric. Both work in exhaustion principle. Jigger is used for processing fabric in open width while winch processes fabric in rope form. Based on liquor ration jigger is a low liquor ratio (~1:3 - 1:5) machine while for winch the liquor ratio is higher (~1:30).

**5.3. Materials/Equipments/Apparatus:** Gray cotton fabric, chemicals (as per given recipe), laboratory atmospheric sample dyeing machine, jigger, winch, beakers, oven and other accessories.

#### 5.4. Pretreatment Recipes and Conditions

**Table 5.1** Recipe and condition for enzymatic desizing using winch

	MLR: 1:30 PH= 6-7 Temperature= 70-80°C Time= 60 min.
<b>Chemicals used</b>	<b>Concentration (gpl)</b>
Biolase PCL-150	10
Sodium chloride	10
Newalole PFN	3
Diadavin UN	1

**Table 5.2** Recipe and condition for scouring using jigger and winch

<b>Chemical used/Condition</b>	<b>Winch</b>	<b>Jigger</b>
Caustic soda, gpl	5 - 10	5 - 15
Wetting agent, gpl	0.2 - 1	0.5 - 1
MLR	15 - 30	2 - 4
Temperature, °C	95 - 98	95 - 98
Time, h	1 - 2	2 - 4

**Table 5.3** Recipe and condition for combined scouring/bleaching using sample dyer

	MLR: 1:40 PH= 11 Temperature= 70-80°C Time= 2hrs.
<b>Chemicals used</b>	<b>Concentration (%)</b>
Caustic soda	1-2
H <sub>2</sub> O <sub>2</sub>	1-3
Sodium silicate	3
TSP	2

**Table 5.4** Recipe and condition for bleaching using jigger and winch

Chemicals used/conditions	Concentration	
	Jig (% o. w. f)	Winch (gpl)
Caustic soda	0.25-0.8	5-15
Hydrogen peroxide (35%)	2-5	5-15
Magnesium Sulphate	-	0.1
Wetting agent	-	0.5-2
Sodium silicate	3.5	7
Organic Stabilizer	1-1.5	1-2
MLR	1:3	1:15-20
Temperature, °C	95	95
Time, h	2 - 4	1 - 2

### 5.5. Pretreatment Procedure

- 1) Prepare the fabric samples to be treated and the solution for each preparatory process according to MLR and recipe given by tables above.
- 2) Mark 65 x 65 mm on each of the samples for shrinkage test.
- 3) Adjust the machines in operating conditions and load the samples following the right sequence of operations for each of the equipments used.

[Refer the manual for each of the equipments used in the experiment]

- 4) Carry out pretreatment for the specified temperature and time as given by treatment conditions in tables above.
- 5) Then rinse with hot and then with cold water.
- 6) Dry (condition) and weigh each sample.
- 7) Level the treated fabric samples.

### 5.6. Property Analysis

Evaluate the treated fabrics for starch removal, absorbency/wettability and degree of whiteness.

## 5.7. Results

**Table 5.5** Preparatory machines results

<b>S.No.</b>	<b>Fabric Parameters</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>
1	Starch removal (Iodine Test)						
2	Absorbency						
3	Reflectance (%)						

**A** --- Desized fabric sample using winch

**B** --- Scoured fabric sample using winch

**C** --- Scoured fabric sample using jigger

**D** --- Bleached fabric sample using winch

**E** --- Bleached fabric sample using jigger

**F** --- Scoured/Bleached fabric sample using with sample dyer

## LABORATORY TASK NO- 6

### PRETREATMENT PROCESS FOR YARNS FOR KNITTED FABRICS

#### 6.1. Experimental Objectives

- ◆ To carry out pretreatment of cotton yarns
- ◆ To compare conventional separate pretreatment and combined pretreatment process of cotton yarns used for knitted fabric construction
- ◆ To study the property of pretreated cotton yarns

#### 6.2 Theoretical Background

White cotton yarns are widely used for knitted fabric as and after dyeing. The impurities such as spinning additives – oils and lubricants and natural coloring matters must be removed by appropriate scouring and bleaching technology to ensure smooth operations in subsequent dyeing and finishing processes as well as for aesthetic value of knitted goods. Like in the case of fabric bleaching the different chemical and physical bleaching agents can be used for yarn bleaching. Recommended standard procedure for scouring/bleaching of cotton yarn:

**Scouring → Bleaching → Fluorescent whitening → Washing → Drying**

**6.3 Materials/Equipments/Apparatus** – Greige cotton yarn, chemicals (as per given recipe), beakers, stoves, ovens and other accessories.

