Technical Textiles
Prof. Apurba Das
Department of Textile and Fibre Engineering
Indian Institute of Technology - Delhi

Lecture - 01
Introduction to Technical Textiles

We will start with the basic understanding of technical textiles before going to specific areas, so, to understand technical textiles, we have to know the basic definition.

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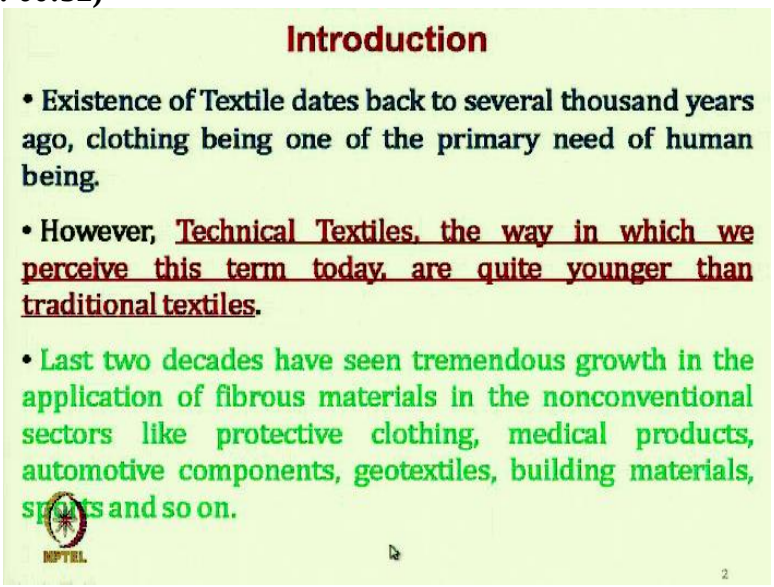

So, the textiles exist dates back to several 1000 years ago and clothing being one of the primary need of human being. But if we see the technical textiles the way in which we perceive today it is quite younger. And if we see that last 2 or 3 decades, we have seen tremendous growth in the application of fibrous materials in non conventional sectors. Non-conventional means non-apparel, non-home furnishing areas.

These are like protective clothing, medical products like medical textiles, automotive components, geotextiles, building materials, sports and many other areas. So, now we use textile materials in these areas for specific technical purpose that is why we may term these textiles as technical textiles.

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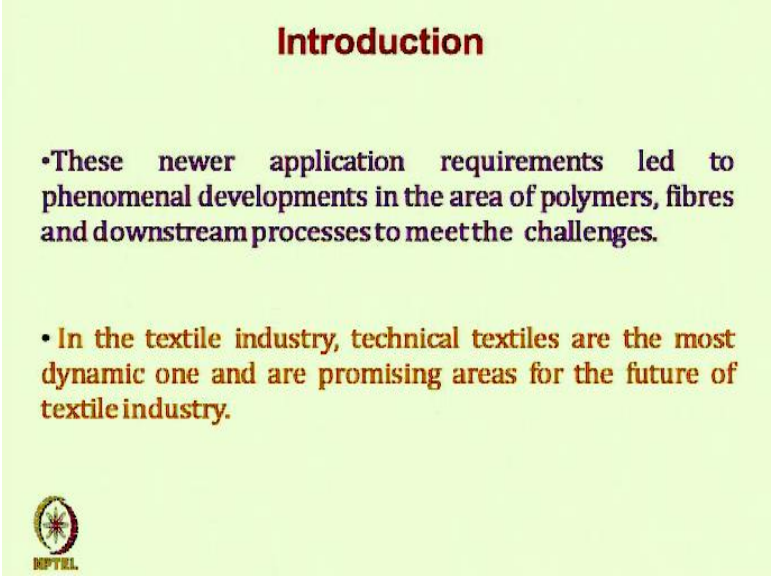

So, these newer applications, so, when we talk about the specific application that required development of polymers, newer polymers type of fibres and downstream processes to meet the specific challenge for a particular area, like woven fabric, let us say woven fabric we can use woven fabric for filter application or woven fabric for say, thermal protective application, but their construction, their selection of fibre finishing techniques will be entirely different depending on the application.

