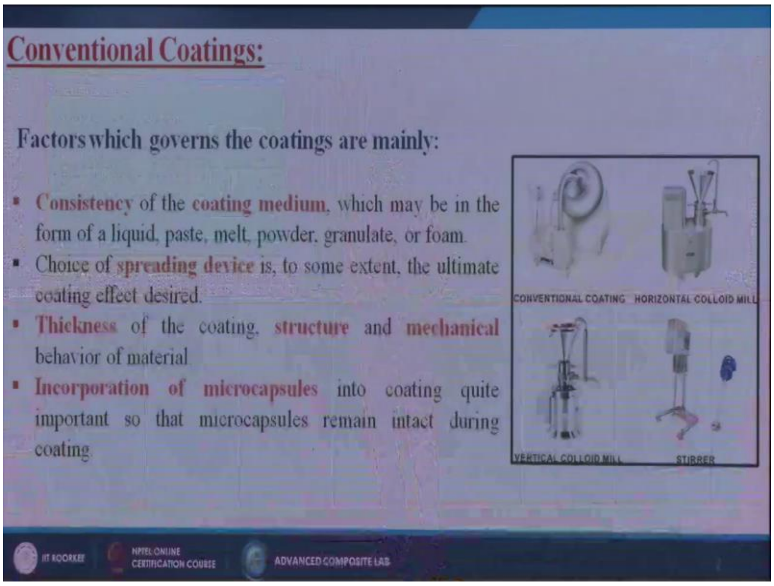
Surface Engineering of Nanomaterials
Dr. Kaushik Pal
Department of Mechanical and Industrial Engineering
Indian Institute of Technology, Roorkee

Lecture – 35
Advantages of Microencapsulation over Other Conventional Methods

Hello. In this lecture actually we are going to discuss that: what are the advantages if you are going to do the coating of microcapsules rather than the other conventional methods. So we keep the title like this - Advantages of Microencapsulation over the Conventional Methods. So, in these particular case a just before going to start the lecture into detail we are going to give you some kind of overview that what we have discussed in our earlier lectures, and what we are going to do.

(Refer Slide Time: 00:57)



So here, first we have shown some kind of conventional coatings; this is the normal conventional coatings by which we can do the modifications of our surface or may be the substrate. So here, from this particular figure we can understand that we are having some conventional coatings, some horizontal colloid mills, some vertical colloid mills, some kind of stirring either it is magnetic stirrer or may be some kind of mechanical stirring process.

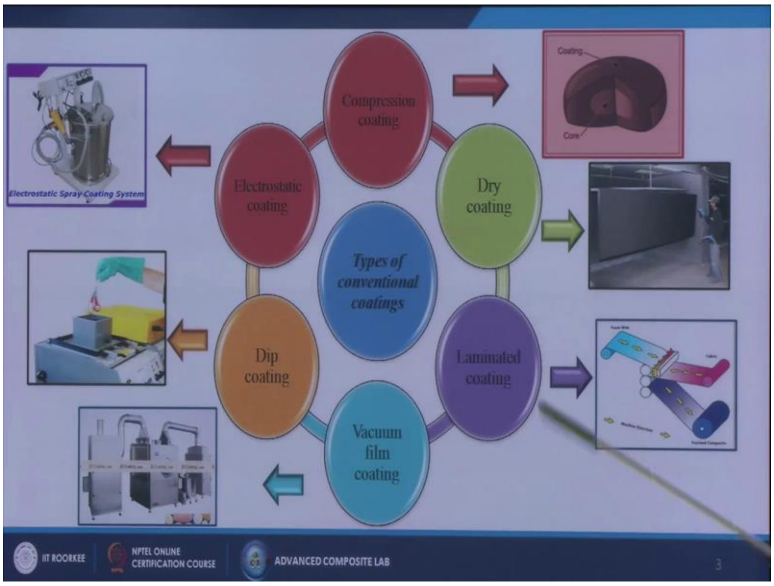
So, factors which governs the coatings are mainly consistency of the coating medium which may be in the form of a liquid paste melt powder granulate or may be the foam.