#### 6.4 Yarn Pretreatment Recipes and Conditions

**Table 6.1** Recipe for yarn scouring

	MLR: 1:10 -1:20 Temperature= 95 – 100 °C PH = 12 Time = 30 – 60min
Chemicals used	Concentration (g/l)
Caustic soda or sodium carbonate	1 - 3
Wetting agent	1- 3

**Table 6.2** Recipe for yarn bleaching

	MLR: 1:10 -1:20 PH = 10.5 – 11 Temperature= 90 – 100 °C Time = 60 – 90min
<b>Chemicals used</b>	<b>Concentration (g/l)</b>
Hydrogen peroxide (35%)	8-30
Sodium silicate	3-5
Sodium tripolyphosphate	1-3
Magnesium sulfate	0.1

**Table 6.3** Recipe for fluorescent whitening

	MLR: 1:10 -1:20 Temperature= 40 – 50 °C PH = Neutral Time = 30min
<b>Chemicals used</b>	<b>Concentration (% o.w.f.)</b>
Fluorescent whitening agent	0.2-0.5
Glauber's salt	0-10.

**Table 6.4** Recipe for one-bath scouring, bleaching and fluorescent whitening

	MLR: 1:10 -1:20 Temperature = 95 °C Time = 60min
<b>Chemicals used</b>	<b>Concentration</b>
Hydrogen peroxide (35%)	8-30g/l
Caustic soda	1g/l
Sodium silicate	3g/l
Wetting agent	3g/l
Sequestering agent	0.1g/l

Fluorescent brightener	0.5% o.w.f.
------------------------	-------------

### **6.5 Yarn Pretreatment Procedure**

1. Take samples of cotton yarn from a lot provided in the laboratory.
2. Prepare the liquor for scouring according to recipe given and carry out scouring for the specified temperature and time. (Table 6.1)
3. Prepare the liquor for bleaching according to recipe given and carry out bleaching for the specified temperature and time (Table 6.2).
4. Prepare the liquor for fluorescent whitening according to recipe given and carry out fluorescent whitening for the specified temperature and time (Table 6.3).
5. Carry out the combined pretreatment in a solution prepared according to recipe given (Table 6. 4) and as per the pretreatment cycle shown in the above figure.

### **6.6 Results**

- Measure the absorbency and degree of whiteness after each pretreatment and compare with the original yarn samples.

**LABORATORY TASK NO- 7**  
**MERCERIZATION OF COTTON**

**7.1. 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

**7.2 Theoretical Background**

Mercerization is treatment of cotton with concentrated caustic soda for value addition. Both mercerizing and causticizing require cotton to be treated with concentrated solutions of sodium hydroxide (caustic soda). Mercerization requires higher concentrations of caustic soda (19 to 26 % solutions) whereas causticizing is done with concentrations ranging between 10 to 16 %. Their end effects differ accordingly.

If cotton is dipped into a strong alkaline solution such as caustic soda, the fibers will swell and shrink. If the fibers are placed under tension while in this swollen state and then rinsed with water, the alkali will be removed and a permanent silk-like luster will result. Alternatively, after swelling, if the alkali is rinsed off when the fiber is in its shrunk state, an increase in luster may not be discernable, but the fibers will fix in that shrunk state, thus giving good elasticity to external stress. The former is known as tension mercerization and is often simply called mercerization, while the latter is referred to as slack mercerization. Due to considerations of cost and efficacy, only caustic soda is used as the alkali in industry.

