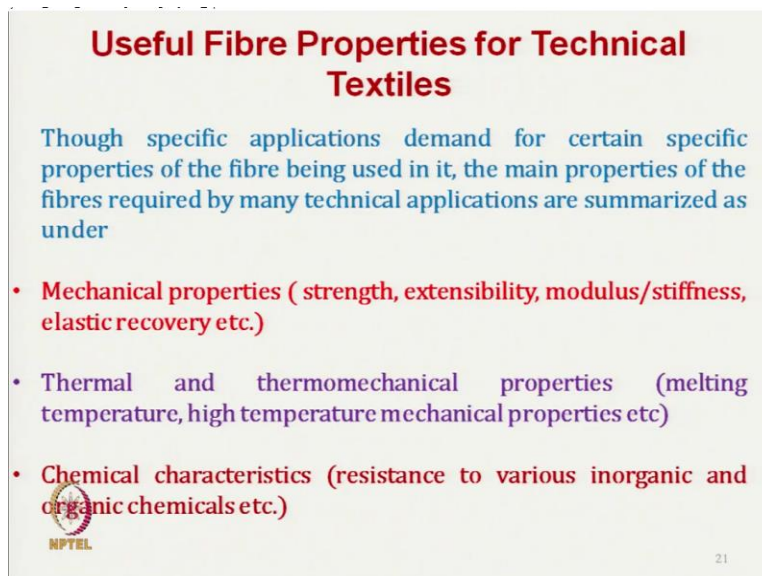


**Technical Textiles**  
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**Lecture - 02**  
**Introduction to Technical Textiles (Contd.,)**

Hello everyone, so we will continue with the technical textiles understanding, basic understanding part. Now, what you are discussing in last class was that the fibre properties, what are the basic fibre properties for technical textiles.

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**Useful Fibre Properties for Technical Textiles**

Though specific applications demand for certain specific properties of the fibre being used in it, the main properties of the fibres required by many technical applications are summarized as under

- **Mechanical properties ( strength, extensibility, modulus/stiffness, elastic recovery etc.)**
- **Thermal and thermomechanical properties (melting temperature, high temperature mechanical properties etc)**
- **Chemical characteristics (resistance to various inorganic and organic chemicals etc.)**

NPTEL 21

So, although specific technical textiles for the specific application requires certain specific property, but in general the main properties of fibres required by many textile application for the technical uses are mechanical properties. This is the basic property where we need to have better strength; we need to understand the extensibility, modulus and elastic recovery. These are the basic mechanical properties of any technical textile fibres.

We may not require that high strength for apparel textiles, but for technical textiles, we need strength, at least for some specific areas. Then comes thermal and thermo-mechanical properties. In conventional textile, the melting point is not that important but for technical application, particularly high temperature application or composite application, we must know the melting point of fibre.


Depending on that, we should select the areas of application and also most important characteristic is the mechanical property at high temperature. At normal temperatures, some fibres will have higher strength, but at higher temperature, if the mechanical properties deteriorate, we should not use that fibre for the particular application. Next is chemical characteristics, which is very important. Whether the polymer is chemically reactive or chemically inert that decides the areas of application.

So, chemical characteristics, the resistance to various inorganic and organic chemicals are important. Particularly, say for geotextiles, we must use such fibre which are relatively chemically inert like polypropylene, we use for geotextile application where the fibre does not degrade by chemical reaction.

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**Useful Fibre Properties for Technical Textiles**

- Electrical properties (static build up, dielectric behaviour, insulating nature etc.)
- Ageing behaviour (oxidative, thermal ageing etc.)
- Surface properties (adhesion, moisture transport behaviour etc.)
- Optical properties
- Other special properties

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22

Electrical properties are also very important, like static build up, dielectric behavior. So, the fibre should have insulating nature. Ageing behavior, oxidative or thermal ageing, that we must take into consideration. Surface properties, adhesion, moisture transport behavior, optical properties and there are various special properties which are required for the fibres to be used for technical textiles. So, we must understand, we must characterize the fibre before we select the particular fibre for a specific application.

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## Developments in Fibre Materials

- Around 80% of the usage in technical textiles is of fibres made out of everyday polymers and materials like cotton, viscose, jute, polyester, polyamide, polyolefins etc.
  - Modifications in the shape and dimensions of the regular fibre polymers like in polyester, polyamide, viscose alongwith special chemical treatment to impart additional functional properties, combination into hybrid and bicomponent products have taken place to meet the requirements as a technical textile material.



Modification of spinning process has led to development of high tenacity, high modulus fibres.

23

So, if we see at present around 80% of the technical textiles are being used for the normal application where we use everyday polymer and materials, like cotton, viscose, jute, polyester, polyamide, polyolefins. These are used typically around 80% of technical textile application. Rest 20% we use high performance textiles fibre.