So, in the textile industry, technical textiles are the most dynamic one and promising area for future of the textile industry. Now, if we talk about the traditional textile, as far as textile industry is concerned, it is getting saturated, stagnant there is no scope or very little scope of development. Although in apparel fashion industries, they are doing well. But as far as textile manufacturing is concerned, for apparel and home furnishing of non-technical applications rather, it is getting saturated. So, it is very important to shift towards the technical textile area for the survival of the textile industry.

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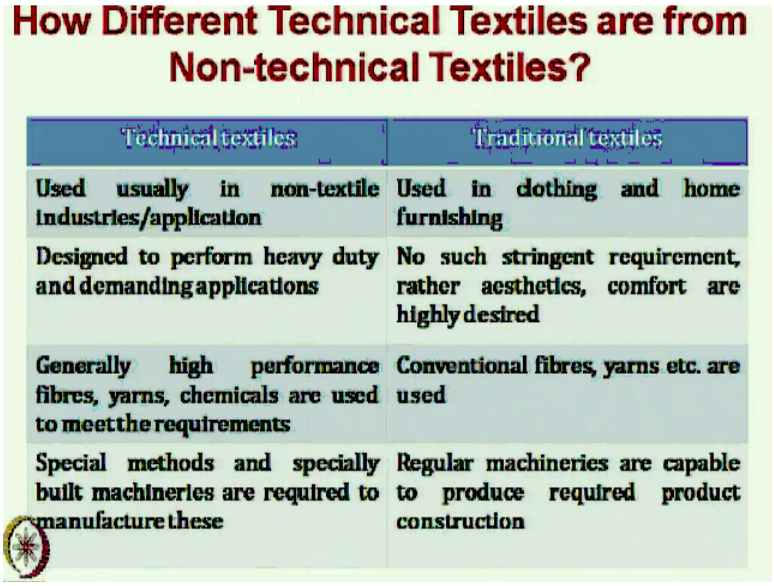

So, let us try to understand the difference between technical and traditional textiles. This will help us in understanding the ways to develop technical textiles and to shift from traditional to technical textiles. So, in technical textile we use the product mainly in non-textile industry like, if it is automotive textiles, the automotive industries are using, filter fabric different industries are using the filter fabric, but in traditional textile basically limited to clothing and home furnishing.

The technical textiles are designed to perform heavy duty and demanding applications, like fire protective clothing. Apparently it looks a normal clothing, but it has to perform specific application, like it has to be fire retardant, heat protection, protection from extreme heat, it has to be breathable so that moisture generated in the skin should come out. It should be water impermeable, so there are various specific requirements. If we talk about the geotextiles their requirements are entirely different.

But in traditional textiles, no such stringent requirements are there. Even in traditional textiles, the strength is not that important because once the product is developed or production process is done so we do not need that much strength, like in weaving, we need strength of yarn that is enough, but in whenever we come to the fabric area basically in traditional textiles, aesthetic, comfort, these are the characteristics which are important.

In technical textile generally we use high performance fibres, yarns, chemicals, these are required to meet the specific performance, basically that if we talk about the fire protective

clothing again we use meta aramid fibre which is fire protective, very high melting point. But in traditional textiles we normally do not need any special fibres, yarns or fabric conversion technique conventional fibres yarns are generally used. In technical textiles, we require special methods and specially built machine to manufacture technical textiles.

But in traditional textiles, we do not need specialty machines to produce the traditional product, like in technical textiles, we may need composite manufacturing, for composite we need very special machines, we will discuss in detail, or may be filter fabric we may need nano fibre coating. So, that requires specialty manufacturing technique. But in traditional textiles, we do not need such machinery regular machines are capable to produce the traditional textile products.

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Another important aspect is that this technical textiles are generally very expensive. So, it is expected to last longer not only due to the cost but the expected life should be long because the other parameters other structures are dependent on the technical textiles, like for geotextiles, once we lay the geotextile under the ground, say for railway track construction or road way construction, the life should be very long. Otherwise we cannot afford to change frequently.

