Introduction to Machining and Machining Fluids
Dr. Mamilla Ravi Sankar
Department of Mechanical Engineering
Indian Institute of Technology, Guwahati

Lecture – 25
Unbonded Conventional Abrasive Processes

Now, we are in the conventional abrasive finishing processes. Till now, we have seen the bonded type of conventional abrasive finishing process; like grinding and the corresponding grinding fluids, honing and all those things. Now, we are moving in this particular class to un-bonded conventional abrasive finishing processes.

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Like lapping, super finishing, sand blasting, vibratory bowl feeding and drag finishing and we summarised about the abrasive finishing processes. So, the first thing that I was saying is un-bonded conventional abrasive finishing processes. Wherein the first process comes is a lapping process.

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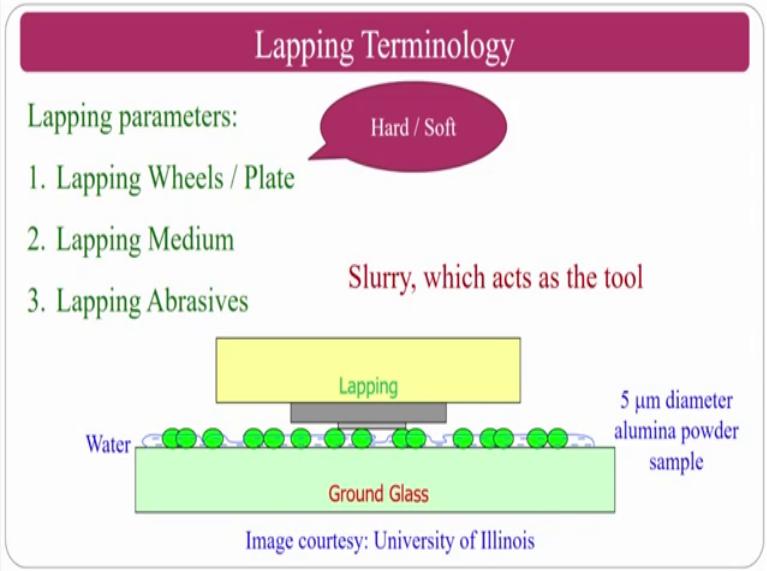

In the lapping process the parameters are like lapping wheels, are the plates that are there, at the same time lapping medium and abrasives that are there which are used in lapping process. So, the lapping if at all the if you want to finish any particular sample or the workpiece you will have a lap; that is plate, wherein you have abrasive particles carrying medium and all those things. So, we will see what is this lapping process and all those things.

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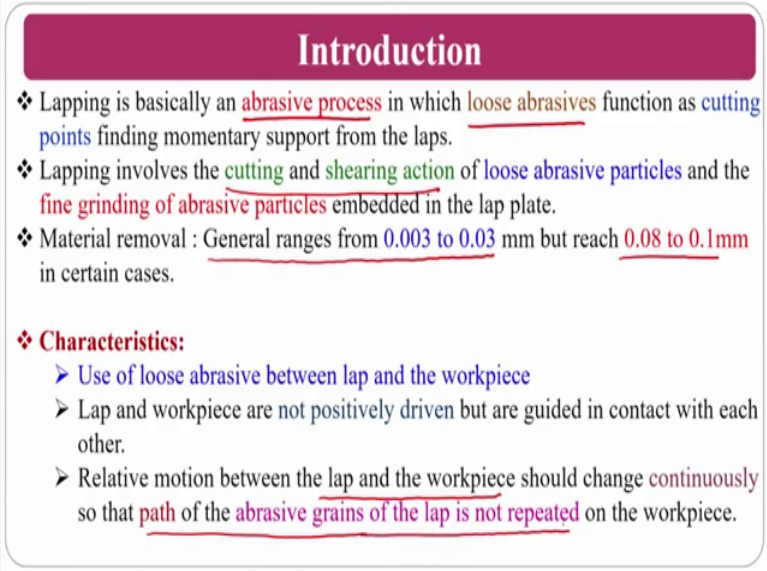

Lapping is basically an abrasive finishing process, machining process. If at all people are talking about machining; that is material removal, it is machining process; otherwise it is a finishing process. Mostly lapping process is comes as a finishing process, only you do not bother about, what is the material removal. We always go for the finishing that is achieved on the final product.