And this fibres we some time required to modify, the shape and dimension, like we change the cross section of polyester from circular to different shaped polyester fibre for high absorbent application, sports textile, active sports textile we use polyester but not normally circular cross section, various special cross sections are used. Also the same normal polymers, we convert it to hybrid and bicomponent product to be used for technical textile applications. Also the normal polymer if we modify the spinning process, we can achieve high tenacity, high modulus fibre which may be used for technical textile application.

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## Developments in Fibre Materials

### Viscose:

- Excellent resistance to higher temperatures

Applications : automotive and industrial equipment markets

- Good absorbency and suitability for processing in industries of wet laying techniques.

Applications : Nonwoven Industry especially in disposable cleaning and hygiene end uses.



24

So, if we talk about the normal fibres like viscose, it is used for technical textile application due to its excellent resistance to high temperature. So, where we require this high temperature resistance characteristic we may select viscose. Like in automotive and industrial equipment market, we use viscose fibre, it has good absorbency, suitability for processing in industries of wet laying technique. So, viscose fibre is used for wet laying nonwovens due to its good absorbency characteristics. The applications are nonwoven industry, especially in disposable cleaning and hygiene end uses where we need absorbency characteristics.

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## Developments in Fibre Materials

### Polyamide :

- High strength
- Good abrasion resistance
- Good elasticity and uniformity
- Better resistance to moisture
- Excellent energy absorbing property

Applications: parachute fabrics, tyre cords etc.

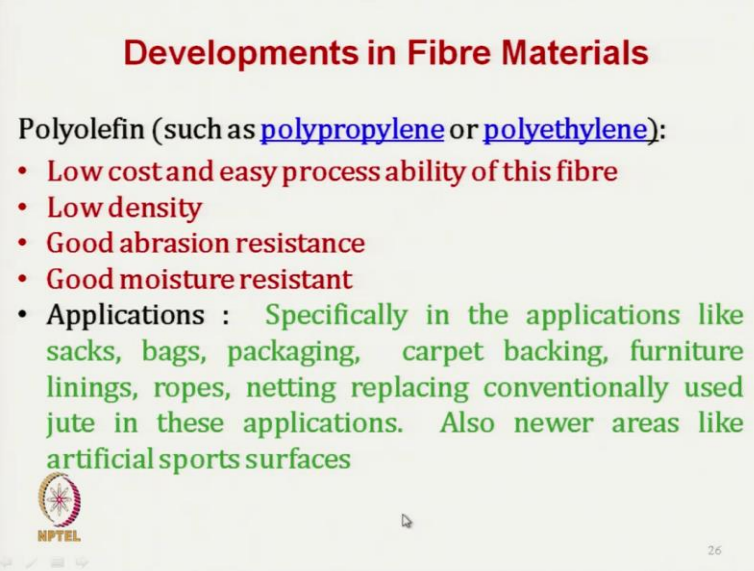


25

Then polyamide fibres, polyamide has high strength, very good abrasion resistance. So, the applications where good abrasion resistance is required the polyamide fibres are being used. It

has good elastic recovery, elasticity and uniformity is good, better resistance to moisture, excellent energy absorbing property, that is higher work of rupture. So, this characteristic, higher work of rupture, due to these characteristics the polyamide fibres are used for rope. The applications are parachute fabric, tyre cords fabric.

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**Developments in Fibre Materials**

Polyolefin (such as [polypropylene](#) or [polyethylene](#)):

- Low cost and easy process ability of this fibre
- Low density
- Good abrasion resistance
- Good moisture resistant
- Applications : Specifically in the applications like sacks, bags, packaging, carpet backing, furniture linings, ropes, netting replacing conventionally used jute in these applications. Also newer areas like artificial sports surfaces

NPTEL 26

Polyolefin like polypropylene, polyethylene, these fibres, they have low cost, easy process ability, lighter in weight due to lower density, good abrasion resistance, good moisture resistant. So, their moisture absorption properties good that means they have almost 0 moisture absorption property. Polypropylene has got almost 0 moisture absorption property. These characteristics we use for technical textile application.

Due to its surface characteristics it wicks liquid particularly water at very faster rate. The applications of polyolefin fibres are sacks, packages, bags due to the high abrasion resistance, carpet backing, furniture lining, ropes, netting. So, the all these applications are there and the newer application areas like artificial sports surface.

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## Developments in Fibre Materials

Polyolefin ...cont:

- The disadvantages like poor temperature resistance, hydrophobicity in fact turned as a boon to this fibre to be used into nonwovens.
- For example its good moisture wicking property got used into the hygiene products like diapers.



27

The disadvantage of polyolefin fibres were basically earlier it was thought that they have poor temperature resistance because of their lower melting point, and they are hydrophobic in nature. But these disadvantages, apparent disadvantages are being used as positive point in technical textile manufacturing like nonwovens. Melt blown or spunbonded nonwovens are easily manufactured from due to its lower melting point.


