Textile Product Design and Development
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Lecture – 11
Performance and Aesthetic Enhancement by Finishing Process

The present topic focuses on the performance and aesthetic enhancement of the finishing process. The properties or characteristics of the fabric can be changed by appropriate finishing treatments. It is essential for designers to have a good understanding of the available finishing processes and their effects on the properties of the fabric. Most of you have been taught the finishing process in much detail. We will not discuss the finishing treatments, any chemical processes, or the chemistry aspect of the finishing in detail; that is not the purpose. The purpose is to know what properties can be manipulated by the finishing treatments so that every designer should have some understanding of this. So, what are the purposes of finishing?

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The first is the purpose of finishing is to improve the appearance of the fabric, which is directly connected to the aesthetics of a product. When aiming to enhance the aesthetic value of a product, there are specific processes that can be employed to remove impurities, oil stains, waxes, and sizing agents. They can be removed properly through some finishing treatments. The other things are a reduction in pill formation and hairiness. The pilling tendency of fabric can diminish the aesthetic look of a product. Pilling is the formation of small balls on the surface of the fabric, which leads to customer dissatisfaction and complaints after several days

of usage. So, the pill formation can be reduced with the help of finishing treatments. The other thing is hairiness. Hairiness also can diminish the appearance of the fabric. Especially in cotton fabric, the fabric would look brighter and lustrous if it had less hairiness.

Another important aspect of finishing is adding new performance characteristics to the fabric. By applying finishing treatments, we can enhance the performance-related properties of a product. Some of the functional properties imparted by finishing are wrinkle resistance, flame resistance, hydrophobicity, hydrophilicity, handle of the fabric and soil release. These finishing treatments are vital for improving the functionality of fabrics in specific products and understanding them enables designers to enhance product performance.

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Fabric finishes are categorized based on the nature of the finishing treatments, such as mechanical, chemical, or thermal. The type of finish could also be classified based on its purpose, such as preparatory finishes and performance enhancement finishes. Preparatory finishes are important for improving the dyeability of a fabric.

For instance, scouring and bleaching are used to improve the dyeability of the fabric. So, certain treatments come under preparatory, and some are the final ones that directly influence the enhancement of the performance of the product.

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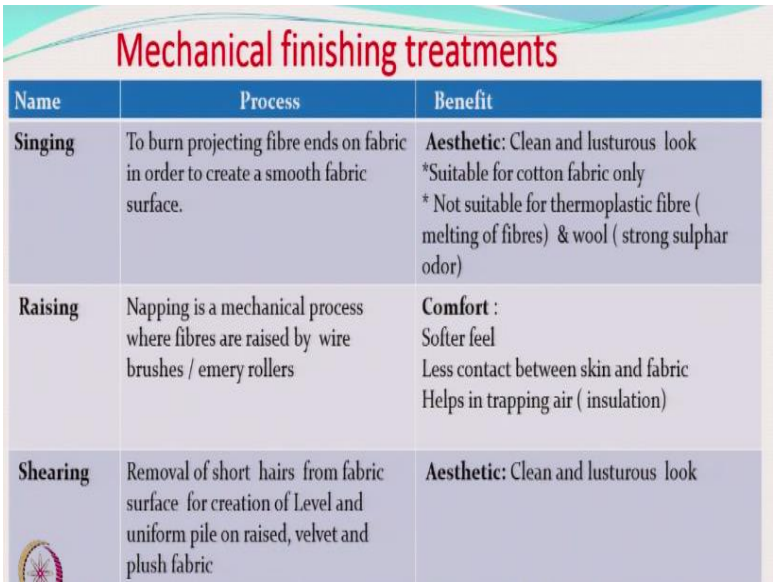

Let us gain some insight into various mechanical treatments and their benefits. Focussing on the benefit part, the singeing is directly related to aesthetics. Singeing primarily enhances aesthetics by giving the fabric a clean and lustrous appearance. This treatment is commonly applied to cotton fabrics. However, it is important to note that singeing is unsuitable for thermoplastic fibres due to the risk of melting from the high temperatures.

