Manufacturing of Composites
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Lecture - 03
Continued.
Laboratory Demonstration

Good morning. Welcome back to the course Manufacturing of Composites. I am Dr Amandeep Singh, I am working as TA with Dr. Ramkumar in this course. So, this is the lab demonstration session 1.

In this session, we will give the basic introduction to various kinds of fibers. We will show some fiber forms and we will show some kinds of resins here as well. And further, we will do some fabrication here as well. We will show various like a parameters, which are taken into consideration, while publication. For example, port life, the orientation of fibers, the amount of resins, that is to be put. Then various parameter, this would be; obviously, the some specific kind of properties, what we need to obtain, where we need to achieve, that would be like attain by some specific combinations.

So, those will test in the further sessions. So, first I will start here with an overview of few fibers.

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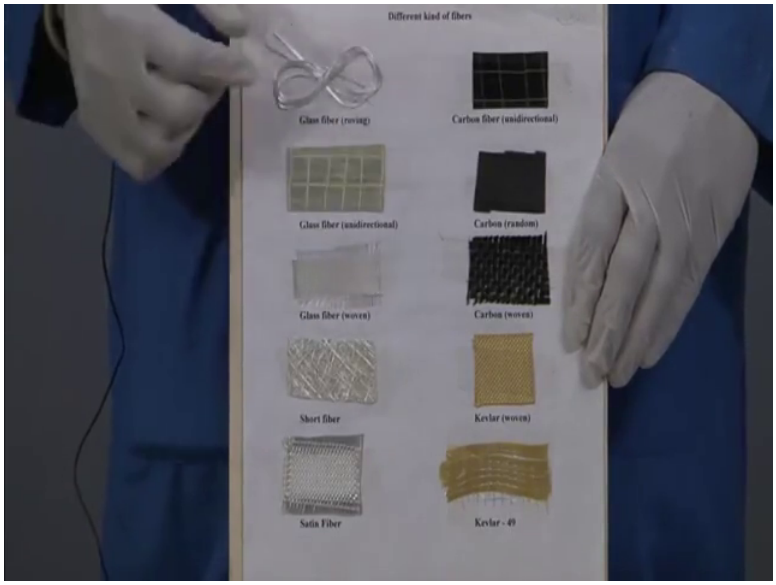

Now, what we have here is a template that is made to demonstrate the kinds of fibers that are used in composite manufacturing. So, in this, we have two columns; the first column is essentially, the glass fibers and the second one is, carbon fibers like regarding the properties of glass fibers. It is already discussed in the class, in the like previous lectures, we have various kinds like e glass, e is for electrical, electrical light is, it is used for insulation, then s glass, it is your strength, then we have c glass, that is a or c is for corrosion, that is corrosion resistant glass is there. And you can see that, this fibers, these are very flexible. And Dr. Ramkumar has also given an assignment to find out, why the glass fiber, and glass, that is simple glass; that is manufactured glass have different properties. This fiber is flexible, the glass is brittle, it breaks and shatters into pieces, when you break it.

So, this is your assignment. It is very simple like a reason for that, but you have to just find out that. Now in this first, we have is this roving glass fiber we call it roving. This is a single thread, this is only fiber that is one dimensional I would say one dimensional fiber, it is used for filament winding and the second one is unidirectional fiber. This is also used for making other composites parts for example, it is use in autoclave or some other resin transform molding and other processes. The other fibers, other three fibers are actually, two dimensional fibers. Here, we do not have any three dimensional fiber here. The two dimensional fiber are there. This is a woven fiber. Woven fiber means, it is woven, it is a kind of stitch like this cloth is there, this cloth has some pattern, some pattern of there kind, of different patterns of fibers.

So, this is a woven fiber, the woven type can be the, it is weaved in a, if it is weaved in a way. So, that the threads stay together. So, the weave can be directional that is we call it a plain weave or uniform weave. It can be even basket weave, there are kinds of weave (Refer Time: 03:44) weave then we, they have, we have satin weave, this is the kind of satin fiber haters, when this kind of weave is used, the strength raises, because it is thickness also rises and this is chopped fiber also. We called it as short fiber. So, this is used. Where in integrate parts, where the shapes are there, which are difficult to form it, because it can attain any shape, we put it in a glass, we put it in a any curved shaped, it will attend that shape. Next, we have here is carbon fibers, carbon fiber are high fiber strength, the strength is typically 15 percent more than the glass fiber, otherwise this, like

15 percent is not specific thing, we can have different types of ingredients, in this fiber to have different stands.