It has good moisture wicking properties which help it is use in the hygiene products. Like diapers and napkins where we need very fast moisture transport characteristics, keeping the skin dry as it does not absorb moisture. It is hydrophobic in nature, but at the same time it wicks very quickly. Now, let us see this polypropylene, suppose this is the fabric made of polypropylene and here it is a human skin and for diaper application.

So, inner layer which is in contact with the human body where liquid is generated due to its very high wicking characteristics, this liquid is being transported to inner core, there are inner layers leaving this skin entirely dry, so this skin become dry, at the same time as this fibre does not absorb moisture, so there would not be any water accumulation in this surface though, so the person will feel comfortable. So, this characteristic is very important for hygiene product. As I mentioned, that lower extrusion temperature made it suitable material for technologies like spunbonding and melt blowing, so to reduce the energy cost.

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## High Performance Fibres

- Though technical textiles industry still consumes around 80% of the commodity fibres discussed above with their modifications, the really high functional applications have emerged subsequent to the development of so called high performance fibres.
- **Aramids (Kevlar and Nomex), Carbon, Glass etc. are the fibres belonging to this category.**



28


Apart from the normal fibre, high performance fibres are also being used. So, though technical textiles industry still consume 80% of commodity fibres that I have already mentioned. The really high functional application requires high performance fibre, there we cannot use commodity fibres. So, some of the fibres are like Aramid fibres, Meta or Para aramid fibres, Carbon, Glass fibres, these are coming under high performance fibres, used for technical textiles for very specific application where we cannot use commodity fibres.

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## Developments in Fibre Materials

Aramids: Aramid fibers are 43% lighter than glass fiber, with a density of 1.44 g/cc compared to 2.5 g/cc for glass fiber. They are twice as strong as E-glass, ten times as strong as aluminum and approach the strength of high strength carbon on a specific tensile strength basis.

- Low density
- High temperature resistant meta-aramids (Nomex)
  - Applications: Protective clothing and similar applications
- High strength and high modulus para-aramids (Kevlar)
  - Applications: Bulletproof vests, tyre reinforcement, friction materials, ropes, advanced composites etc.



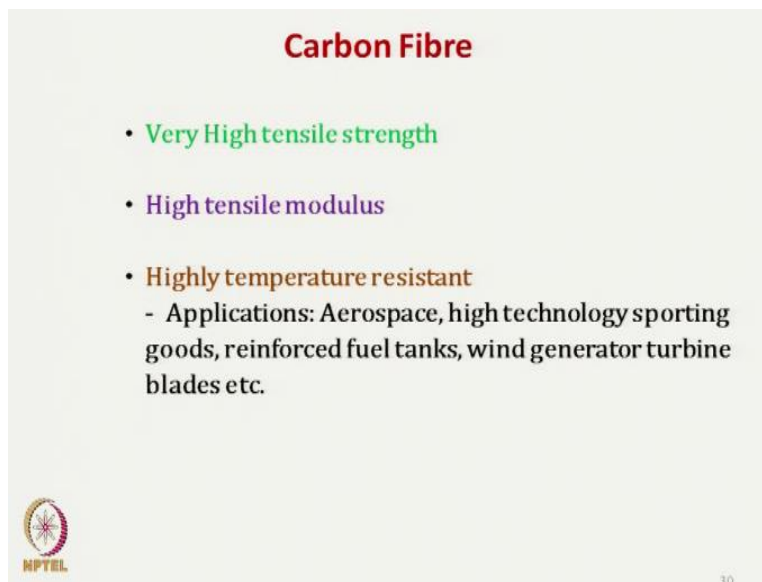
29

The aramid fibres, they have special characteristics, they are lighter like 43% lighter than glass fibre with a density of 1.44 gram per cc, as compared to 2.5 gram per cc for glass fibre, with very high strength. They are twice as strong as E-glass, 10 times as strong as aluminum and

approaches the strength of high strength carbon on a specific tensile strength basis. So, these fibres are very strong fibre, they have low density, high temperature resistant particularly meta aramid fibres are high temperature resistant.


Nomex is a fibre, produced by DuPont, their applications are protective clothing and similar high temperature application. High strength and high modulus para-aramids like for example Kevlar these are used for bulletproof vests, tyre reinforcement, ropes. So, the high strength and high modulus fibres are used in this area. So, these specific requirements, specific characteristics are not present in commodity fibres.

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**Carbon Fibre**

- Very High tensile strength
- High tensile modulus
- Highly temperature resistant
  - Applications: Aerospace, high technology sporting goods, reinforced fuel tanks, wind generator turbine blades etc.

