



ACADEMIC YEAR 2024-2025, SEMESTER – VI  
STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY  
TEXTILE FINISHING



STUDY MATERIAL FOR B.Sc., (FASHION TECHNOLOGY)

TEXTILE FINISHING

SEMESTER – VI



ACADEMIC YEAR 2024-25

PREPARED BY

FASHION TECHNOLOGY DEPARTMENT



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



## INDEX

UNIT	CONTENT	PAGE NO
I	INTRODUCTION OF FINISHING	03-16
II	CHEMICAL FINISHING	17-37
III	FUNCTIONAL FINISHES	38-58
IV	ECO – FRIENDLY PROCESSING	59-74
V	EFFLUENT PLANT	75-85



## UNIT – I

### INTRODUCTION TO FINISHING

#### **DEFINITION:**

Textile finishing refers to the processes applied to fabric after it has been woven or knitted, aimed at improving its properties and preparing it for final use. This stage is crucial in transforming raw textiles into finished products that are visually appealing, functional, and durable.

The term finishing means completing the manufacture of cloth by surface treatment. In a broad sense, it covers all the treatments it undergoes after leaving the loom or knitting machine till it enters the market. The clothes we wear are not made from raw fabrics. Most of fabrics are processed in fabric stage and in some cases textile finishing may be performed in after making the garment.

#### **Key Components of Textile Finishing:**

##### **1. Mechanical Finishing:** Involves physical processes such as:

- Calendering: Smoothing and glossing the fabric.
- Brushing: Raising the fibers to create a soft texture.
- Shearing: Cutting surface fibers for uniformity.

##### **2. Chemical Finishing:** Utilizes various chemicals to impart specific characteristics, such as:

- Water Repellency: Making fabrics resistant to water.
- Flame Retardance: Reducing flammability.
- Anti-static Treatments: Preventing static electricity buildup.

##### **3. Thermal Finishing:** Involves the application of heat to:

- Stabilize the fabric.
- Set shapes or patterns.

##### **4. Purpose:**

- Enhance aesthetic qualities (color, texture).
- Improve performance attributes (durability, comfort).
- Extend the lifespan of textiles.

**5. Sustainability:** The industry is increasingly adopting eco-friendly practices, focusing on reducing harmful chemicals and minimizing waste.



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



Textile finishing plays a vital role in determining the final quality and functionality of textiles used in various applications, from fashion to home furnishings and industrial products.

**Why Finishing is needed for textiles?**

The need of textile finishing is explained below with few points. Main objects of textile finishing includes

- To improve the appearance of the fabric that makes it more attractive lustrous by operations like calendaring, shearing, optical whitening etc
- To improve the feel of the fabric by softening, stiffening etc
- To cover faults in the original fabric (e.g. by starch finishing)
- To increase the weight of the cloth, (e.g. by back filling with starch and china clay or by chloride treatment for silk)
- To improve wearing qualities of cloth by making it shrink resistant (e.g. by sanforising cotton cloth or by non-felting wool), crease resistant (by incorporating suitable resins) or free from pills and soiling (by anti pilling and soil release finish)
- To make garments to hold shape and enable them be worn without ironing e.g. by durable finishing
- To impart special properties to the fabric for the specific end uses such as water proofing, flame proofing, moth proofing etc
- To set the texture of certain fabrics and makes others dimensionally stable e.g. by crabbing or potting (wool) and heat setting (synthetic fibre fabrics):
- To produce stronger and more durable fabrics such as seat covers of car by coating, bonding and laminating:
- To produce novelty effect (e.g. organdie fabrics by parchmentising)

Textile finishing is essential for several reasons, significantly impacting the quality, usability, and appeal of fabrics. Here are some key points highlighting its importance:

**IMPORTANCE FOR TEXTILE FINISHING**

**1. Enhanced Aesthetics:**

- Visual Appeal: Finishing processes improve the fabric's color, texture, and overall look, making it more attractive to consumers.
- Surface Feel: Techniques like brushing or calendaring enhance the softness or smoothness, which can be crucial for clothing and home textiles.



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



---

## **2. Improved Performance:**

- **Functional Properties:** Finishing can impart characteristics such as water resistance, stain protection, and UV resistance, making fabrics more suitable for specific applications.
- **Durability:** Processes like heat-setting help stabilize fabrics, reducing shrinkage and wear, which prolongs the life of the textile.

## **3. Comfort and Usability:**

- **Breathability and Moisture Management:** Finishing treatments can enhance the comfort of fabrics, especially in clothing, by improving moisture-wicking and breathability.
- **Ease of Care:** Treatments such as wrinkle resistance make fabrics easier to care for, appealing to consumers seeking low-maintenance options.

## **4. Market Competitiveness:**

- **Differentiation:** Innovative finishing techniques can set products apart in a crowded market, allowing brands to offer unique features.
- **Consumer Demand:** As consumers increasingly seek specialized fabrics (e.g., technical textiles), finishing becomes critical to meet these demands.

## **5. Sustainability Considerations:**

- **Eco-Friendly Practices:** Advances in finishing technology can reduce the environmental impact of textile production by minimizing water and chemical use.
- **Recyclability:** Certain finishes can enhance the recyclability of textiles, aligning with the growing focus on sustainable fashion.

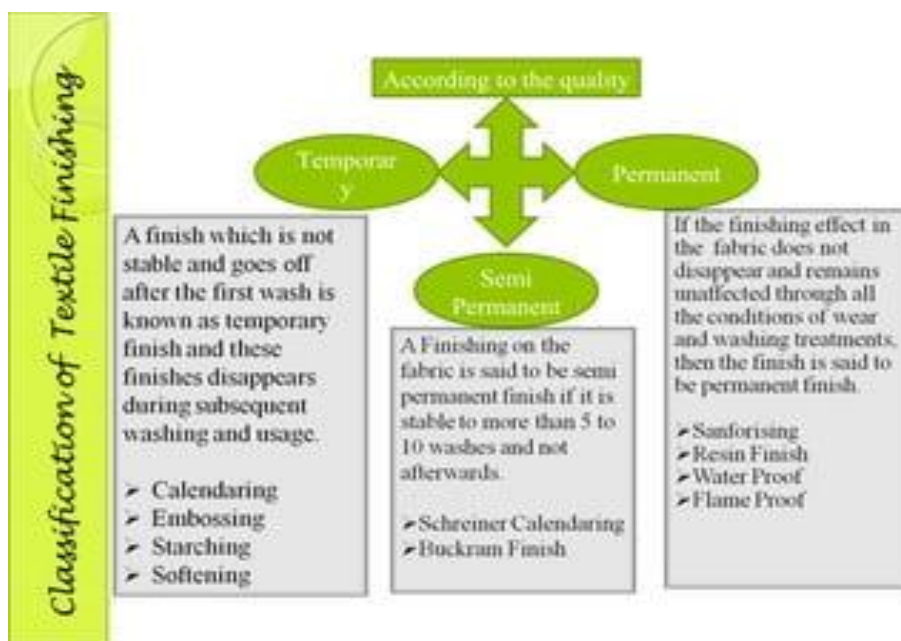
## **6. Compliance with Regulations:**

- **Safety Standards:** Many industries, such as automotive and healthcare, have specific regulations regarding fabric properties (e.g., flame retardance), making finishing essential for compliance.

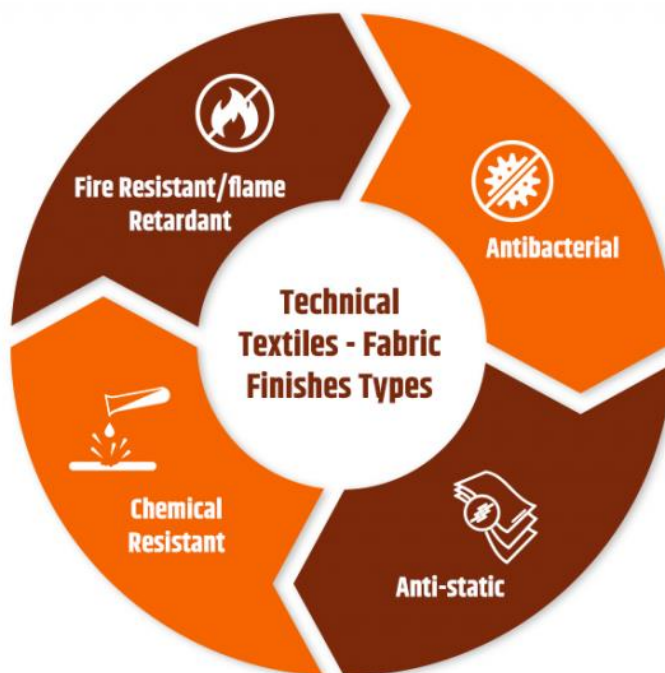
Overall, textile finishing is vital for ensuring that fabrics meet aesthetic, functional, and regulatory requirements, ultimately enhancing their value in the marketplace.



ACADEMIC YEAR 2024-2025, SEMESTER – VI  
STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY  
TEXTILE FINISHING



**Technical Textiles - Fabric Finishes Types**



Textile finishing can be classified based on various criteria, including the methods used, the effects achieved, and the types of fabrics treated. Here are the main classifications:

**1. Based on Methodology:**

- Mechanical Finishing: Involves physical processes to alter the fabric's surface and structure. Common methods include:



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



- Calendering: Smoothing and compressing the fabric.
- Brushing: Raising fibers for a soft, fuzzy texture.
- Shearing: Cutting fibers to achieve a uniform surface.
- Chemical Finishing: Utilizes chemicals to impart specific properties. Examples include:
  - Water Repellent: Treatments that create a barrier against water.
  - Flame Retardant: Chemicals that reduce flammability.
  - Anti-microbial: Treatments that inhibit the growth of bacteria and fungi.
- Thermal Finishing: Involves heat application to stabilize or set the fabric. Techniques include:
  - Heat-setting: Stabilizing synthetic fibers.
  - Curing: Fixing chemical finishes through heat.

**2. Based on Purpose:**

- Aesthetic Finishing: Aimed at enhancing appearance and texture, such as:
  - Dyeing: Adding color to fabrics.
  - Printing: Applying patterns or designs.
- Functional Finishing: Focused on enhancing performance characteristics, such as:
  - Waterproofing: Making fabrics resistant to water.
  - Stain Resistance: Preventing stains from adhering to the fabric.
  - Durability Finishing: Enhancing the longevity and wear resistance of textiles, such as:
    - Wrinkle Resistance: Reducing creasing in fabrics.
    - Abrasion Resistance : Improving the fabric's resistance to wear.

**3. Based on End Use:**

- Apparel Finishing: Specific treatments for clothing, like softeners and crease-resist finishes.
- Home Textile Finishing: For items like curtains and upholstery, which may require treatments for durability and aesthetics?
- Industrial Textile Finishing: Specialized treatments for textiles used in technical applications, such as automotive or medical textiles.





**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



---

#### **4. Based on Fabric Type:**

- Natural Fiber Finishing: Finishing processes tailored for cotton, wool, silk, etc.
- Synthetic Fiber Finishing: Techniques specifically designed for polyester, nylon, and other man-made fibers.

#### **CLASSIFICATION OF TEXTILE FINISHING**

Textile finishing refers to the processes applied to textiles after they are woven or knitted to enhance their appearance, performance, or handle (feel). These processes can be classified broadly into the following categories:

##### **1. Mechanical Finishes**

Mechanical finishes involve the use of physical processes to alter the fabric's surface or structure.

- Calendaring: The fabric is passed between heated rollers to create a smooth, shiny surface.
- Sanforizing: A pre-shrinking process to prevent further shrinkage during washing.
- Raising: The surface of the fabric is brushed to lift fibers, giving it a fluffy texture (common in flannels).
- Singeing: Burning off the protruding fibers to make the fabric smooth.
- Crabbing: Setting the fabric's warp and weft threads to maintain its shape, often used for woollens.

##### **2. Chemical Finishes**

Chemical finishes involve treating the fabric with various chemicals to modify its properties.

- Mercerization: Treating cotton with sodium hydroxide to increase its luster, strength, and affinity for dye.
- Flame Retardant Finishing: Applying chemicals to make the fabric resistant to fire.
- Water Repellent Finishing: Chemicals are added to make the fabric resistant to water without affecting its breathability.
- Stain Resistance: A chemical treatment to prevent fabric from absorbing liquids and stains.
- Antimicrobial Finishing: Chemicals added to inhibit the growth of microbes, often used in medical and sports textiles.





**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



---

### **3. Aesthetic or Special Effects Finishes**

These finishes enhance the appearance or provide special textures or visual effects.

- Embossing: Creating a raised design on fabric using engraved rollers.
- Glazing: Applying a resin or wax and then polishing the fabric to give it a shiny, glossy finish.
- Moire: Producing a wavy or water-marked pattern on the fabric by passing it through heated engraved rollers.
- Flocking: Adhering small fibers onto the fabric surface to create a velvet-like texture.
- Shearing: Trimming the surface fibers of the fabric to create a uniform texture, often used in pile fabrics.

### **4. Functional or Performance Finishes**

These finishes improve the functional properties of the fabric for specific uses.

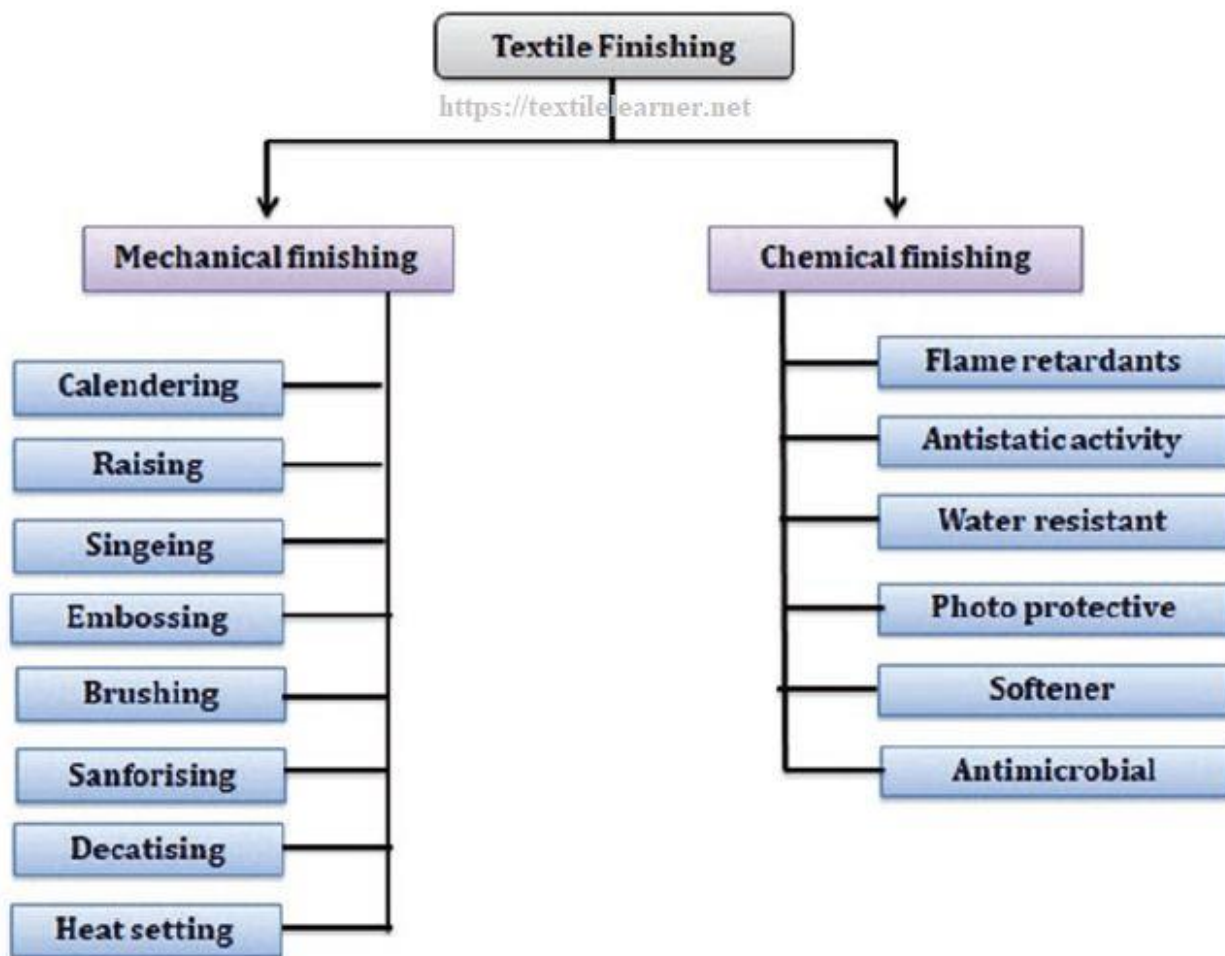
- Wrinkle Resistance: Applying resins or other chemicals to make fabrics less prone to creasing.
- Anti-Static Finishing: Chemicals that reduce the buildup of static electricity, commonly used in synthetic fabrics.
- UV Protection: Adding chemicals that block ultraviolet rays, protecting both the fabric and the wearer.
- Temperature Regulation: Phase-change materials (PCM) or other treatments are applied to regulate the wearer's body temperature by absorbing or releasing heat.

### **5. Biological Finishes**

These finishes use enzymes or biological agents to modify the textile.

- Bio-Polishing: Using enzymes to remove short fibers from cotton fabrics, resulting in a smoother, shinier appearance.
- Bio-Stoning: Enzyme treatment to give denim a worn, stone-washed effect without using pumice stones.

Each of these textile finishing techniques can be applied individually or in combination, depending on the desired properties of the fabric.



### Mechanical Finishing:

Involving the application of physical principles such as friction, temperature, pressure, tension and many others. Commonly used mechanical finishes include calendaring, compressive shrinkage / Sanforizing, raising, emerizing / sueding / peaching, shearing / cropping.