The effects of mercerization are:

- |                                      |                                 |
|--------------------------------------|---------------------------------|
| 1. Improved luster                   | 5. Improved strength/elongation |
| 2. Increased ability to absorb dye   | 6. Improved smoothness          |
| 3. Improved reactions with chemicals | 7. Improved hand                |
| 4. Improved stability of form        |                                 |

Appearance is improved through increased luster, a deepening of the color and the production of a transparent look, the feel of the fabric is improved through a resulting soft hand and improved smoothness, and strength and elongation are also improved, along with the addition of good stretching ability. The treatment and handling can be adjusted to fit different requirements, thus allowing for the best application of the results of different processing.

Conventionally mercerization is performed in fabric stage. Some times it can also be done in yarn stage and some particular reasons for yarn mercerization are:

1. To produce lustrous, strong 100% cotton sewing thread and to produce yarns for special construction effects.
2. To produce yarns for constructions that are difficult to mercerize and for complete mercerization for luster and strength.
3. To produce yarn dyed fabrics and to produce knit goods.

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

**7.4 Recipes and Conditions for Mercerization**

**Table 7.1:** Recipe for mercerization and causticization

<b>Chemicals used /Conditions</b>	<b>Mercerization</b>	<b>Causticization</b>
Caustic soda	22 to 25%	10 to 18%
Temperature	RT	RT
Time	2 min	2 min

**7.5 Mercerization Procedure**

- 1) Prepare a set of gray, scoured and bleached cotton fabric and yarn samples.
- 2) Prepare the mercerizing solution in a suitable bath based on the recipe given above.
- 3) For slack mercerization, put the fabric in slack (tensionless) form in the bath and carry out mercerization for 2min at room temperature.

- 4) 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.
- 5) Carry out causticization (in tension and slack form) for one set of gray, scoured and bleached fabric samples based on the recipe and condition specified by the table above.
- 6) Carry out mercerization of the cotton yarn samples as per given recipe and condition.
- 7) Rinse all the treated samples.
- 8) Dry all the treated fabric and yarn samples.
- 9) Carry out dyeing of half of all the treated samples.

## 7.6 Mercerized Cotton Analysis

1. *Observe lusturity of the different samples*

2. *Test for degree of mercerization (Calculate barium number)*

AATCC Test Method 89 is a common test used for quantifying the degree of mercerization. It is based on the fabric's ability to absorb barium hydroxide. A two gram swatch of fabric is placed in a flask containing 30 ml of a standardized 0.25 N barium hydroxide solution. The fabric is stirred for two hours (to allow the barium hydroxide to be absorbed by the fabric). A 10 ml aliquot is withdrawn and titrated with 0.1 N hydrochloric acid to a phenolphthalein end point. The difference between the starting concentration and the remaining concentration of barium hydroxide is the amount absorbed by the fabric. The procedure is carried out on the fabric both before and after mercerizing and the barium number is calculated as shown below.

$$\text{Ba No.} = \frac{\text{Amt. absorbed by mercerized}}{\text{Amt. absorbed by unmercerised}} \times 100$$

3. *Measure absorbency*

AATCC Test Method No. 79 can be used to measure fabric wetting. A drop of water is placed on the fabric and the time it takes for the drop to penetrate the fabric is recorded. The wettability is determined by counting the elapsed seconds between the contact of the water

drop with the fabric and disappearance of the drop into the fabric. The faster the wetting time, the more absorbent is the fabric.

Capillarity test can also be used for wettability/absorbency determination. In this test each specimen is cut vertically into a 20 x 2cm strip, hung longways with the bottom end dipped in water in order to measure the length of fabric by which water is absorbed in 5 minutes. Examination will be based on comparison of the length of the specimens by which water is absorbed.

4. *Measure tensile strength*

5. *Compare dyeing characteristics* (visual observation of depth)

## 7.7 Results

**Table 7.2a** Fabric mercerization and causticization results

S.N.	Fabric Property	A	B	C	D	E	F	G	H	I	J	K	L
1	Lusture												
2	Barium number												
3	Absorbency												
4	Tensile strength												
5	Dyeability												

- A. Unmercerized gray fabric sample
- B. Unmercerized scoured fabric sample
- C. Unmercerized bleached fabric sample
- D. Mercerized gray fabric sample [Tension]
- E. Mercerized scoured fabric sample [Tension]
- F. Mercerized bleached fabric sample [Tension]
- G. Mercerized gray fabric sample [Slack]
- H. Mercerized scoured fabric sample [Slack]