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30

Next fibre is that carbon fibre. It has very high tensile strength, very high tensile modulus, high temperature resistance. Due to all these characteristics they are used in aerospace, high technology sports goods, reinforcement in fuel tank, wind generator, wind turbine, so, turbine blades. So, they are reinforced by carbon fibre.

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## Developments in Fibre Materials

Glass fibre :

- Excellent ignition resistance
- High strength ( stronger than steel of same diameter)
- Sunlight, mildew, bleach, weather, chemical resistance

Applications : high performance composite applications, packaging, protective clothing, filtration, body panels in automotives etc.



31

So, the developments in fibre materials are to continue with then it is a glass fibre. It has got excellent ignition resistance. So, we can use in high temperature application, very high strength stronger than steel with the same diameter, it is sunlight, mildew, bleach, weather, chemical resistance. So, we can use all in all these applications where sunlight degradation, degradation due to mildew, bleaching, weathering, chemical. So, are there the applications areas are high performance composite, packaging, protective clothing, filtration, mainly high temperature filtration, so, body panels in automotive. So, all these area we can use glass fibres.

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## Developments in Fibre Materials

Other fibres :

Polybenzimidazole (PBI) fiber is a synthetic fiber with a very high melting point. It has exceptional thermal and chemical stability and does not readily ignite.

High modulus polyethylene (HMPE), Ceramic etc.



The other fibres are, PBI fibre which is a synthetic fibre with very high melting point, it has exceptional thermal and chemical stability and it does not really ignite. So, these are the fibres which are used for very specific technical textile application. So, PBI is used for firefighter clothing, it has got the other fibre is that ceramic fibre, high modulus polyethylene fibres.

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**Developments in fibre materials**

**PBI fiber characteristics**

- continuous temperature: 1,000°F (540°C); melting temperature: 1,400°F (760°C)
- no melting point (in flame tests); will not ignite or smolder; retains fiber integrity and suppleness up to 1,000°F
- low shrinkage and high strength retention when exposed to high temperature
- dyeable to dark shades with basic dyes following caustic pretreatment
- mildew and age resistant
- abrasion resistant
- low thermal conductivity
- resistant to most chemicals
- low electrical conductivity and low static electricity buildup
- resistant to sparks and welding spatter

NPTEL 33

So, PBI fibres, their basic characteristics are it is stable at very high temperature like around 1000 degree Fahrenheit continuous temperature exposure, it is stable and it is melting temperature is around 1400 degrees Fahrenheit. No specific melting point up to 1000 degrees Fahrenheit, will not ignite, retain fibre integrity. It has low shrinkage, high strength tension when exposed to high temperature. It is dyeable. So, we can dye the fibre easily with the basic dye. Mildew and age resistant, abrasion resistant, low thermal conductivity.

And it is resistant to most of the chemicals and it has low electrical conductivity, low static electricity buildup and resistant to sparks and welding spatter. So this fabric that is why this PBI fibres are used for welders clothing.

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## Developments in fibre materials

- Major Industrial PBI Fiber Uses
- high-performance protective apparel such as:
  - firefighter turnout coats and suits
  - astronaut space suits
  - high temperature protective gloves
  - welders' apparel
  - race car driver suits
- aircraft wall fabrics
- race car driver suits



34

So the major industrial applications are high performance protective apparel such as firefighter cloth, astronaut suit, high temperature protective gloves, welders apparel as I mentioned, race car driver suit, aircraft wall fabrics. So, these are the applications of the PBI fibres.

(Refer Slide Time: 23:10)

## Developments in Textile processes

Vast number of textile processes being used in the manufacture of technical textiles.

- Core-Sheath structure of yarn by Friction Spinning
- Still today, weaving plays a major role in the manufacture of technical textiles. Developments like 3D weaving, crimpless weaving have led to exploration of newer applications.
- A forecast of this industry predicts that nonwovens will overtake weaving in terms of total weight of textiles produced. In terms of the area, nonwovens have already surpassed weaving.
- Other manufacturing technologies like warp knitting, weft knitting, braiding have also seen advancements in technical textiles manufacturing.



36

Now, we will discuss the textile processes. So, after fibre, we have to now modify the textile processes for technical textiles, we have to reorient the conventional textile process towards the technical textile manufacturing processes. There are different processes being applied for yarn manufacturing, core-sheath structure of yarn, which is by friction spinning is widely used for technical applications.

So, core-sheath yarns are not normally used for apparel application where these are used for technical applications. As far as fabrics are concerned, weaving still plays a major role in manufacturing of technical textiles with modification also. So, 3D weaving, crimpless weaving. So, they have been modified normal weaving has been modified to these areas for newer applications.

It has been forecasted that nonwoven will overtake weaving in terms of total weight, because nonwoven has got their versatile characteristics apart from weaving and nonwoven, other applications are manufacturing techniques are knitting, both warp and weft knitting although warp knittings are majorly usually used for technical application. Braiding is also one area which is used for technical textile manufacturing.

