

Pretreatments

Why is pretreatment needed

- As a whole this process consist of desizing process, scouring and bleaching.
- Pretreatment process basically aim to removal all impurities found on fiber (especially cellulose) so that materials have
 - i) degree of white,
 - ii) absorbent to dyestuff .

What causes impurities

- The raw material is generally containing unwanted matter of fibres and the impurities of fibres. This impurities is :

Natural impurities is the dirt is emerge together on cotton.

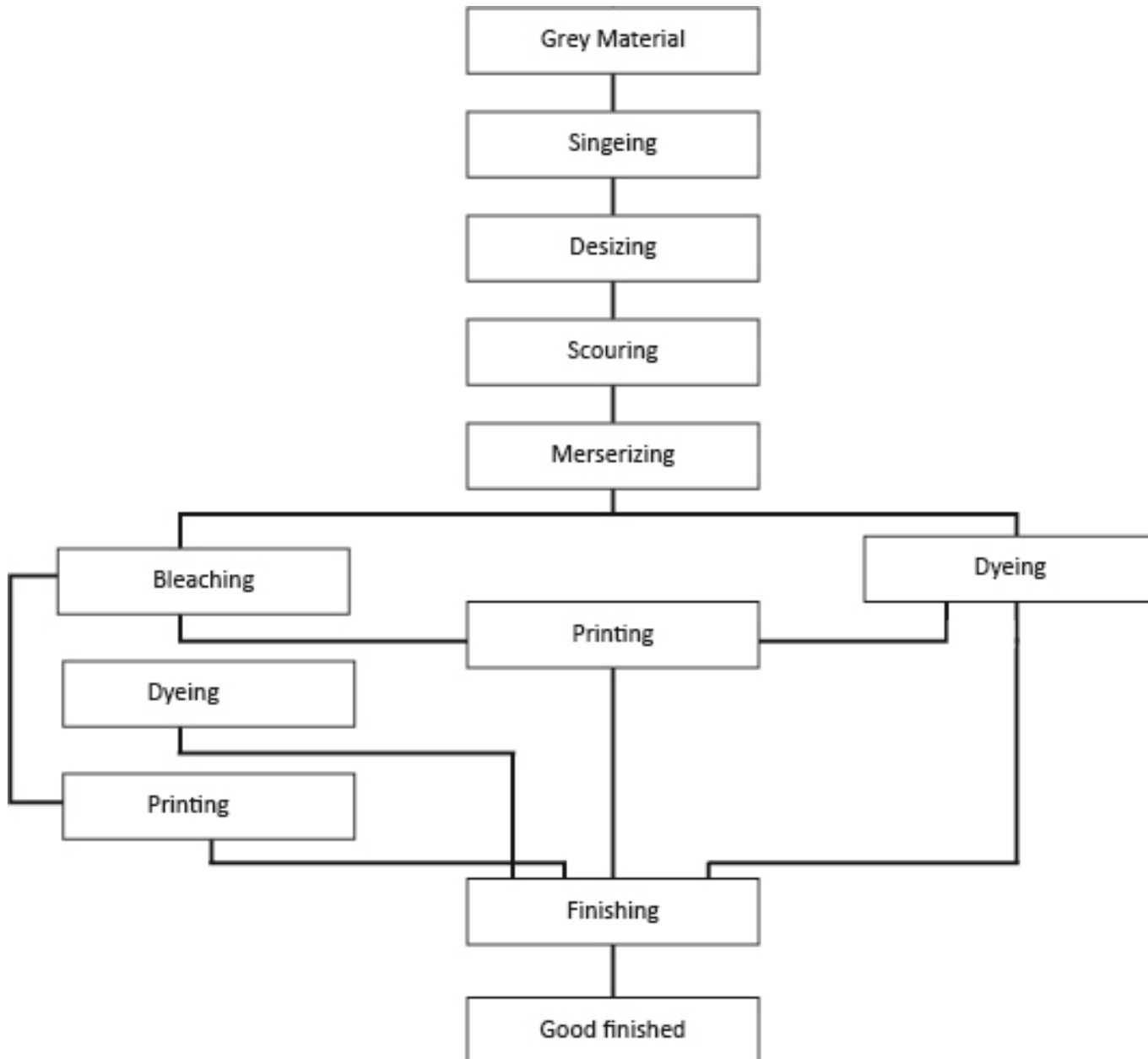
Impurities from outside

- Dirt coming from outsider, yarn or fabric , for example : oil, ,dust , parts of leaf, branch, stains of oil from machine and etc.