On the other end, traditional textiles are little bit cheaper in price and we do not expect longer life. For technical textiles we need specific test methods because the requirement of technical textiles are very specific, which we do not need in case of traditional textiles. Like geotextile, for geotextile we need very very specific test methods, like repeated loading, long term, clogging

behavior, surface adherence characteristics, which you do not need for traditional textiles. So, all these aspects will discuss in detail. Now, let us try to first understand, what are technical textiles as far as literature is concerned?

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The technical textiles are value added textile products that provide added functionality and applications other than regular fibre to fashion supply chain. So, we need some added functionality, regular fibre to fashion supply chain is okay. But, if we add some functionality then we will call those products as technical textile products, like normal fabric, normal fibre to fashion supply chain products, if we say impart one extra functionality like, UV protection that will become technical textile product or may be anti-bacterial finishing. We can call that as technical textile product or functional product and this technical textile encompass high performance fibre, yarn and different type of conversion techniques like woven, knitted, nonwoven, braided, as well as composite structures.

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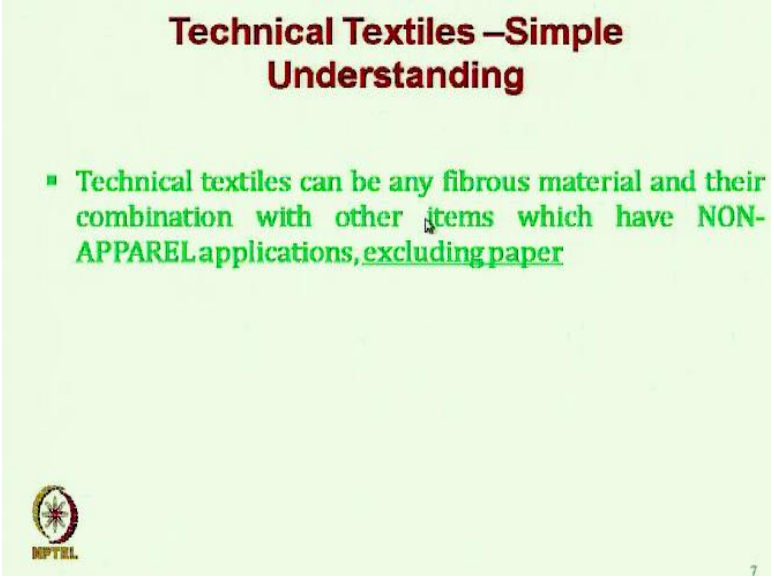

So, the simple understanding of technical textile is, these technical textiles can be any fibrous material and their combinations with other items which have non-apparel applications, excluding paper. Paper we do not consider as technical textile product, although it is made up of very short fibres.

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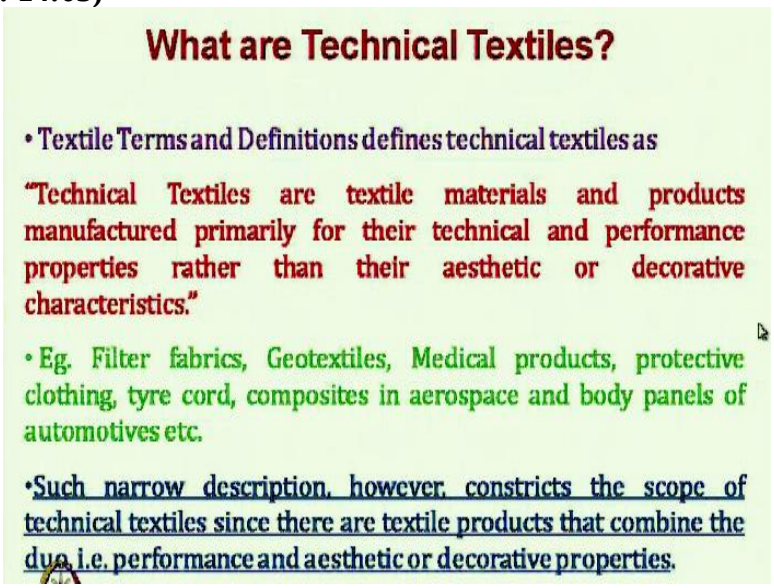

So, by standard definition, the technical textile is defined as these are the textile materials and products manufactured primarily for their technical and performance properties rather than their aesthetic and decorative characteristics. Although this we consider as standard definition, but it has got limitations. So, in this definition, we term filter fabri,c geotextiles, medical product, protective clothing, tyre cord, composite in aerospace, these are the areas we can bring all this area within this definition.