So, any kind of particles in any other forms it can do the coatings whether that particle will simply stuck on to the substrate itself or maybe it will deposit on to the substrate itself, it will make a film on to the substrate itself or may be as a powder foam it can stick with the substrate itself we can do any kind of coating by these conventional methods.

Thickness of the coatings structure and the mechanical behaviour of the materials; so either we can change the mechanical properties or may be the thermal properties of those particular materials, we can change the thickness of the coatings, structure means outer surface of the coating structure we can increase or decrease the surface roughness of these particular materials or maybe we can change the outer properties of these particular materials by these conventional techniques.

Next is that incorporation of microcapsules into coating quite important so that microcapsules remain intact during coatings. So, whatever the coating materials we are trying to use that kind of coating materials simply we are putting on to the substrate itself so that that coating or may be the microcapsules materials will remain intact into the coating so that it will give you the better properties.

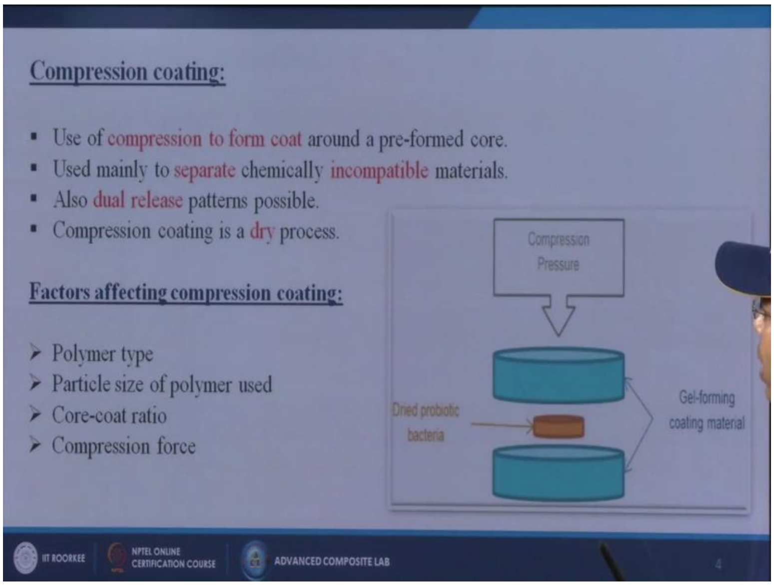
(Refer Slide Time: 02:41)



So here, there are several types of conventional coating techniques are adopted over here some kind is known as the compression coating, so here it is known as the compression coating by simple using the pressure we are compressing our substrate into the coating techniques. Then we are using some kind of dry coating; that means we are applying some kind of particles with may be some heat or something like that like spring we are doing the coatings. Some kind of laminated coatings; that means, structural coatings or may be the layer by layer coatings we can do unto our substrate itself. Some kind of vacuum film coating by applying the vacuum medium we can do the coating of our materials. Then we are doing the deep coating, so simple we are putting out sub street or may that our materials in two some chemical solutions and like some kind of viscous materials and like this we can do the coating on to the substrate itself, some kind of electrostatic coatings also we can do for our materials or may be the substrate.

So, these all are the different types of conventional coatings. Generally we can adopt or maybe we are adopting in our day to day life. So, first one is known as the compression coating.