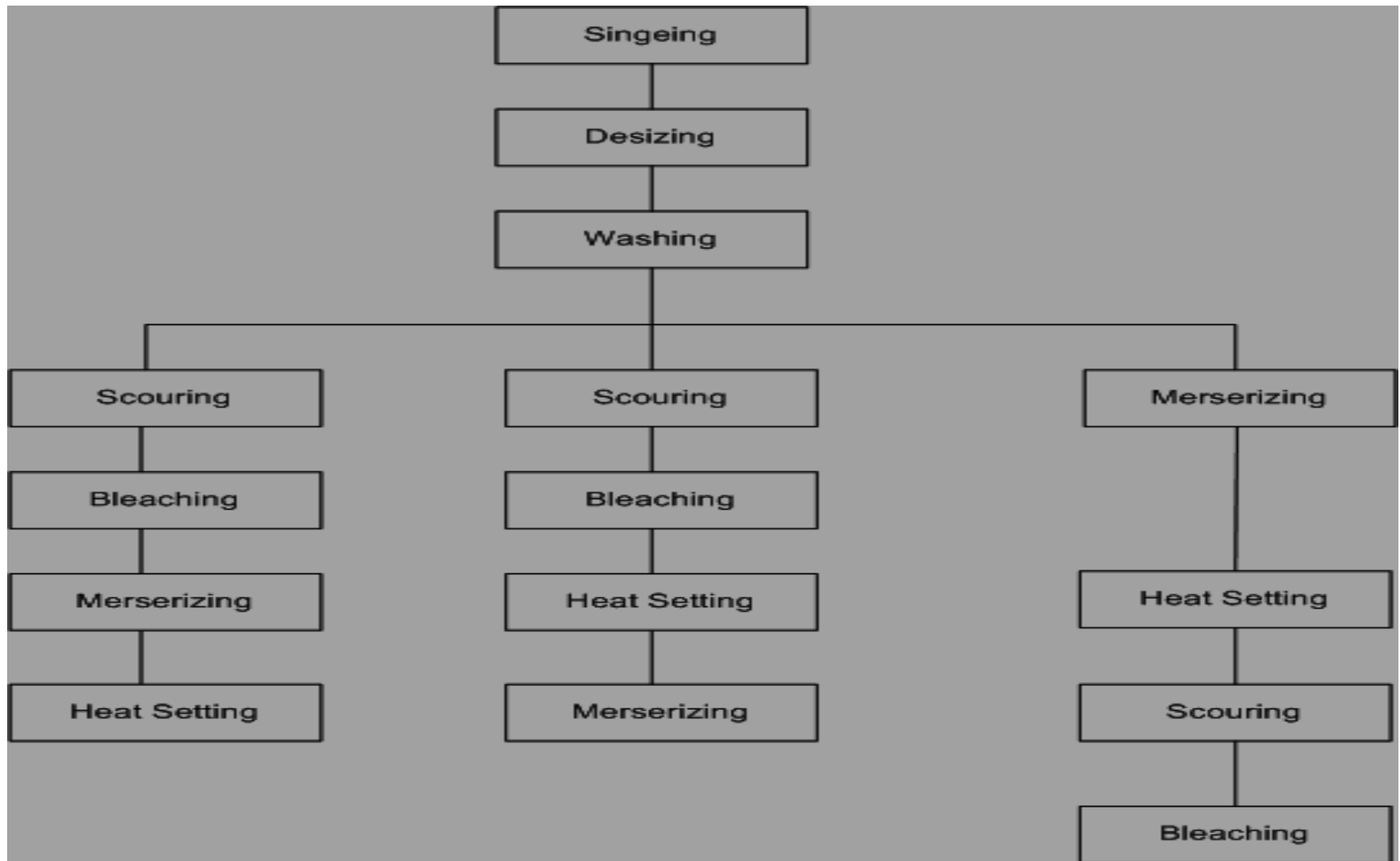
The addition of impurities

- The addition material impurities for the fluency of process for example : oil, starch at warp of yarn, etc.

Flow chart on process textile



Flow chart of pre treatment of cotton fabric



Typical pretreatment of cotton involves

1. Singeing
2. Desizing by conventional /enzymatic process
3. Scouring by conventional /enzymatic process
4. Bleaching
5. Neutralization
6. Peroxide removal
7. Bio-polishing
8. Mercerizing
9. Optical Brightening



Objectives of the Pretreatments

1. Good sizing effects
2. Removal of seed husks
3. Removal of foreign substances from the fibre
4. Low possible fibre damage
5. High degree of whiteness
6. Good physical/ technological ratings
7. High color yield
8. Levelness of the effect
9. High and even hydrophilicity/ rewettability

Singeing

- It is the process of burning out projecting hairy fibres from surface of the grey fabric by passing the fabric through a gas flame. Both sides of the fabric are burnt out by the flame. It helps in subsequent chemical process of the fabric. After dyeing or printing of singed fabric, brightness and luster of color and fabric becomes better. Singeing is a process applied to both yarns and fabrics to produce an even surface by burning off projecting fibres, yarn ends, and fuzz. This is accomplished by passing the fibre or yarn over a gas flame or heated copper plates at a speed sufficient to burn away the protruding material without scorching or burning the yarn or fabric.

