**Polymer Assisted Abrasive Finishing Processes**

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**Lecture – 15**
**Summary of the Course**

Coming to week 4 we will be seeing about the advancements and hibernation of polymer assisted finishing process such as abrasive flow finishing process, advancements such as advancements and hybridization of our abrasive finishing process.

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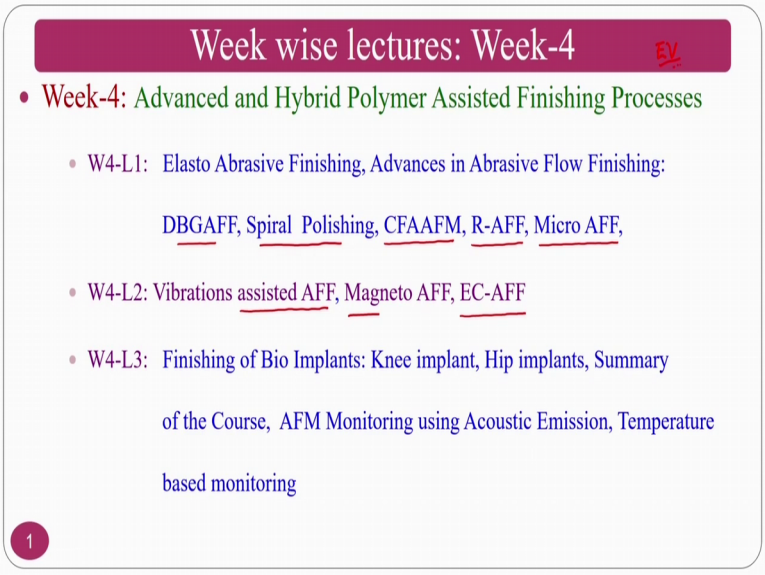


So, one of such things is elastic abrasive finishing which is called as some advancements of AFF process, then some of the advancements by putting some of the abstractions. So, that the medium should make more active in the finishing region such as drill bit guided abrasive flow finishing process, spiral polishing process and centrifugal force assisted process, rotational abrasive flow finishing process and micro abrasive flow finishing process.

See whenever you see about micro abrasive flow finishing process this is similar to abrasive flow finishing process only, but here 2 things one has to note, one is your medium should be low viscous that is it should be fluid like and another one is it will be

always used for finishing of micro features like less than 1 mm micro channels or micro holes and other things. So, in that circumstances you can call it as a micro AFF process.

The advancements you can see in terms of hybridization, suppose if you know the ultra sonic machining and where you produce the ultrasonic vibrations and you do the machining operations. So, whenever you are going to have ultrasonic vibrations along with the abrasive flow finishing process then it is called vibration assisted abrasive flow finishing process or vibration assisted abrasive flow machining process. Magneto abrasive finishing process you will see all these processes in coming lights and electro chemical abrasive flow finishing process.

Then we will see the applications, what is the applications of this course, normally one has to appreciate this course whenever you see that what really is going to help, you will appreciate this course whenever you see some of the applications of this course. So, you have studied all the way what are the polymer assisted grinding process, flexible honing process, elasto dynamic peak polishing, pad polishing, abrasive flow finishing, so on you are studying, then what is the applications.

Some of the application you might have seen while you are going through the introductions and some of the things that you will also see whenever you are going to study about that particular process, but particularly the last week one of the lectures if time permits I will concentrate on this is the application of this particular process, this is what you can achieve and this is what you can apply if you have a component like this or if you have this type of shapes and other things.

So, you can see the applications and advantages of those like, finishing of bio implants like knee implant, hip implant, and other things and you can also see about how to monitor the abrasive flow finishing using acoustic emission. This is subjected to if there is a time and other things are there and the temperature control how you can use the temperature control of this medium to control the viscous properties or the rheological properties of the medium.

So, you all see all these things. So, the first one which we are going to see in the week 4 are sometimes if the less amount of classes are there in week 3 this particular process may also be covered in the week 3 itself.