So, which is the loose abrasives for cutting points for the this one. Lapping involves the cutting and the shearing action. This is of the loose abrasive particles in order to fine finish the components material removal. Generally it ranges from 0.003 to 0.03 mm that is the thickness and, but maximum it may reach 2.1 mm also, that is the material removal; that means, that it is not a material removal process, because the material removal is very very minute

So, the characteristics of lapping process, it uses the loose abrasive particles between lap and the workpiece which you have seen in the previous slide. So, lap and the workpiece are not positively driven, but it is guided in contact with the each other, because there two contacts will be there. So, in between the fluid as well as the abrasive particles will be there and it will be done like this. So, there will be a fixed one, there will be a lap in between the medium will be there and the workpiece is fixed on the bottom and you can do the lapping process, relative motion between the lap and the workpiece.

This is the most important, should change continuously. So, that the path of the abrasive

grains of the lap is not repeated. Assume that if the path is not changed what will happen? The finishing takes place on the same path, the workpiece is like this. If I have a lap on top and abrasive particles are there, if it rotates there itself, there is a possibility that the abrasive particle will follow the same track and create the scratch in the same.

So, you need to change the relative motion, you need to change the path. If at all the path has to be changed then you should change, continuously change the path.

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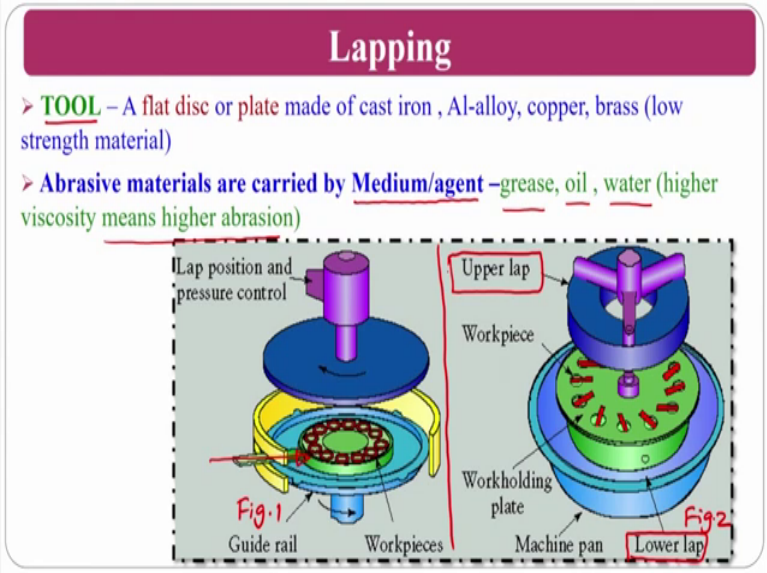

So, for that purpose you should change the relative motion between the workpiece as well as the lap continuously to in order to change the path of the abrasive lapping normally the tool which is a flat disc or a plate made up of, normally the soft of type of materials such as cast iron, aluminium alloy, copper and brass. The abrasive mediums are carried out by medium basically.

Medium is nothing, but an agent which carries the abrasive particles like grease oil, water and high viscosity means a high abrasion. Normally if you are going for grease, if you are going for the grease what will happen? The viscosity will be very high. If the viscosity is very high, the material removal will also will be very high; that is what the meaning of the sentences

There are two varieties of lappings are there; one you just have the work pieces on the bottom like the red ones. If you see the figure one and this is figure 2. In the figure one

what is the thing that I want to say is the work pieces are placed on the green one, these are the work pieces and the lap will come on the from the top and it try to finish. This is with respect to one lap it; you can do on the both sides like you will have a lower lap. If you see the figure 2 and there will be a upper lap.

So, you will have two laps in between you are holding the work pieces. So, you can do the both ways, both the second one. Figure 2 is a quite economical, because for the same input you can do on both sides