Singeing

- Singeing is a finishing method for smoothing surfaces of fabrics by burning. A gas-singeing machine is normally employed. The gas-singeing machine is typically equipped with four burners, and is capable of singeing one or both surfaces of the fabrics.
- A water-cooled roller is provided at a location opposite to the burners, thereby enabling singeing to be performed without undermining the strength of even thin fabrics. It is important to set a drain temperature of the water-cooled roller in a range of 50 to 55 C.
- Cautions are required because a dew-point is generated when the water-cooled roller is cooled down too much, and results in increased amount of remaining fuzz or adhered carbon. The fabric feed speed is preferably set at around 100 to 150m/minute.

Desizing

- It is the process of removing starch materials present in the gray fabric. Generally enzyme is used to degrade and remove the starch present in the grey fabric. If those size materials are not removed from the grey fabrics, then the subsequent chemical treatments on the fabric will be irregular, which will cause the defective dyeing and printing.

Desizing

- The processes by which we remove sizes are known as desizing. Sizing is the need for the weaving but is an obstacle for the dyeing. It can be done by many ways such as acid steep, rot steep, enzymatic etc. in all these enzymatic desizing is dominating because of its eco-friendliness and also because of its characteristics that is it acts at specific sites only at definite pH, temperature and concentration. Mainly starch is used as the ingredient in sizing.
- Chemically starch is poly- α -glucopyranose in which straight chain (amylose) and branched chain (amylopectin) polymers are present. Both constituents of starch are insoluble in water, but they can be solubilised by hydrolysis of these long chain compounds to shorter ones. Thus under suitable conditions starch can be progressively hydrolyzed to the following stages. In desizing the hydrolysis reaction is carried out up to the stage of soluble dextrin only and not further to α -glucose.

A typical desizing method

- Conventional Method:
- In this method we first take the weight of the sized fabric, let it be W_1 . Then desize the fabric, dry & take the weight, let it be W_2 . After that the fabric is treated with 3gpl (35%) HCl at 70° C for 30 min. dry & take the weight of the fabric. Let it be W_3 .
- Total size = $W_1 - W_3$.
- Residual size = $W_2 - W_3$.
- Desizing Efficiency = $(\text{Total size} - \text{Residual size}) / \text{Total size} \times 100$.

Desizing

- Like starch polyvinyl alcohol is also common. Since it is a powerful film forming sizing agent and because of the ease with which it can be removed (it is soluble in water) it is an ideal sizing agent. The molecular weight and the degree of hydrolysis are the two primary factors, which influence its solubility in water, the solubility decreasing with increasing molecular weight. The desizing of polyvinyl-treated fabrics involves three steps- swelling, dissolving and dispersing. In contrast to starch, enzymes, normally used for desizing starches, do not hydrolyze it. The principle steps in the desizing procedure are
- Wetting out with suitable wetting agent.
- Steeping for affecting the swelling and softening of the polyvinyl alcohol film.
- Rising thoroughly in overflowing water.
- Desizing efficiency is found in two ways conventional and modern

Scouring

- It is the process of removing natural impurities present in the cotton fibre. The natural impurities are pectin's, pectos, ash, wax, mineral compounds, etc. if those impurities present in the cotton fibres are not removed, then it will be difficult to dye or print the fabric uniformly. Normally caustic soda ash is used as main reagent fro scouring of cotton fabric.

Scouring of special cotton & its influence on physical properties

- Cotton, being a natural fibre, contains more natural impurities on its primary and secondary walls. Analysis of cotton wax, in the past, has revealed a general composition as 25% fatty acids, 52% alcohols, 10% sterols, 7% hydrocarbons and 6% “inert matters”. The main constituents of the wax include 1-triacontanol, montanol, beta sisterol and a mixture of high molecular weight esters . About 85% of carboxyl groups in the pectic substances of cotton are methylated and are in the form of insoluble calcium, magnesium and iron salts of polygalacturonic acid, which also constitutes to the non-absorbent characteristics of raw cotton.
- Very much limited literatures are available with regard to special types of cotton fibres like organic cotton, coloured cotton and Bt cotton fibres and the effect of alkali scouring and enzyme scouring on the changes in physical properties of these fibres. However, colour development and original physical properties of these fibres are well analysed in the past and reported on various occasions