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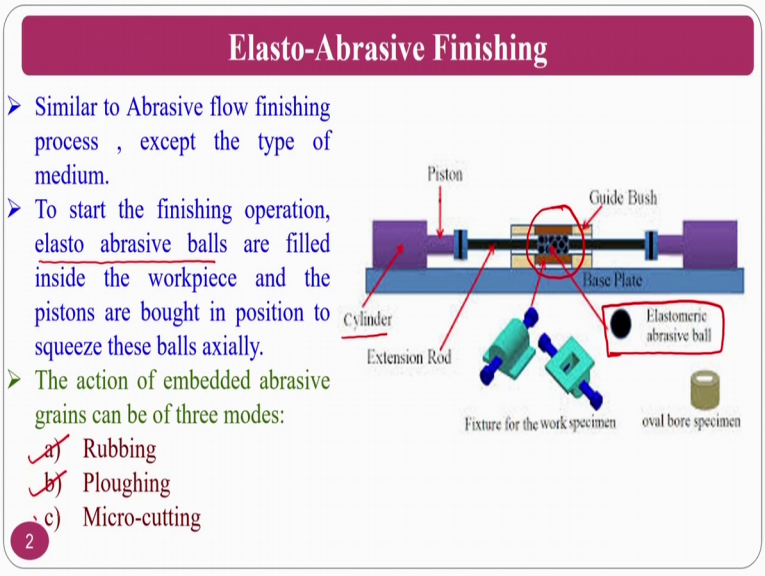


So, Elasto - abrasive finishing process this is approximately similar to abrasive flow finishing process that you have seen in the week 3 and here you will have a cylinder hydrolytic cylinders and you have a medium is placed inside the work peace. And the only difference here is that you are going to have elastic abrasive balls, see the difference between abrasive flow finishing process and elasto abrasive finishing process are some of papers you may also see this process as elasto abrasive squeeze finishing process.

So, the start of the finishing operation elasto abrasive balls are filled inside the work piece and pistons are brought and axial motion is given to this elasto abrasive balls. What are things that you can see here is this is a only specialty about this process where you will have elastic abrasive ball that you will see how it is prepared and what is it in the next slide. These balls are very tiny balls where polymer is there and top of it you are going to quote the abrasive particle so, that you will see.

So, here also the basic finishing mechanisms is rubbing, ploughing and micro cutting.

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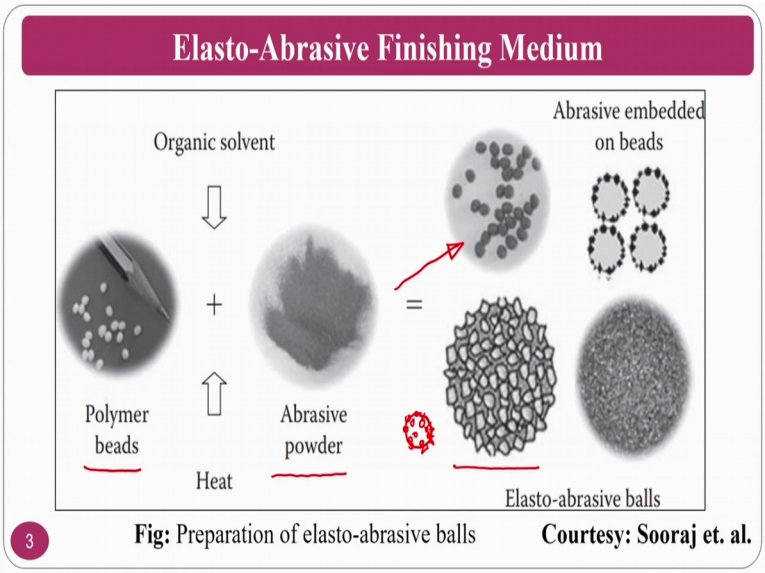


You can see the difference in abrasive flow machining you have seen in week 3 how it is a semi solid it is a continuous phase, but here it is a discontinuous phase because you are going to have the polymer beats or polymer particles. Then you are going to blend with a organic solvent and you heat up to certain degrees like 180 degrees or 150 degrees depending on your polymer and other things then you are going to add the abrasive particles, whenever you are going to add this abrasive particles this will convert practically like this and schematic what you can represent is this one.