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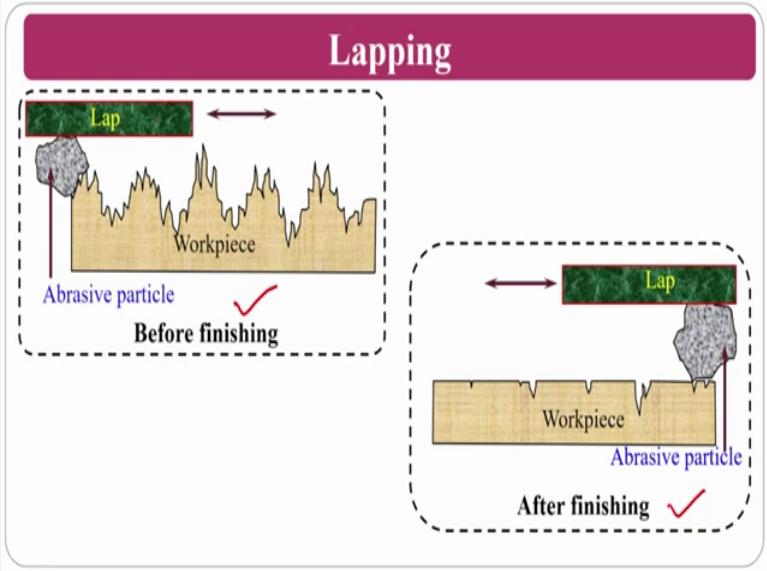

So, the main function of the lapping process is the finishing process. If you see the before finishing and after finishing, the finishing that you are going to get is better and better so, the before finishing this is a surface and after finishing this is the surface. So, what will happen that you are going to get a good aesthetic appeal, you are going to get better surface finish that is low roughness.

At the same time you will have a high load bearing capacity and all those things, that this is a common for most of the finishing process. And lapping is one of the finishing process that is why mostly you go for the finishing using lapping if at all. If it is a flat surface or if it is a cylindrical surface and all those things, normally people go in a small scale industry for the lapping process

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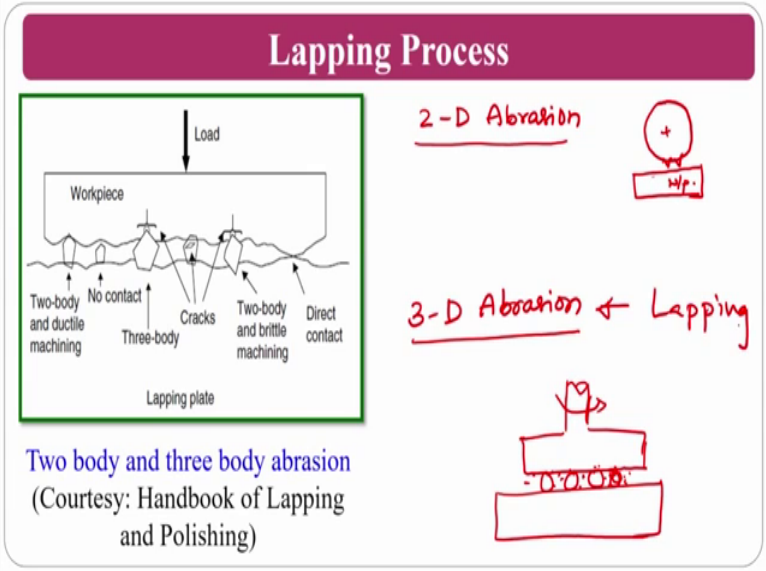

So, lapping process if you see in D, there are the mechanism goes by 2 D and 3 D abrasions, whatever I want to say is 2D abrasion. 2D abrasion means if there is no relative motion between two surfaces, assume the grinding. In a grinding process what will happen? You have a grinding wheel where you have abrasive particles are fixed and you have a workpiece on the bottom.

So, there is no relative motion between abrasive particles and the grinding wheels. So; that means, that whatever the abrasion, if I give the depth of cut and all those things what will happen? Same, approximately same depth of cut will be removed from the workpiece ok. So, that is nothing, but the 2D abrasion

Here 3D abrasion means. In a 3D abrasion what will happen? Lapping is good example you have a workpiece on the bottom and you have a particles, abrasive particles which are carried by the carrier medium. So, you have a lap and the topside in that circumstances what will happen. These particles are loosely bonded or these are un-bonded in that circumstances. The abrasive particles not only follow the path of the lap, but also has its own orientation or rotation about own axis. In that circumstances the abrasion takes place in the 3 dimension that is why it is called the 3D abrasion

So, in the grinding, process is a bonded abrasives and the lapping process is a un-bonded abrasive. So; that means, the un-bonded abrasives have the freedom or independent to move about or rotate about its own axis, also along with the axis of rotation of the lap for

that purpose. Normally this lapping process is considered to be the three abrasion process