But such narrow description, however, constrict the scope of technical textiles, since there are textile products that combine the dual performance that is performance as well as aesthetic or decorative properties. So, aesthetic and decorative properties are also important. And if we add some performance, then we may call them as technical textiles. Like flame retardant furnishings, breathable leisurewear, these are technical textiles. So a furnishing fabric, if we impart flame retardancy, although it's basic function is decorative performing, but if we impart flame retardancy then it will become technical textiles.

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So, first, then we can ask, why do we need technical textiles? The areas in various industries, where other technical materials like normally we use steel were being used for centuries together the technical textile could make their foray to replace the conventional materials due to various advantages. So, the conventional technical materials are being replaced by technical textiles gradually. The main advantages of technical textiles over conventional products like steel or wood are their flexibility, their elasticity, strength and design possibilities.

The strength means specific strength, if we compare the technical textile product the specific strength that means strength offered per unit mass is much, much higher. So, tyre cord fabric, a textile construction provides 75% of total strength of automotive tyre. So, these are the textile products, textile structure in composites, the composite parts used in automotive, aerospace, civil and mechanical engineer applications. They are mainly used for their lightweight and they are

stronger than steel as far as specific strength is concerned. So, now automotive and aerospace body parts are produced from textile composites due to reduction in mass.

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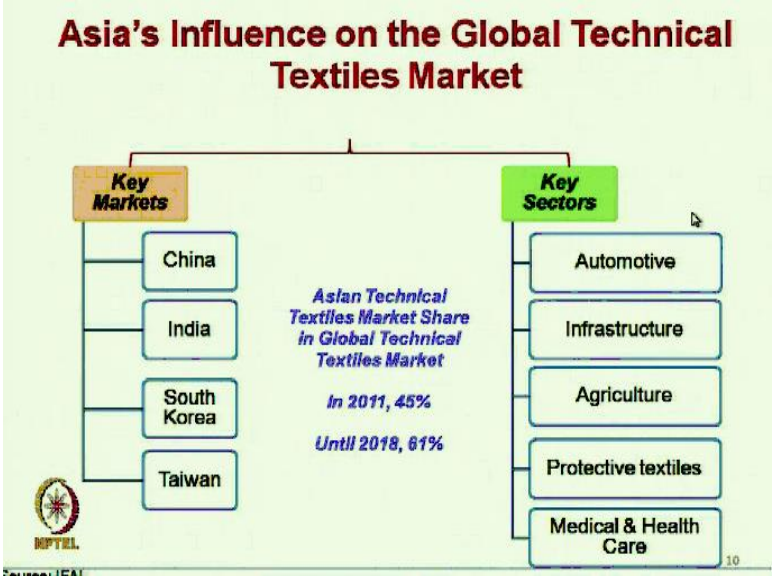

So, if we see the Asia's influence on the global textile market, technical textile market, there are basically 4 players, China, India, South Korea and Taiwan. And the main sectors are automotive, infrastructure, agriculture, protective textiles, medical and healthcare textiles. These are the major sectors. Apart from these sectors, there are many other sectors also coming up.

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Now, if we see the technical textile scenario in India, unfortunately it has not picked up, but we are gradually trying to pick the market. The technical textile consumption in India is one-fifth of total Asian consumption. Our consumption is one-fifth of total Asian consumption and

employment growth is expected 13% and around 3 million people were involved in technical textile sector but if we see the nonwoven products, it is only 3% of Asia's product. So, we have tremendous scope in nonwoven sector.

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And the areas of Indian textile industry, if you see the technical textile industry, mainly packaging sector, we are doing here little bit, home textiles and industrial textiles mainly filter fabric and conveyor belts like this. So, we need to focus all these areas, although average growth rate is 12%. But if you see the actual production expected production in billion dollar it is 8.4 in packtech, these are the major area, India is doing well but we must concentrate in other areas also. So, we must see, what are the reasons, why then the Indian technical textile industry has not grown yet?