Singeing is also unsuitable for woollen fabrics, as it can produce a strong sulphur odour. Therefore, it is predominantly applied to cotton fabrics. Another treatment is raising, which aims to raise the fibres from the fabric surface. This process involves using rollers to raise the fibres, generating a lot of hair on the surface of the fabric. On the contrary, singeing is used to reduce the number of projecting hairs on the fabric surface, creating a cleaner and smoother appearance.

So, raising is employed to increase the amount of projecting hairs, which enhances the softness of the fabric and reduces direct contact between the skin and the fabric, thereby improving comfort. Additionally, the raised fibres help in trapping air, which can enhance the insulation properties of fabrics.

Shearing is used to remove short hairs and to create a uniform pile on the fabric surface. This process is essential for producing fabrics like velvet and plush. Velvet is known for its luxurious and smooth surface, which is achieved through shearing to ensure all fibres are of uniform height and texture. Shearing gives velvet fabric a smooth and pleasant touch. When

we rub our hand over a velvet fabric, we notice its soft, uniform texture, which feels smooth and luxurious. This process enhances both the aesthetic appeal and the tactile experience of the fabric, making it look clean and lustrous while providing a delightful sensation to the touch.

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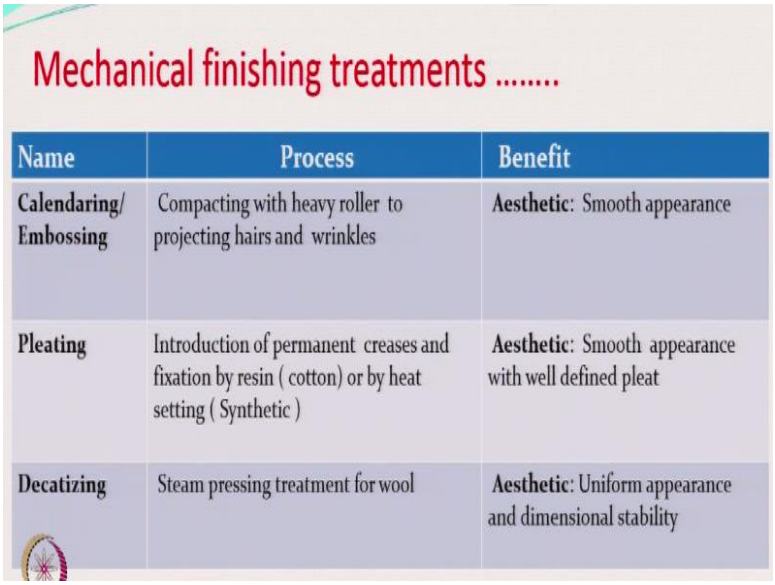

The other mechanical finishing is calendaring or embossing. It improves the appearance by making the fabric surface very smooth. Calendaring makes the fabric surface very smooth, while embossing can create patterns like floral effects.

Pleating, on the other hand, is used to create permanent creases. There are certain fabrics or certain products where a permanent crease is required. For example, a very neat crease is essential for formal trousers, which are used as suiting material. It gives a smooth appearance, and this is the purpose of pleating.

Decatizing, often used for wool fabrics, involves steam pressing to improve appearance and dimensional stability. These treatments have a direct effect on the aesthetic value of the final product.

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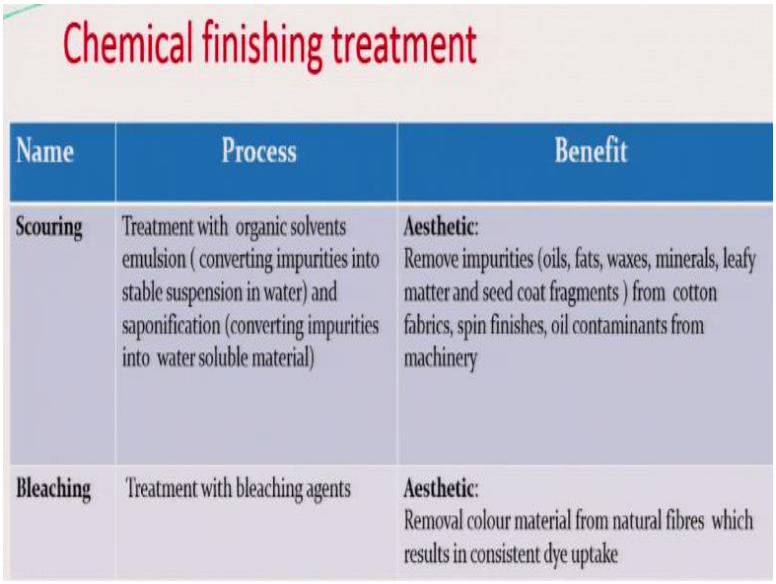