- I. Mercerized bleached fabric sample [Slack]
- J. Causticized gray fabric sample [Slack]
- K. Causticized scoured fabric sample [Slack]
- L. Causticized bleached fabric sample [Slack]

**Table 7.2b** Yarn mercerization results

S.N.	Yarn property	Before mercerization	After mercerization
1	Lusture		
2	Barium number		
3	Absorbency		
4	Tensile strength		
5	Dyeability		

**LABORATORY TASK NO – 8**  
**PREPARATION OF WOOL**

### 8.1. Experimental Objectives

- ◆ To carry out scouring, carbonization and bleaching processes for wool
- ◆ To study the property of pretreated [scoured , carbonized and bleached] wool

### 8.2. Theoretical Background

Wool in the raw state is highly contaminated with natural and added impurities. These impurities inhibit the smooth conversion of wool fiber in to yarn and fabric as well as inhibit smooth further chemical processing. The typical composition of wool fiber is shown below.

**Table 8.1** Typical composition of raw wool

Component	% composition
Keratin	33
Grease	28
Suint	12
Sand and dirt	26
Vegetable matter	1

The major pretreatment process carried out on raw wool fibers is scouring which removes the variety of impurities present in the fiber. Except the vegetable matters (removed by the so called carbonization process) and the coloring matters (removed by bleaching) other impurities such as wool grease, suint and dirt matters are removed by effective scouring process. Different methods can be used for scouring raw wool. The conventional raw wool scouring involves treatment with mild alkaline liquor by the so called emulsion scouring method. For the purpose of removal of added impurities such as processing lubricants it is customary to conduct pretreatment of wool yarns and fabrics though not widely practiced as raw wool processing.

**8.3 Materials/Equipments/Apparatus** – Raw wool fiber, wool yarn/fabric, chemicals (as given in recipe), beakers, stoves, and other accessories.

## 8.4 Recipes and Treatment Conditions for Wool

**Table 8.2** Recipe for scouring of raw wool

	MLR = 1:10 PH = 10 Temperature = 50 - 55 °C Time = 10 – 15min
<b>Chemicals used</b>	<b>Concentration (% o. w. f)</b>
NaCO <sub>3</sub>	2
Soap	2 - 3
Wetting agent	0.5

\* Similar recipe for scouring of wool yarns and fabrics

**Table 8.3** Recipe for carbonization of wool (Acidizing bath)

	MLR = 1:10 Temperature = RT Time = 30sec
<b>Chemicals used</b>	<b>Concentration (% o. w. f)</b>
H <sub>2</sub> SO <sub>4</sub>	8
Wetting agent	1

**Table 8.4** Recipe for alkaline peroxide bleaching of wool

	MLR = 1:10 Temperature = 50°C Time = 3 – 5hr
<b>Chemicals used</b>	<b>Concentration</b>
H <sub>2</sub> O <sub>2</sub>	1.5 – 3 ml/l
Na <sub>2</sub> CO <sub>3</sub>	(for PH = 8 – 10)
Sodium pyrophosphate	2 - 3 gpl

### 8.5a Scouring Procedure

- 1) Take sample of raw wool according to the material liquor ratio (MLR) provided.
- 2) Oven - dry (condition) the sample and weigh the dried up sample.

- 3) Prepare the scouring liquor according to the recipe given in table (Table 8.2).
- 4) Check the solution pH.
- 5) Put the raw wool sample in the scouring liquor, and carry out scouring according to the time and temperature specified by the conditions for scouring (Table 8.2).
- 6) Carry out aftertreatment (warm wash followed by final cold wash cycles).
- 7) Oven - dry (condition) and weigh each sample.
- 8) Finally level the scoured fiber samples.

### **8.5b Carbonizing Procedure**

- 1) Take sample of raw wool according to the material liquor ratio (MLR) provided.
- 2) Oven - dry (condition) the sample and weigh the dried up sample.
- 3) Prepare the acidizing liquor according to the recipe given in table (Table 8.3).
- 4) Check the solution pH.
- 5) Place the raw wool sample in the acidizing liquor for the time and temperature specified for impregnation (Table 8.3).
- 6) Carryout predrying [60 - 70<sup>0</sup>C] and final drying [110<sup>0</sup>C] for a short period of time.
- 7) Then crush and dedust the sample.
- 8) Carry out aftertreatment (neutralization followed by warm and final cold wash cycles).
- 9) Oven - dry (condition) and weigh each sample.
- 10) Finally level the carbonized fiber samples.