#### Calendering

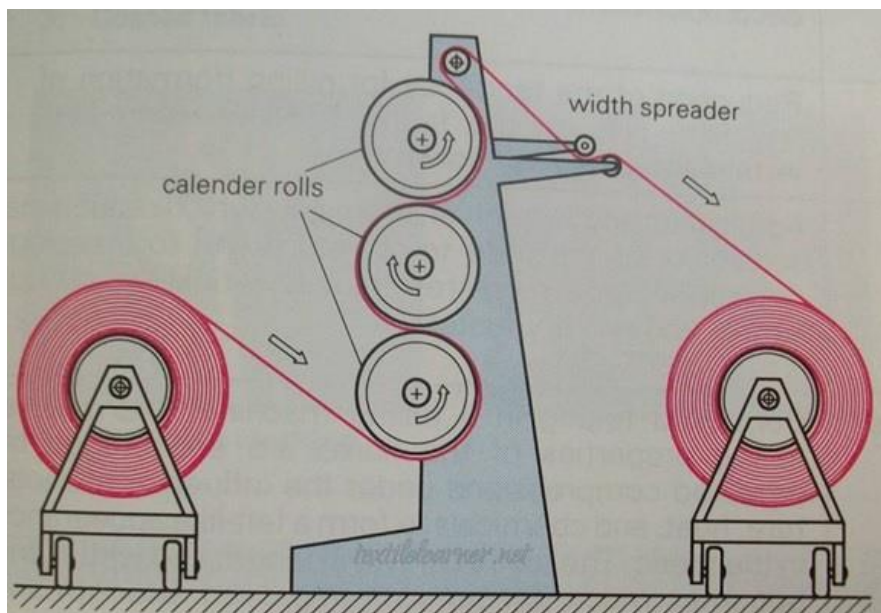
A process of passing cloth between rollers (or “calendars”), usually under carefully controlled heat and pressure, to produce a variety of surface textures or effects in fabric such as compact, smooth, supple, flat and glazed. The process involves passing fabric through a calendar in which a highly polished, usually heated, steel bowl rotates at a higher surface speed than the softer (e.g. cotton or paper packed) bowl against which it works, thus producing a glaze on the face of the fabric that is in contact with the steel bowl. The friction ratio is the ratio of the peripheral speed of the faster steel bowl to that of the slower bowl and is normally in the range 1.5 to 3.0. The normal woven fabric surface is not flat, particularly in ordinary quality plain weave fabrics, because of the round shape of the yarns, and interlacings of warp and weft at right angles to each other. In such fabrics it is more often seen that even when the fabric is quite regular, it is not flat.



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



During calendering, the yarns in the fabric are squashed into a flattened elliptical shape; the intersections are made to close-up between the yarns. This causes the fabric surface to become flat and compact. The improved planeness of surface in turn improves the glaze of the fabric. The calender machines may have several rollers, some of which can be heated and varied in speed, so that in addition to pressure a polishing action can be exerted to increase luster.



### **Compacting**

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

### **Embossing**

This particular type of calendering process allows engraving a simple pattern on the fabric. To produce a pattern in relief by passing fabric through a calendar in which a heated metal bowl engraved with the pattern works against a relatively soft bowl, built up of compressed paper or cotton on a metal centre.



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



---

### **Sueding**

Sueding finishing process is carried out by means of a roller coated with abrasive material. The fabric has a much softer hand and an improved insulating effect thanks to the fiber end pulled out of the fabric surface.

### **Raising or Napping**

The raising of the fiber on the face of the goods by means of teasels or rollers covered with card clothing (steel wires) that are about one inch in height. Action by either method raises the protruding fibers and causes the finished fabric to provide greater warmth to the wearer makes the cloth more compact, causes the fabric to become softer in hand or smoother in feel; increase durability and covers the minute areas between the interlacing of the warp and the filling. Napped fabrics include blankets, flannel, unfinished worsted, and several types of coatings and some dress goods. Other names for napping are Gigging, Genapping, Teaseled, Raised.

### **Wool Glazing**

This is done on a special machine, which is used to perform functional finishing on wool fabrics after raising.

### **Shearing**

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

### **Stabilization**

A term usually referring to fabrics in which the dimensions have been set by a suitable preshrinking operation

### **Decating**

Also called Decatizing. A finishing process applied to fabrics to set the material, enhance luster and improve the hand. Fabric wound onto a perforated roller is immersed in hot water or has steam blown through it.

### **Steaming and Heat setting**

It is done by using high temperatures to stabilize fabrics containing polyester, nylon, or triacetate but not effective on cotton or rayon. It may be performed in fabric form or garment form. It may cause shade variation from side-to-side if done prior to dyeing; may change the shade if done after dyeing.

### **Sanforizing or Pre Shrinking**

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



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



**Fulling:**

The structure, bulk and shrinkage of wool are modified by applying heat combined with friction and compression.

**Objectives / Purposes of Calendering Finishing:**

The major changes to the fabric induced by the calendering process are

- (1) Reduced fabric thickness,
- (2) Increased fabric luster,
- (3) Increased fabric cover,
- (4) Smooth silky surface feel,
- (5) Reduced air porosity, and
- (6) Reduced yarn slippage.

**Main purposes of calendering finishing process are given below:**

1. To upgrade the fabric hand and to impart a smooth silky touch to the fabric.
2. To improve the opacity of the fabric
3. To compress the fabric and reduce its thickness.
4. To impart different degree of luster to the fabric.
5. To reduce yarn slippage.
6. To give different visual and feel effects on the fabric

The mechanical finish is done for softness and shining of the fabric or stiffness according to the nature of the chemical, this process is done after the chemical finishing as per buyer requirement.

**Parameters of Calendering Finishing Process:**

Some of the parameters affecting the calendering process are as follows:

1. Fabric construction
2. Fiber content
3. Finish applied
4. Moisture content
5. Temperature of the calender bowls
6. Running speed



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



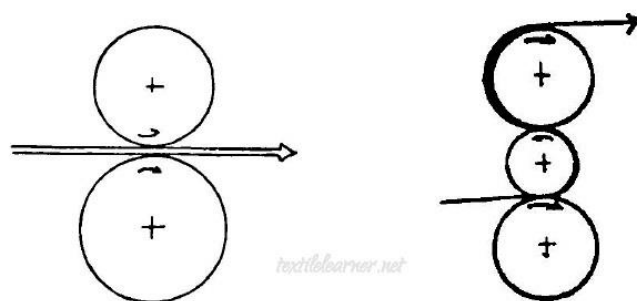
7. Differential bowl speed – degree or ratio of friction
8. Pressure applied
9. Bowl composition.

**Effects of the Calendering Finishing Process:**

- Reduction in fabric thickness
- Compaction of the weave structure – alteration to the fabric porosity
- Change in the handle – softening effect, stiffening effect
- Change in appearance – effect on lustre

**Types of Calenders in Textile:**

This non-permanent mechanical finishing treatment is applied to fabrics made of cellulose, protein and synthetic fibers, by means of a calender. There are various calender types, including embossing calenders, friction calenders, swissing calenders, chase calenders, and compaction calenders. The difference between them is determined by the number of rollers and the drive system.



**The use of different types of calenders gives different effects such as:**

1. Sheen appearance: It can be obtained by smoothing the cloth surface, which ensures a better reflection of light.
2. Better coverage: It is due to the compression of the cloth, which generates a flattening of each single yarn.
3. Softer hand: It is obtained thanks to a slight ironing effect, which produces a smoother, and softer cloth surface.
4. Surface patterns: They can be obtained by means of special effects (“embossing” for example) for decorative purposes or to modify the surface smoothness.





**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



5. Yarn swelling and rounding effect: They give a modest glaze finishing to the fabric, a surface smoothness and above all a full and soft hand.

**TYPES OF BRUSHING:**

Brushing is a textile finishing process that involves running the fabric through brushes or other abrasive surfaces to create a soft, fluffy, and textured surface. This process can be applied to various types of fabrics, including cotton, wool, synthetic fibers, and blends.

During brushing, the fabric is fed through a machine that has one or more rollers covered with wire bristles, abrasive paper, or other materials. The fabric passes between the rollers, and the bristles or abrasive surface rub against the surface of the fabric, raising the fibers and creating a nap. The process can be repeated multiple times to achieve the desired level of softness and texture.

There are several benefits to brushing. First, it can create a softer and more comfortable feel, which is especially desirable for fabrics used in clothing and bedding. Second, brushing can increase the insulation properties of the fabric by trapping air between the raised fibers. Third, it can give the fabric a more luxurious appearance, making it suitable for high-end products.

Brushing is commonly used in the production of flannel, fleece, and other fabrics that require a soft and fluffy surface. Brushed flannel, for example, is a popular choice for pajamas and other sleepwear due to its softness and warmth. Fleece, on the other hand, is a popular material for outerwear and athletic wear due to its insulating properties and moisture-wicking abilities.

Several companies specialize in brushing services for textiles. One such company is Brushing Service, Inc., based in the United States. The company offers brushing services for a wide range of fabrics, including cotton, wool, and synthetic blends. Another company, Tietex International, offers brushing services as part of its fabric production process. The company produces brushed fabrics for a variety of industries, including automotive, bedding, and apparel.

It is worth noting that brushing can have some drawbacks as well. For example, it can cause pilling, or the formation of small balls of fibers on the surface of the fabric. Pilling can occur when the raised fibers rub against each other, especially in areas of high friction such as sleeves and pant legs. Additionally, brushing can cause the fabric to shed, which can be problematic for some applications.

**Decatising in Textile:**

This process is mainly carried out on wool by exploiting its elastic properties in hot and wet conditions by the direct action of the steam on the fabric. This treatment gives the processed fabric the following characteristics:

1. Dimensional stability;
2. Setting of pile after raising;





**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



3. Reduction of possible glazing effect after calendering, thank to the swelling caused by steam blown on fibers;
4. Modification of the hand, which is much more consistent after the treatment;
5. Pre-stabilization to autoclave dyeing.

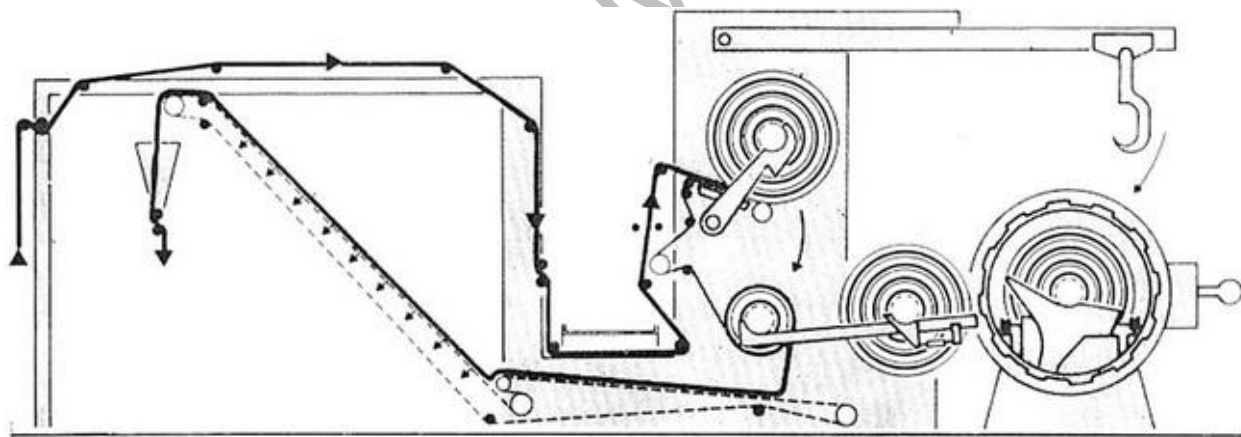
This category of treatments does not include the stabilization of wool fabrics such as potting, where the dimensional stabilization is obtained thanks to the “plasticization” phenomenon occurring when the wool fabric is immersed in hot water. On fabrics made with other fibers, the same treatment can be carried out as “steam ironing” alternatively to the calendering treatment, when an excessive “glazing effect” could result from the treatment.

The steam decatizing, which is also referred to as dry decatizing, is carried out on decatizing machines in one continuous treatment or two discontinuous ones.

**Operation Techniques of Decatizing Machine in Textile:**

Operating techniques of decatizing machine are given below:

1. Drum decatizing (alternated at atmospheric pressure);
2. Autoclave vacuum decatizing (KD);
3. Continuous decatizing.





## UNIT – II

### CHEMICAL FINISHING

Textile wet processing can be thought of having three stages, pretreatment (or preparation), coloration (dyeing or printing) and finishing. Finishing is the final step in the fabric manufacturing process, the last chance to provide the properties that customers will value. It is also called the beautification process of fabric. Finishing completes the fabric's performance and gives it special functional properties including the final 'touch'.

Chemical finishing can be defined as the use of chemicals to achieve a desired fabric property. Chemical finishing, also referred to as 'wet' finishing, includes processes that change the chemical composition of the fabrics that they are applied to. In other words, an elemental analysis of a fabric treated with a chemical finish will be different from the same analysis done prior to the finishing.

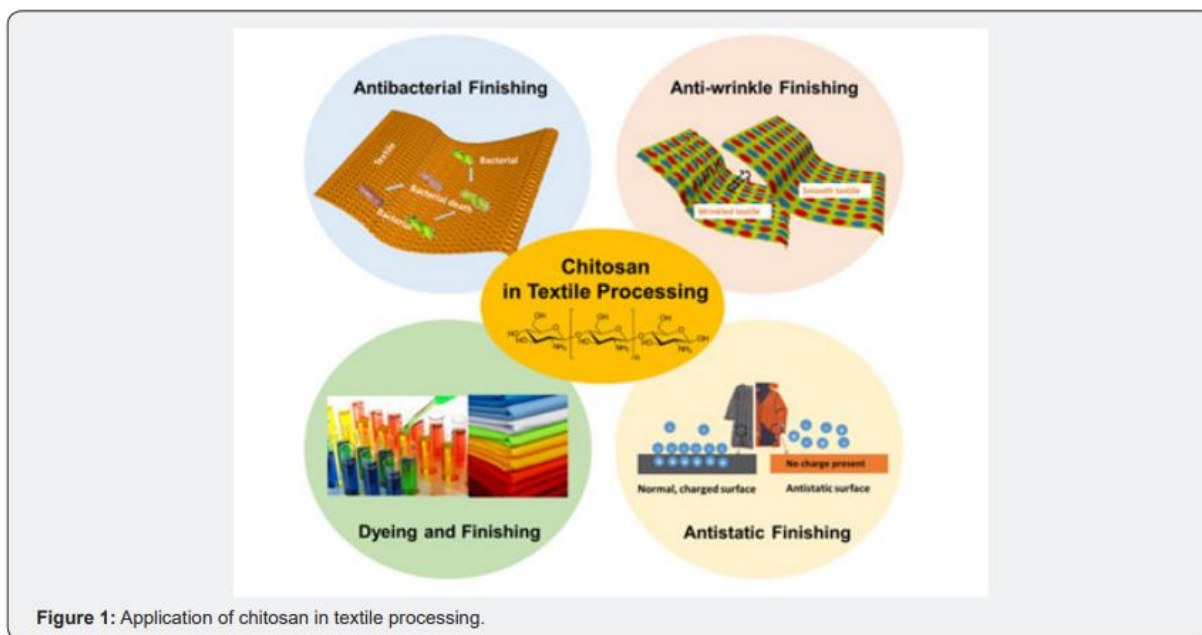


Figure 1: Application of chitosan in textile processing.

The finishing processes may be broadly classified into two groups:

- Physical or mechanical finishing
- Chemical chemical finishing

In this article, I only describe on chemical finishing of textiles.

Chemical finishing or 'wet finishing' involves the addition of chemicals to textiles to achieve a desired result. Physical properties such as dimensional stability and chemical properties such as flame retardancy can both be improved with chemical finishing. Normally, the appearance of the textile is unchanged after chemical finishing.



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



The proper formulation of chemical finishes is not easy. Several important factors are to be considered before the finalisation of a formulation; a few are as follows:

1. The type of textile (fibre composition of the fabric and its construction)
2. The performance requirements (extent of effect and durability)
3. The economics of the formulation
4. Availability of machinery and associated process restrictions
5. Procedure requirements
6. Environmental consideration
7. Compatibility and interactions of finishing components.

**Chemical finishes should meet the following requirements:**

1. Low-cost product and process
2. Stable during storage and application in terms of pH, temperature and mechanical stress
3. Compatible with other finishes
4. Adaptation to customer requirement and substrate variation
5. Suitable for all kind of fibres and all textile forms such as yarn, woven or knit fabric, garment, nonwovens, etc.
6. Satisfactory stability during washing and dry cleaning
7. Should not hamper important textile qualities
8. On application should be distributed evenly on the fabric and fibre surface
9. No yellowing of white goods or colour change of dyed goods.
10. Easy correction of finishing faults
11. Nontoxic and ecofriendly
12. No release of volatile organic compounds
13. Biodegradable

**List of chemical finishing used in textile industry:**

- Softening
- Stiffening / Hand-building
- Easy-care, Wrinkle Recovery and Durable Press Finishing



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



- Water Repellent Finishing
- Stain Resistance Finishing
- Soil Release Finishing
- Flame Retardant Finishing
- Anti-microbial Finishing
- Bio-polishing
- Moisture Management Finishing
- Anti-static Finishing
- Optical Brightening

**Importance of chemical finishing in textiles:**

Chemical finishing has always been an important component of textile processing, but in recent years the trend to 'high tech' products has increased the interest and use of chemical finishes. As the use of high performance textiles has grown, the need for chemical finishes to provide the fabric properties required in these special applications has grown accordingly.

**Softening**

Softening is carried out when the softness characteristics of a certain fabric must be improved, always carefully considering the composition and properties of the substrate.

**Elastomeric finishes**

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

**Crease resistant or Crease proofing**

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

**Soil release finishes**

These finishes attract water to the surface of fibers during cleaning and help remove soil.



### **Flame retardant treatment**

Are applied to combustible fabrics used in children's sleepwear, carpets and curtains and prevent highly flammable textiles from bursting into flame.

### **Peach finish**

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

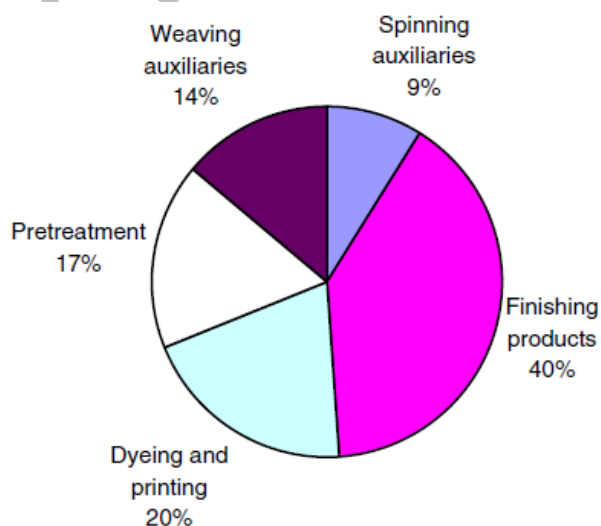
### **Anti Pilling**

Pilling is a phenomenon exhibited by fabrics formed from spun yarns (yarns made from staple fibers). Pills are masses of tangled fibers that appear on fabric surfaces during wear or laundering. Fabrics with pills have an unsightly appearance and an unpleasant handle. Loose fibers are pulled from yarns and are formed into spherical balls by the frictional forces of abrasion. These balls of tangled fibers are held to the fabric surface by longer fibers called anchor fibers.