So, you will have a polymer beads because of the organic solvent and temperature this is going to have some soft nature at the time this abrasive particles are added to it and it will have all the periphery of this one. So, it will have abrasive particles will held. The helding or the holding ability of the abrasive particle by the polymer bead are a particle will depend on what type of solvent that you are going to use and how much temperature that you are going to feed ok, you have to optimize which type of solvent and you have to optimize the temperature also.

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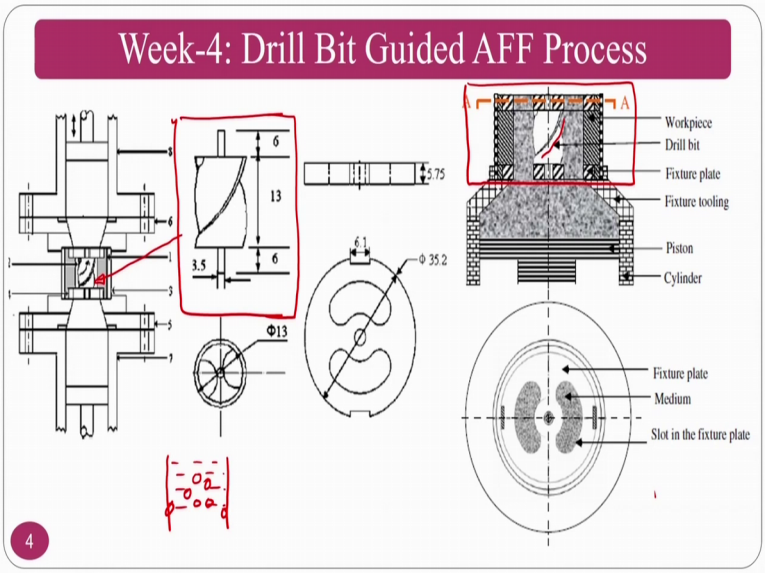


So, next advancement is drill bit guided abrasive flow finishing process in drill bit guided abrasive finishing process the main moto is that active abrasive particles enhancement how to increase the number of active abrasive particles, because if you see in abrasive flow finishing process this is our cylinder which is to be finished and completely it is filled with the medium. So, abrasive particles at the center are inactive the abrasive particles which are there on the work piece surface are active that we have seen.

So, if I can put certain abstraction at the center assume that I am going to put a drill bit like this is the drill bit that I am going to place in the medium cylinder at the center what will happen. This is since it is a solid this will occupy certain space and the active abrasive particles will be increased because abrasive particles will be flown from the other way. The abrasive particle will be flown outside this drill bit you can see in this particular picture this is the region where you can see here.

So, if you do not have the drill bit what will happen here also you will have abrasive particles, but which we do not want if I am placing the drill bit because of that what will happen my number of abrasive particles which are going to finish the work piece will increase. At the same time since there is a helical path and helical flute is there on a drill bit it will also guide along with that one, because of this the number of active abrasive particles enhances. So, the finishing rate will improve.

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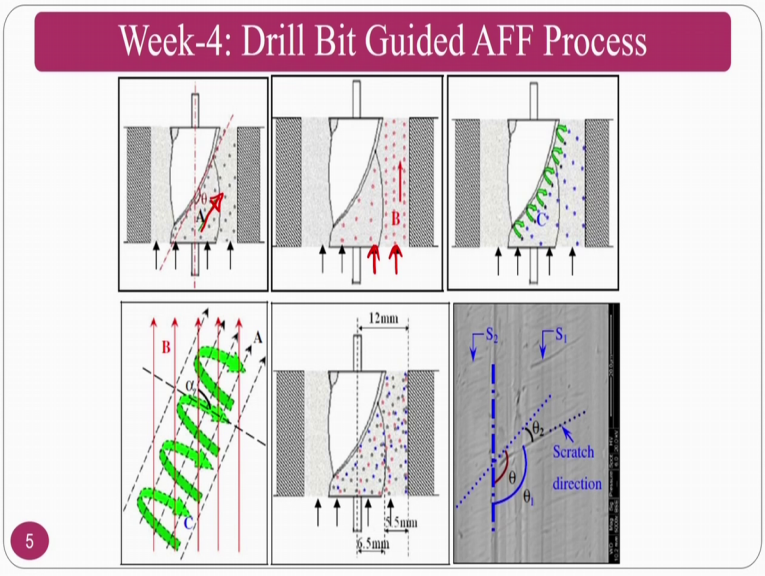