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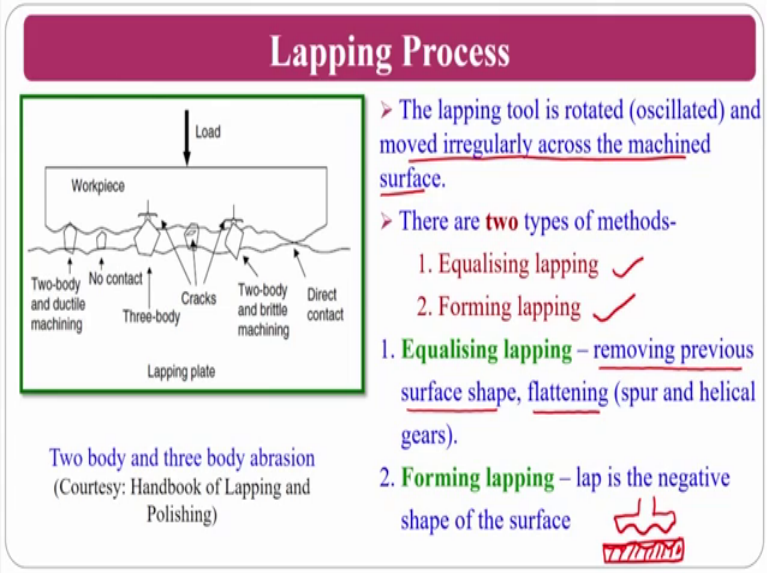

The lapping tool is rotated or oscillated moved irregularly across the machined surface, so that the random motion can be generated. If the random motion is generated the surface finish will be better. So, there are two types of methods which are equalising lapping, another one is formed lapping. So, equalising lapping removes the previous shapes or the flattening, this is the main purpose normally. If at all somebody I want to remove certain micro-layers or nano-layers, you can use at the same time, you you can use for the flattening the surface.

For the form lapping, the lap is a negative shape of the surface what will happen? If at all I want to generate particular shape, assume that I want to generate certain shape on a flat workpiece what will happen? You will have a lap like this, and you will rotate what will happen? This negativeness will generate basically. So, this portion you are going to get, this is called the form lapping process. Negative shape will be there and you can generate; that is the difference between equalising lapping as well as the form lapping

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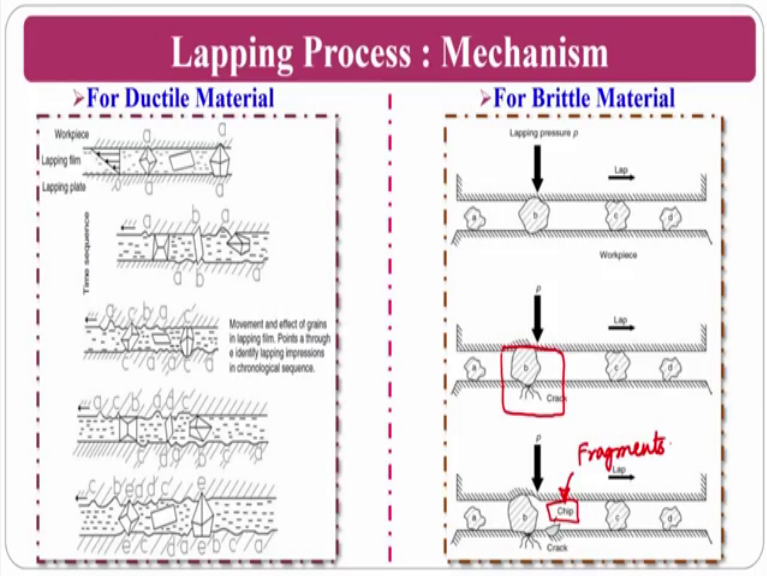

The lapping process mechanism for the brittle materials and ductile materials goes like this. Just first we discuss about the ductile materials. Always ductile materials will go by chipping process only; that means that shearing process like metal cutting process, whenever you are seeing the continuous chips in ductile material and all those things similar fashion, the material removal takes place by the shearing of the surface of the workpiece by the abrasive particles that are involved in the lapping process.