Anti pilling finish reduces the forming of pills on fabrics and knitted products made from yarns with synthetic-fiber content, which are inclined to pilling by their considerable strength, flexibility and resistance to impact. Anti pilling finish is based on the use of chemical treatments which aim to suppress the ability of fibers to slacken and also to reduce the mechanical resistance of synthetic fiber.

### **Non slip finish**

A finish applied to a yarn to make it resistant to slipping and sliding when in contact with another yarn. The main effect of non-slip finishes is to increase the adhesion between fibers and yarns regardless of fabric





---

## **WASH AND WEAR FINISHING**

### **Introduction**

The primary function of clothing is to prevent the loss of body heat and to allow the sweat to pass through it to the outside atmosphere. Cotton is good in each of these functions. These properties together with its hydrophilicity, durability, ability to withstand rough laundering, good perspiration absorption, comfort during wear, ability to take up a wide range of dyestuffs, freedom from static charge generation and pleasant natural feel make it an excellent and comfortable fibre for apparel.

However, Cotton has certain deficiencies in properties and finishing is required to improve these properties to maximize consumer usage and acceptance. One of the major shortcomings of cotton is that it is prone to creasing during wear and washing. The formation of creases is an undesirable property to apparels. So it has to be made crease resistant. A treatment with cross linking agent is given to impart wrinkle free properties to cotton. This finish imparts crease resistant properties to cotton and keeps shrinkage under control.

The object of this finish is to keep the fabric flat and smooth and free from undesirable creases. So the finish is referred as anti crease, crease resistant or wrinkle free finish. Fabrics treated with these finishes tend to smooth out when properly hung after wearing. It is also called resin finishing as resins are used for this finish. This is a chemical and permanent finish. Usually crease resistant and wash 'n' finishes are applied to cellulose fibers ie cotton, linen, viscose and rayon .

### **Learning Objectives**

- To know about Crease recovery and Wash 'n' Wear finishes
- To get an insight into the finishing agents used for these finishes
- To be acquainted with the process of application of these finishes
- To be aware of the various care practices for the finished fabrics

### **Crease resistant finish**

#### **Causes for Wrinkles or crease formation**

Cotton cellulose chains contain hydroxyl groups in both amorphous and crystalline region. There are hydrogen bonds between the hydroxyl groups of the molecular chains. When a load is applied on the cotton fabrics, the cellulosic chain in the fibre bends, hydrogen bonds between the molecular chains in the amorphous region break and allow the chains to slip past one another, and this bending remains permanent since cellulosic chains are in elastic. This bending of the cellulose chains of the fibre under the application of load causes the formation of crease.





**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



The primary cause of shrinkage of cellulosic fibres is the fact that these fibres can readily absorb moisture. The absorbed moisture facilitates internal polymer chain movements in the amorphous fiber areas by lubrication. It disrupts the internal hydrogen bonding between these polymer chains. When a moisture laden cellulosic fiber is stressed, the internal polymer chains of the amorphous areas are free to move to relieve the stress. Hydrogen bonds can reform between the polymer chains in their shifted positions, With no restoring force available, a newly formed wrinkle or crease will remain until additional processes (ironing for example) apply adequate moisture and mechanical forces to overcome the internal forces. The swelling of cellulosic fibres by moisture can be reduced by application of self crosslinking urea or melamine products as well as products that crosslink with cellulose. Without such a crosslinking finish, cellulose fibres can take up more than 10 % of their weight in water. As the fiber swells the fabric must crease and shrink to relieve the internal stress caused by swelling

### **Method to prevent creases**

The method of minimizing the formation of creases involves the reaction of the hydroxyl groups of adjacent cellulose macromolecules with some cross linking agents. The introduction of cross links imparts dimensional stability and elasticity to the fibrous material and makes it Crease resistant. The most commonly used cross linking agents are Resins. The resins react with the hydroxyl group in cellulose to form a bond which gives good recovery from creasing and improved dimensional stability.

The resin crosses link cellulose chains and they do so in the amorphous regions of the structure where the spacing between fibre molecules is relatively open. The effect of this is to give a more crystalline character to the fibre, so that if the fibre is distorted it will have a greater tendency to spring back to its original position. If the fabric is cured with a resin in a flat configuration it will have a tendency to recover to the original flat position.

### **Finishing agents for imparting crease recovery**

#### **Resins or crosslinking agents**

Resin cross links give fibers a 'memory' and good wrinkle recovery. Resins are of two types – deposition and crosslinking type. Cross linking type of resins are used for this finish. This type of resins chemically react with the fibre and cross link the fibre molecules. This type of resin finishing is durable and much better than deposition type of resin finishing.

These are also known as N-Methylol compounds as the Methylol groups are attached to the nitrogen. Though these compounds are commonly called resins, calling them as resin precondensates is correct. The precondensates further polymerise to form resins. The resin precondensates are used for this kind of textile finishing and not resins. The following cross linking type of resins are mostly used for crease resistant finishing.

- DMU- Dimethylol urea /Urea formaldehyde
- DMEU- Dimethylol ethylene urea



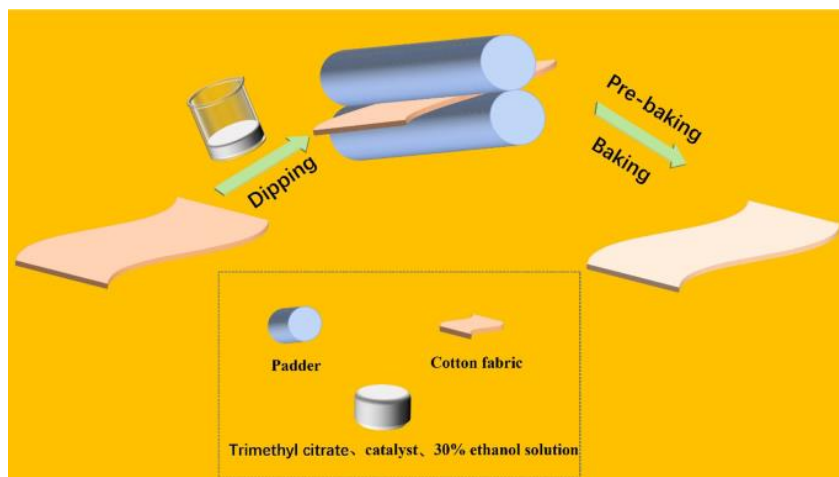


**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



- DMDHEU-Dimethylol dihydroxy ethylene urea
- Dimethylol ethyl carbamate
- DMPU- Dimethylol Propylene Urea
- TMM-Trimethylol melamine/melamine formaldehyde

They may be grouped as



- The cloth is padded with a diluted solution of DMEU containing a non-ionic softener and a catalyst (diammonium hydrogen phosphate); polyethylene emulsion is added to the pad liquor to improve tear strength and abrasion resistance.
- The fabric is dried and cured at 150°C for 3 minutes and washed with an anionic detergent (3 g/l) and soda ash (4 g/l) at 60°C for 10 minutes and then rinsed with hot water first and then with cold water.

Anti-crease finish, also known as wrinkle-resistant or wrinkle-free finish, is a textile finishing treatment that reduces or eliminates wrinkles and creases in fabrics. This finish enhances the fabric's smooth appearance, making it more convenient and easier to care for.

**Objectives of Anti-Crease Finish:**

1. Reduce wrinkles and creases
2. Improve fabric smoothness and appearance
3. Enhance durability and resistance to wear and tear
4. Simplify ironing or eliminate the need for ironing



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



5. Improve fabric comfort and drape

**Methods of Achieving Anti-Crease Finish:**

**1. Chemical Finishing:** Application of chemicals such as:

- Formaldehyde-based resins (e.g., melamine, urea-formaldehyde)
- Silicone-based finishes
- Polyurethane-based finishes
- Nano-particle finishes

**2. Mechanical Finishing:** Processes such as:

- Sanforization (shrinking treatment)
- Decatising (heat-setting treatment)
- Calendering (smoothing treatment)

**3. Blends and Treatments:** Combining fibers with inherent wrinkle-resistance, such as:

- Polyester-cotton blends
- Wrinkle-resistant cotton treatments (e.g., Easy Care, Wrinkle-Free)

**Process of Applying Anti-Crease Finish:**

1. Fabric preparation (cleaning, bleaching, and drying)
2. Application of anti-crease chemicals or treatments
3. Fixation of chemicals through heat, steam, or radiation
4. Washing and drying to remove excess chemicals
5. Finishing treatments (calendering, sanforization, etc.)

**Benefits of Anti-Crease Finish:**

1. Convenience (reduced ironing)
2. Time-saving
3. Improved fabric appearance
4. Enhanced durability
5. Increased comfort



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



---

**Limitations and Considerations:**

1. Potential environmental concerns (formaldehyde emissions)
2. Fabric type and weight limitations
3. Cost implications
4. Potential impact on fabric breathability and moisture management
5. Durability of anti-crease finish (may degrade over time or with washing)

**Common Applications:**

1. Apparel (business shirts, pants, dresses)
2. Home textiles (bedding, curtains, upholstery)
3. Technical textiles (outdoor furniture, awnings)
4. Industrial textiles (workwear, medical textiles)

Overall, anti-crease finish is an important textile finishing treatment that enhances fabric performance, appearance, and convenience. However, considerations around environmental impact, fabric type, and cost must be taken into account.

**DURABLE FINISH**

Durable finish in textile finishing refers to treatments that enhance the fabric's resistance to wear and tear, extending its lifespan and performance. These finishes improve the fabric's ability to withstand various environmental factors, use, and maintenance processes.

**Objectives of Durable Finish:**

1. Improve fabric durability and lifespan
2. Enhance resistance to:
  - Abrasion and wear
  - Pilling and snagging
  - Wrinkling and creasing
  - Shrinkage
  - Soil and stain resistance
  - UV degradation
3. Maintain fabric appearance and quality
4. Reduce maintenance and care requirements



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



---

**Types of Durable Finishes:**

**1. Mechanical Finishes:**

- Sanforization (shrinking treatment)
- Decatising (heat-setting treatment)
- Calendering (smoothing treatment)

**2. Chemical Finishes:**

- Fabric strengthening agents (e.g., resins, polyurethanes)
- Soil-repellent and stain-resist treatments (e.g., Teflon, Scotchgard)
- UV-resistant treatments (e.g., UV stabilizers)
- Wrinkle-resistant treatments (e.g., formaldehyde-based resins)

**3. Nanotechnology Finishes:**

- Nano-coatings for water and stain repellency
- Nano-particle finishes for UV resistance

**4. Blends and Treatments:**

- High-performance fibers (e.g., polyester, nylon)
- Fiber blends with inherent durability (e.g., polyester-cotton)

**Durable Finish Techniques:**

1. Pad-Dry-Cure: Chemical application followed by drying and curing
2. Exhaust Method: Chemical application through immersion or spraying
3. Foam Finishing: Application of chemicals via foam
4. Plasma Treatment: Surface modification using plasma technology

**Benefits of Durable Finish:**

1. Extended fabric lifespan
2. Reduced maintenance and care
3. Improved appearance retention
4. Enhanced performance and functionality
5. Increased value and quality perception



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



**Limitations and Considerations:**

1. Cost implications
2. Potential environmental concerns
3. Fabric type and weight limitations
4. Compatibility with dyes and finishes
5. Impact on fabric breathability and moisture management

**Common Applications:**

1. Outdoor textiles (awnings, tents, outdoor furniture)
2. Industrial textiles (workwear, medical textiles)
3. Technical textiles (geotextiles, sportswear)
4. Home textiles (upholstery, carpets)
5. Apparel (outdoor clothing, workwear)

**Some notable durable finish technologies include:**

1. Gore-Tex (water-repellent and breathable)
2. Teflon (soil-repellent and stain-resistant)
3. Scotchgard (soil-repellent and stain-resistant)
4. Nano-Tex (nano-particle finishes for various benefits)
5. Coolmax (moisture-wicking and breathable)

By applying durable finishes, textile manufacturers can create high-performance products that meet specific requirements for various industries and applications.

**STIFF FINISH:**

Stiff finish, also known as rigidity or stiffness finish, is a technical finish applied to textiles to enhance their stiffness, stability, and shape retention. This finish is crucial for various technical textile applications where fabric stability and structure are essential.

**Objectives of Stiff Finish:**

1. Improve fabric stiffness and rigidity
2. Enhance shape retention and stability
3. Reduce fabric drape and flexibility



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



4. Increase fabric resistance to:

- Wrinkling and creasing
- Sagging and stretching
- Distortion and deformation

**Methods of Achieving Stiff Finish:**

**1. Chemical Finishing:**

- Starch-based finishes
- Cellulose derivatives (e.g., cellulose acetate)
- Synthetic polymers (e.g., polyurethane, polyester)
- Cross-linking agents (e.g., formaldehyde)

**2. Mechanical Finishing:**

- Calendering (heat and pressure treatment)
- Embossing (patterned heat and pressure treatment)
- Stretching and setting (mechanical tensioning)

**3. Coating and Laminating:**

- Applying stiffening coatings (e.g., PVC, PU)
- Laminating with stiff materials (e.g., films, foams)

**Stiff Finish Techniques:**

1. Pad-Dry-Cure: Chemical application followed by drying and curing
2. Exhaust Method: Chemical application through immersion or spraying
3. Foam Finishing: Application of chemicals via foam
4. Screen Printing: Localized application of stiffening agents

**Benefits of Stiff Finish:**

1. Improved fabric stability and shape retention
2. Enhanced durability and resistance to wear
3. Reduced fabric distortion and deformation
4. Increased fabric rigidity for structural applications



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



5. Simplified processing and handling

**Limitations and Considerations:**

1. Potential loss of fabric flexibility and drape
2. Increased fabric stiffness may affect comfort
3. Chemicals used may have environmental concerns
4. Compatibility with other finishes and treatments
5. Cost implications

**Common Applications:**

1. Technical textiles:
  - Tent and awning fabrics
  - Outdoor furniture and upholstery
  - Industrial belts and hoses
  - Geotextiles and construction materials
2. Medical textiles:
  - Surgical implants and devices
  - Orthotics and prosthetics
  - Medical clothing and equipment
3. Sportswear and outdoor gear:
  - Backpacks and luggage
  - Camping equipment
  - Sports equipment (e.g., golf clubs, bike frames)

**Some notable stiff finish technologies include:**

1. 3M's Scotchplast (stiffening coating)
2. DuPont's Teflon (non-stick and stiffening coating)
3. Sympatex's membrane technology (waterproof and breathable stiffness)
4. Gore-Tex's membrane technology (waterproof and breathable stiffness)

By applying stiff finishes, textile manufacturers can create technical textiles with enhanced stability, structure, and performance for various industrial, medical, and recreational applications.





**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



**DENIM FINISH:**

Denim finish refers to various chemical and mechanical treatments applied to denim fabrics to enhance their appearance, performance, and durability.

**Objectives of Denim Finish:**

1. Improve fabric appearance (color, texture, and grain)
2. Enhance fabric durability and resistance to wear
3. Increase fabric comfort and softness
4. Reduce shrinkage and distortion
5. Achieve specific functional properties (e.g., stretch, water repellency)

**Types of Denim Finishes:**

**Aesthetic Finishes:**

1. **Sanforization:** Shrinking treatment to reduce shrinkage
2. **Singeing:** Burning off excess fibers for smooth surface
3. **Mercerization:** Treating cotton with sodium hydroxide for luster
4. **Napping:** Brushing to raise fibers for softness
5. **Tumbling:** Mechanical treatment for softness and texture

**Functional Finishes:**

1. **Stretch Finish:** Adding elastane or spandex for flexibility
2. **Water Repellent Finish:** Applying coatings or treatments (e.g., Teflon, Scotchgard)
3. **Wrinkle Resistance Finish:** Using resins or other chemicals
4. **Anti-Shrinkage Finish:** Chemical treatments to reduce shrinkage
5. **Anti-Pilling Finish:** Treatments to reduce pilling

**Sustainable Denim Finishes:**

1. **Eco-Friendly Dyeing:** Using natural dyes or reduced water processes



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



2. **Organic Finishing:** Using organic chemicals and processes
3. **Recycling:** Using recycled materials in denim production
4. **Waterless Finishing:** Using technologies that reduce water consumption

**Denim Finish Techniques:**

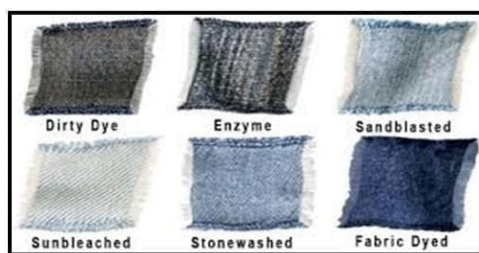
1. **Pad-Dry-Cure:** Chemical application followed by drying and curing
2. **Exhaust Method:** Chemical application through immersion or spraying
3. **Foam Finishing:** Application of chemicals via foam
4. **Spray Finishing:** Chemical application via spraying

**Benefits of Denim Finish:**

1. Enhanced fabric appearance and texture
2. Improved durability and resistance to wear
3. Increased comfort and softness
4. Reduced shrinkage and distortion
5. Achieved functional properties (e.g., stretch, water repellency)

**Common Denim Finish Technologies:**

1. Levi's WaterLess technology (reduced water finishing)
2. G-Star Raw's Eco-Friendly Denim (sustainable dyeing and finishing)
3. Wrangler's Blue Bell finishing technology (reduced water and energy)
4. Candiani's sustainable denim finishing (eco-friendly chemicals and processes)



**Denim Finish Applications:**

1. Jeans and trousers
2. Jackets and coats
3. Shirts and tops



4. Bags and accessories
5. Upholstery and interior textiles

By applying various denim finishes, manufacturers can create high-quality denim products with improved appearance, performance, and sustainability.

### **STONE WASH:**

Stone washing is a textile finishing treatment that gives fabrics a worn, distressed look, while also enhancing softness and comfort.