Scouring is a process used to remove impurities such as oil, wax, and other residues from the surface of fabrics. By eliminating these contaminants, it improves the aesthetic value of the fabric. So, this is also a direct consequence of the aesthetics part of the fabrics.

Bleaching is a process of removing any natural or unwanted colour from fabrics, particularly natural fibres like cotton. This ensures a consistent and uniform dye uptake. So, bleaching is essential to improve the dyeability of the fabric or to give a colour to the fabric which will look pretty uniform. It also enhances the aesthetic value of the product.

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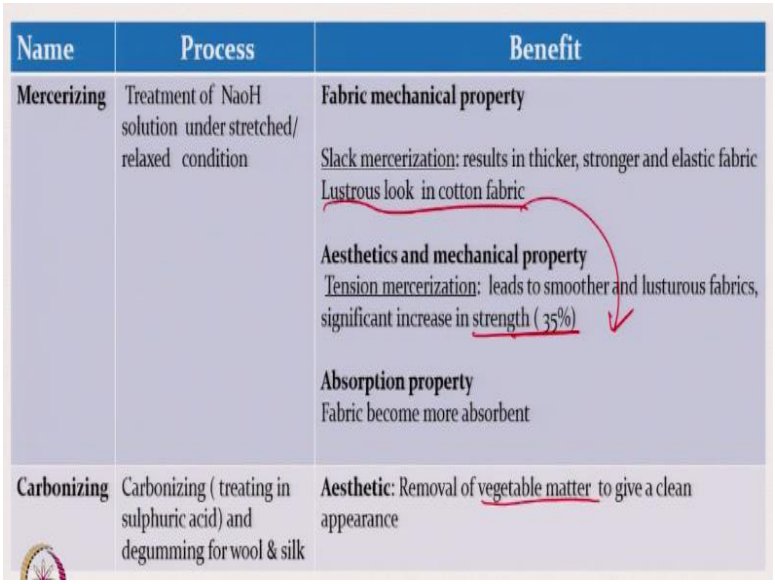

Mercerizing is a finishing process that enhances both the aesthetic and mechanical properties of fabrics. Slack mercerization results in thicker, stronger and more elastic fabrics. It also imparts a lustrous appearance to cotton fabrics. Tension mercerization leads to smoother and lustrous fabric, and strength could be significantly increased. In addition, tension mercerisation improves the strength and absorption properties of cotton fabrics. These are the advantages of mercerization.

Another treatment is called carbonizing, which is mostly done on wool, and degumming techniques are generally used for silk fibres. It enhances the aesthetic value of wool fabric or silk fabric because it removes the vegetable matter from wool fibres. So, many techniques are used to enhance the aesthetic value of the fabric by making it look lustrous or improve certain performance by generating more hairs on the fabric's surface or by enhancing its strength.

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In addition to the performance enhancement finishes, there are some treatments to improve some specific performance. One of them is moisture management. There are three key aspects to producing a moisture management type of fabric. These are water repellency, waterproof and hydrophilicity. These finishes can make the fabric water-repellent, which is essential for fabrics used in heavy rain conditions, as they should prevent raindrops from passing through. Alternatively, there are situations where waterproof fabrics are required, with umbrella cloth being a prime example. Hydrophilicity can also be necessary when a finish is needed to allow the fabric to absorb a certain amount of moisture.

Some fibres are naturally hydrophobic, with very low moisture content. A hydrophilic finish can be applied to enhance their ability to capture moisture. Additionally, there are finishes available for oil repellency and stain resistance. Other types include thermal management and antistatic finishes, along with flame-retardant treatments. Antimicrobial finishes are also available and are especially important in today's development of masks. These finishes are crucial for socks and inner garments, where antimicrobial, antibacterial, or antiviral properties are often necessary.