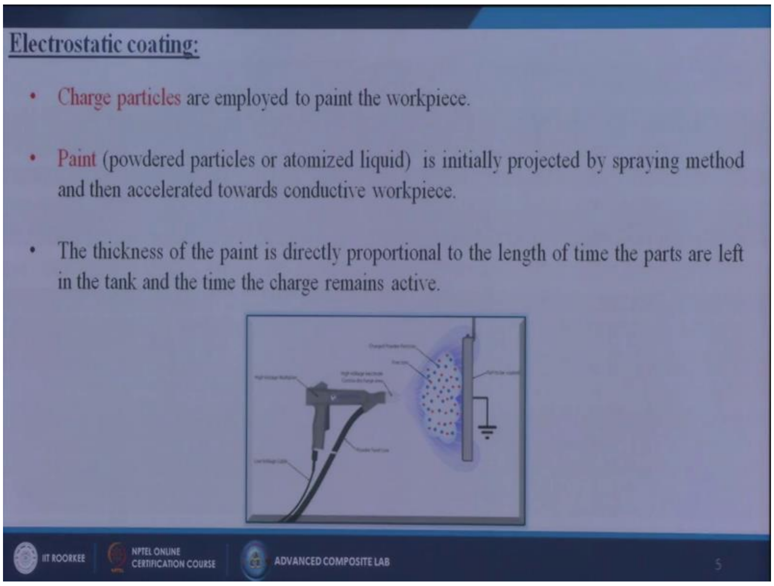
(Refer Slide Time: 03:44)



So here, use a compression to form coat around a pre formed core used mainly to separate chemically incompatible materials, and then also dual release pattern possible compression coating is a dry process. So, simple in that particular case we are having some kind it is an example; so here we are putting some kind of dried probiotic bacteria then we are having two molds and then in between the two molds simply we are putting our coating materials, then by applying the heat and applying the mechanical pressure we are pressing from the both sides and then by these techniques we are doing the coating on to our materials or may be on to the our substrate.

So factors; First one is called the polymer type then the particle size of that particular polymers and that core coat ratio that how much area we are going to coat and the compression force. So, it depends upon how much loads generally we are providing from the top or may be from the both sides. Depending upon that, we can increase or decrease the thickness of our particular coating materials.

(Refer Slide Time: 04:53)

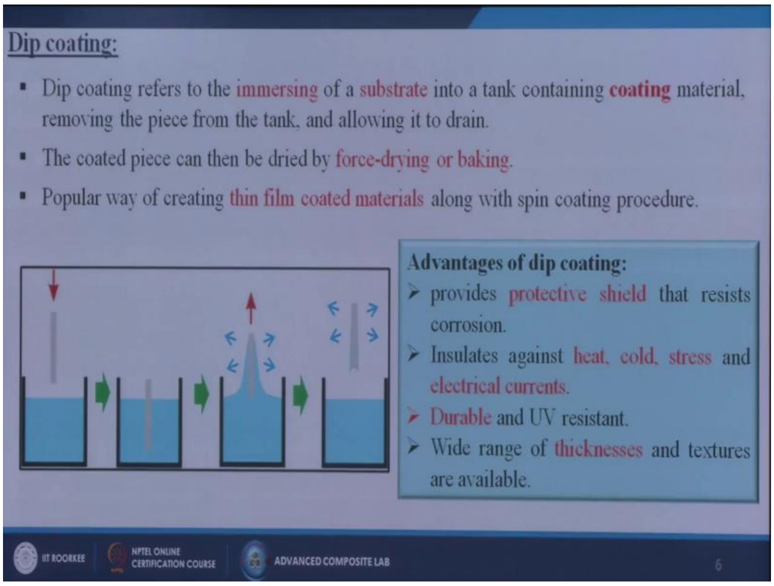


Next one is called the electrostatic coating. It is a charge particles are employed to paint the workpiece. So here from this particular figure you can understand that through these channels the powder or may be that particles which we are going to coat on to a substrate it is coming out over here. Then, through this gun we are pressurising these nano particles on to the substrate itself. And then whatever the particle is charged the opposite charge simply we are employing on to our substrate itself. So, through this charge particle the same opposite particle it will come then it will attract by this substrate itself and it will attach on to the top of that.

So here, like a paint powder particle or may be the atomized liquid is initially projected by spraying method and then accelerated towards the conductive workpiece. So here, the only a small drawbacks is that whatever the material we are going to coat it should be conductive, it should not be any insulator or may be any kind of non conductive materials. The thickness of the paint is directly proportional to the length of time. The parts are left in the tank and the time the charge remains active.