Now, this fiber is a conducting material and this is also high cost fiber, not high costly to the cost, is higher than glass fibers. So, this is used to manufacture the parts, where strength is strength record, is higher random fiber again. Random kind of chop, not exactly chop, but it is there random kind of the orientation, of the fibers is random, then we have woven fibers. Similar, to the woven fibers, we have here in glass, the properties of carbon fibers, just recalling carbon fiber is costly. The cost is higher, when we compared to glass fibers. It is a conducting material, the strength is relatively higher typically 15 percent more than glass fibers, are now. Next we have here is Kevlar fiber. Kevlar fibers are very hard, alike they cannot be cut by a simple blade.

So, these are used for manufacturing bullet proof like jacket or some other things. Now, next we will move on to our fabrication desk, where will show you, how to fabricate a simple composite.

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Now, next we are going to fabricate a simple composite using, we selective fiber, we will select a resin here and we will do fabrication. Now, this kind of fiber, we are selected, is chopped fiber and we will make a simple sheet of composite of dimensions 200 mm into 150 mm. Now, what we have here is, we have cut this, chopped fiber into pieces of the

required size that is 200 to 150 mm. The numbers of pieces cut are 4. 4 pieces are cut and we take it to the casting table.

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Now, in the beaker what we have is resin. Resin here, due resin that is used here is polyester resin.

Now, there are two kinds of resin available in here. There are polyester and epoxy resins and as we know the properties of these resins vary. Now, polyester resins, it is very important to control this tiering level. Here, this tiering actually, lower the viscosity, which is very critical and it this polyester shrinks upon pure, that it is facilitating to release form di, then we have epoxy resin as well as if, epoxy resin that is the process is very slow and the reaction rate is also slow and that is galaxion periods. Galaxion of epoxy occurs at a later stage, what is galaxion? Galaxion is when, we mix additives and we prepare the polyester forecasting, then there is some time after which the solidification starts.

Now, before that time, the casting has to be done that is known as pot life right, that is known as pot life. The life of the pot, when the solidification is not there, when the liquid state and it is in a usable state, now, when we have mix various ingredients to have final resin, that is called the glue. Glue start forming here. Now, this epoxy, if we use epoxy that decompose at 250 degree centigrade and the fiber that, we use here, decompose at 1200 degree centigrade resin. We have here is polyester resin in the beaker. Now, what

steps will follow, will take to mild steel plates, that is 300 mm into 200 mm into 4 mm and clean both the plates using acetone and put one of them on rigid surface, then will take to two mylar sheets. Mylar sheets are smooth sheets of the dimensions 320 mm and into 220 mm with thickness of 200 micrometer.

And we put one of the sheets on the mylar plate and remove all the dust particles by acetone as well, now, will as we have cut the chop fiber. We will polyester resin, first on the mylar sheet, we will take 150 gram of polyester resin. Generally, we call it gp resin in a beaker and we have added 1.5 gram of m e k p that is methyl, ethyl, ketone peroxide and we mixed it properly by glastic. After mixing the m e k p, we added 1.5 gram of cobalt octet as an accelerator; what an accelerator does? Accelerator speeds up the solidification process, maybe speed up, may be lows down. If we are had at lower amount, it may be lower speed then, if we add higher amount then the speed might rise that is why it is called as accelerator and will start, we started mixing it and this is prepared in this beaker and in this mixing, it is avoided to have any bubbles, because bubbles create problem like bubbles might create sound defect some other things.

Now, when final casting is started, we will make a Mylar on the mileage treat or buy resin, then put one of the layer of the chopped fiber, over the resin and roll it using a rubber lined roller for his proper weighting, for it is proper weighting the roller is used; so as the resin is spread uniformly and the bubbles are removed all clear from that. Now, we will keep on adding the layers of resins and fibers to obtain the final composite. Now, this composite would be kept for 12 to 15 hours. So, as the certification happens in a good way. Now, here we start the process, this is a Mylar sheet that is put on here and we use brush to put on the polyester. Now, we are just putting on few resin, this Mylar sheet is used. So, that the final product, which we obtain does not stick on the Mylar sheet. Now, first layer of chopped fiber is put on now, it is being a rolled using, this rubber line roller.