### **8.5c Bleaching Procedure**

- 1) Take sample of wool according to the material liquor ratio (MLR) provided.
- 2) Oven - dry (condition) the sample and weigh the dried up sample.
- 3) Prepare the bleaching liquor according to the recipe given in table (Table 8.4).
- 4) Check the solution pH.
- 5) Put the wool sample in the bleaching liquor, and carry out bleaching according to the time and temperature specified by the conditions for bleaching (Table 8.4).
- 6) Carry out aftertreatment (warm wash followed by final cold wash cycles).
- 7) Oven - dry (condition) and weigh each sample.

8) Finally level the bleached samples.

### 8.6 Property Evaluation

Carry out the following tests for the scoured, carbonized and bleached samples and compare with the original sample.

1. *Weight loss calculation*
2. *Measure for wettability/absorbency*
3. *Measurement of reflectance*
4. *Measure of tensile strength*

### 8.7 Results

S.N.	Property	Pretreatment Type		
		Scoured	Carbonized	Bleached
1	Weight loss (%)			
2	Absorbency/wettability			
3	Reflectance (%)			
4	Tensile strength			

## LABORATORY TASK NO- 9 DEGUMMING OF SILK

### 9.1. Experimental Objectives

- ◆ To carry out degumming of silk using different methods
- ◆ To compare the different methods of silk degumming

- ◆ To study the property of silk after degumming

## 9.2. Theoretical Background

Silk fiber is composed of two proteins namely fibroin and sericin. The fiber forming substance is fibroin whereas sericin surrounds two of these fibroin filaments in the fiber structure. Typical silk fiber composition is 70-80% fibroin and 20 – 30% sericin along with other adventitious impurities such as mineral matter and some added oily matters. In chemical processing the sericin which is a gummy substance blocking the penetration of chemicals, dyes/finishes is considered as impurity. The process of removal of sericin gum from silk is known as degumming.

Different methods of degumming can be carried out depending on the chemical or reagent responsible for the degumming action. In general the mechanism involves breakdown or conversion into simpler forms of the sericin protein. These include soap degumming, acid degumming, alkaline degumming, enzymatic degumming and so on. The efficiency of degumming achieved by the different methods varies depending on the extent of breakdown of the sericin from silk. Degumming also removes the adventitious impurities that are present in silk.

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

## 9.4 Degumming Recipes and Treatment Conditions

**Table 9.1** Recipe for hot water degumming of silk

MLR: 1:20
PH = Neutral
Temperature: 120 <sup>0</sup> C
Time = 2 h [pressure]

Chemicals used	Concentration (% o. w. f)
Water	-
Wetting agent	0.5

**Table 9.2** Recipe for soap degumming of silk

MLR: 1:20 PH = 10 Temperature = 90 - 95 °C Time = 1 - 2 h	
Chemicals used	Concentration (% o. w. f)
Soap/detergent	20 -30

**Table 9.3** Recipe for alkaline degumming of silk

MLR = 1:20 PH = 9.5 - 10 Temperature = 95 °C Time = 20min	
Chemicals used	Concentration
Sodium carbonate	0.5 - 1% o.w.f
Non ionic surfactant	3gpl

**Table 9.4** Recipe for acid degumming of silk

MLR = 1:20 PH = 2 - 2.5 Temperature = 90 - 95 °C Time = 30 min
---

Chemicals used	Concentration
Sulphuric acid	2.5 - 10% o.w.f
Non ionic surfactant	3gpl

### 9.5 Degumming Procedure

- 1) Take a sample of silk fabric (untreated) for each degumming method according to the material liquor ratio (MLR) provided.
- 2) Oven - dry (condition) the sample and weigh the dried up sample.
- 3) Mark 65x 65 mm size on each of the sample for shrinkage test.
- 4) Prepare the degumming liquor according to the respective recipes for the methods of degumming given in tables above (Table 9.1 - 9.4).
- 5) Check the solution pH.
- 6) Put the fabric samples in the respective degumming liquor, and carry out degumming according to the time and temperature specified by the conditions for the respective degumming methods (Table 9.1 - 9.4).
- 7) Carry out aftertreatment: rinse with warm water and give a cold wash.
- 8) Oven - dry (condition) and weigh each sample.
- 9) Finally level the degummed fabric samples.