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**Applications of Technical Textiles**

**Transportation textiles:**

**Technical Textiles are used in cars, lorries, buses, trains, ships and aerospace.**

- It is the largest end use area for technical textiles (around 20%).
- Carpets, Seat covers, tyres, belts, hose reinforcement, safety belts, air bags, filters, composite reinforcements for bodies, wings and engine components are made of textile products.

**Advantages of using such products in automobiles are**

- Weight savings and hence economy of fuel
- Longer life
- Flexibility in the design
- Speed up time to produce, hence cost savings in the process.

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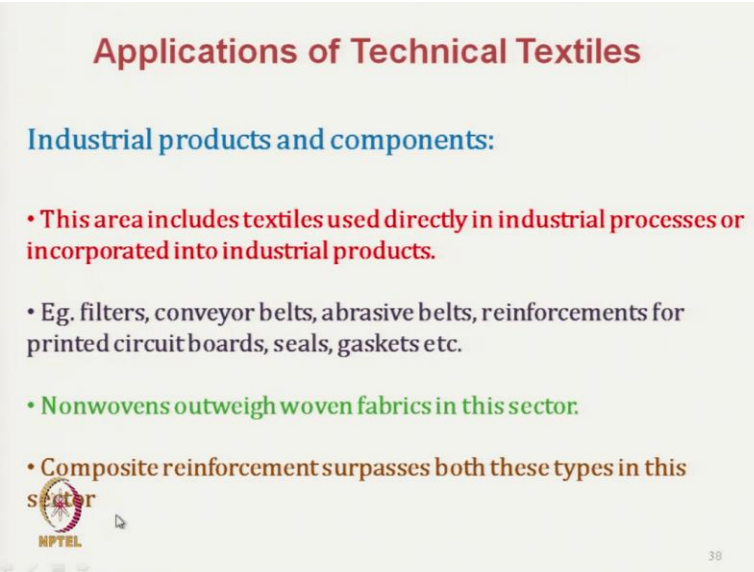
Now, I will discuss the applications of technical textiles. The areas where applications are the transportation textiles these are the textiles where they are used for cars, lorries, buses, trains, ships, aerospace. So any transportation where these textiles are used are termed as transportation textiles. It is the largest end use applications of technical textiles. Around 20% of technical textiles are used in transportation industry.

Where the carpets of cars, buses, trains, aerospace, carpets, seat covers, tyres, belts, safety belts, airbags, filters, composite reinforcement. So all these areas it is for composite body where

technical textiles are used. So advantage of using such technical textiles in automobiles are mainly it is reduction in weight, which actually in terms enhance the fuel efficiency, longer life of protect this technical textiles used in transportation industries.

Flexibility in design, we can change the design easily, which is not possible for other products, like the inner lining of car, for sound insulation. We can easily mold depending on the dimension or design of the car or carpet. So, flexibility in designing is there and we can produce quickly. So, due to all these advantages technical textiles are largely used in transportation area.

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**Applications of Technical Textiles**

**Industrial products and components:**

- This area includes textiles used directly in industrial processes or incorporated into industrial products.
- Eg. filters, conveyor belts, abrasive belts, reinforcements for printed circuit boards, seals, gaskets etc.
- Nonwovens outweigh woven fabrics in this sector.
- Composite reinforcement surpasses both these types in this sector.

NPTEL 38

Next area is that industrial products and components. These technical textiles are used for basically industry like filter, conveyor belts, abrasive belts, reinforcement for printed circuit board, seal gaskets, these are all textile products used in industry. Nonwovens normally it is actually taking over the woven fabrics in these areas. Composite reinforcement surpasses both the types of sectors like composites are used now a days industrial application.

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## Applications of Technical Textiles

### Medical and Hygiene textiles:

- Hygiene textiles are high volume but low value products (Eg. Wipes, babies diapers (nappies), adult sanitary and incontinence. - Nonwovens dominate in this segment)
- Other areas of application which is of very small quantity but very high in terms of value is medical and surgical products like operating gowns, drapes, sterilization packs, dressings, sutures, orthopedic pads.
- Of highest value products are artificial ligaments, veins, arteries, skin replacement, hollow fibres for dialysis machines



39

In medical and hygiene textiles, these are the high volume but low cost product. There are 2 types of application one is a high volume, low cost product and other is very specific very high, very expensive product. As far as hygiene textiles are concerned they are high volume, but low value product like wipes, baby diapers, adult sanitary and incontinence, these are nonwovens are dominated.