So, there is a workpiece and your abrasive particle will come and it will take out a chip. So, that is how the shearing takes place in this one and gradual shearing takes place the surface peaks, this is about the ductile mode of removing material

But in case of brittle materials, if the workpiece is like a glass or if the workpiece is like a silicon. These are the brittle materials, normally material removal. Brittle materials is just first it will have a crack, then it will remove the in terms of the fragments as a chips ok, you are, chips are like fragments of the brittle material, this is how the material removal takes place. In the most of the brittle materials like cracking, then followed by the fragments in the ductile materials, it is like a shearing operation by the abrasive particles. This is the difference between ductile as well as brittle materials material removal

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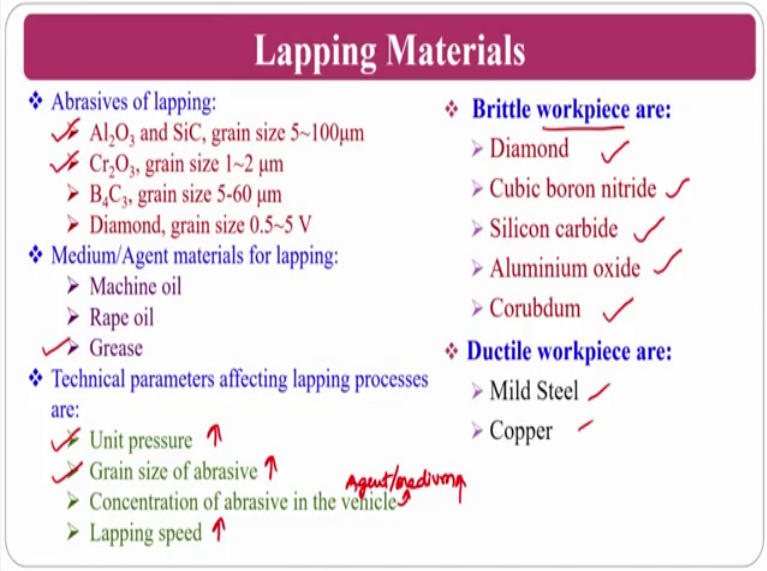

So, lapping materials, if you see the lapping abrasive types; normally the abrasive types of like alumina chromium oxide and boron nitride, boron carbide, diamond. These are the mostly or commonly used abrasives in the lapping process medium; that is carrier medium, like whatever it carries and all those things that is like machining oil, rape oil, grease. Mostly people will use the grease if at all material removal want to be more, if at all material removal is requirement is less, in that circumstances you can go for low viscous liquids

The technical parameters that is unit pressure, how much pressure you are going to apply on the workpiece, the gain size of the abrasive that what is the grain size, whether you are going for coarse grain, whether you are going for a fine grain and a medium grain and all those things that will decide your material removal. If the grain size is coarse, the material removal will be very high. If the grain size is less what will happen? The material removal is very low.

So, the concentration of abrasive particles in the vehicle; that means, that agent are medium, vehicle is also a word some of the people will uses. So, the alternatively you can use, say that medium rs. So, the concentration of the medium, if the concentration of the abrasive medium in the agent; that means, that if I am using 50 percent of the abrasive particles among the concentration, then material removal will be very high.

If I compare to, if the abrasives we are, you concentration, if I am using like 20 25. So, it

is all required by the what type of requirement the particular operator have. If the requirement is finishing, you do not need to go for higher amount of abrasive particles. If you are going for the higher material removal rate, you have to go for coarse as well as high concentration. So; that means, coarse particle you have to go and you have to go for higher concentration also

The lapping speed if the less speed increases what will happen? The number of times the abrasives come in contact with respect to the workpiece will be a very high. So, the material removal also will increase. Since it is, we are considering this particular course as machining as well as the machining fluids course, we should talk about mostly about machining that is why the, if I am going to increase pressure material removal rate will increase.

If I am going to increase the particle size material removal rate is going to increase. If I am going to increase the concentration material removal rate increases. If I am going to increase speed then material removal will be increased; that means, material removal is primary concern, if you are, then you have to increase all the four parameters. If you are finishing is your requirement then you have to play according to the requirements of yours custom raised requirements ok.

Brittle workpiece is normally the abrasive is like diamond, you can use carbon CBN, you can use silicon carbide, alumina and corubdum. These are the workpiece materials you can do the lapping. I mean to say these are the workpiece materials, these are all also as a tool materials; that means, abrasive materials also, but you can also do these work pieces, but only thing is that, whenever you are use this workpiece materials as silicon carbide or aluminium oxide, then you have to choose your abrasive particles slightly higher than the hardness of workpiece material. In that, circumstances you have to go for CBN; that is called cubic boron nitride and all those things.