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The main requirements for growth of technical textile sector in India are these reasons that lack of awareness on how to make finished or convert technical textile products. So, we are lacking the awareness of making the finished product. Marketing know how to sell and trade the technical textile products. So, we must understand the need of the customers. Technical textile sector in India should know where and how technical textiles are used on a daily basis. So these are the areas if we focus we will be able to generate the job opportunity and enhance the production capabilities.

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The global perspective for technical textiles in India: India's specialty fabric and nonwoven industry is fragmented. So, we have industries, but they are in very small players are there. It is totally fragmented. No big industries are there which are working on only technical textiles or

nonwovens. And the industries are also not very interested in setting up state of the art technology as compared to the global players.

We are measurably dependent on the import of technical textiles, but we must change our mindset. Textile industry is also undergoing a major reorientation from apparel to specialty fabric applications. So, this is good sign, but this reorientation is not that fast.

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Although the focus of the government is upgrading the infrastructure where geosynthetics are used and increasing the use of automotive textiles, where nonwovens are measurely used. So, government is trying hard in introducing technical textiles in India. Other niche areas are safety and protective textiles which are mainly used for defense personnel, medical textiles, agricultural textiles like nets, shading, and industrial textiles, basically filter fabrics. These are the areas where we have great scope in India.

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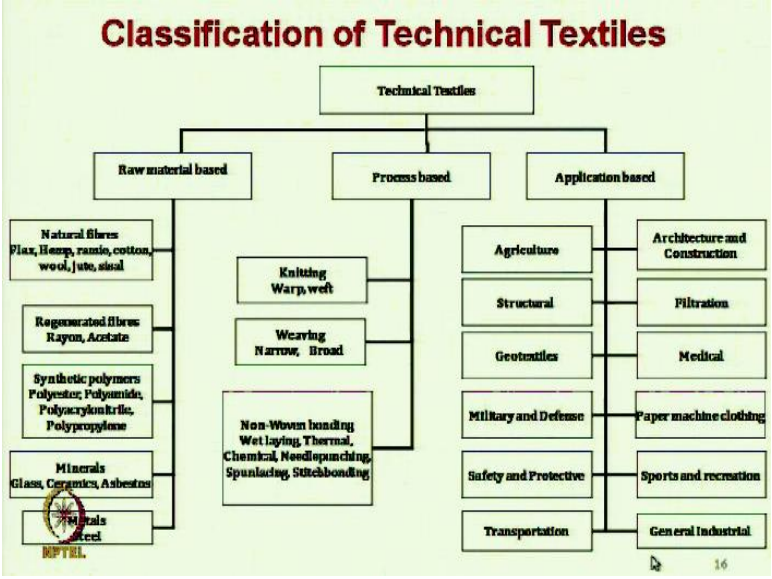

Now coming to the classification of technical textiles. Broadly the technical textiles are classified in 3 areas, they are classified based on raw material, based on manufacturing process and based on areas of application. So, if we see the raw materials, they are again classified in various classes, the fibres are natural fibres where we may use flax, hemp, ramie, cotton, wool, jute.

So, these are the fibres, natural fibres, which we use for technical textiles. Regenerated fibres viscose, rayon, acetate they are also used in technical textiles, they have specific properties, synthetic fibres like polyester, polyamide, polyacrylonitrile. So, these are the normal synthetic fibres. Mineral fibres are also used glass, ceramic, asbestos. So, these are the fibres which we use in technical textiles product and metals. So, these are the raw materials we use for technical textiles.

As far as the conversion process is concerned, we use conventional weaving also, knitting, warp knitting, weft knitting we use. In weaving, depending on the requirement, we sometimes use narrow woven fabric, like seatbelt in car or tape. So, these are the narrow weaving we used and broad weaving also is sometimes used, if we use say geotextile, woven geotextile where we need wide width weaving. These are not required for apparel applications.