### **What is Stone Washing?**

Stone washing is a chemical and mechanical process that involves:

1. Treating fabrics with pumice stones or ceramic stones
2. Applying enzymes or chemicals to break down fibers
3. Washing and rinsing to remove excess dye and treatments

### **Objectives of Stone Washing:**

1. Achieve a distressed, worn look
2. Enhance fabric softness and comfort
3. Reduce fabric shrinkage
4. Improve fabric texture and flexibility
5. Create a vintage or retro appearance

### **Stone Washing Techniques:**

1. **Traditional Stone Washing:** Using pumice stones and enzymes
2. **Enzyme Washing:** Using enzymes to break down fibers
3. **Ceramic Stone Washing:** Using ceramic stones for gentler treatment
4. **Tumble Stone Washing:** Combining stone washing with tumbling
5. **Bio-Stone Washing:** Using biological enzymes for eco-friendly treatment

### **Stone Washing Effects:**

1. Faded colors and uneven dyeing
2. Softened fibers and reduced stiffness
3. Distressed fabric appearance



4. Increased fabric flexibility
5. Reduced shrinkage

**Benefits of Stone Washing:**

1. Unique, fashionable appearance
2. Enhanced fabric comfort and softness
3. Improved durability and resistance to wear
4. Reduced shrinkage and care requirements
5. Increased customer appeal

**Limitations and Considerations:**

1. Potential fabric damage or weakening
2. Color loss or unevenness
3. Increased production costs
4. Limited control over final appearance
5. Environmental concerns (water and energy consumption)

**Common Applications:**

1. Denim jeans and jackets
2. Casual wear (t-shirts, trousers)
3. Sportswear (jackets, pants)
4. Fashion clothing (dresses, skirts)
5. Upholstery and interior textiles

**Eco-Friendly Alternatives:**

1. Enzyme-based stone washing
2. Ozone washing
3. Low-water stone washing
4. Recycled water stone washing
5. Biodegradable stone washing agents



ACADEMIC YEAR 2024-2025, SEMESTER – VI  
STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY  
TEXTILE FINISHING



**Notable Brands Using Stone Washing:**

1. Levi's (Vintage Clothing line)
2. Gap (Distressed Denim collection)
3. Diesel (Faded and worn looks)
4. G-Star Raw (Eco-friendly stone washing)
5. AG Jeans (Premium denim with stone washing)

By applying stone washing treatments, textile manufacturers can create unique, fashion-forward products with enhanced comfort and durability.

**Stone Wash**

Stone washing is a textile manufacturing process used to give a newly manufactured cloth garment a worn-in (or worn-out) appearance.

Stone-washing also helps to increase the softness and flexibility of otherwise stiff and rigid fabrics such as canvas and denim.

**Stone washing!!! Why ???**

- ✓ To create or produce irregular fading
- ✓ To remove dust, oil spot, impurities from the garment
- ✓ To improve softness.
- ✓ To achieve the buyer washing standard.





**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



---

### **SILICONE FINISH:**

Silicone finish is a type of textile finishing treatment that utilizes silicone-based chemicals to impart various beneficial properties to fabrics.

#### **Benefits of Silicone Finish:**

1. **Softness and smoothness:** Silicones improve fabric handfeel and drape.
2. **Water repellency:** Silicones create a hydrophobic surface, resisting water penetration.
3. **Stain resistance:** Silicones prevent stains from setting into fabric.
4. **Easy care:** Silicones reduce wrinkling, shrinkage, and ironing requirements.
5. **Durability:** Silicones enhance fabric abrasion resistance and lifespan.
6. **UV resistance:** Silicones protect fabrics from UV degradation.
7. **Anti-static properties:** Silicones reduce static cling and electrical charging.

#### **Types of Silicone Finishes:**

1. **Reactive silicones:** Chemically bond to fabric, providing durable effects.
2. **Non-reactive silicones:** Physically deposited on fabric, offering temporary benefits.
3. **Cured silicones:** Thermally or chemically cured for enhanced durability.
4. **Self-crosslinking silicones:** Automatically crosslink without external catalysts.

#### **Applications of Silicone Finish:**

1. **Apparel:** Outerwear, sportswear, workwear, and activewear.
2. **Home textiles:** Upholstery, curtains, bedding, and towels.
3. **Technical textiles:** Industrial belts, hoses, filters, and medical textiles.
4. **Outdoor textiles:** Awnings, tents, and camping equipment.
5. **Automotive textiles:** Car seats, carpets, and interior trim.

#### **Silicone Finish Techniques:**

1. **Pad-dry-cure:** Chemical application followed by drying and curing.
2. **Exhaust method:** Chemical application through immersion or spraying.
3. **Foam finishing:** Application of chemicals via foam.
4. **Spray finishing:** Chemical application via spraying.





**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



**Common Silicone-Based Textile Finishes:**

1. **Teflon** (DuPont)
2. **Scotchgard** (3M)
3. **Gore-Tex** (W.L. Gore & Associates)
4. **Nano-Tex** (Nano-Tex Technologies)
5. **Si-Tech** (SIT Group)

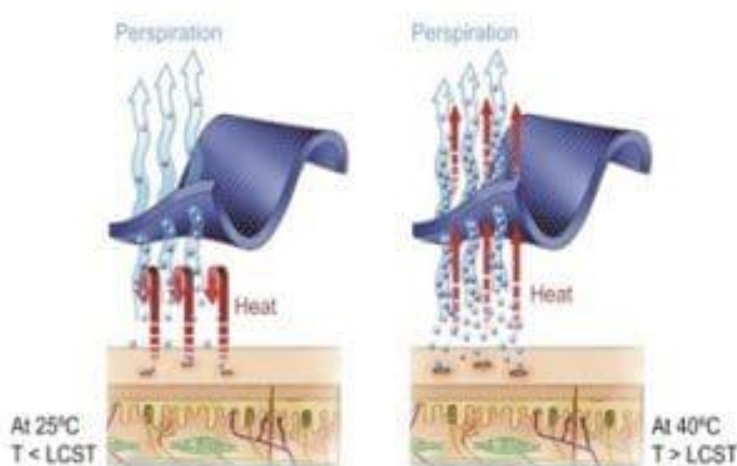
**Eco-Friendly Silicone Alternatives:**

1. Bio-based silicones
2. Water-repellent coatings from plant-based materials
3. Silicone-free water repellency treatments
4. Low-VOC (Volatile Organic Compound) silicones
5. Recyclable silicone-based finishes

**Regulations and Standards:**

1. OEKO-TEX Standard 100
2. GOTS (Global Organic Textile Standard)
3. REACH (Registration, Evaluation, Authorization, and Restriction of Chemicals)
4. US EPA (Environmental Protection Agency) regulations

By incorporating silicone finishes, textile manufacturers can create high-performance products with enhanced functionality, comfort, and durability.









## UNIT – III

### FUNCTIONAL FINISHES

#### **DEFINITION:**

Functional finishes in textile finishing refer to chemical or physical treatments applied to fabrics to impart specific performance properties, enhancing their functionality and usability.

Functional finishes are treatments that provide textiles with advanced properties, beyond aesthetics, to meet specific requirements for various applications.

#### **Types of Functional Finishes:**

1. **Water Repellency Finishes:** Resist water penetration (e.g., Teflon, Scotchgard)
2. **Stain Resistance Finishes:** Prevent stains from setting into fabric (e.g., Nano-Tex)
3. **UV Protection Finishes:** Protect against ultraviolet radiation (e.g., UV stabilizers)
4. **Antimicrobial Finishes:** Inhibit growth of microorganisms (e.g., antibacterial, antifungal)
5. **Flame Retardant Finishes:** Resist ignition and flame spread (e.g., FR treatments)
6. **Insulation Finishes:** Enhance thermal insulation properties (e.g., Thinsulate)
7. **Breathability Finishes:** Improve moisture vapor transmission (e.g., Gore-Tex)
8. **Anti-Static Finishes:** Reduce static electricity buildup (e.g., anti-static coatings)
9. **Self-Cleaning Finishes:** Enable easy cleaning and maintenance (e.g., lotus-effect coatings)
10. **Sustainable Finishes:** Eco-friendly treatments using natural materials or processes

#### **Applications:**

1. **Apparel:** Outdoor clothing, sportswear, workwear, and protective clothing
2. **Home Textiles:** Upholstery, curtains, bedding, and towels
3. **Technical Textiles:** Industrial belts, hoses, filters, and medical textiles
4. **Outdoor Textiles:** Awnings, tents, and camping equipment
5. **Automotive Textiles:** Car seats, carpets, and interior trim

#### **Benefits:**

1. Enhanced performance and functionality
2. Improved durability and lifespan
3. Increased user comfort and safety



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



4. Reduced maintenance and care requirements
5. Expanded application possibilities

**Functional Finish Techniques:**

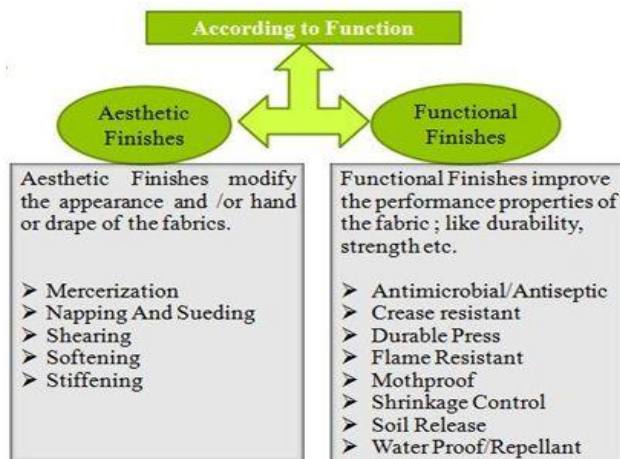
1. **Pad-dry-cure:** Chemical application followed by drying and curing
2. **Exhaust method:** Chemical application through immersion or spraying
3. **Foam finishing:** Application of chemicals via foam
4. **Spray finishing:** Chemical application via spraying
5. **Coating and laminating:** Applying functional coatings or laminates

**Notable Functional Finish Technologies:**

1. Gore-Tex (waterproof and breathable)
2. Teflon (non-stick and water-repellent)
3. Scotchgard (stain-resistant and water-repellent)
4. Nano-Tex (stain-resistant and breathable)
5. Coolmax (moisture-wicking and breathable)

**Regulations and Standards:**

1. OEKO-TEX Standard 100
2. GOTS (Global Organic Textile Standard)
3. REACH (Registration, Evaluation, Authorization, and Restriction of Chemicals)
4. US EPA (Environmental Protection Agency) regulations
5. ISO (International Organization for Standardization) standards





**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



---

**WATER PROOF FINISHES:**

Waterproof finish is a type of functional finish applied to textiles to prevent water penetration, ensuring the fabric remains dry and protected.

The waterproof finish should still be classified by a degree because of its involvement in a big duty rate difference for export to the United States. Please note the following:

If the fabric in question is a TC fabric and the waterproof finish is only a regular waterproof finish which cannot pass the Rainwater Test No. AATCC-35 the import duty is 34% for jackets. However, if the same fabric with waterproof finishes which can pass an AATCC-35 test and qualifies as rainwater resistant, then the duty is 7.6%.

To pass the rainwater test no. AATCC-35 the fabric has to go through a Cup Test where the fabric has to stand 600mm water pressure without leakage. (The laboratory can do the test for you)

Most fabric finishing mills know about the above test and the required waterproof standard to qualify for rainwater duty. The importance is to specify clearly what you need when you order the fabric.

**Types of Waterproof Finishes:**

1. Membrane-based finishes: Thin, porous membranes (e.g., Gore-Tex, eVent)
2. Coating-based finishes: Water-repellent coatings (e.g., Teflon, Scotchgard)
3. Lamination-based finishes: Water-resistant laminates (e.g., nylon, polyester)
4. Nano-finishing: Nano-particle-based water repellency treatments

**Waterproof Finish Technologies:**

1. Gore-Tex: Expanded PTFE membrane
2. eVent: ePTFE membrane
3. Teflon: Non-stick, water-repellent coating
4. Scotchgard: Water-repellent, stain-resistant coating
5. Nano-Tex: Nano-particle-based water repellency treatment

**Applications:**

1. Outdoor apparel: Jackets, pants, gloves
2. Sportswear: Waterproof clothing, footwear
3. Workwear: Industrial, construction, and military clothing
4. Tents and awnings: Waterproof canopies, camping gear
5. Upholstery: Waterproof furniture, car seats



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



---

**Benefits:**

1. Water resistance: Prevents water penetration
2. Breathability: Allows moisture vapor transmission
3. Durability: Enhances fabric lifespan
4. Easy cleaning: Simplifies maintenance
5. Comfort: Keeps users dry and comfortable

**Waterproof Finish Testing Standards:**

1. Waterproof rating: Measured in mm (e.g., 10,000 mm)
2. Water column pressure: Measures water resistance (e.g., 10,000 Pa)
3. Hydrostatic head: Measures water penetration resistance
4. MVT (Moisture Vapor Transmission): Measures breathability

**Regulations and Certifications:**

1. ISO 811: Waterproofing test standard
2. EN 343: Waterproof and breathable clothing standard
3. ASTM D737: Waterproofing test standard
4. GOTS (Global Organic Textile Standard): Eco-friendly waterproofing

**Limitations and Considerations:**

1. Cost: Waterproof finishes can increase fabric cost
2. Durability: Finishes may degrade over time
3. Breathability: May compromise moisture vapor transmission
4. Environmental concerns: Chemicals used in finishes
5. Maintenance: Requires regular cleaning and drying

**Eco-Friendly Waterproof Alternatives:**

1. Bio-based water repellents
2. Natural wax finishes
3. Solvent-free coatings
4. Recyclable waterproof membranes
5. Upcycled waterproof materials



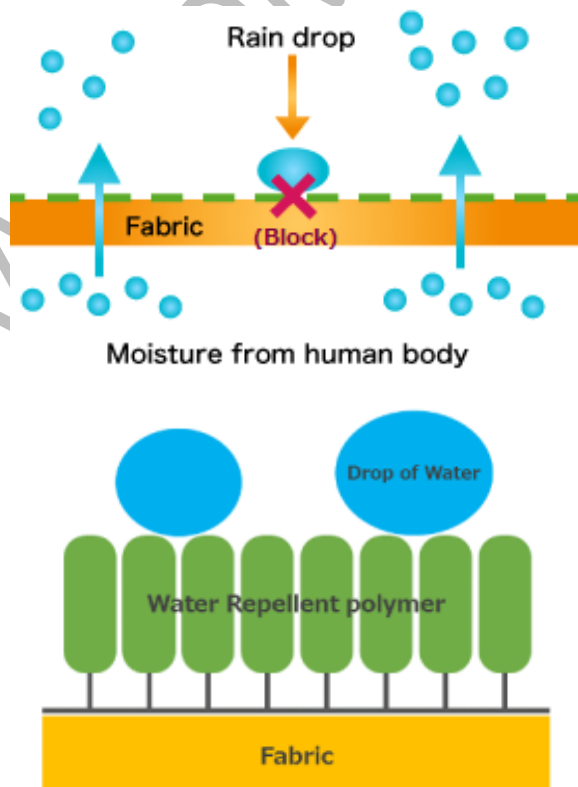
**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



**WATER REPELLENT FINISH:**

Water repellency is most difficult to define, as various static and dynamic tests based on varied criteria are used to measure it. In general, water repellent fabrics are those which resist being wetted by water; the water drops will simply roll off the fabric. A fabric's resistance to water will depend on the nature of the fiber surface, the porosity of the fabric and the dynamic force behind the impacting water spray. Higher repellency or poor wetting with water and oil as well as resistance to staining are essential for various end uses in clothing, home and technical textiles. The purpose of water repellent finish is that the drops of water should not spread on the surface of the textile and should not wet the fabric.

On a water repellent textile, water droplets roll off the surface. The intrusion of water into the textile owing to its kinetic energy must be avoided. The behavior of the textile strongly depends on its surface structure, which can be changed during finishing.







**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



Water repellent finish is a type of functional finish applied to textiles to resist water penetration, but not completely prevent it.

**Types of Water Repellent Finishes:**

1. Hydrophobic finishes: Water-repelling coatings or treatments
2. Oleophobic finishes: Oil-repelling coatings or treatments
3. Fluorocarbon finishes: Fluorine-based water-repellent coatings
4. Nano-finishing: Nano-particle-based water repellency treatments

**Water Repellent Finish Technologies:**

1. Teflon: Non-stick, water-repellent coating
2. Scotchgard: Water-repellent, stain-resistant coating
3. Nano-Tex: Nano-particle-based water repellency treatment
4. Gore-Tex's Windstopper: Wind-resistant, water-repellent membrane
5. eVent's DVdry: Water-repellent, breathable membrane

**Applications:**

1. Apparel: Outerwear, sportswear, workwear
2. Upholstery: Furniture, car seats
3. Textiles: Awnings, tents, camping gear
4. Industrial textiles: Filters, belts, hoses
5. Medical textiles: Surgical gowns, drapes

**Benefits:**

1. Water resistance: Repels water, preventing penetration
2. Stain resistance: Prevents stains from setting in
3. Easy cleaning: Simplifies maintenance
4. Durability: Enhances fabric lifespan
5. Comfort: Keeps users dry and comfortable

**Water Repellent Finish Testing Standards:**

1. Water repellency rating: Measured in mm (e.g., 5,000 mm)
2. Water column pressure: Measures water resistance (e.g., 5,000 Pa)



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



3. Contact angle: Measures water droplet behavior
4. MVT (Moisture Vapor Transmission): Measures breathability

**Regulations and Certifications:**

1. ISO 4920: Water repellency test standard
2. ASTM D737: Water repellency test standard
3. AATCC 127: Water repellency test standard
4. GOTS (Global Organic Textile Standard): Eco-friendly water repellency

**Limitations and Considerations:**

1. Durability: Finishes may degrade over time
2. Breathability: May compromise moisture vapor transmission
3. Environmental concerns: Chemicals used in finishes
4. Maintenance: Requires regular cleaning and drying
5. Cost: Water repellent finishes can increase fabric cost

**Eco-Friendly Water Repellent Alternatives:**

1. Bio-based water repellents
2. Natural wax finishes
3. Solvent-free coatings
4. Recyclable water-repellent materials
5. Upcycled water-repellent materials

**Notable Water Repellent Finish Brands:**

1. Gore-Tex
2. Teflon
3. Scotchgard
4. Nano-Tex
5. eVent



ACADEMIC YEAR 2024-2025, SEMESTER – VI  
STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY  
TEXTILE FINISHING



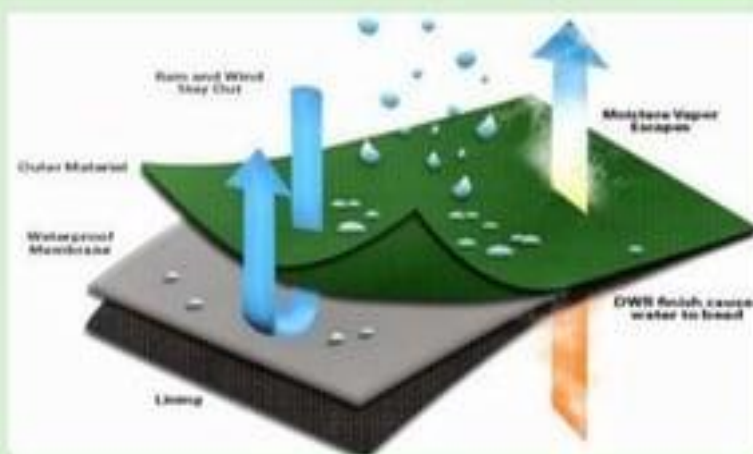
Water repellent with water



### Distinguish between water-repellent and water-proof fabrics

water-repellent fabrics	water-proof fabrics
i. Water Repellent Fabrics have open pores and are permeable to air and water vapour.	i. Water-Proof Fabrics have fewer open pores and are less permeable to the passage of air and water vapour.
ii. Water-repellent fabrics will permit the passage of liquid water once hydro-static pressure is high.	ii. Water-Proof Fabrics are resistant to the penetration of water under much higher hydrostatic pressure.
iii. A fabric is made water-repellent by depositing a hydrophobic material on the fibre's surface.	iii. however, Waterproofing requires filling the pores as well as depositing a hydrophobic material on the fibre's surface.