So, if these particles will be in the negative charge it should be it should be positive, so when this total positive or may be the negative percentage will be filled up then automatically the ion transfer particle transfer will be stopped and your coating will be finished. Or may be how much time we are keeping this one for a longer time the coating thickness will be more, if the holding time will be less than we can observe the lesser thickness.

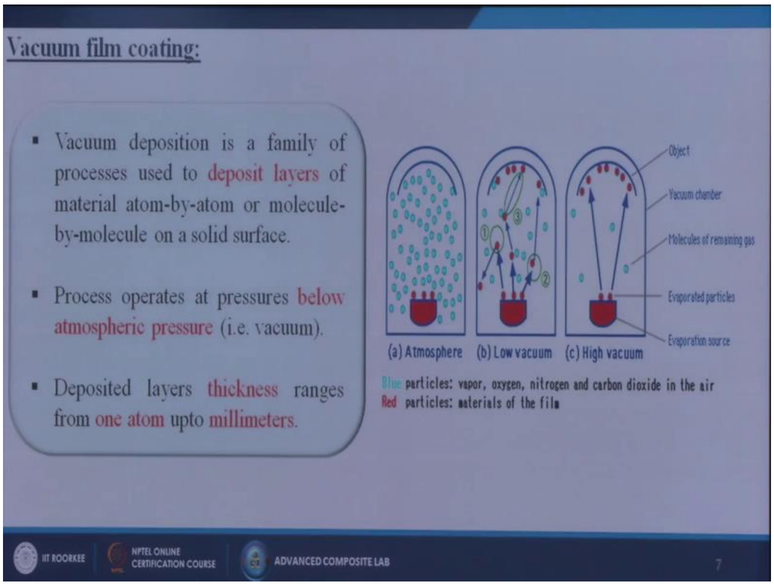
(Refer Slide Time: 06:29)



Next one is call the deep coating. So, deep coating refers to the immersing of a substrate into a tank containing coating materials removing the piece from the tank and allowing it to drain, it is the simple methods. Simple, we are having that substrate which materials we are going to coat we have to take into the solution formations, then simple we have to deep our materials into the solutions, we have to keep some time depending upon that whatever the coatings thickness you want. Then after certain times simple you have to take it out and finally you can find that you are having the substrate having the coating on to that material.

So, if you need by layer by layer techniques then several samples you have to put into the different solutions or may be if you want the more thickness then again you have to deep the solution materials into the same solutions so that you can get a more thickness of your coatings materials on to the substrate itself. Whatever the advantages of deep coating: provides protective shield that resists the corrosions, insulate against heat cold stress and the electrical currents, durable and ultra violet resistant, wide range of thicknesses and the textures are available. So, these kinds of properties you can get by this type of coating.

(Refer Slide Time: 07:40)



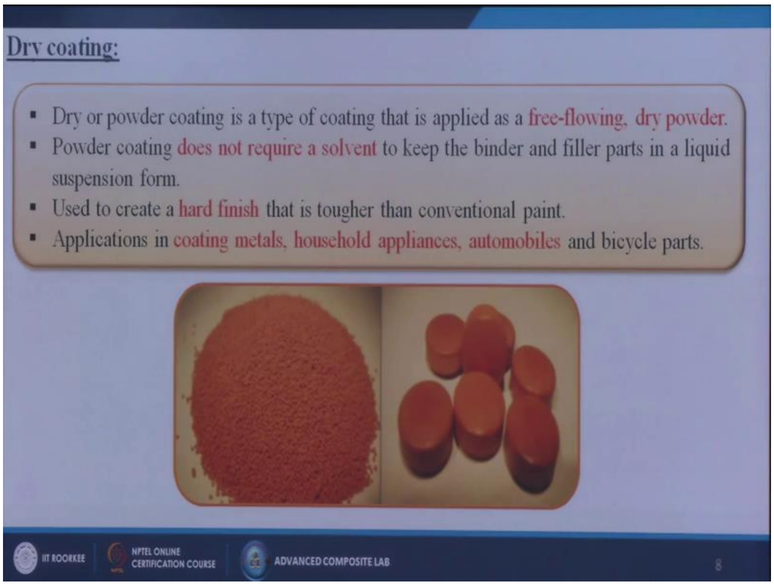
Next one is called the vacuum film coating. So, vacuum depositions are a family of processes used to deposit layers of material atom by atom or molecule by molecule on a solid surface. Process operates at pressures below atmospheric pressure. So generally we are doing into the vacuum conditions. Deposited layer thickness ranges from one atom up to the millimetres. As I said already depending upon the keeping time, depending the material quantity, depending upon the flow rate you can change the coating thickness onto your material.