And on the other hand, there are technical textile product we used in medical and hygiene application which are very expensive, high value but used in small quantity. These are basically medical and surgical products like operating gowns, drapes, sterilization packs, dressings, sutures, orthopedic pads; these are actually used in small quantity. There is another area where the products are highly specialized and very expensive of highest value products are artificial ligaments, veins, arteries, skin replacement. So these are the areas where technical textile products are used for this specific application.

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## Applications of Technical Textiles

### Home textiles:

- Main applications are loose fibres in wadding and fiberfill applications.
- Hollow fibres with excellent insulating properties in bedding and sleeping bags.
- Replacement of foam in the furniture with fibres due to health concerns
- Woven fabrics and nonwovens (spun-bonded) as carpet and furniture backings, curtain header tapes.
- Dry-laid and hydro-entangled products in household cleaning applications



40

In home textiles also use technical products. So, main application of technical textile in home textile area is wadding and fibrefill application. Hollow fibres with excellent insulating properties in bedding and sleeping bags are being used. Foams are being replaced by technical textile product due to the health concern. Woven and nonwoven fabrics are used for carpet and furniture backing. Dry-laid and hydro-entangled products are used for household cleaning application. So, these are the technical textile products used for home textiles.

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## Applications of Technical Textiles

### Clothing components:

- These are the technical components used in the manufacture of clothing
- Eg. Sewing threads, interlinings, waddings, insulation.
- It is a major market for fibrefill products.
- Latest development of incorporation of phase change materials into insulation products to cope up with sudden extremes of temperatures.



41

Clothing components in clothing components apart from normal from normal textile, we use technical textile products like sewing threads, interlinings, insulation, waddings, these are technical textile products used in clothing components. Fibre fill products. And latest

development of incorporation of phase change materials into insulation product to cope up with sudden extreme change in temperature. So, the phase change materials which are technical textile products are being used as clothing component.

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**Applications of Technical Textiles**

**Fishing industry:**

- Nets, ropes and lines.
- High modulus polyethylene is being used for lightweight, ultra-strong lines and nets.

**Agriculture and horticulture:**

- Covering, protection and containment applications.
- Conventionally used heavier weight textiles like jute, sisal are being replaced by light weight, long lasting synthetic materials like polypropylene.
- Lightweight spunbonded fleeces used for shading, thermal insulation, weed suppression.
- Heavier nonwoven, woven and knitted structures are used for wind and hail protection.
-  Pre-Seeded Nonwovens

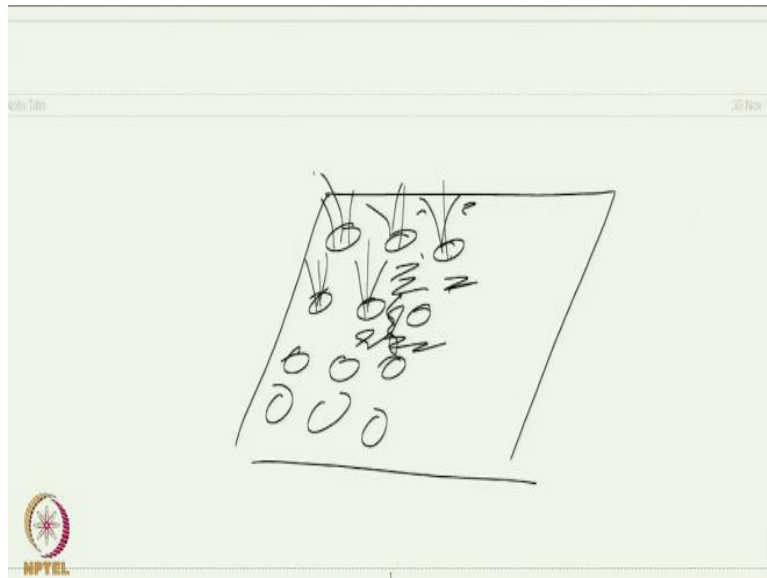
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In fishing industry, we use technical textiles like nets, ropes and lines, we use technical textiles. High modulus polyethylene being used for lightweight, ultra strong. So the polyethylene being used for nets due to its lightweight and low absorption. In agriculture and horticulture we use technical textiles in wide areas, like covering and protection and containment application.

Like conventionally we use heavy weight textile like jute, sisal are replaced with the lightweight materials like polyethylene, polypropylene. Lightweight spunbonded fleece used for shedding, thermal insulation and weed suppression. Basically, where weeds are coming along with the actual plants, if we cover the area with this type of fabric shedding, keeping the other zone ready for the plants, so, weed will get suppressed and effectively this will die.

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Like if we see, this is the field and if we cover the field with weed suppression technical textile the fabric will have holes, with specific area where we want the plants to grow these are the required area where plants are growing but, remaining all these areas we do not want any weed to grow. So if we covered this area with this type of cloth, so weed will automatically die. So this area is being used. And heavier nonwoven, woven and knitted structures are used for wind and hail protection.