### 9.6 Degummed Fabric Property Evaluation

#### 1. Weight loss calculation

Weigh the degummed silk fabric samples, compare with the original silk fabric sample weight and calculate weight loss in percentage. The following equation is used to calculate the weight loss (Wt. %):

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

Where:  $W_1$  and  $W_2$  are the weights of the fabric before and after treatment, respectively.

#### 2. Measure for wettability/absorbency

AATCC Test Method No. 79 can be used to measure fabric wetting. A drop of water is placed on the fabric and the time it takes for the drop to penetrate the fabric is recorded. The wettability is determined by counting the elapsed seconds between the contact of the water

drop with the fabric and disappearance of the drop into the fabric. The faster the wetting time, the more absorbent is the fabric.

Capillarity test can also be used for wettability/absorbency determination. In this test each specimen is cut vertically into a 20 x 2cm strip, hung longways with the bottom end dipped in water in order to measure the length of fabric by which water is absorbed in 5 minutes. Examination will be based on comparison of the length of the specimens by which water is absorbed.

#### *4. Measurement of reflectance*

Since yellow impurities adsorb blue light, AATCC Test Method 110 measures the amount of blue light reflected by the goods, against a white standard (usually a ceramic tile). This gives a measure of how well the yellow impurities were removed by bleaching. Whiteness is measured by reflectance of green light and by the removal of yellow impurities. The standard ceramic tile is measured and set to equal 100. The other specimens are rated against this standard. Unbleached fabrics will give values in the 50 to 60 ranges. Well-bleached fabrics will rank 95 or better.

#### *5. Evaluate percentage shrinkage and tensile strength*

#### *6. Observe hand value by feeling test*

### **9.7 Results**

Record the original silk fabric parameters and the results for degummed fabric property by using tables as shown below.

**Table 9.5** Silk fabric parameters

<b>S.No</b>	<b>Fabric Parameter</b>	<b>Characteristic Value</b>
1	Gsm	
2	Ends per inch	

3	Picks per inch	
---	----------------	--

**Table 9.6** Silk degumming results

S.No.	Fabric Property	Original Fabric	Method of degumming			
			Hot Water	Soap	Alkaline	Acid
1	Weight loss (%)					
2	Absorbency/Wettability					
3	Reflectance (%)					
4	Tensile strength					
5	Shrinkage (%)					
6	Handle					

### **LABORATORY TASK NQ - 10**

#### **PREPARATION OF POLYESTER AND POLYESTER/COTTON BLENDS**

#### **10.1. Experimental Objectives**

- ◆ To carry out preparatory finishing of polyester and polyester/cotton blend fabrics

- ◆ To study the property of pretreated polyester and polyester/cotton (PC) blend fabrics

## 10. 2. Theoretical Background

Even though synthetic fibers such as polyester are not contaminated with natural impurities as cotton and wool; added impurities such as soft sizes like PVA, spin finishes and processing lubricants can become potential impurities that inhibit smooth further chemical processing. For the purpose of product optimization, nowadays blend fabrics are widely used in the textile market.

Among the variety of blends is the mixture of polyester and cotton which is utilized as polyester/cotton [PC] blend fabrics. In particular when polyester is blended with cotton these impurities must be removed for smooth and uniform processing such as dyeing, printing and finishing. The impurities from PC blend fabrics are removed by selection of appropriate pretreatment process/technology taking into consideration the characteristics of the impurities associated with the individual fibers, the property of the fibers and the characteristics required by the end product.

**10.3 Materials/Equipments/Apparatus** – Polyester fabric, PC blend (gray) fabric, chemicals (as given in recipe), beakers, stoves, and other accessories.