### Mechanism of Water Repellency





**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



---

**FLAME RETARDANT FINISH:**

Flame retardant (FR) finishes are chemical or physical treatments applied to textiles to reduce their flammability and prevent or delay the spread of fire.

Flame retardants are used by adding to flammable materials such as textiles to make them hard to burn or not spread. Flame retardant processing on textile products can minimize damage and save lives when a fire occurs.

For example, curtains, carpets, car seats, sofas, firefighting clothes, etc. are processed flame retardant.

**Types of Flame Retardant Finishes:**

1. Inherent FR: Fibers with built-in FR properties (e.g., polyester, nylon)
2. Treated FR: Chemical treatments applied to fabrics (e.g., halogen-based, halogen-free)
3. Coated FR: FR coatings or laminates applied to fabrics
4. Backcoating FR: FR treatment applied to fabric's backside

**Flame Retardant Finish Technologies:**

1. Halogen-based FR: Chlorine or bromine-based chemicals
2. Halogen-free FR: Phosphorus, nitrogen, or silicon-based chemicals
3. Intumescent FR: Swells to form protective barrier
4. Ceramic FR: Ceramic-based coatings or treatments
5. Nanoparticle FR: Nano-particle-based treatments

**Applications:**

1. Apparel: Firefighter gear, industrial workwear
2. Upholstery: Furniture, car seats, aircraft seats
3. Textiles: Curtains, drapes, awnings
4. Industrial textiles: Filters, belts, hoses
5. Transportation: Train, bus, and aircraft interiors

**Benefits:**

1. Fire safety: Reduces risk of injury or death
2. Property protection: Prevents or delays fire spread
3. Compliance: Meets regulatory requirements



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



4. Durability: Enhances fabric lifespan
5. Comfort: Maintains fabric breathability and softness

**Flame Retardant Finish Testing Standards:**

1. ISO 15025: FR testing standard
2. ASTM D6413: FR testing standard
3. NFPA 701: FR testing standard for textiles
4. EN 13501-1: FR testing standard for construction products
5. UL (Underwriters Laboratories): FR testing and certification

**Regulations and Certifications:**

1. NFPA (National Fire Protection Association)
2. UL (Underwriters Laboratories)
3. ASTM (American Society for Testing and Materials)
4. ISO (International Organization for Standardization)
5. REACH (Registration, Evaluation, Authorization, and Restriction of Chemicals)

**Limitations and Considerations:**

1. Cost: FR finishes can increase fabric cost
2. Durability: FR finishes may degrade over time
3. Toxicity: Some FR chemicals raise health concerns
4. Environmental impact: FR chemicals may harm environment
5. Maintenance: Requires regular cleaning and drying

**Eco-Friendly Flame Retardant Alternatives:**

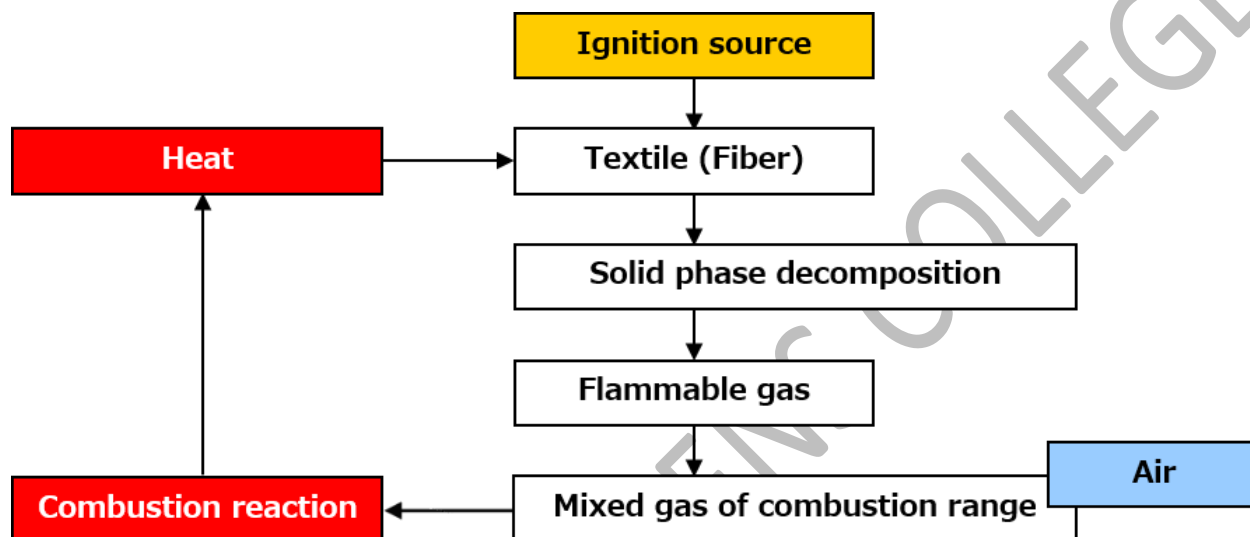
1. Bio-based FR chemicals
2. Natural fiber blends
3. Inherent FR fibers
4. Halogen-free FR treatments
5. Recyclable FR materials



**Notable Flame Retardant Finish Brands:**

1. DuPont's Nomex
2. 3M's FR treatments
3. Bayer's FR chemicals

**MECHANISM OF ACTION:**



Combustion means that flammable textile products are decomposed by the heat of the ignition source, gasified, and mixed with oxygen in the air to cause a violent oxidation reaction. The reaction heat generated by this oxidation reaction decomposes and gasifies the subsequent fiber, and combustion is repeated.

In order to suppress combustion, it is effective to make the textile flame retardant by the method shown in the following 1 to 5 and to prevent the progress of this cycle.

**1. Control of heat transfer:**

Coating with inorganic compound (borax, thermal insulation layer, etc.)

**2. Gas dilution or addition of noncombustible gas:**

Add noncombustible gas to mixed gas and suppress combustion (halogen compound)

**3. Control of solid phase decomposition rate:**

Lower the melting point of the fiber and increase the endothermic capacity of the surface

**4. Dehydration reaction:**

Acceleration of carbonization by dehydration reaction (ammonium sulfate, phosphorus compound)





---

### **5. Radical termination:**

Traps radicals in combustion reactions (halogen compounds)

### **SOIL RELEASE FINISH:**

What is Soil Release Finish?

Soil or stain release is a chemical finish that permits relatively easy removal of soils with ordinary laundering. The finish that allow stains to leave the fabric faster and makes fabric cleanable without significant loss of soil release properties. Soil release is the term used to describe the clean ability of the fabric by the laundering process. Stain or soil release is the ability of a fabric to be cleaned easily by laundering. Soil release properties are important for those textiles that can be washed whereas stain resistant properties are important for upholstery, carpets or such other fabrics that cannot be conveniently laundered. Soil release, particularly of oily stains, is usually difficult in textiles made from hydrophobic fibers such as polyester. Soil release properties may be impacted by applying hydrophilic treatments to hydrophobic textiles.

For example, low molecular weight block copolymers of hydrophilic segments like polyoxyethylene can be used to improve soil release properties of polyester fabrics. Conventional soil resistance finishes deteriorate soil release properties of fabrics but dual action fluorocarbons comprising a block copolymer of fluorocarbon component and a hydrophilic polyoxyethylene component have good soil resistance as well as good soil release properties.

**Soils are unwanted substances and they belong to one of the following four types:**

1. Water-borne stains,
2. Oil-borne stains,
3. Dry particulate soils and
4. Composite soils involving oil and grease adsorbed on particulate matter

Soil release finish is a type of functional finish applied to textiles to enhance their ability to release stains and soils easily, making cleaning and maintenance simpler.

### **Benefits of Soil Release Finish:**

1. Easy cleaning and maintenance
2. Reduced staining and soiling
3. Improved fabric durability
4. Enhanced appearance retention
5. Increased comfort and hygiene



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



---

**Types of Soil Release Finishes:**

1. Fluorocarbon-based finishes
2. Silicone-based finishes
3. Polyester-based finishes
4. Nano-particle-based finishes
5. Bio-based finishes

**Soil Release Finish Technologies:**

1. Teflon (DuPont)
2. Scotchgard (3M)
3. Nano-Tex (Nano-Tex Technologies)
4. Stainmaster (Invista)
5. Easy Care (BASF)

**Applications:**

1. Apparel: Workwear, sportswear, outdoor clothing
2. Upholstery: Furniture, car seats, aircraft seats
3. Textiles: Carpets, curtains, drapes
4. Industrial textiles: Filters, belts, hoses
5. Medical textiles: Surgical gowns, drapes

**Testing Standards:**

1. AATCC 130: Soil release testing standard
2. ISO 2740: Soil release testing standard
3. ASTM D6549: Soil release testing standard
4. NFPA 701: Soil release testing standard for textiles

**Regulations and Certifications:**

1. Oeko-Tex Standard 100
2. GOTS (Global Organic Textile Standard)
3. REACH (Registration, Evaluation, Authorization, and Restriction of Chemicals)



4. US EPA (Environmental Protection Agency) regulations

**Limitations and Considerations:**

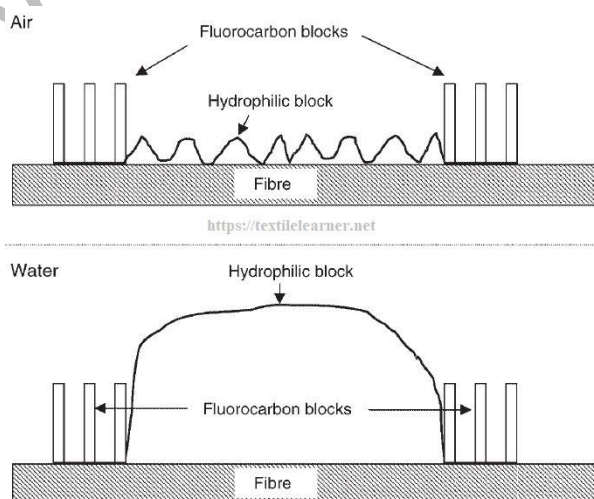
1. Durability: Finishes may degrade over time
2. Environmental concerns: Chemicals used in finishes
3. Cost: Soil release finishes can increase fabric cost
4. Compatibility: May not be compatible with all fabrics
5. Maintenance: Requires regular cleaning and drying

**Eco-Friendly Soil Release Alternatives:**

1. Bio-based soil release agents
2. Natural wax finishes
3. Solvent-free coatings
4. Recyclable soil release materials
5. Upcycled soil release materials

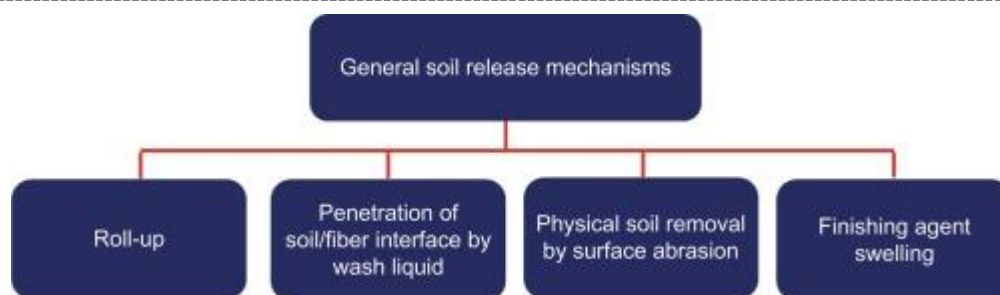
**Notable Soil Release Finish Brands:**

1. DuPont's Teflon
2. 3M's Scotchgard
3. Nano-Tex Technologies
4. Invista's Stainmaster
5. BASF's Easy Care

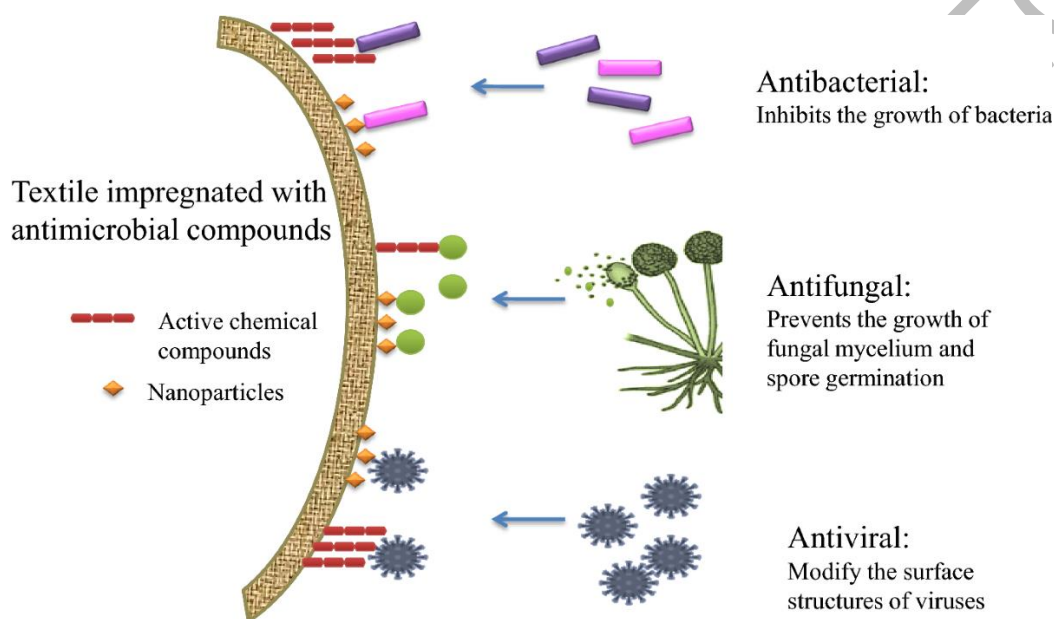




ACADEMIC YEAR 2024-2025, SEMESTER – VI  
STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY  
TEXTILE FINISHING



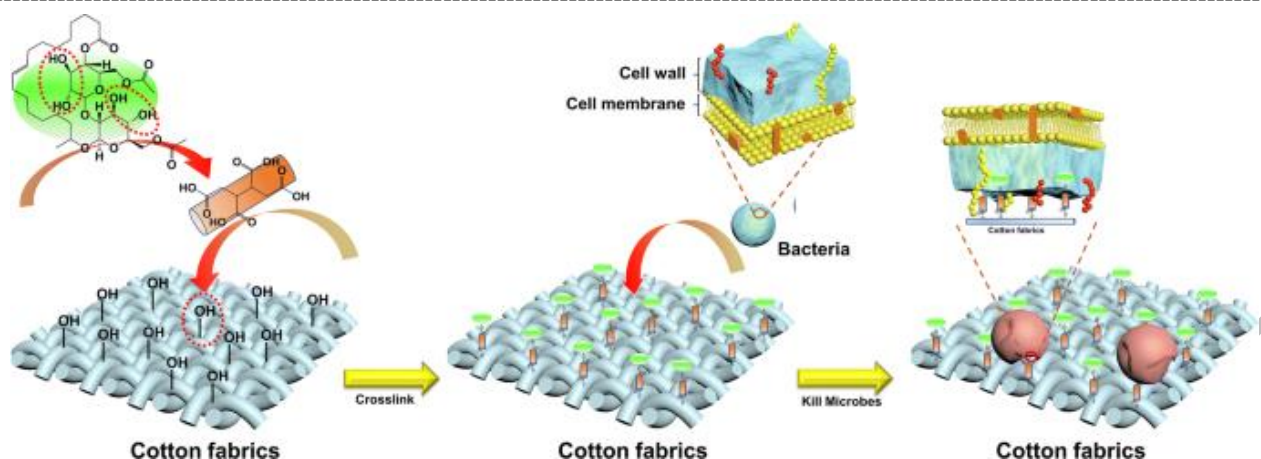
#### ANTIMICROBIAL FINISH:



An antimicrobial finish on printed matter is a coating or laminate with antibacterial, antiviral and antifungal properties. It protects against the growth of microorganisms on the print's surface so it's ideal for hygiene-critical settings or industries whose printed materials are frequently touched by a high volume of people. Antimicrobial products are key to our health.

#### Why is an antimicrobial finish so valuable?

The Centres for Disease Control and Prevention (CDC) found that 80% of illness-causing germs are transferred by touch alone. Paper and cardboard can be a vehicle for cross-contamination because bacteria move around and survive on surfaces for a long time. Printed matter could be a threat to our health if the right protection isn't used. Antimicrobial laminates and coatings work 24 hours a day to significantly reduce the risk of cross-contamination – prohibiting the growth of microorganisms and preventing the build-up of bacteria for the lifetime of the product.