Another area where nonwoven technical textiles are used in agriculture it is called, pre-seeded nonwoven where nonwoven fabric within the structure already it is pre-seeded, seed has been actually incorporated within the structure. Now, that total nonwoven mat is laid on the surface and this nonwoven fabrics are generally it is a biodegradable natural fibres like jute nonwoven being used and with the time from the seed plants will grow and the fabric will get degraded. So, that is one area of technical textile. Capillary nonwoven mats which are used to distribute moisture to the growing plant.

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## Applications of Technical Textiles

### Agriculture and horticulture ... cont:

- Capillary nonwoven matting used to distribute moisture to the growing plants.
- Bulk storage and transport of fertilizer and agricultural products use PP
- Geotextile for drainage
- Protective clothing for the employees handling sprays and hazardous equipments
- Transport textiles for tractors, lorries, conveyor belts, hoses, filters, Composite reinforcement in tanks and piping.

So, nonwoven mats, capillary mats are used to moisten the plants. Bulk storage and transport of fertilizer and agricultural product where polypropylene are used like bags, sacks where polypropylene are used for transportation and storage of fertilizer. Geotextile for drainage so we use for drainage. Protective clothing for employees handling the spraying and hazardous equipment so that protective textiles are being used where the employees are being protected from the harmful chemicals.

Maybe mask, maybe gowns we use. Transport textiles for tractors, lorries, conveyors, belts, hoses, composite reinforcement these are actually comes under transport textiles but used in agricultural applications.

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## Applications of Technical Textiles

### Construction-building and roofing:

- Application areas are permanent constructions like dams, tunnels, bridges, roads.
- Temporary structures like tents, awnings use textiles.
- Architectural membranes are being used prominently in sports stadia, exhibition centres, modern buildings.
- Nonwoven glass and polyester fabrics widely used in roofing materials
- Other textiles are used as breathable membranes to prevent moisture penetration of walls
- These act as building and equipment insulation



Double wall spacer fabrics filled with suitable material provides thermal and sound insulation

44

Next application is construction of building and roofing. The application areas are permanent construction like dam, tunnels, bridges where we use geotextiles or fibre reinforced concrete. Temporary structures like tents, awnings are used where textile structures are used for this building on and the roofing. In architectural area, the architectural membranes are being used, predominantly it is mainly used in sports stadia, exhibition centre, modern buildings.

Nonwoven glass and polyester fabrics widely used in roofing. So glass nonwovens and polyester they are widely used in roofing mainly for insulation purpose. Some breathable membranes are also used for moisture penetration of wall. These acts as building and equipment insulation. So all this nonwovens and this membranes they act as insulation materials. So double wall spacer fabrics filled with suitable material provide thermal and sound insulation. So, this spacer fabrics are used for sound insulation of a building.

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## Applications of Technical Textiles

### Construction-building and roofing .... cont:

- Glass, PP, acrylic are used to prevent cracking of concrete, plaster etc.
- Glass is being used in bridge construction
- Carbon fibers are seen as possible reinforcement for earthquake-prone buildings.
- During construction operations like safety nettings, lifting, tensioning ropes, flexible shuttering for curing concrete



45

Glass, polypropylene, acrylic, they are used for preventing the cracks in concrete or plasters. So, that is a fibre reinforced concrete are being used to prevent the cracks. Glass is being used for bridge construction. Carbon fibres are used for earthquake prone building due to its very high strength it gives reinforcement with lightweight. And during construction, we use technical textiles in the area of safety nettings, lifting, tensioning ropes, flexible structure. So, for curing the concrete so these are the areas where technical textiles are used.

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## Applications of Technical Textiles

### Packaging and containment:

- Manufacturing of bags, sacks from cotton, jute, flax.
- This area is increasingly using PP for its strength and regularity of this material for efficient handling of powdered and granular materials like fertilizer, sand, cement, sugar, flour, dyestuffs.
- Light weight nonwovens, knitted structures are being used for wrapping and protection applications, mainly in food industry.
- Wet laid nonwovens in tea and coffee bags.
- Meats, vegetables, fruits are packed with a nonwoven insert to absorb liquid
- Strong, lightweight spunbonded, nonwoven paper like materials are used for courier envelopes
- Woven strappings are safer than metal bands used with bales.



Environmental concerns are driving developments in this area

46

In packaging and containment area, so it is bags of cotton, jute, flax and gradually this cotton, jute, flax, this packaging materials are being replaced by polypropylene due to its higher strength, lower moisture regain and relatively inert chemical nature. Lightweight nonwoven and

knitted structures are being used for wrapping and protecting products, mainly in food industry. Wet laid nonwoven fabrics are used for tea and coffee bags.