So, as to uniformly distributed the resin and to clear bubbles or some other things. This is a second layer of resin, now all the layers of fiber are used here. Now finally, we will add some more resin here, after rolling this final layer all the second Mylar sheet is put on the mylar sheets are used for easy release of the composite form the die now. What we have here is a mild steel rod of1.5 inch size. Now, this will be used to finally, clear the extras resin and to have uniform shape instead of thickness in the composite.

Now, the casting is completed, next to put this second Mylar sheet and we will put some weight here. Here, we took 10 kg weight; so as it is compressed and the cast is completed. Now, here now we will do the similar kind of thing with other fiber that is next fiber. We have here is the glass fiber that is woven glass fiber, we are doing it using 2 fibers, because we will use it for testing further like we will do tension compression fatigue analysis is inter laminar shear stress than three point bending. We will do various stress for different kinds of fiber on this kind of casting. We just using the layers of fibers and resin. We could even sandwich some other things for example, we can use hollow structures between fibers and between faces, we can sandwich a like a 2 I have more thickness.

For example, you can use honey comb that is hexagonal structure or core mat, but that reduces strength, here we are just like preparing a kind of a specimen, that we will use for testing. Now, this second Mylar sheet is put on are the same by steel rod is used to finally, roll down. Now, the second sheet, I must ms plate essentially, I must m s plate and weight is put on. Now, the second casting of the laminate is also done.

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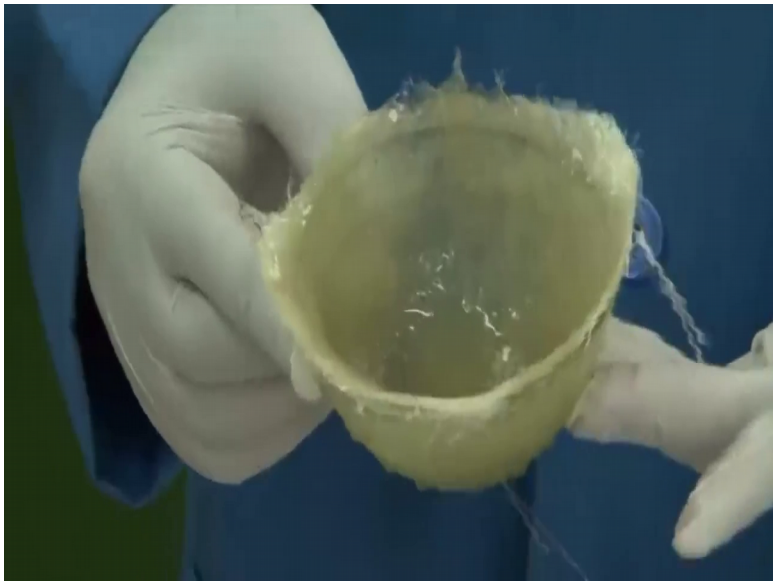

Next, what we are doing here is we have taken a curve shaped, curve shape. We will just, we have just use this to show that chopped fiber also attain the curved or some intricate shape.

So, we will, here chosen this cup, for this one. We are adding resin here, then we will add this chopped fiber, it is cut in a shape. So, as it fully covers the inner surface of the cup and is all (Refer Time: 22:56) like fibers would be cut after final casting. Now, second layer of resin is put on. Now, we are cutting, the extra fiber material. So, we have roughly cutted with the scissors and we will finally, cut this extra layer as well with a blade and this casting is also like for solidification, for final removal or releasing of the layers for obtain part 10 to 12 hours are required. So, we will remove it next day.

Now, we on the next day, now, we are moving this weight and the ms plate and this Mylar sheets would be removed.

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Now, we are ready with our final composite. So, in demonstration, we just had an look, over the types of fibers, we had used resin polyester resin, then we did fabrication of composites, this process which is used here is known as wet layer process or maybe hand layer process

So, next, in next demonstration session, we might take this two, a testing lab. And we will do it some tests some strength testing on this one.

Thank you.