Antimicrobial finish is a type of functional finish applied to textiles to inhibit the growth of microorganisms, such as bacteria, fungi, and viruses.

#### Benefits of Antimicrobial Finish:

1. Reduced risk of infection
2. Freshness and odor control
3. Improved hygiene
4. Enhanced durability
5. Protection against biofilm formation

#### Types of Antimicrobial Finishes:

1. Biocidal finishes: Kill or inactivate microorganisms
2. Biostatic finishes: Inhibit microorganism growth
3. Antiviral finishes: Inhibit virus replication
4. Antifungal finishes: Inhibit fungal growth

#### Antimicrobial Finish Technologies:

**Silver-based finishes:** Silver ions or nanoparticles

**Copper-based finishes:** Copper ions or nanoparticles

**Zinc-based finishes:** Zinc ions or nanoparticles

**Quaternary ammonium compounds (QACs):** Synthetic antimicrobials

**Natural antimicrobials:** Plant-based extracts (e.g., tea tree oil)



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



---

**Applications:**

1. Apparel: Activewear, sportswear, medical clothing
2. Upholstery: Furniture, car seats, aircraft seats
3. Textiles: Curtains, drapes, bedding
4. Industrial textiles: Filters, belts, hoses
5. Medical textiles: Surgical gowns, drapes, implantable devices

**Testing Standards:**

1. ISO 20743: Antimicrobial testing standard
2. ASTM E2149: Antimicrobial testing standard
3. AATCC 100: Antimicrobial testing standard
4. JIS L 1902: Antimicrobial testing standard

**Regulations and Certifications:**

1. EPA (Environmental Protection Agency): Registration required
2. FDA (Food and Drug Administration): Clearance required
3. OEKO-TEX Standard 100: Certification for safety
4. GOTS (Global Organic Textile Standard): Certification for sustainability

**Limitations and Considerations:**

1. Durability: Finishes may degrade over time
2. Toxicity: Some antimicrobials raise health concerns
3. Resistance: Overuse may lead to microbial resistance
4. Cost: Antimicrobial finishes can increase fabric cost
5. Environmental impact: Chemicals used in finishes

**Eco-Friendly Antimicrobial Alternatives:**

1. Natural antimicrobials: Plant-based extracts
2. Bio-based antimicrobials: Microbial-derived compounds
3. Nanoparticle-based antimicrobials: Silver, copper, or zinc nanoparticles
4. Photocatalytic antimicrobials: Titanium dioxide-based coatings





**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



- 
5. Enzyme-based antimicrobials: Lysozyme or other enzymes

**Notable Antimicrobial Finish Brands:**

1. DuPont's Sorona
2. 3M's Microban
3. BASF's Sanitised
4. Invista's FreshIQ
5. Milliken's T1

**NANOTECHNOLOGY IN TEXTILE FINISHING;**

Nanotechnology finish in textile finishing refers to the application of nanomaterials or nanoparticles to enhance textile properties.

**Benefits of Nanotechnology Finish:**

1. Improved durability and resistance to wear
2. Enhanced water repellency and stain resistance
3. Increased UV protection and anti-aging
4. Better thermal insulation and temperature regulation
5. Antimicrobial and antibacterial properties
6. Improved softness and smoothness
7. Enhanced breathability and moisture management

**Types of Nanotechnology Finishes:**

1. Nanoparticle-based finishes: Silver, copper, zinc, or titanium dioxide
2. Nano-coatings: Thin, nanoscale coatings for water repellency or UV protection
3. Nano-encapsulation: Encapsulation of active agents for controlled release
4. Nano-composites: Combination of nanoparticles with other materials

**Nanomaterials Used:**

1. Silver nanoparticles: Antimicrobial and antibacterial
2. Titanium dioxide nanoparticles: UV protection and self-cleaning
3. Copper nanoparticles: Antimicrobial and antibacterial
4. Zinc oxide nanoparticles: UV protection and antimicrobial



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



5. Carbon nanotubes: Improved strength and conductivity

**Applications:**

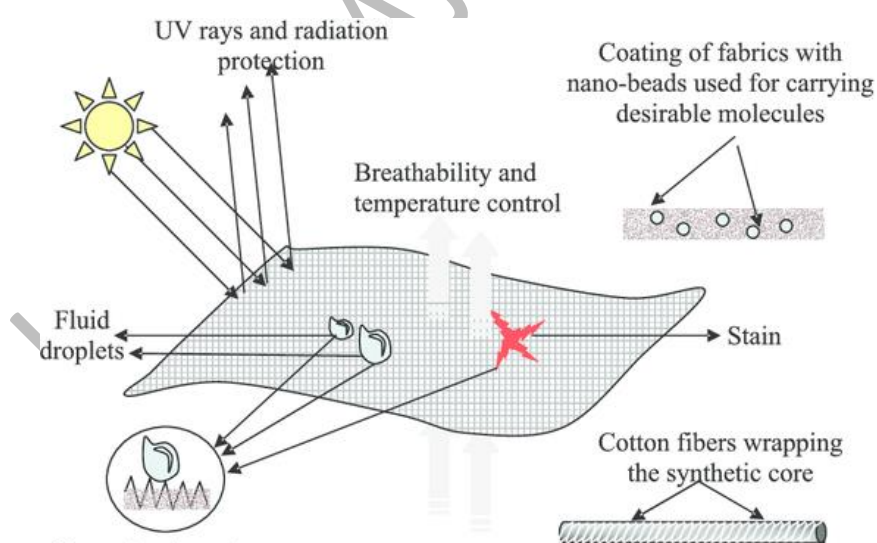
1. Apparel: Outdoor clothing, sportswear, and workwear
2. Upholstery: Furniture, car seats, and aircraft seats
3. Textiles: Curtains, drapes, and bedding
4. Industrial textiles: Filters, belts, and hoses
5. Medical textiles: Surgical gowns, drapes, and implantable devices

**Nanotechnology Finish Techniques:**

1. Sol-gel processing: Formation of nanoscale coatings
2. Electrospinning: Creation of nanofibers
3. Nanoparticle deposition: Application of nanoparticles to fabric
4. Plasma treatment: Surface modification for nanomaterial attachment

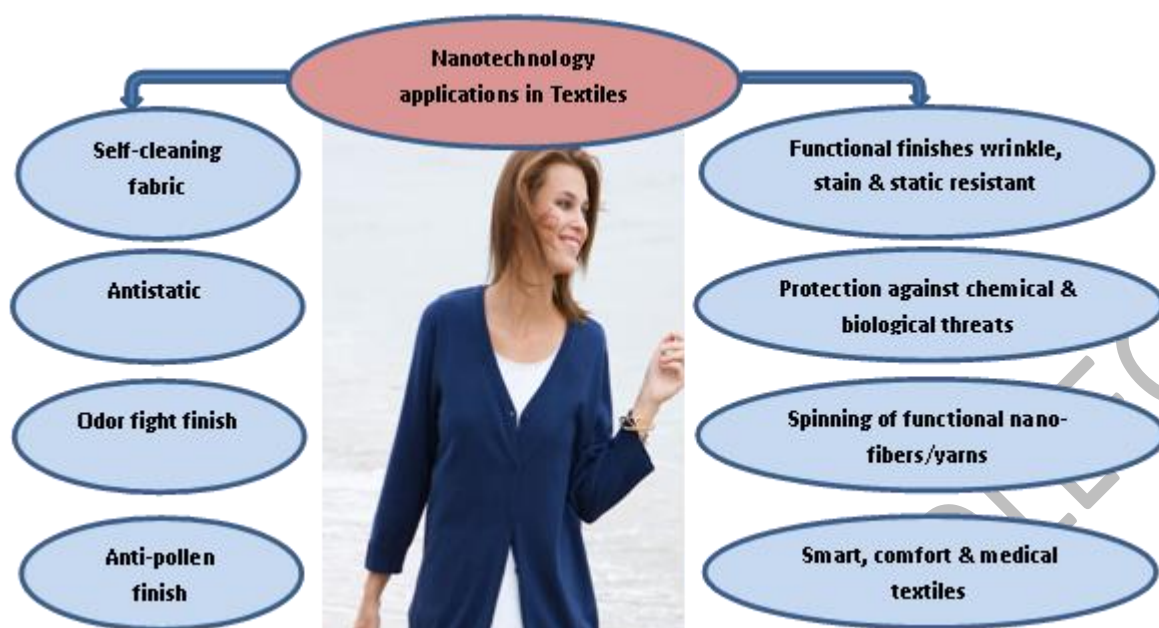
**Testing Standards:**

1. ISO 13374: Nanotechnology testing standard
2. ASTM E2855: Nanoparticle testing standard
3. AATCC 147: Nanotechnology testing standard
4. OEKO-TEX Standard 100: Certification for safety





**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



**Regulations and Certifications:**

1. EPA (Environmental Protection Agency): Registration required
2. FDA (Food and Drug Administration): Clearance required
3. REACH (Registration, Evaluation, Authorization, and Restriction of Chemicals): Registration required
4. GOTS (Global Organic Textile Standard): Certification for sustainability

**Limitations and Considerations:**

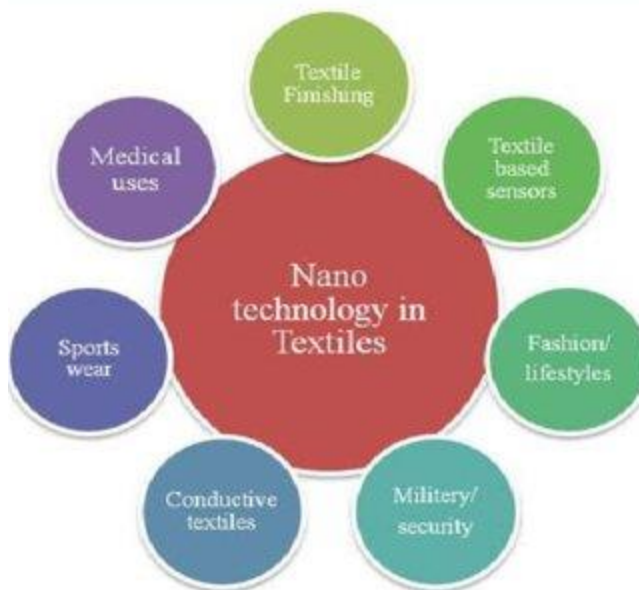
1. Toxicity: Potential health risks from nanomaterials
2. Environmental impact: Uncertainty around nanomaterial fate
3. Scalability: Challenges in large-scale production
4. Cost: Higher costs compared to traditional finishes
5. Durability: Potential degradation of nanomaterials over time

**Notable Nanotechnology Finish Brands:**

1. Nano-Tex
2. DuPont's Sorona
3. 3M's Nanotech
4. BASF's Nanolayer
5. Milliken's T1



ACADEMIC YEAR 2024-2025, SEMESTER – VI  
STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY  
TEXTILE FINISHING



KAMARAJ WOMENS COLLEGE



## UNIT – IV

### ECO- FRIENDLY PROCESSING

#### DEFINITION:

Eco-friendly processing in textile finishing refers to sustainable and environmentally responsible methods that minimize harm to the environment, conserve resources, and promote human health.

#### Eco-Friendly Textile Finishing Processes:

1. Waterless dyeing: Using air or carbon dioxide instead of water
2. Low-water dyeing: Reducing water consumption through efficient dyeing methods
3. Natural dyeing: Using plant-based dyes, such as indigo, madder, and pomegranate
4. Enzyme-based finishing: Replacing chemicals with enzymes for softening, wrinkle resistance, and shrinkage control
5. Plasma treatment: Surface modification using plasma technology
6. Ultrasonic finishing: Using high-frequency sound waves for fabric treatment
7. Solar curing: Using solar energy for drying and curing
8. Bio-based finishes: Using renewable resources, such as plant-based polymers

#### Eco-Friendly Textile Finishing Chemicals:

1. Bio-based chemicals: Derived from renewable resources
2. Natural polymers: Cellulose, starch, and protein-based polymers
3. Silicone-free finishes: Replacing silicones with natural alternatives
4. Fluorocarbon-free finishes: Eliminating fluorocarbons for water repellency
5. Azo-free dyes: Avoiding dyes containing harmful azo compounds

#### Sustainable Textile Finishing Technologies:

1. Nanofiltration: Efficient water treatment and dye recovery
2. Membrane bioreactors: Wastewater treatment and recycling
3. Advanced oxidation processes: Efficient wastewater treatment
4. Biodegradable finishes: Easily decomposable finishes



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



---

**Certifications and Labels:**

1. GOTS (Global Organic Textile Standard)
2. Oeko-Tex Standard 100
3. Bluesign
4. Eco-Institut
5. ISO 14001 (Environmental Management System)

**Benefits:**

1. Reduced water consumption
2. Lower energy consumption
3. Minimized waste generation
4. Improved air and water quality
5. Enhanced human health and safety
6. Increased customer satisfaction
7. Cost savings

**Challenges:**

1. Higher costs
2. Limited availability of eco-friendly chemicals
3. Scalability and production efficiency
4. Regulatory frameworks
5. Consumer education and awareness

**Notable Eco-Friendly Textile Finishing Companies:**

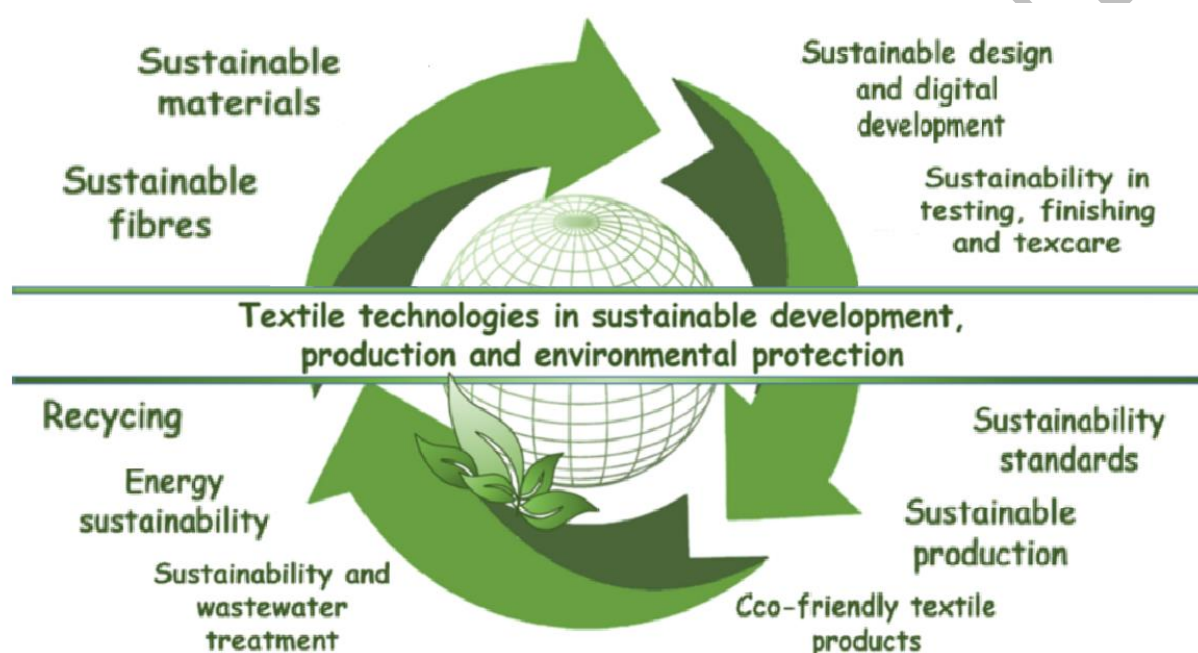
1. Patagonia
2. Reima
3. H&M Conscious
4. Nike Sustainable Business
5. BASF's Eco-Efficiency





**Future Trends:**

1. Circular economy approaches
2. Biodegradable materials
3. Digital printing and finishing
4. Nanotechnology and graphene applications
5. Integration of renewable energy sources



The finishing sector comprises operations such as the textile industry's processing and functionalization unit, which is a high-cost, energy-intensive, and hazardous chemical-demanding process. Sustainability is a critical aspect that must be addressed to address the many problems provided by the textile industry in terms of regulating the use of water, electricity, hazardous chemicals, and so on. Textile finishing in a sustainable manner may be accomplished using environmentally friendly techniques.

**Textile Finishing Techniques that are Eco-Friendly**

**1. Antimicrobial finish derived from natural ingredients:**

Antimicrobial materials are widely utilized in a variety of applications, including surgical gowns, undergarments, and infant wear. Antimicrobial treatments are now being applied to traditional clothing and household textiles. Antimicrobial agents kill or prevent pathogens from developing, and their effects are regulated. Because of the presence of carbohydrates in the fibres, bacteria may readily destroy cotton and other natural fibres. Antimicrobial-finished fabrics are utilized in a



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



variety of goods, including athletic equipment, footwear, medical textiles, furniture, automotive textiles, intimate clothing, and others.

The presence of microorganisms in textiles causes odor and discoloration, as well as health problems. Microbial infections cause inflammation, allergies, and skin diseases; thus, clothes worn next to the skin should be antibacterial. Natural antibacterial compounds-based eco-friendly antimicrobial fabrics are becoming increasingly popular. Many plants contain compounds that, when applied, have an antibacterial effect, such as tannin, flavonoids, and terpenoids. They can act as both a bactericide (killing the bacterium) and a bacteriostat (preventing the microorganism from growing).

## **2. Plasma completing processing**

Plasma treatment is a physicochemical approach for surface modification that changes the surface both physically and chemically while leaving the material's bulk characteristics intact. The plasma surface modification concept is as follows:

The plasma atmosphere is made up of free electrons, radicals, ions, atoms, molecules, and different excited particles, depending on the plasma gas involved. The interaction of these excited species with solid surfaces placed in plasma reactors causes chemical and physical change of the material surface.

All the active species react with the surface of the substrate, resulting in chemical functionality on the surface. Furthermore, the reactive particles produced react directly with the surface of the treated substrates without altering their bulk characteristics.

Cold plasmas, also known as non-thermal plasmas, are used extensively in a wide range of textile applications. Cold plasma is used to cure textiles either under vacuum or at atmospheric pressure. Without a doubt, plasmas are the most effective surface treatment treatments.

### **The following features differentiate plasma:**

- Because plasma is utilized at a low temperature, the possibility of fabric damage is reduced.
- The ability to apply plasma over a wide range of thermal, physical, and chemical temperatures enables fine-tuning of fabric surface treatments.
- Because of its dry treatment procedures, plasma is an ecologically friendly alternative.