Additionally, durable press finishes are used, particularly for cotton fabrics, to enhance their overall hand value. Surface roughness can also be adjusted with specific finishes designed to modify the texture of the fabric. Therefore, a wide range of performance-enhancing finishing techniques are available, each capable of improving different fabric properties based on the intended use. Accordingly, the fabric must be treated with the appropriate finish to meet the desired performance requirements.

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Advantages and disadvantages

Substance	Advantage	Disadvantage
Paraffin wax	Economical	Not permanent , easily rubbed off Dissolve in dry cleaning fluid
Silicone water repellant	Durable, High resistance to abrasion Less soluble in dry cleaning fluids Soft fabric hand Improves appearance and feel	Moderate durability to laundering and dry cleaning No oil and soil repellency May increase pilling
Fluorochemicals	Repels both water & oil Durable Improved soil release	High cost Greying during laundering

The advantages and disadvantages of some kinds of finishes are listed in the table. Paraffin wax is very economical, but it is non-permanent in nature. It can be easily rubbed off and dissolved in dry cleaning fluid. Silicone water-repellent finishes are durable. They are resistant to abrasion. They have moderate durability for laundering and no oil and soil repellency. It may also increase pill formation in the fabric.

Fluorochemicals are also used for water-repellent types of fabrics. It makes the fabric resistant to oil and other types of stains. The advantage of fluorochemicals is that they repel oil and water, are durable, and have improved soil release. However, the disadvantage is that they are costly. Depending on the end use, we can select an appropriate finish to make the fabric resistant to water or both water and oil.

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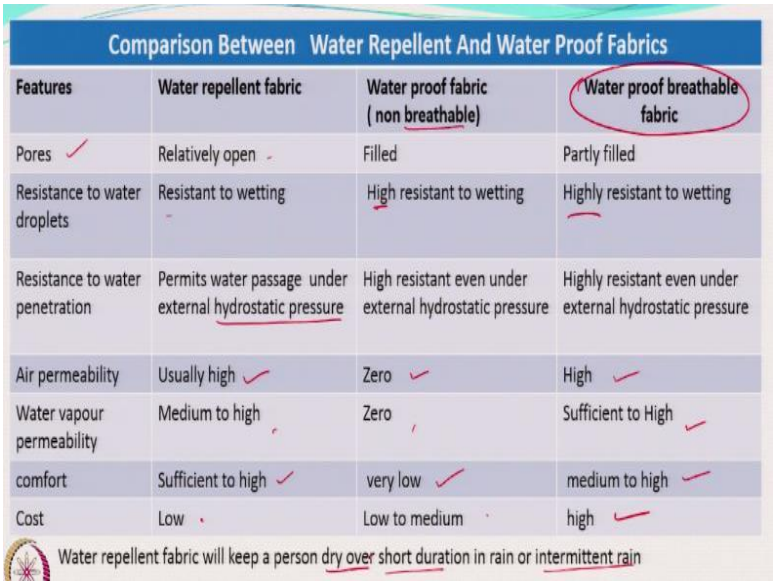

Comparison Between Water Repellent And Water Proof Fabrics

Features	Water repellent fabric	Water proof fabric (non breathable)	Water proof breathable fabric
Pores	Relatively open	Filled	Partly filled
Resistance to water droplets	Resistant to wetting	High resistant to wetting	Highly resistant to wetting
Resistance to water penetration	Permits water passage under external hydrostatic pressure	High resistant even under external hydrostatic pressure	Highly resistant even under external hydrostatic pressure
Air permeability	Usually high	Zero	High
Water vapour permeability	Medium to high	Zero	Sufficient to High
comfort	Sufficient to high	very low	medium to high
Cost	Low	Low to medium	high

Water repellent fabric will keep a person dry over short duration in rain or intermittent rain

Another important aspect is the growing demand for water-repellent and waterproof fabrics. Understanding the difference between water-repellent, waterproof, and waterproof-breathable fabrics is crucial. Nowadays, it is not enough for fabrics to be waterproof; they must also be breathable. For example, raincoats and cold weather clothing must not only block water but also allow moisture from the body to escape, ensuring comfort.