How the various motions can be generated by using this particular process also will be seen in this particular process. So, if you see here what will happen, whenever you are sending the abrasive medium here because of the flute nature this will move along with this direction, at the same time because of the hydrolytic power, it will move axially.

So, because of the flute nature this will move in this direction because of the axial power what will happen, this will move in this direction and at the same time you have a flute on the drill bit what will happen there is a scooping flow because whenever you are pushing and flute is there. So, there will be a scooping like a ice cream whenever customer goes to the shop he will scoop the ice cream and gives. So, that scoping flow will also will come into picture, because of this axial motion because of the flute direction and the scooping these 3 motions are clubbed and you will get a very good dynamics.

Since the medium is self deformable and easily flow able medium because of this randomization or because of this dynamic flows what will happen. The medium abrasive particles will reshuffle the abrasive particles which are there at the center which are inactive in nature may come out in a finishing way and those who have already finished and might have become blunt may go inside because of this dynamic flow.

So; that means, that it is not only going to enhance the active abrasive particles, but also it is going to increase the reshuffling of the abrasive particles which enhances the

finishing rate. And this particular process also can generate certain texture if at all not only the finishing is required you need some cross hatch patterns or if you need any lines in certain direction certain pattern you want according to that you can design your drill bit or any other guiding mantle you can fabricate according to your requirement and you can place there in the finishing region.

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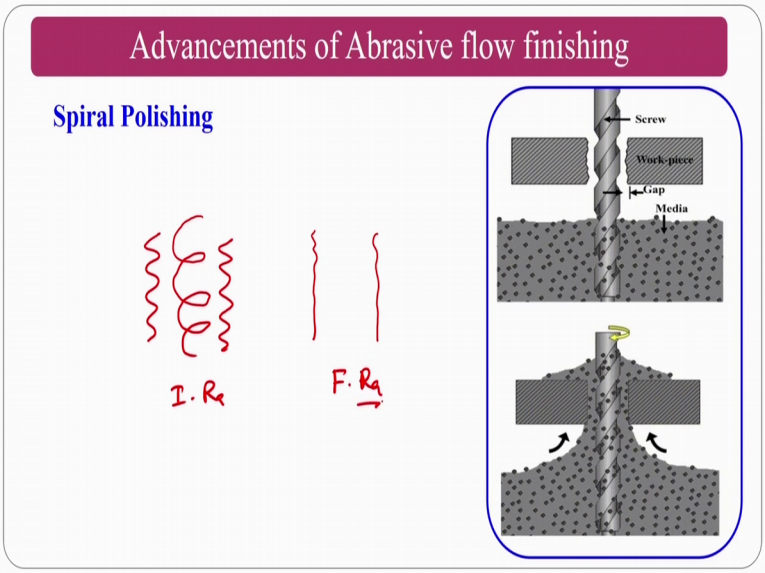


The another advancement is that you are going to study clearly later what is thing that you are going to see is spiral polishing. Spiral polishing also similar to the drill bit guided abrasive flow finishing process, but here you will have a big screw where in one cylinder you have the medium and because of the rotation of the screw, what will happen. The medium will climb and it will try to finish, assume that my initial surface is like this and because of the screw rotation the finishing action will takes place and you will get approximately a smooth end surface ok.