Another ways nonwoven wet laying, thermal bonding or chemical bonding, needle punching. So, these are the areas we use. As far as applications are concerned the technical textiles are classified in different areas, agricultural application, structural application, geotextile, military

and defense application, safety and protective application, transportation, architectural construction, filtration, medical application, paper making machine clothing application, sports and recreation, general industrial application, like conveyor belts and all these appear. These are the few areas apart from this there are many areas of application.

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So, after this classification, basically the Techtextil, one leading international trade exhibition organization for technical textiles, they have classified the technical textiles in 12 main areas of application. What are these areas? First is agrotech. Agrotech is basically it is the technical textiles used for mainly the agriculture, aquaculture, horticulture or forestry application. So whatever textiles we used specifically for these areas are coming under agrotech.

Buildtech- basically it is a building and construction, like fibre reinforced concrete, this technical textile will come under buildtech or composites also. Clothtech basically technical components for footwear or clothing. Now-a-days we see in footwear majority of the components are basically textile these are the, these are coming under clothtech. Geotech is an applications in geotextiles and civil engineering applications.

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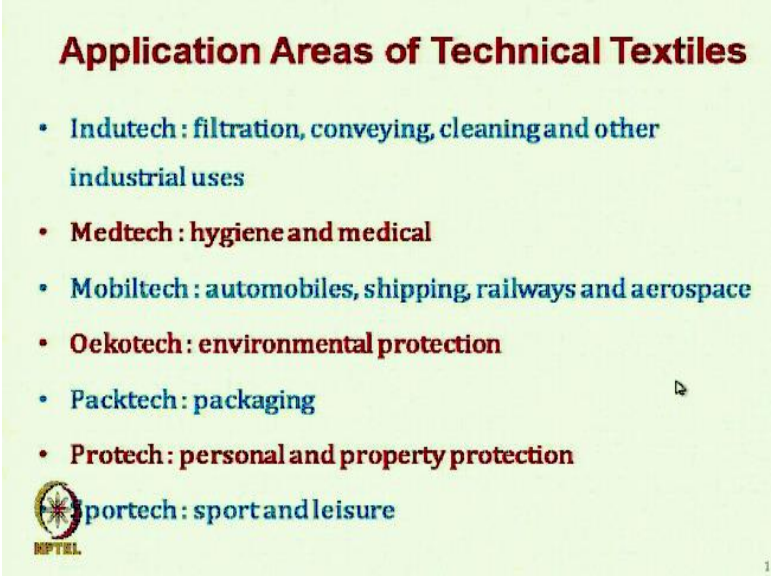

So, this geotextile, geotech, are different from agrotech and buildtech, although sometimes it may overlap hometech The technical textile products which are used as the components of furniture, floor covering, household textiles, these all are coming under hometech. Indotech- basically it is these are the filtration, industrial filtration, conveying cleaning and other industrial applications. Medtech- basically hygiene and medical applications. Mobiltech- automobiles, shipping, railway and aerospace application.

Oekotect- mainly environment protection, textiles used for environment protection, like filter may also come in to environmental protection, oekotech. Packtech- it is basically used for packaging where our countries doing well. Protech- personal and property protection, like extreme heat or fire protective clothing, extreme cold protective clothing, these are all coming under this protech. Sportech- basically sports and leisure. So, these are the 12 areas the technical textiles are divided in based on the areas of application. Now, let us understand the variables, what are the variables in the production of technical textiles?

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First variable is the selection of Polymer. We cannot use polymers randomly. Depending on the type of application type of functional requirement we have to select the polymer. Whether we need thermoplastic or thermoset polymer that depends on the areas of application. Crystallinity and molecular weight typically influenced the fibre property. So, we have to decide the crystallinity and molecular weight we have to select accordingly.

Next is the type of fibre. As I have already mentioned, there are different types of fibres; natural fibre or synthetic fibre. So, depending on the application, we may select natural fibre or manmade fibre. If we need high strength, very high strength, say a bulletproof clothing, we cannot use normal natural fibre like cotton, flax, jute, there we have to use high performance fibre like Kevlar. We normally use for very high strength composite manufacturing, we normally use carbon.

So, depending on the application area we have to decide the type of fibre. And also whether we need the filament or staple that also depends on the areas of application. Suppose we want to entrap higher amount of air within the structure, we may go for staple fibre. Sometime we need fibre with higher safe factor for better wickability. So, we have to decide depending on the application.