Effect of scouring on weight loss

- Higher weight loss values were observed in the case of alkali scoured samples compared to solvent extracted and enzyme scoured samples. Invariably, enzyme scouring resulted in the lowest weight loss values in all the samples followed by solvent extraction. In spite of higher weight losses observed in the solvent extraction, the lower values of enzyme treatment, perhaps, indicate the influence of the surface bound impurities in accessing the substrate for the enzyme reaction.
- Fineness of the fibres, expressed in terms of $\mu\text{g}/\text{inch}$ or tex, to a larger extent depends on the maturity of the fibres, and also by the amount of the moisture present in the material to some extent. Removal of hydrophobic impurities in the surface of fibres is likely to increase the moisture regain of the fibres, which, otherwise, could reduce the bound water to the hydrophobic surface of the impurities.

Effect of scouring on fineness of fibres

- In the case of alkali scoured samples, a significant increase in the fineness values were observed compared raw cotton fibres and enzyme scoured samples. This, possibly, could be due to residual pectins present in the alkali scoured materials and the lower values observed in the case of enzyme treated samples could be, possibly, due to partial removal of hydrophobic impurities from the surface of the fibres as expressed by the lower weight loss values. However, in the case of fineness, large differences in the values were not observed as in the case of weight loss.
- Tensile strength of the fibres, mainly, depends on the capacity of the polymeric molecules to withstand the load and their ability to distribute the load between the ordered and disordered regions. Here, the disordered regions (matrix) help to transfer the force to the adjacent ordered regions for better strength realisation

Scouring

Removal of hydrophobic impurities in the samples resulted in higher moisture content values in the treated fibres, however, difference in the extraction of hydrophobic impurities in the treatments could result in the variations in the moisture content of the samples tested after the treatment.

Though solvent extractions resulted in higher weight loss compared to enzyme treatment, the moisture content values were found to be low in the solvent extracted samples, which is interesting and would require further analysis

Enzymatic scouring is a widely accepted method in industrial practice since the biocatalysts do not harm the cellulosic materials present in the cotton. However, the entire substrates present in the fibres are not hydrolysed by the enzymes during the enzymatic scouring operation due to poor accessibility of the pectic substances present in the fibres.

This also results in difference in various properties like fineness, strength, elongation and moisture control of the fibres.

Bleaching

- It is the process of removing natural coloring matters present in the cotton fibre. For this purpose, hydrogen peroxide, bleaching powder or other bleaching agents are used. Hydrogen peroxide is the best and most commonly used bleaching agent. If this bleaching treatment is not carried out before dyeing or printing then the color yield and shade matching may be a great problem.

Bleaching cotton

- When bleaching cotton, a lot of chemicals, energy and water are part of the process, and reducing the environmental impact of cotton production addresses these issues. The company Huntsman has developed a wetter/stabiliser that maximises the wetting and detergency of the bleaching process and a one-bath caustic neutraliser and peroxide remover in order to shorten the bleaching cycle, reduce energy and water required and deliver more consistent bleaching results. They have developed surfactants that are environmentally friendly (in that they do not contain Alkylphenol ethoxylates), and the system that is both Oeko-Tex and GOTS approved.

Mercerizing

- It is a special chemical pre-treatment on cotton fabric that improves the properties and performance of cotton fabric. The cotton fabric is treated under tension in the 20% caustic soda solution which is called mercerization. Many properties of cotton fabric are improved, some of them are mentioned below:
- Increases fabric strength
Increases absorbency power
Increases fabric lustre
Increases fabric softness and handle property
Reduces dye consumption
Reduces chemical consumption in dyeing.

Mercerization

- **Mercerization** is a process that makes cotton take dye better and increases its luster!
- It was originally developed and patented by a man named John Mercer in 1844. The cotton is treated with Sodium Hydroxide (Caustic Soda) to swell the fibers and increase the fiber's luster as well as its affinity for dye by increasing the surface area of the fiber. Afterwards, the fabric is soaked in an acidic bath to neutralize the base. Also, by swelling the fibers in this highly alkaline bath, it makes the cotton fibers stronger and "pre-shrunk" because they don't retract, so the woven fabric will shrink less later. The fabric also has a smoother and more lustrous look when mercerized under tension.
- **Mercerized Cotton Fabrics** accept dye so much better than other fabrics, it's amazing. Mercerization gives a much richer and more vibrant color saturation than with unmercerized versions of the same cotton fabric.
- Here is a picture, side by side, of mercerized and unmercerized fabrics dyed in the same dye bath. You can see that the mercerized one is a much deeper and richer color.