## **3. Nanotechnology implementation:**

Nanotechnology is one of the most sustainable technologies in the dyeing and finishing business. This technique employs textile fibres with sizes ranging from 1 to 100nm. When applied in textiles, nanotechnology has already demonstrated the ability to increase the surface area of individual threads. The long-term use of nanotechnology in the textile sector can minimize the use of hazardous and toxic chemicals that affect the environment. Water and beverage repellent



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



protective coating is applied to nano-processed garments. Their protective layer is not visible to the naked eye.

When a material is transformed at sizes of about 100 nm, the structure of treated clothes becomes more compressed. As a result, clothing becomes stain- and dirt-resistant. This saves time and money on laundry. Technology is embracing environmentally beneficial features. Nanomaterials provide for superior ventilation and moisture absorption, resulting in enhanced breathability while retaining traditional materials' pleasant hand feel. The crease-resistant function aids in the appearance of your garments. Toxins are not present in these Nano-processed products. Garments are more durable than usual fabrics and maintain their bright and new appearance. Manufacturing expenses are low, resulting in increased output.

#### 4. Ultrasound-based finishing:

The procedure employs zinc oxide nanoparticles as an active medium and is based on the physical phenomenon of acoustic cavitation, which occurs when a solution containing nanoparticles is exposed to ultrasound, causing small bubbles in the solution to form, expand, and collapse in a matter of seconds. As a result, high-energy microstreaming patterns travel at a pace of around 500 meters per second. These particles are transported and securely embedded in the fabrics. This unique system enables maximum process reliability, productivity, sustainability, ease of maintenance, and cost effectiveness.

#### 5. Sustainable UV technology:

Ultra-Violet exposure at low concentrations helps in killing the pathogens and others disease causing microbes. However, UV radiation causes wrinkles, skin damage, blisters, ageing, and other problems in the skin layer. As a result, UV protection gear has gained popularity in the textile sector. UV protection finishing is used in the fabric to counteract these negative effects. Several natural sources derived from mulberry, grapes, tulsi, aloe vera, honey, almonds, and other plants are used in the synthesis of UV protective garments to increase sun protection.

### Eco-Friendly Textile Industry

Pollution-free eco-friendly textiles have become the dominant market in the 21<sup>st</sup> century, the main products.





**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



---

**IMPORTANCE OF ECO- FRIENDLY PROCESSING;**

**Point: Sustainable Energy Use in Manufacturing Processes**

Transitioning to renewable energy sources, such as solar panels and wind turbines, reduces the carbon footprint of manufacturing. It also decreases reliance on fossil fuels and brings long-term cost savings.

**Point: Waste Reduction and Recycling Strategies**

Efficient waste management and recycling initiatives minimize environmental impact, conserve resources, and create a circular economy. Implementing closed-loop manufacturing reduces waste generation and promotes sustainability.

**Point: Green Materials and Technologies**

Using eco-friendly materials and adopting green technologies significantly reduces the environmental footprint of manufacturing processes. Choices such as biodegradable alternatives and recycled materials contribute to the sustainability of the entire product lifecycle.

**STUDY OF CONVENTIONAL PROCESSING WITH ECO FRIENDLY PROCESSING:**

Here's a comparison study between conventional processing and eco-friendly processing in textile finishing:

**Conventional Processing vs. Eco-Friendly Processing:**

**Conventional Processing**

1. Chemical-based finishes
2. Water-intensive processes
3. Energy-consuming methods
4. Waste generation
5. Potential health risks

**Eco-Friendly Processing**

1. Bio-based finishes
2. Waterless or low-water processes
3. Energy-efficient methods
4. Minimal waste generation
5. Reduced health risks



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



**Comparison of Key Parameters:**

Parameter	Conventional Processing	Eco-Friendly Processing
Water Consumption	High	Low/Zero
Energy Consumption	High	Low
Chemical Usage	High	Low/Zero
Waste Generation	High	Low/Zero
Health Risks	High	Low
Cost	Medium	High (initial), Low (long-term)
Product Quality	Good	Excellent

**Eco-Friendly Processing Methods:**

1. Plasma treatment
2. Nanotechnology
3. Enzyme-based finishing
4. Ultrasonic finishing
5. Solar curing
6. Bio-based finishes
7. Natural dyeing
8. Low-water dyeing

**Eco-Friendly Textile Finishing Chemicals:**

1. Bio-based polymers
2. Natural waxes
3. Silicone-free finishes



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



4. Fluorocarbon-free finishes
5. Azo-free dyes

**Benefits of Eco-Friendly Processing:**

1. Reduced environmental impact
2. Improved human health and safety
3. Cost savings (long-term)
4. Enhanced product quality
5. Increased customer satisfaction
6. Compliance with regulations
7. Improved brand reputation

**Challenges in Eco-Friendly Processing:**

1. Higher initial costs
2. Limited availability of eco-friendly chemicals
3. Need for education and training
4. Integration with existing infrastructure
5. Scalability and production efficiency

**Future Directions:**

1. Development of new eco-friendly chemicals
2. Improvement in production efficiency
3. Scaling up eco-friendly processing
4. Integration with renewable energy sources
5. Circular economy approaches

**Case Studies:**

1. Patagonia's environmental responsibility initiatives
2. Reima's sustainable textile production
3. H&M's Conscious Collection
4. Nike's Sustainable Business strategy
5. BASF's Eco-Efficiency approach





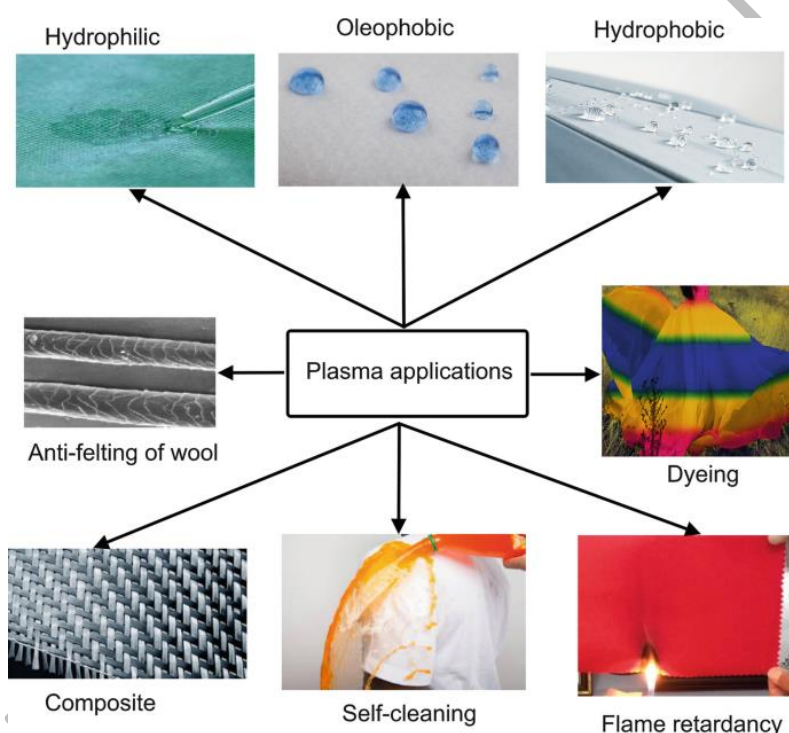
**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



**Regulatory Frameworks:**

1. GOTS (Global Organic Textile Standard)
2. Oeko-Tex Standard 100
3. Bluesign Technologies
4. ISO 14001 (Environmental Management System)
5. REACH (Registration, Evaluation, Authorization, and Restriction of Chemicals)

This study highlights the benefits and challenges of eco-friendly processing in textile finishing, providing insights for the industry to adopt sustainable practices.



**ENZYMES AND CHARACTERISTICS OF ECO-FRIENDLY PROCESSING**

Enzymes play a crucial role in eco-friendly processing in textile finishing, offering numerous benefits over traditional chemical-based methods.

**Types of Enzymes Used in Textile Processing:**

1. Amylases: Break down starch-based sizes
2. Cellulases: Improve cotton fabric softness and durability
3. Proteases: Degrade protein-based fibers (e.g., wool, silk)
4. Lipases: Hydrolyze triglycerides in oil-based finishes
5. Pectinases: Break down pectin in plant-based fibers



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



---

**Characteristics of Eco-Friendly Enzyme-Based Processing:**

1. Biodegradable: Enzymes break down naturally
2. Non-toxic: Safe for humans and environment
3. Low temperature: Energy-efficient processing
4. Low water usage: Reduced water consumption
5. High specificity: Targeted action on specific fibers or impurities
6. Mild pH: No harsh chemicals or extreme pH levels
7. Reusability: Enzymes can be recovered and reused

**Benefits of Enzyme-Based Processing:**

1. Improved fabric softness
2. Enhanced durability
3. Reduced shrinkage
4. Increased color yield
5. Better wash fastness
6. Reduced energy consumption
7. Lower chemical usage
8. Minimized waste generation
9. Improved worker safety
10. Enhanced environmental sustainability

**Applications of Enzyme-Based Processing:**

1. Desizing: Enzymatic removal of starch-based sizes
2. Bleaching: Enzymatic bleaching of natural fibers
3. Softening: Enzymatic treatment for improved fabric softness
4. Shrinkage control: Enzymatic treatment to reduce shrinkage
5. Dyeing: Enzymatic assistance for improved color yield

**Eco-Friendly Enzyme-Based Textile Finishing Products:**

1. Novozymes' Cellusoft



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



2. Genencor's OxiMax
3. BASF's Optimax
4. DuPont's BioSoft
5. AB Enzymes' Ecoral

**Future Directions:**

1. Development of new enzymes
2. Improved enzyme stability
3. Enhanced enzyme activity
4. Integration with other eco-friendly technologies
5. Scaling up enzyme-based processing

**Regulatory Frameworks:**

1. GOTS (Global Organic Textile Standard)
2. Oeko-Tex Standard 100
3. Bluesign Technologies
4. ISO 14001 (Environmental Management System)
5. REACH (Registration, Evaluation, Authorization, and Restriction of Chemicals)

**NATURAL ENZYMES AND THEIR CHARACTERISTICS:**

Natural enzymes have gained significant attention in textile finishing due to their eco-friendly and sustainable properties.

**Types of Natural Enzymes Used in Textile Finishing:**

1. Amylases: Derived from plants, bacteria, or fungi, break down starch-based sizes.
2. Cellulases: Obtained from fungi or bacteria, improve cotton fabric softness and durability.
3. Proteases: Sourced from plants, bacteria, or fungi, degrade protein-based fibers (e.g., wool, silk).
4. Lipases: Derived from fungi or bacteria, hydrolyze triglycerides in oil-based finishes.
5. Pectinases: Obtained from fungi or bacteria, break down pectin in plant-based fibers.

**Characteristics of Natural Enzyme-Based Textile Finishing:**

1. Biodegradable: Natural enzymes break down easily.



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



2. Non-toxic: Safe for humans and the environment.
3. Low temperature: Energy-efficient processing.
4. Low water usage: Reduced water consumption.
5. High specificity: Targeted action on specific fibers or impurities.
6. Mild pH: No harsh chemicals or extreme pH levels.
7. Renewable: Derived from natural sources.

**Benefits of Natural Enzyme-Based Textile Finishing:**

1. Improved fabric softness
2. Enhanced durability
3. Reduced shrinkage
4. Increased color yield
5. Better wash fastness
6. Reduced energy consumption
7. Lower chemical usage
8. Minimized waste generation
9. Improved worker safety
10. Enhanced environmental sustainability

**Applications of Natural Enzyme-Based Textile Finishing:**

1. Desizing: Enzymatic removal of starch-based sizes.
2. Bleaching: Enzymatic bleaching of natural fibers.
3. Softening: Enzymatic treatment for improved fabric softness.
4. Shrinkage control: Enzymatic treatment to reduce shrinkage.
5. Dyeing: Enzymatic assistance for improved color yield.

**Sources of Natural Enzymes:**

1. Plants: Papaya, pineapple, and fig leaves.
2. Fungi: Trichoderma, Aspergillus, and Penicillium species.
3. Bacteria: Bacillus, Pseudomonas, and Streptomyces species.



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



**Commercial Natural Enzyme Products:**

1. Novozymes' BioSoft
2. Genencor's OxiMax
3. BASF's Optimax
4. DuPont's Verdezyne
5. AB Enzymes' Ecoral

**Future Directions:**

1. Exploring new natural enzyme sources
2. Improving enzyme stability and activity
3. Developing customized enzyme blends
4. Scaling up natural enzyme-based processing
5. Integration with other eco-friendly technologies

Here are some types of natural enzymes used in textile finishing:

**Amylolytic Enzymes:**

1.  $\alpha$ -Amylase: Breaks down starch-based sizes
2.  $\beta$ -Amylase: Hydrolyzes starch into maltose
3. Glucamylase: Converts starch into glucose

**Cellulolytic Enzymes:**

1. Endoglucanase: Breaks down cellulose fibers
2. Exoglucanase: Hydrolyzes cellulose to cellobiose
3. Cellobiase: Converts cellobiose to glucose

**Proteolytic Enzymes:**

1. Papain: Breaks down protein-based fibers (e.g., wool, silk)
2. Ficin: Hydrolyzes protein-based fibers
3. Bromelain: Breaks down protein-based fibers

**Lipolytic Enzymes:**

1. Lipase: Hydrolyzes triglycerides in oil-based finishes



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



2. Phospholipase: Breaks down phospholipids in oil-based finishes

**Pectinolytic Enzymes:**

1. Pectinase: Breaks down pectin in plant-based fibers
2. Polygalacturonase: Hydrolyzes pectin to galacturonic acid

**Other Natural Enzymes:**

1. Catalase: Removes hydrogen peroxide from bleaching processes
2. Laccase: Oxidizes phenolic compounds for dyeing and printing
3. Peroxidase: Oxidizes and removes impurities from fibers

**Sources of Natural Enzymes:**

1. Plants: Papaya, pineapple, fig leaves, and horseradish
2. Fungi: Trichoderma, Aspergillus, Penicillium, and Fusarium species
3. Bacteria: Bacillus, Pseudomonas, Streptomyces, and Micrococcus species
4. Animals: Pancreatic enzymes from animals (e.g., trypsin, chymotrypsin)

**Commercial Natural Enzyme Products:**

1. Novozymes' BioSoft
2. Genencor's OxiMax
3. BASF's Optimax
4. DuPont's Verdezyne
5. AB Enzymes' Ecoral

**Benefits of Natural Enzymes:**

1. Eco-friendly
2. Biodegradable
3. Non-toxic
4. Energy-efficient
5. Improved fabric quality
6. Reduced chemical usage
7. Minimized waste generation
8. Enhanced sustainability





**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



Enzymes have various applications in textile processing, improving fabric quality, sustainability, and production efficiency.

**Applications of Enzymes in Textile:**

**Pre-Treatment:**

1. Desizing: Enzymatic removal of starch-based sizes
2. Scouring: Enzymatic removal of impurities and oils
3. Bleaching: Enzymatic bleaching of natural fibers

**Finishing:**

1. Softening: Enzymatic treatment for improved fabric softness
2. Shrinkage control: Enzymatic treatment to reduce shrinkage
3. Wrinkle resistance: Enzymatic treatment for improved wrinkle resistance
4. Water repellency: Enzymatic treatment for improved water repellency

**Dyeing and Printing:**

1. Dyeing: Enzymatic assistance for improved color yield
2. Printing: Enzymatic treatment for improved print quality

**Degradation and Recycling:**

1. Biodegradation: Enzymatic degradation of synthetic fibers
2. Recycling: Enzymatic treatment for textile recycling

**Other Applications:**

1. Effluent treatment: Enzymatic treatment of textile wastewater
2. Fabric cleaning: Enzymatic cleaning of fabrics
3. Leather processing: Enzymatic treatment for leather processing

**Types of Enzymes Used:**

1. Amylases: Desizing, scouring
2. Cellulases: Softening, shrinkage control
3. Proteases: Degradation of protein-based fibers
4. Lipases: Hydrolysis of triglycerides
5. Pectinases: Degradation of pectin-based fibers



---

**Benefits of Enzyme Applications:**

1. Improved fabric quality
2. Reduced chemical usage
3. Minimized waste generation
4. Enhanced sustainability
5. Energy efficiency
6. Cost savings
7. Increased productivity
8. Improved worker safety

**Textile Industries Using Enzymes:**

1. Cotton
2. Wool
3. Silk
4. Synthetic fibers
5. Leather
6. Dyeing and printing
7. Finishing
8. Recycling

**Future Directions:**

1. Development of new enzymes
2. Improved enzyme stability
3. Customized enzyme blends
4. Integration with other eco-friendly technologies
5. Scaling up enzyme-based processing



## UNIT – V

### EFFLUENT PLANT

#### **DEFINITION:**

An effluent treatment plant (ETP) is essential for textile industries to treat wastewater and minimize environmental impact.