So here, this is known as the atmosphere conditions, this is known as the low vacuum conditions, this is known as the high vacuum conditions. Here, the top most is your object, this whole things is the vacuum chamber, here the molecules of remaining gases, here it is the evaporated particles and this is the source.

So, what type of material we are going to coat? You have to put that material as a source then you have to put that whole thing into the vacuum formations, you have to hesitate that materials so ion will come from these particular source and then the ion will directly go. So here we are using some kind of gases which is nothing but the carrier gases, because if we do not put any kind of carrier gases the ion will not come from one source to another. So, simple these kinds of carrier gases it will allow that ion to come from the source and to deposit on to the substrate, just it will act as a helping hand for these ionization process.

So here, the blue particles vapour oxygen nitrogen or may be the carbon dioxide in the air red particles is the materials of the film which we are going to coat onto the substrate itself.

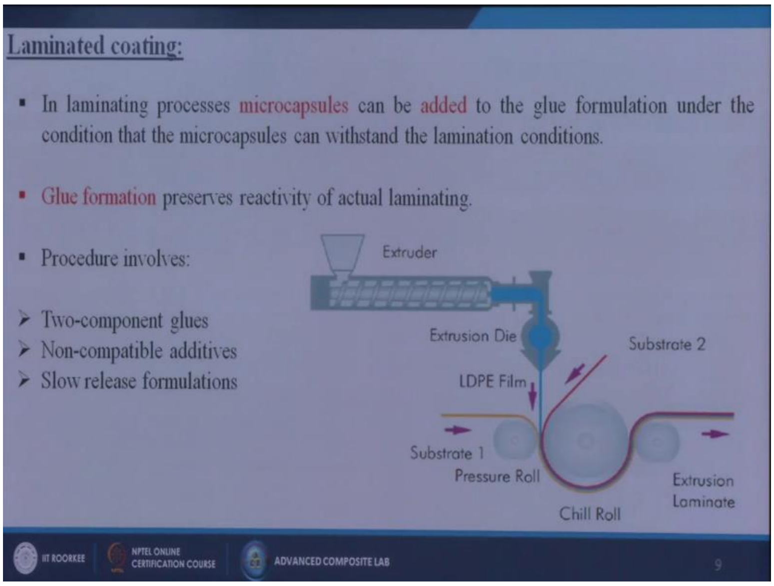
(Refer Slide Time: 09:16)



Next one is called the dry coating. So, dry powder or some kind of dry or powder coating is a type of coating that is applied as a free flowing dry powder. Powder coating does not require a solvent to keep the binder and filler parts in a liquid suspension form; used to create a hard finish that is tougher than the conventional paint; applications, coating metals, household appliances, automobiles and bicycle parts.

So, simple it is like a that we are having some kind of powder or may be the heap of the powder or may be the heap of the nano particles I am having the substrate, I have to hold that substrate onto the powder may be some kind of rolling actions or may be some kind of sliding actions simply we are attaching this kind of dry powder on to the top of the substrate itself. So, that is why you are not applying any kind of heat or may that powder into the dry formations that is why it is called the dry coating techniques.