The comparative statement of these three types of fabrics is represented in the table. Based on features like pores, water-repellent fabrics are relatively open pores; waterproof fabrics are all filled, and hence, they are non-breathable. So, waterproof fabrics make the person suffocate because moisture vapour from the skin will not be able to escape. Therefore, it becomes nonbreathable in nature. However, in the case of waterproof-breathable fabric, they are partially filled. They have very fine pores through which the moisture can escape.

When comparing the features of resistance to water droplets, the water-repellent fabric is resistant to wetting; waterproof fabrics are high resistant to wetting, and waterproof breathable fabrics are highly resistant to wetting. From the point of view of resistant to water penetration,

water-repellent fabric permits water passage under external hydrostatic pressure. Waterproof fabric shows high resistance, and waterproof breathable fabric is highly resistant even under external hydrostatic pressure. Comparing the air permeability and water vapour permeability, water-repellent fabrics are high, waterproof fabrics have zero air permeability, and waterproof-breathable fabrics are higher.

From the comfort point of view, water-repellent is sufficient to high; waterproof is low; waterproof-breathable is medium to high. Cost is low for water repellent, low to medium for waterproof, and high for waterproof-breathable fabrics. Depending on the intended use and cost constraints for the final product, the appropriate type of fabric must be chosen. Water-repellent fabrics are suitable for short-duration exposure to rain or intermittent showers, as they keep a person dry for limited periods. Its advantage lies in its lower cost, making it an economical choice compared to more advanced fabrics.

Water-repellent fabrics offer a cost-effective solution for applications where high-end or highly durable fabrics are not necessary. During the design process, it is essential to consider the conditions under which the product will be used. Key factors include whether the product will be used indoors or outdoors, the specific environmental conditions, and the duration of time the user will spend in that environment.

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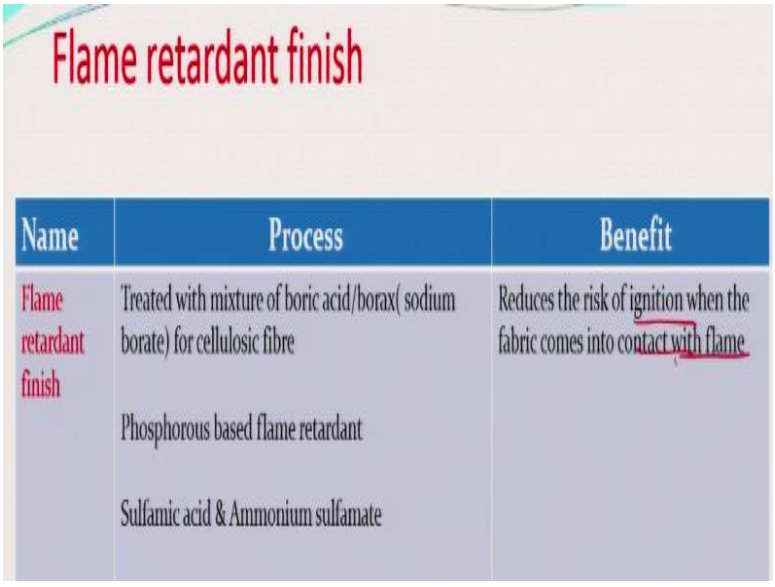

Flame retardant finishes and various types of finishes and processes are listed. Flame retardant finishes are designed to reduce the risk of ignition when the fabric comes into contact with flames. There are various types and processes for applying these finishes, and more detailed information is often covered in specialized courses. The primary purpose of flame retardant treatments is to enhance safety by minimizing the risk of the fabric catching fire, making them essential for situations where there is a potential fire hazard.