#### **Types of Effluent Treatment Plants:**

1. Physical Treatment: Removes suspended solids and oils
2. Chemical Treatment: Removes pollutants through chemical reactions
3. Biological Treatment: Breaks down organic pollutants using microorganisms
4. Hybrid Treatment: Combination of physical, chemical, and biological treatments

#### **Components of Effluent Treatment Plant:**

1. Primary Clarifier: Removes suspended solids
2. Aeration Tank: Provides oxygen for biological treatment
3. Secondary Clarifier: Removes remaining suspended solids
4. Filter Press: Removes residual solids
5. Sludge Handling: Manages waste sludge

#### **Textile Effluent Treatment Processes:**

1. Coagulation: Removes suspended solids
2. Flocculation: Removes colloidal particles
3. Sedimentation: Removes settled particles
4. Filtration: Removes remaining impurities
5. Disinfection: Kills pathogens

#### **Technologies Used:**

1. Activated Sludge Process
2. Trickling Filter
3. Rotating Biological Contactor (RBC)
4. Membrane Bioreactor (MBR)
5. Advanced Oxidation Processes (AOP)



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



**Benefits:**

1. Reduced water pollution
2. Compliance with regulations
3. Cost savings
4. Improved public health
5. Enhanced corporate image
6. Conservation of water resources
7. Reduced waste generation
8. Improved worker safety

**Challenges:**

1. High operational costs
2. Complexity of treatment processes
3. Limited space
4. Energy consumption
5. Skilled labor requirements
6. Sludge disposal
7. Maintenance requirements
8. Regulatory compliance

**Notable Effluent Treatment Plant Companies:**

1. Veolia Water Technologies
2. SUEZ Water Technologies
3. Xylem Water Solutions
4. AECOM
5. Thermax Global

**Future Directions:**

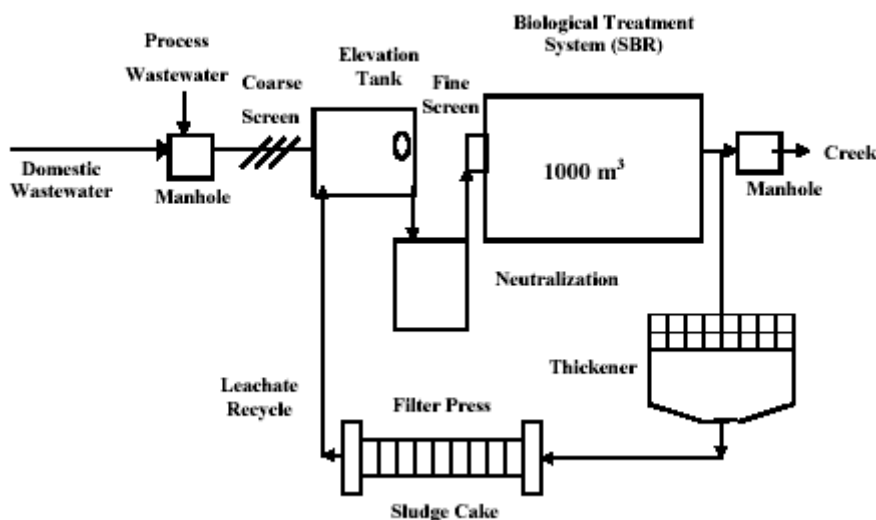
1. Integration with renewable energy
2. Advanced water reuse technologies



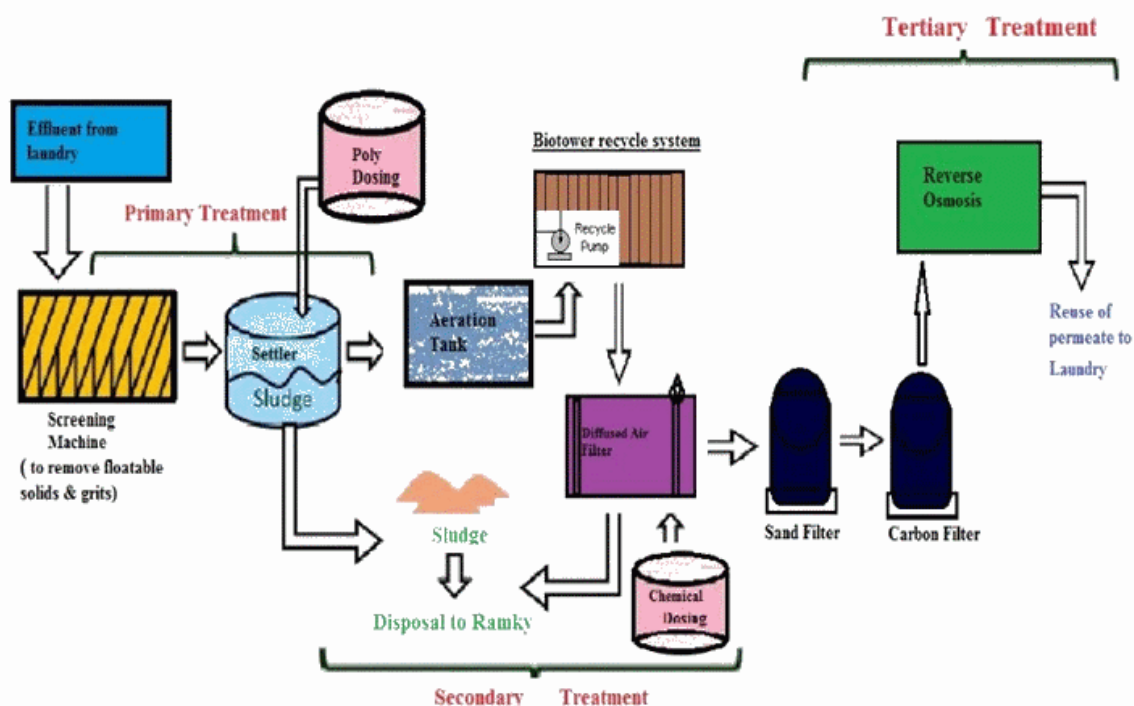
ACADEMIC YEAR 2024-2025, SEMESTER – VI  
STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY  
TEXTILE FINISHING



3. Biodegradable materials
4. Nanotechnology applications
5. Artificial intelligence and automation
6. Circular economy approaches
7. Biological treatment innovations
8. Wastewater-to-energy conversion



EIP Flow Chart





**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



---

**EFFECTS FROM VARIOUS PLANTS:**

Various plants have been explored for their potential in textile finishing, offering eco-friendly and sustainable alternatives to traditional chemical-based methods.

**Plants Used in Textile Finishing:**

1. Neem (*Azadirachta indica*): Natural insect repellent and antimicrobial agent
2. Aloe vera (*Aloe barbadensis*): Moisturizing and softening agent
3. Tea tree (*Melaleuca alternifolia*): Antimicrobial and antifungal agent
4. Eucalyptus (*Eucalyptus globulus*): Freshening and deodorizing agent
5. Rosemary (*Rosmarinus officinalis*): Antioxidant and antimicrobial agent
6. Ginger (*Zingiber officinale*): Anti-inflammatory and antioxidant agent
7. Turmeric (*Curcuma longa*): Natural dye and antimicrobial agent
8. Pomegranate (*Punica granatum*): Antimicrobial and antioxidant agent
9. Bamboo (*Bambusa spp.*): Natural antibacterial and antifungal agent
10. Henna (*Lawsonia inermis*): Natural dye and antimicrobial agent

**Effects of Plant-Based Textile Finishing:**

**Physical Effects:**

1. Softening: Improved fabric softness
2. Smoothing: Reduced fabric wrinkles
3. Water repellency: Improved water resistance
4. UV protection: Enhanced UV protection

**Chemical Effects:**

1. Antimicrobial: Reduced microbial growth
2. Antifungal: Reduced fungal growth
3. Antioxidant: Reduced oxidative stress
4. Dyeing: Natural dyeing effects

**Biological Effects:**

1. Skin health: Improved skin compatibility
2. Allergy reduction: Reduced allergic reactions





**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



3. Antibacterial: Reduced bacterial growth
4. Antiviral: Reduced viral activity

**Textile Finishing Methods Using Plants:**

1. Extraction: Plant extracts used as finishing agents
2. Infusion: Plant infusions used as finishing agents
3. Coating: Plant-based coatings applied to fabrics
4. Padding: Plant-based paddings applied to fabrics

**Benefits:**

1. Eco-friendly
2. Biodegradable
3. Non-toxic
4. Renewable
5. Cost-effective
6. Improved fabric quality
7. Enhanced sustainability
8. Reduced chemical usage

**Challenges:**

1. Scalability
2. Standardization
3. Regulatory compliance
4. Stability and shelf life
5. Compatibility with existing processes
6. Public awareness and education
7. Research and development
8. Supply chain management

**Future Directions:**

1. Exploring new plant species



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



2. Improving extraction and processing methods
3. Developing standardized protocols
4. Scaling up production
5. Integrating with other eco-friendly technologies
6. Investigating synergistic effects
7. Developing plant-based textile finishes for specific applications
8. Life cycle assessment and environmental impact studies

There are various processes for treating wastewater, categorized into physical, chemical, and biological methods.

**Physical Methods:**

1. Sedimentation: Removes suspended solids
2. Flotation: Removes suspended solids and oils
3. Filtration: Removes suspended solids and contaminants
4. Centrifugation: Removes suspended solids
5. Microfiltration/Ultrafiltration: Removes suspended solids and bacteria

**Chemical Methods:**

1. Coagulation: Removes suspended solids
2. Flocculation: Removes colloidal particles
3. Neutralization: Adjusts pH levels
4. Disinfection: Kills pathogens
5. Advanced Oxidation Processes (AOP): Removes organic pollutants

**Biological Methods:**

1. Activated Sludge Process: Breaks down organic matter
2. Trickling Filter: Breaks down organic matter
3. Rotating Biological Contactor (RBC): Breaks down organic matter
4. Membrane Bioreactor (MBR): Breaks down organic matter
5. Anaerobic Treatment: Breaks down organic matter in absence of oxygen



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



---

**Hybrid Methods:**

1. Physical-Chemical Treatment: Combination of physical and chemical methods
2. Biological-Chemical Treatment: Combination of biological and chemical methods
3. Integrated Fixed-Film Activated Sludge (IFAS): Combination of biological and physical methods

**Natural Treatment Methods:**

1. Wetlands: Natural filtration and biological treatment
2. Lagoons: Natural sedimentation and biological treatment
3. Land Application: Natural filtration and biological treatment

**Advanced Treatment Technologies:**

1. Nanofiltration/Reverse Osmosis: Removes dissolved solids and contaminants
2. Advanced Oxidation Processes (AOP): Removes organic pollutants
3. Ultraviolet (UV) Disinfection: Kills pathogens
4. Microbial Fuel Cells: Generates electricity while treating wastewater
5. Bioremediation: Uses microorganisms to remove pollutants

**Wastewater Treatment Plant Design Considerations:**

1. Influent characteristics
2. Treatment goals
3. Space availability
4. Energy consumption
5. Operating costs
6. Maintenance requirements
7. Regulatory compliance
8. Public health and safety

**Future Directions:**

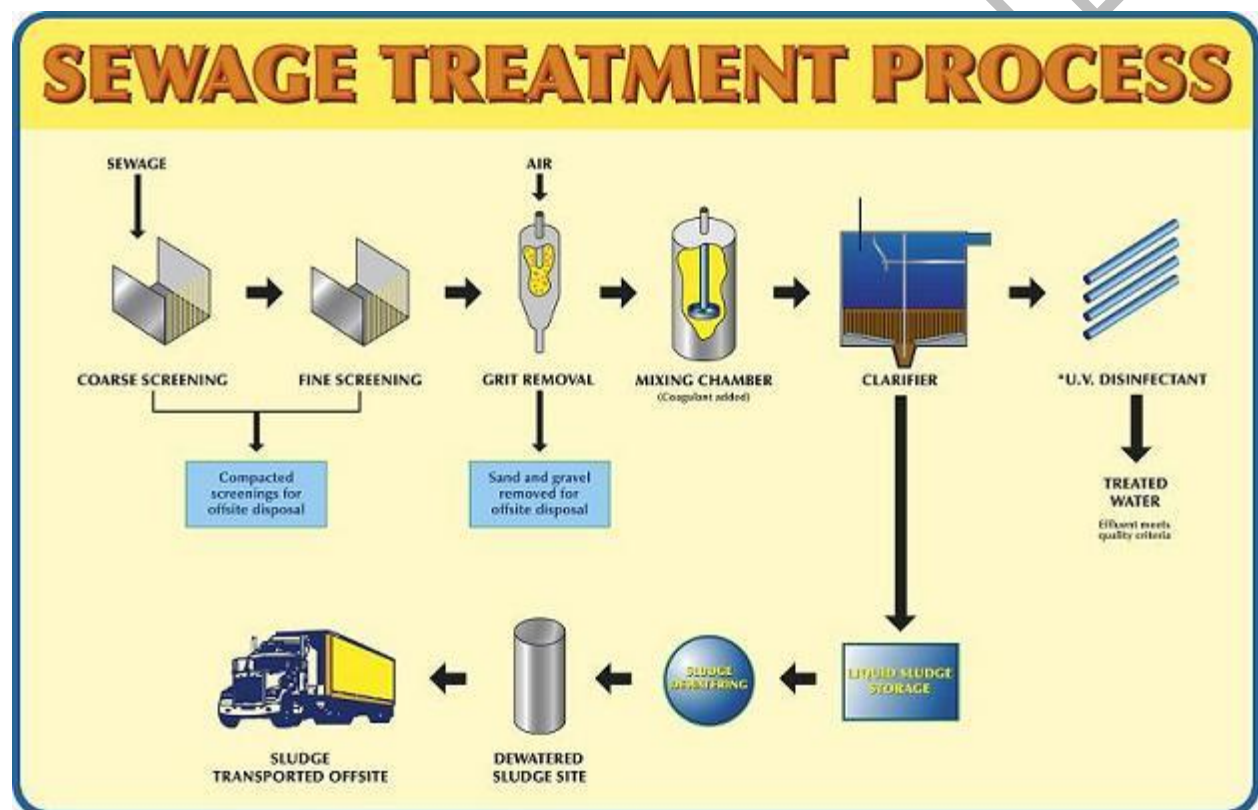
1. Water reuse and recycling
2. Energy-efficient technologies
3. Decentralized treatment systems



4. Natural treatment methods
5. Advanced materials and technologies
6. Integration with renewable energy
7. Smart wastewater treatment systems
8. Circular economy approaches

#### VARIOUS PROCESSES FOR TREATING WASTE WATER:

There are various processes for treating wastewater, categorized into physical, chemical, and biological methods.



#### Physical Methods:

1. Sedimentation: Removes suspended solids
2. Flotation: Removes suspended solids and oils
3. Filtration: Removes suspended solids and contaminants
4. Centrifugation: Removes suspended solids
5. Microfiltration/Ultrafiltration: Removes suspended solids and bacteria



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



---

**Chemical Methods:**

1. Coagulation: Removes suspended solids
2. Flocculation: Removes colloidal particles
3. Neutralization: Adjusts pH levels
4. Disinfection: Kills pathogens
5. Advanced Oxidation Processes (AOP): Removes organic pollutants

**Biological Methods:**

1. Activated Sludge Process: Breaks down organic matter
2. Trickling Filter: Breaks down organic matter
3. Rotating Biological Contactor (RBC): Breaks down organic matter
4. Membrane Bioreactor (MBR): Breaks down organic matter
5. Anaerobic Treatment: Breaks down organic matter in absence of oxygen

**Hybrid Methods:**

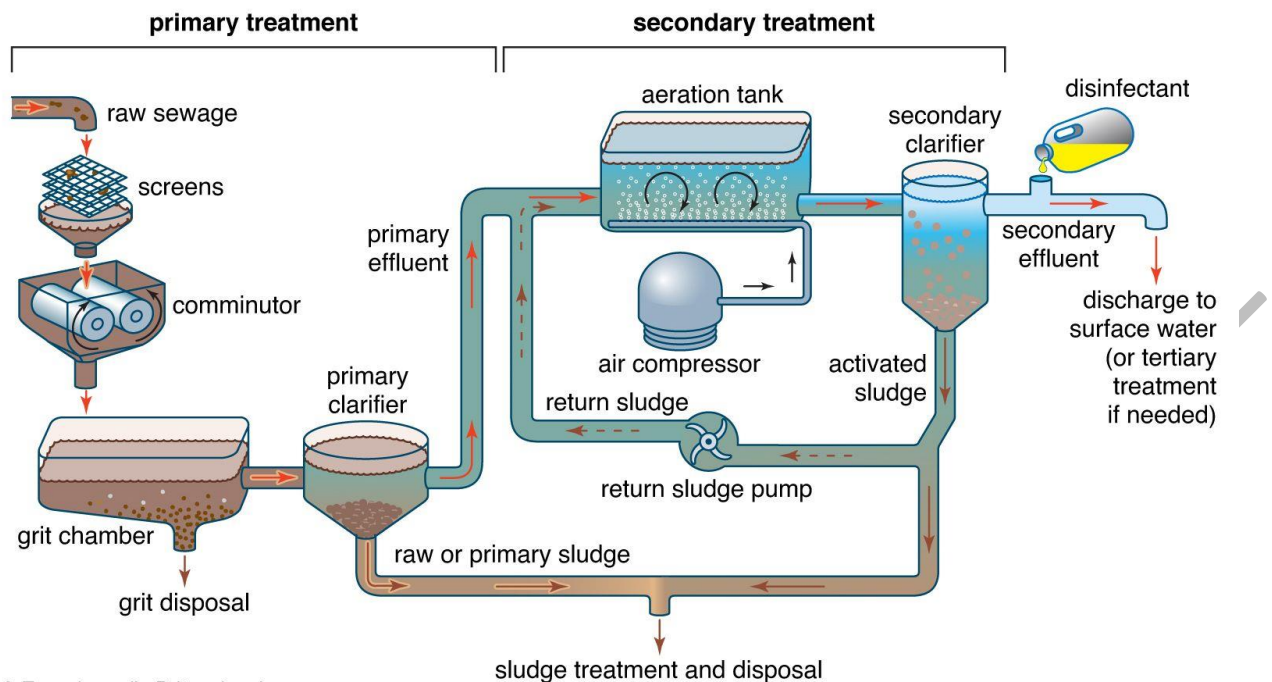
1. Physical-Chemical Treatment: Combination of physical and chemical methods
2. Biological-Chemical Treatment: Combination of biological and chemical methods
3. Integrated Fixed-Film Activated Sludge (IFAS): Combination of biological and physical methods

**Natural Treatment Methods:**

1. Wetlands: Natural filtration and biological treatment
2. Lagoons: Natural sedimentation and biological treatment
3. Land Application: Natural filtration and biological treatment



**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



#### Advanced Treatment Technologies:

1. Nanofiltration/Reverse Osmosis: Removes dissolved solids and contaminants
2. Advanced Oxidation Processes (AOP): Removes organic pollutants
3. Ultraviolet (UV) Disinfection: Kills pathogens
4. Microbial Fuel Cells: Generates electricity while treating wastewater
5. Bioremediation: Uses microorganisms to remove pollutants

#### Wastewater Treatment Plant Design Considerations:

1. Influent characteristics
2. Treatment goals
3. Space availability
4. Energy consumption
5. Operating costs
6. Maintenance requirements
7. Regulatory compliance
8. Public health and safety





**ACADEMIC YEAR 2024-2025, SEMESTER – VI**  
**STUDY MATERIAL FOR B.Sc., FASHION TECHNOLOGY**  
**TEXTILE FINISHING**



**Future Directions:**

1. Water reuse and recycling
2. Energy-efficient technologies
3. Decentralized treatment systems
4. Natural treatment methods
5. Advanced materials and technologies
6. Integration with renewable energy
7. Smart wastewater treatment systems
8. Circular economy approaches