So, this is how the spiral polishing will takes place and the path it will move along the screw and the screw you can see a flute is there and this flute will assist the medium to bring from bottom medium cylinder to the top medium cylinder ok. This is initial R a and this is final R a so that you can get the good finish.

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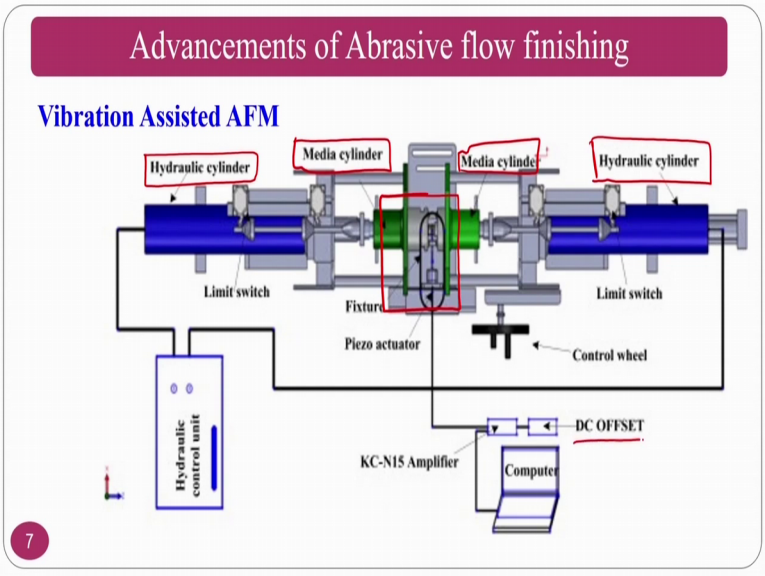


Another advancement is vibration assisted abrasive flow machining process or vibration assisted abrasive flow finishing process, here it is approximately similar to the abrasive flow finishing process only, but the work piece is given vibrations.

So, as you can see here hydraulic cylinder 1 and hydraulic cylinder 2. So, that the medium can be pushed and medium cylinder 1 and medium cylinder 2 and this is our piece region because these work piece region is coupled with a vibration thing that is piezo activator. So, that if there is a vibration is produced or vibration is given to the work-piece and the axial motion is given to the medium what will happen. The authors that the finishing rate is improved under the same time final surface roughness that is achieved in this vibration assisted abrasive flow finishing process is increased compared to conventional type of abrasive flow machining process or finishing process.

This piezoelectric actuator is coupled by the dc offset and which is the amplitude of the vibration and other things can be controlled using the computer ok.

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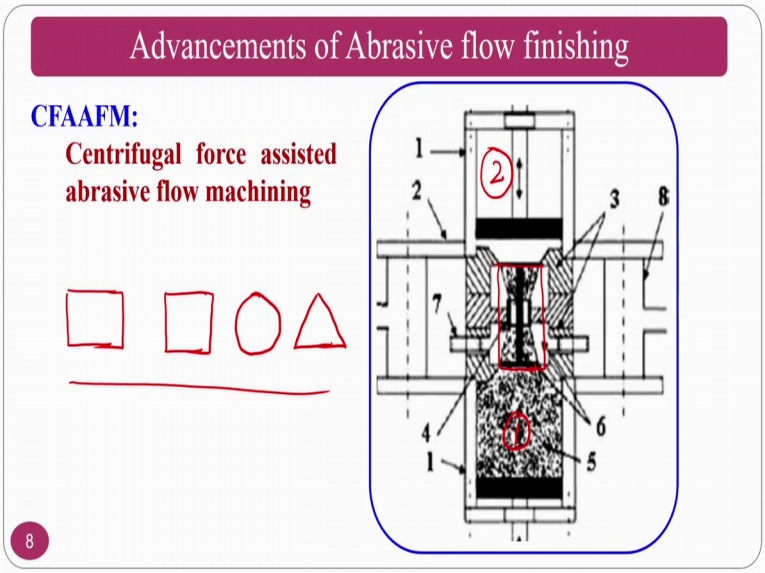


Another advancement is done by some other authors that is called centrifugal forces assisted abrasive flow finishing process or centrifugal force assisted abrasive flow machining process. There the authors have used a rod as I said drill bit guided these are somewhat variance of drill bit guided process, drill bit guided spiral polishing and centrifugal forces assisted abrasive flow finishing process. These 3 flow approximately same concept, that is having a mandrill at the center, so that the number of active abrasive particles will be enhanced for the finishing of internal features.