So, if at you are going to do the lapping process for aluminium oxide; that is alumina, then you have to choose always higher hardness; that is like cubic boron nitride or diamond and all those things that should be taken care with respect to this particular part of this slide. So, the ductile workpiece materials, normally the ductile workpiece materials are like a mild steel copper and these are all the one variety of the materials. The ductile materials getting surface finish is not that much easy, because the scratching

is one of the prominent problem that is why mostly the lapping process will be used for the harder materials, but you can also go for the ductile materials and softer materials.

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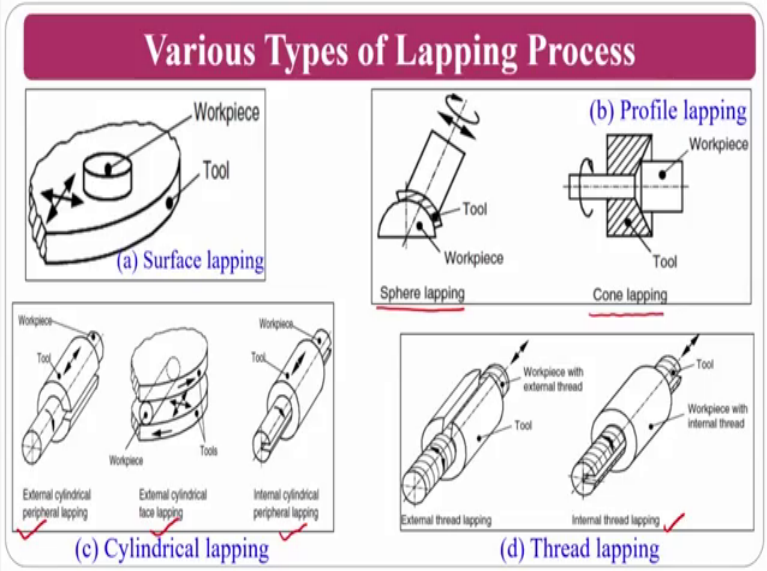

The various types of lapping process if you see, this is called the surface lapping where you have, a tool will be there, workpiece will be there and you just give the motion or the relative motion to both of this one there called sphere lapping, where if at all I want to go for lapping of a sphere, just you need to have a converse shape or the negative shape of it and you can do the finishing process.

Then cone lapping. Again the converse shape you are going to have, then you are doing, these are all called the profile lapping. If at all I want to do a profile, you have to have the converse of that profile then you do the lapping process cylindrical lapping. Cylindrical lapping will be external cylindrical, peripheral lapping is one of the process, external cylindrical, face lapping will be another process, internal cylindrical peripheral lapping will be another process.

So, you can do whatever you want, but only thing is that according to your requirement you have to change, you have to medium that is abrasive medium. Abrasive medium is abrasive press the carrier you should have selected according to your requirement. So, another one is thread lapping, where thread lapping is external thread lapping as well as internal thread lapping, two types of things are there. So, you can go for here and here also, the shapes that the tool which will have or the lap that you will use, will have the

converse shape. These are the four varieties of the lapping process.

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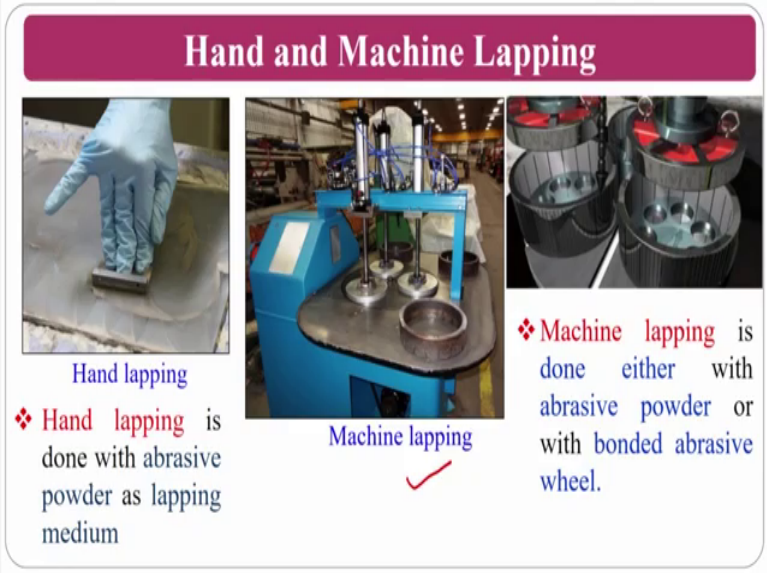

So, the mostly commonly used in the small scale industries is the hand lapping process and if at all I want to do some of batch or mass production of that particular components, people can go for the machine lapping ok. Machine lapping you can go in a one go, multiple components and you can do the lapping process.