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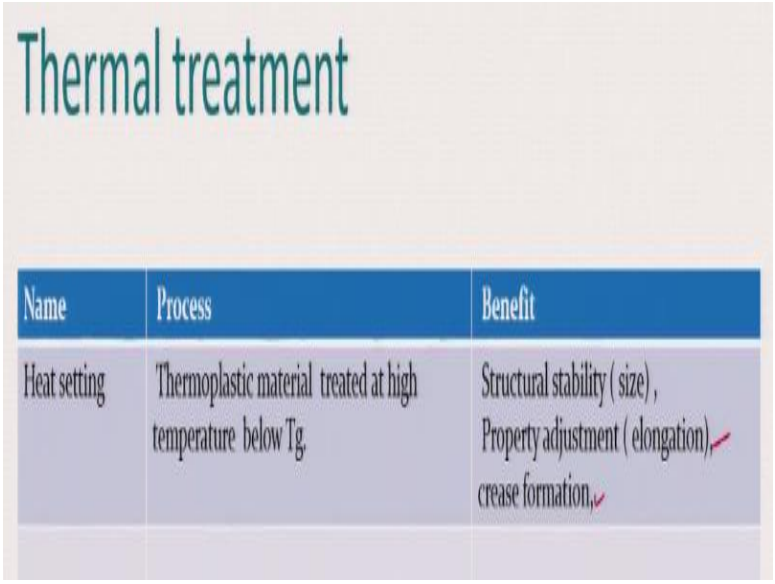

Thermal or heat treatment is applied to fabrics and various technical textile products after manufacturing processes like weaving or twisting. This treatment is essential for stabilizing the fabric's structure, ensuring size consistency, and sometimes adjusting specific properties. Heat treatment is used after manufacturing to change the elongation behaviour of a fabric, such as in the case of car seat belts.

For example, car seat belts, typically made from nylon, undergo heat treatment to adjust their properties. This process allows for specific stretch and heat resistance adjustments, ensuring the seatbelt performs optimally under various conditions and meets safety requirements. Similarly, heat treatment can introduce or enhance creases in fabrics to control crease formation. This process helps achieve the desired firmness of fabrics.

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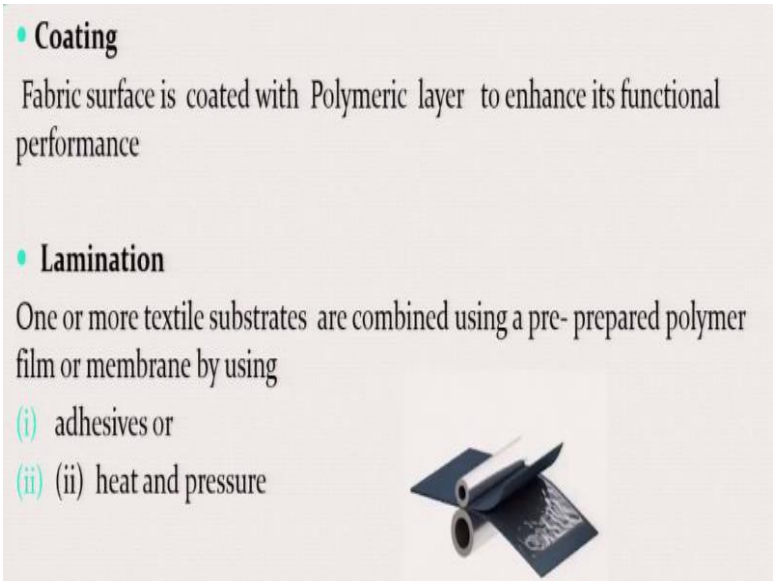

Coating and lamination are other finishings used to enhance the functional performance of fabrics. Coating involves applying a polymeric layer to the fabric surface to improve its properties. The lamination process combines one or more textile substrates using a pre-prepared polymer film or membrane, typically with the help of adhesives or through heat and pressure. Both coated and laminated fabrics serve specialized purposes, depending on the requirements of their intended use.