So, in this work the authors are having the medium cylinder 1 to cylinder 2 they are going to send in between they have one shape of mandrills that is at the center ok. They have chosen the variety of mandrills such as rectangle type of mandrill and square type, circular type and triangular type this is done at IIT Roorkee by Professor H S Shaan and his group.

So, what they are choosing is that the different mandrills and these are rotated because of this rotation there will be a centrifugal action and this abrasive particles which are there in a fluid like abrasive medium the abrasive medium that they are going to use is too low viscous; that means, it is low viscous medium abrasive particles are suspended in a low viscous polymer base medium and whenever you are pushing it in along with the pushing there will be a centrifugal action that is externally given to the rod that is having different shapes that are mentioned here.

This will be rotated and abrasive particles which are there will activate our this shapes will hit that abrasive particle and this abrasive particles are sent because of the centrifugal action to the corners and this will not only finish and the rate of finishing will improve. This is what authors reported in centrifugal forces assisted abrasive flow finishing process, in a elaborative way you will see whenever I am going to teach this particular process.

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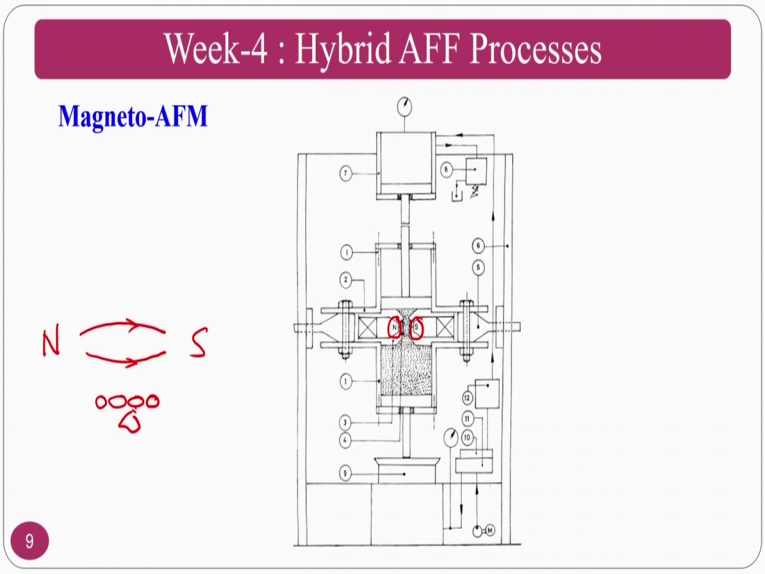


Then hybrid abrasive flow finishing process, this hybrid abrasive flow finishing process also done by Professor H S Shaan and his group out from IIT Roorkee and in this case what they are going to add is they are going to add some of the iron particles such as CIP particles, carbonyl iron particles and they are going to use the North Pole and South Pole.

So, along with the abrasive flow finishing medium they are going to add another particles that is iron particles which is in the form of pure iron that is called CIPs carbonate iron particles because of magnetic field that is given from the North Pole and South Pole there will be a chains formation. This chains formation will enhance the viscosity of the fluid and which in turn will help the finishing not only holding the abrasive particle in the base polymer medium this chains which are generated because of the CIP particles can also hold some of the abrasive particles and this polymer chains as well as CIP particle chains that is iron chains both will combine and enhances the finishing ability of this particular process.

So, you have to observe 2 things, one polymer chains are involved this polymer chains holding the abrasive particles and iron particles also hold this one. So, because of this 2 and some cases there may be hybridization of both, because of this the finishing action will enhance that is why this process uses magnetic field as well as polymers technology.