## 10.4 Pretreatment Recipes and Treatment Conditions

**Table 10.1** Recipe for scouring of polyester fabric

	MLR = 1:20 Temperature = 75 - 80 °C Time = 30 - 60min
<b>Chemicals used</b>	<b>Concentration (gpl)</b>
Na <sub>2</sub> CO <sub>3</sub>	2
Detergent	1

**Table 10.2** Recipe for scouring of polyester/cotton blend fabric

MLR = 1:20 Temperature = 75°C Time = 15min
--

Chemicals used	Concentration (gpl)
NaOH	1 - 2
Detergent	1 - 2

**Table 10.3** Recipe for chlorite bleaching of polyester fabric

MLR = 1:20 PH = 3 Temperature = 95 °C Time = 1 – 2hr	
Chemicals used	Concentration (gpl)
NaClO <sub>2</sub>	3 - 5
Formic acid	(for pH)
Wetting agent	0.5

**Table 10.4** Recipe for chlorite bleaching of polyester/cotton blend fabric

MLR = 1:20 PH = 3.5 - 4 Temperature = 80 - 90 °C Time = 1hr	
Chemicals used	Concentration (gpl)
NaClO <sub>2</sub>	1-2
Formic acid	(for pH)
Na <sub>2</sub> NO <sub>3</sub>	0.5
Sodium dipersulphate	0.5 - 1

**Table 10.5** Single stage combined pretreatment process for polyester/cotton blend fabric

MLR = 1:5 PH = 5 - 6
-------------------------

	Temperature = 75 - 80°C Time = 90min
<b>Chemicals used</b>	<b>Concentration (gpl)</b>
Peracetic acid	5 – 6
Bacterial amylase	1
Tetrasodiumpyrophosphate	1
NaCl	2
Non-ionic wetting agent	0.5

### 10.5 Pretreatment Procedure

- 1) Take sample of polyester or PC blend fabric for each pretreatment process according to the material liquor ratio (MLR) provided.
- 2) Oven - dry (condition) the sample and weigh the dried up sample.
- 3) Mark 65x 65 mm size on each of the sample for shrinkage test.
- 4) Prepare the pretreatment liquor according to the respective recipes for scouring, bleaching and single stage pretreatments given in tables above (Table 10.1 - 10.5). Check the solution pH.
- 5) Put the fabric samples in the respective liquors, and carry out pretreatment according to the time and temperature specified by the conditions for the respective pretreatment processes (Table 10.1 - 10.5).
- 6) For chlorite bleached fabrics carry out antichlorination treatment with thiosulphate (2-3 g/l) at 60 °C for 20 min.
- 7) Carry out aftertreatment - rinse with warm water [60 - 70 °C] and give a cold wash.
- 8) Oven - dry (condition) and weigh each sample.
- 9) Finally level the pretreated fabric samples.

### 10.6 Pretreated Fabric Property Evaluation

Carry out the following tests for the pretreated fabric samples.

- 1. Weight loss calculation*
- 2. Test for starch (cotton portion of blend)*
- 3. Measure for wettability/absorbency*
- 4. Measurement of reflectance*
- 5. Measure of tensile strength*
- 6. Evaluate percentage shrinkage*
- 7. Observe hand value by feeling test*

## 10.7 Results

Record the original polyester and PC blend fabric parameters and the results for treated fabric property by using tables as shown below.

**Table 10.6a** Original fabric parameters [Polyester]

S.No	Fabric Parameter	Characteristic Value
1	Gsm	
2	Ends per inch	
3	Picks per inch	

**Table 10.6b** Original fabric parameters [PC blend]

S.No	Fabric Parameter	Characteristic Value
1	Gsm	
2	Ends per inch	
3	Picks per inch	

**Table 10.7** Pretreatment of polyester and PC blend results

S.No.	Fabric Property	Pretreated Fabric							
		Original		Scoured		Bleached		Combined	
		P	PC	P	PC	P	PC	P	PC
1	Weight loss (%)								
2	Starch presence (Color change by Iodine Test)								
3	Absorbency/Wettability								
4	Reflectance (%)								
5	Tensile strength								
6	Shrinkage (%)								
7	Handle								