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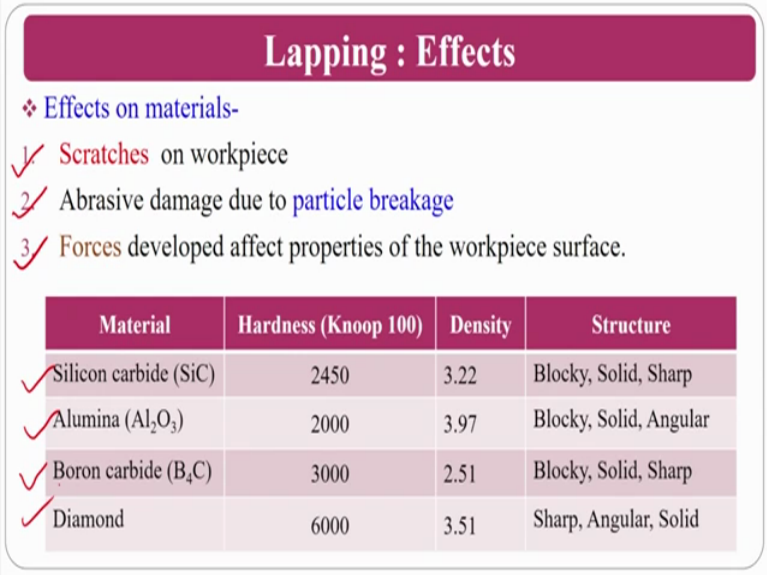

This is about the lapping process and the effects. If you see regarding the lapping process is concerned, the basic problem comes is a scratches on the workpiece. If the workpiece

is ductile or soft material, normally the problem will be like scratches on it. It is not only the polishes are the finishes, but also it generates its own scratch marks, because the hardness variation between the workpiece, if it is soft workpiece, the hardness will be much low and if you are using your abrasive particle like a CBN or silicon carbide, the hardness ratio is very very high. In that circumstances if not only remove the surface peaks, but also can generate the scratches on it.

The second one is abrasive damage due to particle breakage. Since the abrasive particles are about brittle materials, whenever you are giving the motion, random motion they collide with another particles at the same time by involving continuously with respect to workpiece, what will happen? Particle breakage will take place and this may damage the workpiece. Also the forces developed affect the properties of the workpiece surface.

If the forces are very high the problem will be that the material removal will be very high, the forces should be uniform across the surface; otherwise you will get a non-uniform surface roughness. These are the materials abrasive materials. Normally you can go or the you can also do the finishing of this work as a workpiece materials also

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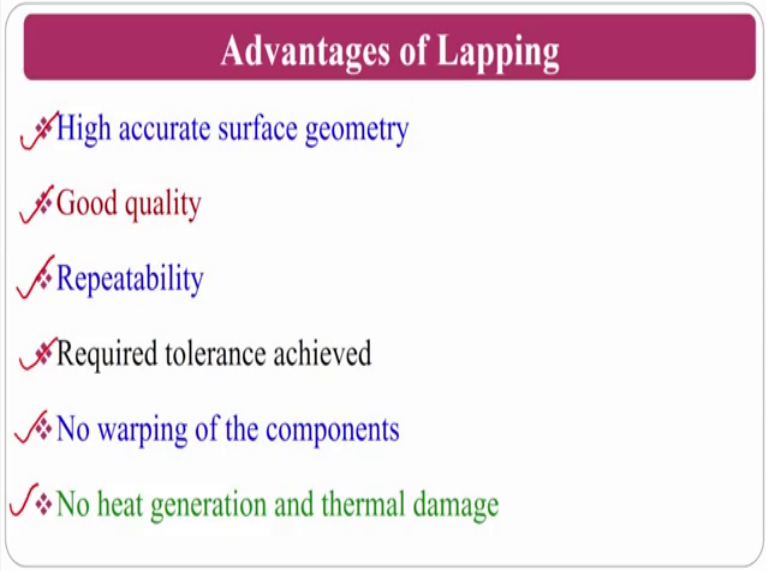

So, advantage of lapping, the advantages of lapping is high accuracy surface geometry, good quality means aesthetic appeal will be very good, repeatability will be very good and you can achieve the required tolerances and no warping of the components. There is no warping and no heat generation, because continuously liquid presence is there; that

means, that medium presence is there that is why there is no problem of heat generation in the lapping process; that is why most of the small to medium to large companies will go for the lapping process for the polishing or the finishing of any simple geometrical components.