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Then we will see at last what are the applications of this polymer assisted abrasive finishing processes in terms of various advanced materials such as biomaterials, normally one of the common examples that are going to finish by the patented technology companies that are producing this abrasive flow fining process and polymer rheological abrasive medium uses for knee implant finishing, hip implant finishing and so on, hot walls and other common examples.

This particular processes can also be used for finishing of aerospace applications such as components which are in micro shapes to the macro shapes and this polymer assisted abrasive finishing process also uses for finishing of some of the electronic materials such as silicon for various applications and other things.

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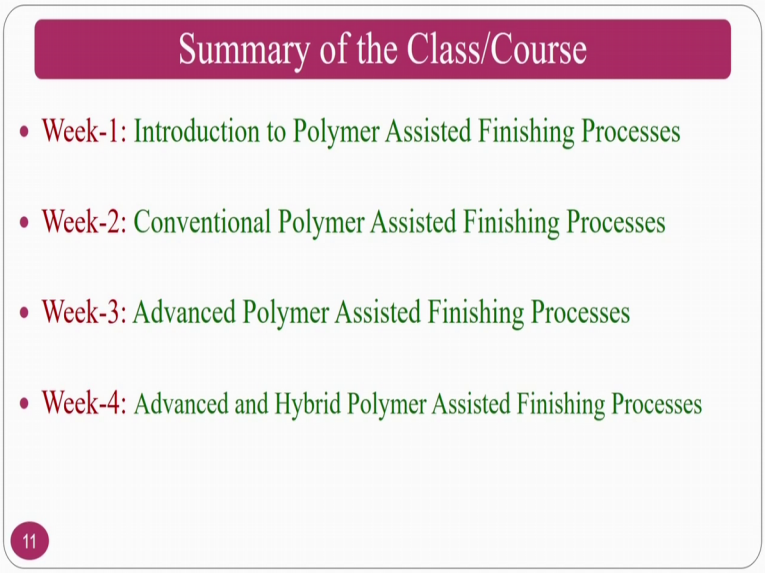


Now, we will see the summary of this particular class or what I am going to given to you is introduction to this particular course in the first class. So, that the people will get the knowledge what I am going to teach elaborative way in the upcoming classes and they have to can prepare themselves that whether this course is really helpful for them or may not be.

So, in week one I will be teaching you introduction to polymer assisted finishing process such as conventional polymer finishing processes and I am going to teach you what is surface integrity like what is surface morphology as well as surface metallurgy. Why surface metallurgy is also important along with the surface morphology and all those things also will be covered. And apart from it some of the conventional polymer assisted finishing processes such as polymer grinding wheel and introduction to grinding, then what are the classification of various polymer grinding wheels such as resinoid bonding, shell of bonding, rubber bonding and where these type of polymer assisted abrasive wheels are used in practical application and other things.

Second we will move forward to some of the conventional polymer assisted finishing process such as pitch polishing, pad polishing and mass finishing processes such as vibratory bowl finishing and tumbling and drag finishing processes how polymer beads or polymer bonded abrasive beads are used to finish in a mass scale. Then we will move on to advanced polymer assisted finishing process such as abrasive finishing process and

the medium mostly because the medium will have lot of polymers in it. So, we will see what are the polymers that are used in this case and how this polymer rheological medium will help and we will also see what about the elasto abrasive finishing process, how the medium in the conventional abrasive flow finishing process is different from elasto abrasive squeeze finishing process and other things.

Then we move on to some of the advancements like drill big guided abrasive finishing process, magneto abrasive finishing process, centrifugal forces assisted abrasive finishing process and so on. So, this is about a basic course at the same time some of the things are advanced. So, the final year B Techs are the M Techs and PhD students can also get the basic knowledge as well as you will also get some of the advancements which can help you in choosing your project works ok. In between I will be posing some of the advancements that are going across the globe in this area so, that you can come across and you can choose your work.

Thank you.