Meats, vegetable, fruits are packed with a nonwoven insert, to absorb liquid present in the product. Strong light weight spunbonded nonwovens are used for courier envelopes. So for envelopes used in courier purpose, we will see that we use spunbonded nonwovens because it is strong and lightweight. So, woven straps are now a days is being used and it is replacing the steel bands due to the environmental concern and due to its flexibility.

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In sports and leisure area the performance clothing and footwears are being used due to their lighter weight, higher stretchability. Artificial turfs in sports surface, like many sports will see that artificial turfs are being used. Carbon fibre reinforced composites are used for racket frames, golf clubs, fishing rods, cycle frames these are the areas. Balloon fabrics, parachute, paraglider fabrics, sailcloth are used for sports. These are the very specific area of technical textiles.

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## Applications of Technical Textiles

### Geotextiles in civil engineering:

- These are the textiles used in conjunction with earth.
- Predicted to be an area with highest growth rate than any other sector
- Its functions are reinforcement, separation, filtration, drainage, stabilization.
- Applications are hazardous or sanitary landfills, earth embankments, dams, coastline slope protection, temporary walls, erosion control structures, clay liners, reservoirs, tanks etc.



48

Geotextiles are used in civil engineering construction for their different applications. These textiles are used in conjunction with the earth for reinforcement or drainage or different other applications, we will discuss in that segment. So, this area is predicted to be at most promising. So, the main use is the functions are reinforcement, separation, filtration, drainage, stabilization of earth. These are the different applications dams, temporary wall, erosion control. So, these are different application.

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## Applications of Technical Textiles

### Protective and safety clothing:

- New generation high performance fibres like aramids are used in this sector
- Protections needs to be given against cuts, abrasion, ballistic, impacts, explosions, fire, hazardous dust particles, nuclear, biological, chemical, high voltage, static electricity, extreme cold, foul weather, poor visibility etc.
- Sensitive instruments and processes like that of electronics and pharmaceuticals need protection wherein textiles can be used. - EMS

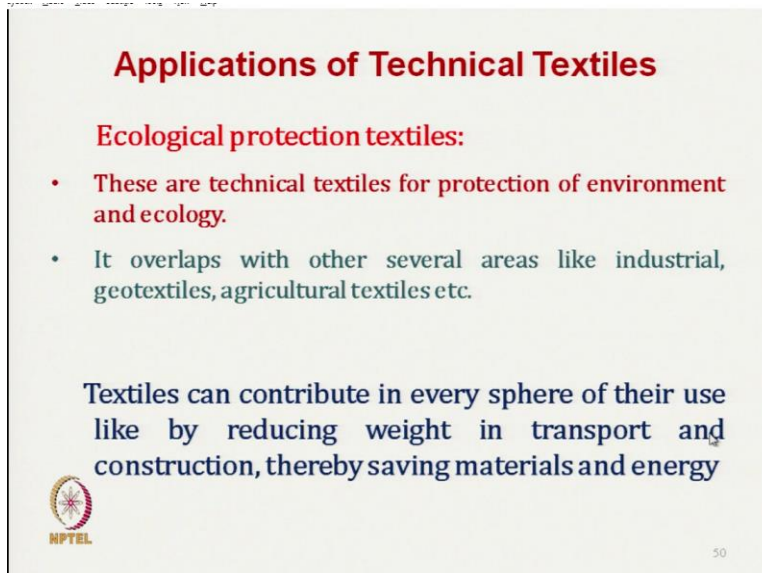


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Protective and safety clothing area, new generation high performance fibres like aramid are used in this sector. So, they have various specific applications depending on the requirement. So, that I have already mentioned like fire protection, ballistic protection, chemical protection. So, these

are the different application areas and sensitive instruments are protected. For that we need electromagnetic shielding clothing to protect instruments, electronic gadgets.

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**Applications of Technical Textiles**

**Ecological protection textiles:**

- These are technical textiles for protection of environment and ecology.
- It overlaps with other several areas like industrial, geotextiles, agricultural textiles etc.

Textiles can contribute in every sphere of their use like by reducing weight in transport and construction, thereby saving materials and energy

 NPTL

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Ecological protection is also one area where technical textiles are important. These are used for protection of environment and ecology. In fact, this area overlaps many other areas like industry, industrial textile, geotextiles, agricultural textiles. So if we see these industrial textiles like your filter fabric, it is coming under ecological protection. Geotextiles, if we protect the soil, we are actually protecting the ecology. So like that it is overlapping.

So, we can say the textile can contribute in every sphere of their use like by reducing weight in transport and construction, thereby saving materials and energy. So, as far as ecology is concerned, if we use textile product, we are reducing the mass. At the same time we are reducing the energy. So, indirectly we are protecting the ecology. So, that is all about basic introduction of technical textile. We have understood the application areas, different types of fibres and from next class; we will start the specific area, we will start with the fibre reinforced composite. Till then thank you.