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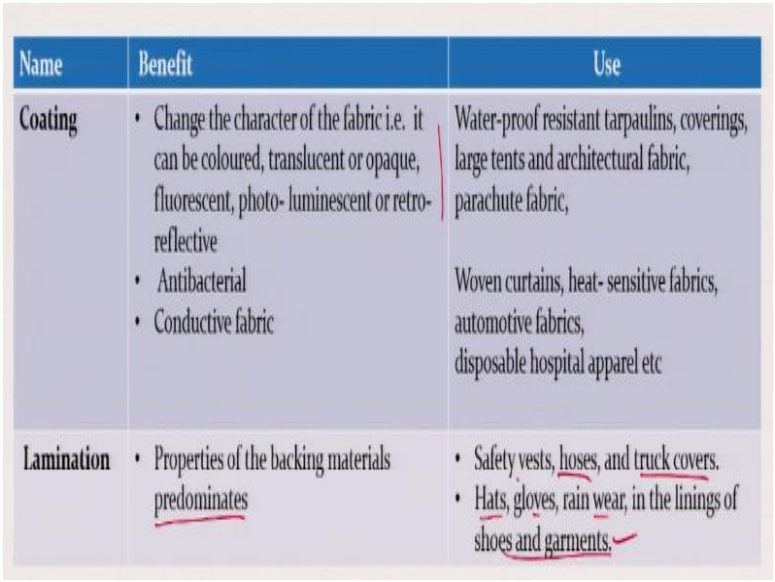

Name	Benefit	Use
Coating	• Change the character of the fabric i.e. it can be coloured, translucent or opaque, fluorescent, photo- luminescent or retro-reflective • Antibacterial • Conductive fabric	Water-proof resistant tarpaulins, coverings, large tents and architectural fabric, parachute fabric, Woven curtains, heat- sensitive fabrics, automotive fabrics, disposable hospital apparel etc
Lamination	• Properties of the backing materials predominates	• Safety vests, hoses, and truck covers. • Hats, gloves, rain wear, in the linings of shoes and garments.

In the coating process, the fabric characteristics can be significantly altered. The coating can make the fabric coloured, translucent, opaque, fluorescent, photoluminescent, or retroreflective. It can also impart properties such as antibacterial or conductive capabilities.

Typically, a base fabric like polyester or another fibre is used, and then a coating is applied to achieve these desired attributes. The choice of finishing process depends on the specific properties that are vital for the product. Coating is a technique that enhances the fabric attributes. On the other hand, lamination focuses on the properties of the backing material, which can be predominant in certain applications.

Laminated fabrics are commonly used in applications such as safety vests, hoses, truck covers, hats, gloves, and rainwear. These fabrics benefit from the enhanced properties provided by lamination. On the other hand, coated fabrics are used for various purposes, including waterproof tarpaulins, coverings, large tents, architectural fabrics, parachute fabrics, woven curtains, heat-sensitive fabrics, and automotive fabrics. So, the fundamental property of the fabric is retained, but some additional property can be imparted. Therefore, these two techniques are prevalent.

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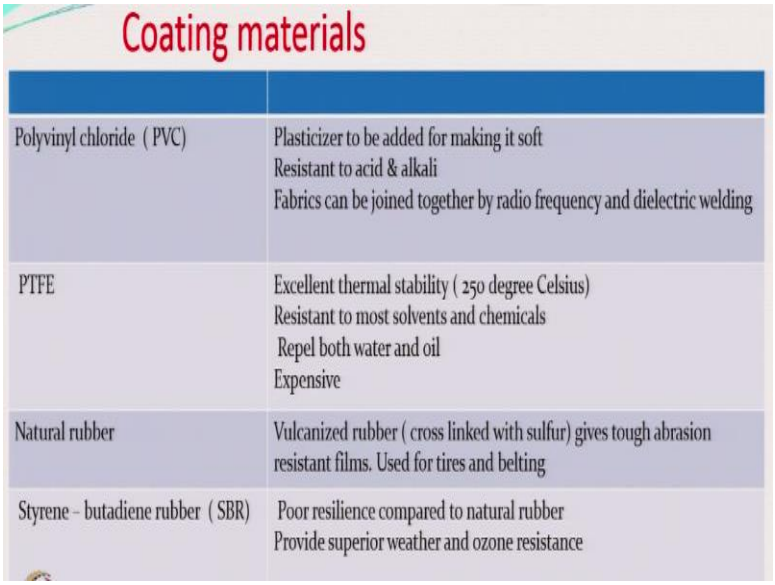

These are typical coating materials used and are listed in the table. With that, we conclude this session. Thank you!