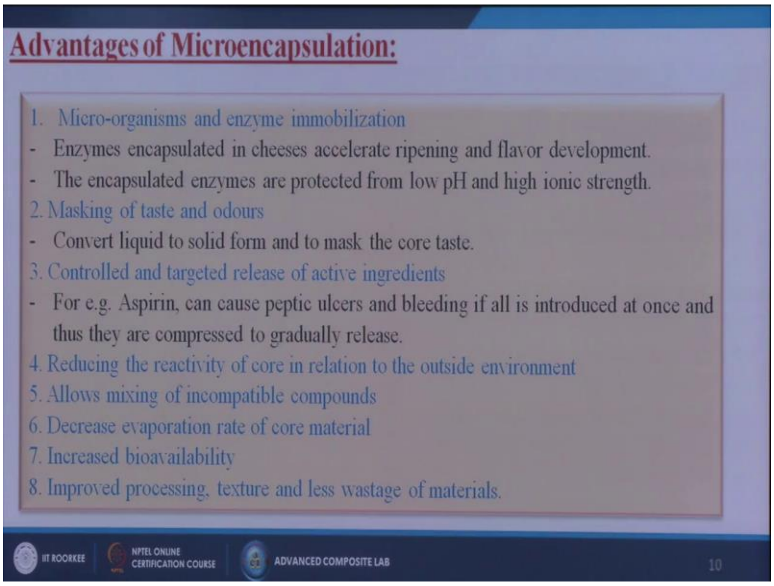
(Refer Slide Time: 10:09)



Next one is called the laminated coating. As I have already discussed that this kind of coatings is by the layer by layer coatings onto the substrate itself. So here, from this particular case the laminated process microcapsules can be added to the glue formulations under the conditions that the microcapsules can withstand the lamination conditions. Glue formation preserves reactivity of the actual laminating. Procedures involve two component glues, non-compatible additives, slow release formulations.

So here this is nothing but the extruder it is having the hopper, in hopper you are putting the different materials so that we are putting certain kind of temperature because it is having different types of heating zone. So, by getting that heating zone these materials in the pallet forms it will melted properly, then through these nozzle it will come like a film structure, then we are having the substrate on top of that it is giving a layer by layer, by layer by layer techniques it will give a coating on to the material. So, that is why it is called the laminated coatings by these conventional methods.

(Refer Slide Time: 11:19)

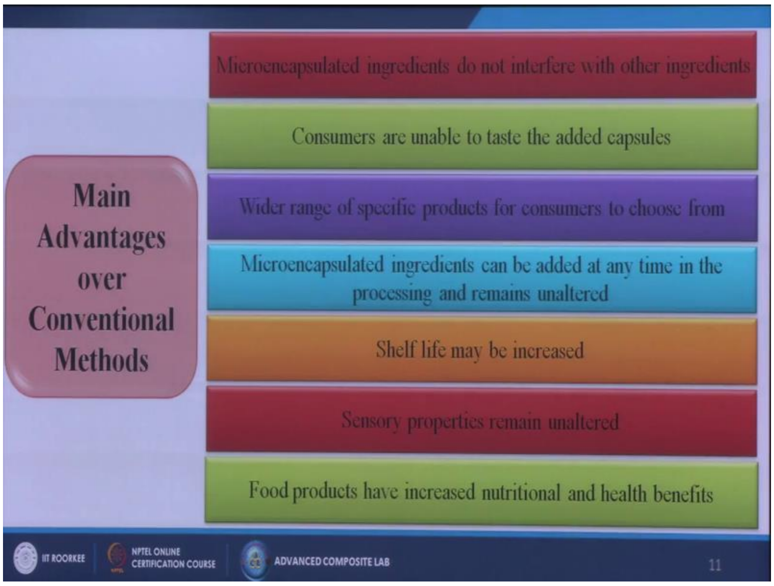


Then come to the advantages of the microencapsulations, because the main aim of our this lecture is that what is the microencapsulations and what are the advantages of microencapsulations over these conventional techniques.