Next comes the type of yarn. Staple yarn, monofilament, multifilament, twisted, textured. These are the different types of yarn and this methods of selection of type of yarn whether we will go

for monofilament yarn or multifilament yarn, staple yarn or whether it is a twist less or twisted depends on the type of application. And we may select different methods of staple yarn production like ring spun, rotor spun, air jet, friction. They are used in technical textiles, but depending on the type of application.

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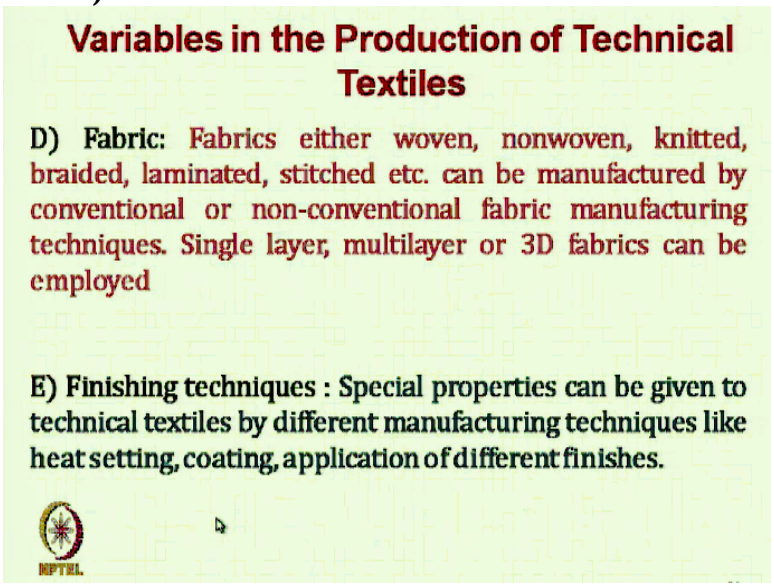

After yarn, then comes the fabric. Converting the yarn to fabric, as far as woven and knitted are concerned, we need to first select yarn then the fabric, but nonwoven we get directly from the fibre. For higher performance many technical textile product we use multi-layer, so selection of single layer or multi-layer or sometimes we use 3 dimensional fabric to have required characteristics.

And after everything, polymer, fibre, yarn, fabric the finishing technique is extremely important, where we can impart special properties, like special coating, breathable coating or maybe water repellent coating, anti-static coating or maybe anti-soil coating. So, different types of coatings are there, where we can impart through finishing techniques.

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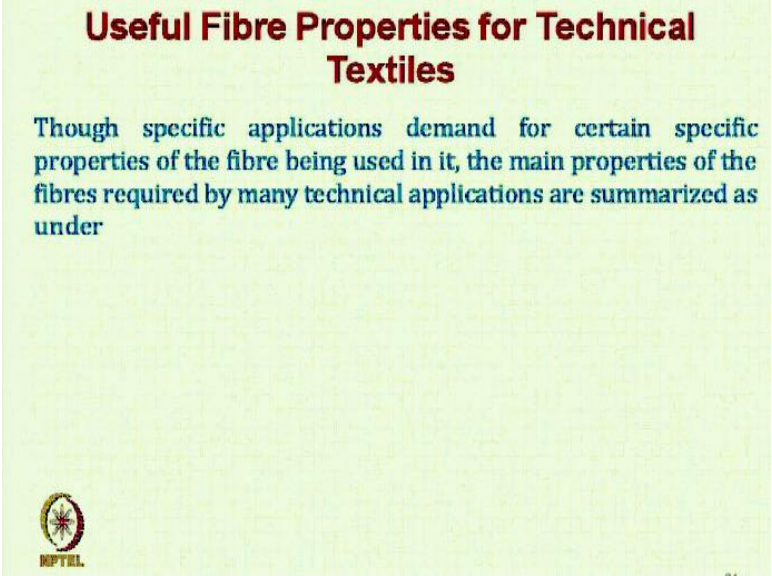

Now, if we see the fibre properties, this we will discuss in next class. Till then thank you.