So, first is that micro organisms and enzyme immobilizations: enzymes encapsulated in cheeses accelerate ripening and flavor development, the encapsulated enzymes are protected from low pH and high ionic strength. So, this is also a one advantage for this microencapsulation. Next one is that masking of taste and odours: convert liquid to solid form and to mask the core taste. So, by changing the outer properties you can change the material properties, you can change the taste of these particular materials. Like aspirin can cause peptic ulcers and bleeding if all is introduced at once and thus they are compressed to gradually release. So, when we are taking the medicine as aspirin we are keeping these materials slowly slowly so that slowly slowly it will decompose into our stomach so that it can act properly not only that if it will release in a high rate, so may be some kind of peptic ulcers and bleeding can be occurred into our stomach itself.

Next reducing the reactivity of core in relation to the outside environment, allows mixing of incompatible compounds, decrease evaporation rate of core materials, increased bioavailability, improved processing texture and less wastage of the materials. So, these all are the added advantage for this kind of microencapsulations.

(Refer Slide Time: 12:57)



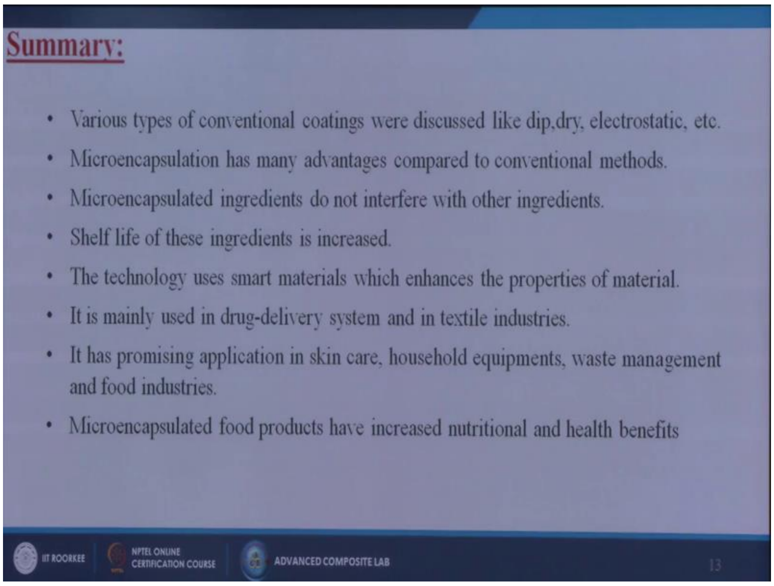
Here also it is into the broad spectrum we are showing that; what are the main advantages over the conventional methods? First one is that microencapsulated ingredients do not interfere with other ingredient that is the beauty of this kind of techniques, it is one kind of like a targeted outcomes of this kind of materials. Consumers are unable to taste the added capsules; wider range of specific products for consumers to choose from. Microencapsulated ingredients can be added at any time in the processing and remains unaltered. Shelf life may be increased. Sensory properties remain unaltered. Food products have increased nutritional and health benefits.

Actually, the main advantages of this microcapsule are that it can be used widely for the biomaterial applications, food packaging applications, food applications, or may be some kind of medical applications.

(Refer Slide Time: 13:56)

So, what are the applications of the microencapsulations? West management treatment, electronic purposes: medicine, pharmaceutical, biotech purposes; vetenary, food and feed purposes: chemical industry and agriculture: household and personal care, textiles: photography, graphics and printing. So, for this is the various list properties we have mentioned over here, but still the applications are more.

(Refer Slide Time: 14:25)



So, what are the summary of this particular lecture? Various types of conventional coatings were discussed like dip dry and the electrostatic process, so these all are the conventional methods. Microencapsulation has many advantages compared to conventional methods. Microencapsulated ingredients do not interface with other ingredients; that is the added advantage for these microencapsulations. Shelf life of these ingredients is increased; we can increase or decrease the shelf life of these particular materials. The technology uses smart materials which enhances the properties of material it is mainly used in drug delivery systems and in textile industries. It has promising applications in skin care like a biomaterial applications, household equipment, waste management, and food industries for food packaging or may be that conservation of the food technology. Microencapsulated food products have increased nutritional and health benefits.

So by incorporating different type of microcapsules having different properties we can enhance the food order or may be that food taste or may be some kind of other techniques or may be that other properties.

Thank you.