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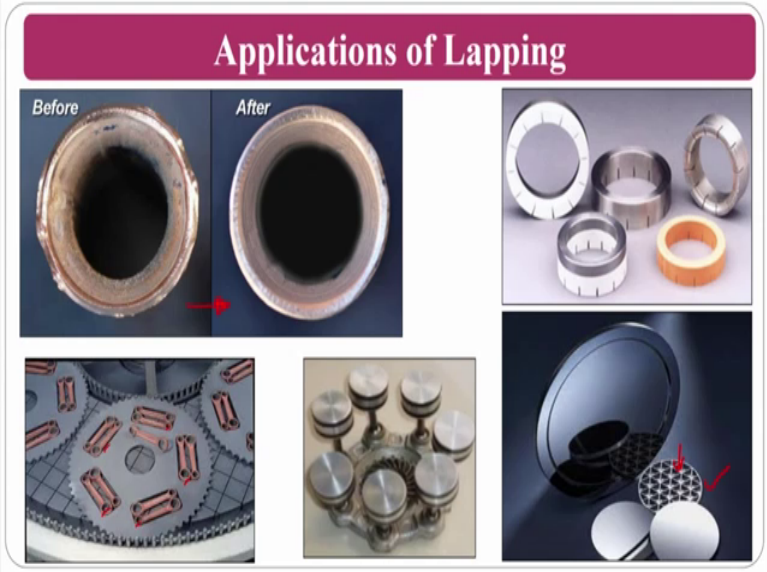

So the applications, if you see this before and after. This is the before and after the lapping process and you can also see in a single go, you can go for the multiple components you. If you see here how many components they are finishing? If you see 2 2 2 2 10 in one set you are going. So, if this type of sets, multiple sets will be there. So, it can also use for batch as well as mass production. Also you can do the finishing on in a mass spectrum.

So, you can do for the braces whatever the internal surfaces. Also you can use and the most importantly some of the high-tech applications of the lapping is mirror like finishing. So, you can use for the mirrors you can use. You can see here these are the advanced type of mirrors where on one side you have a mirror surface and another side you have this type of texture.

So, these are all used for the high-tech applications, some of the applications like one side you need you can go for the cooling application, on other side you can go for bombarding of some of the advanced raise and all those things. So, this is having a wide variety of applications from the point of finishing.

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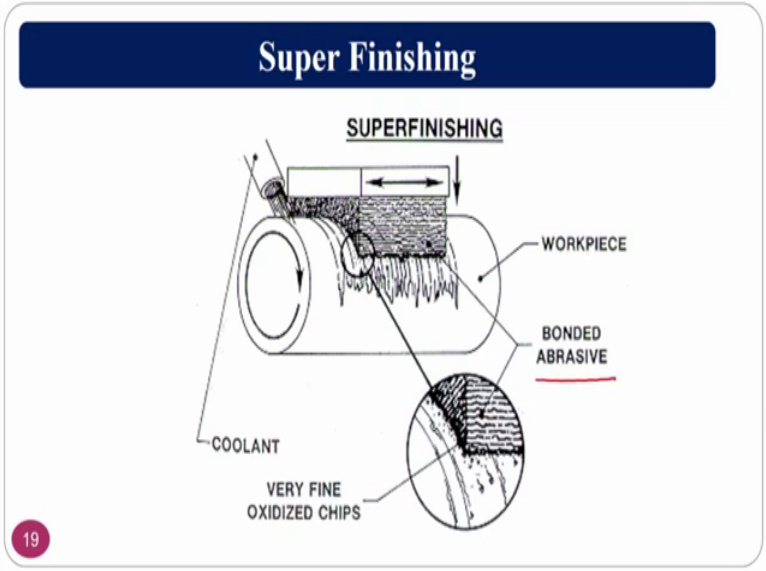

Now, we move on to the super finishing. This is one of the conventional finishing process where you will use the coolant, where you can use the bonded abrasives partially as per your requirement.

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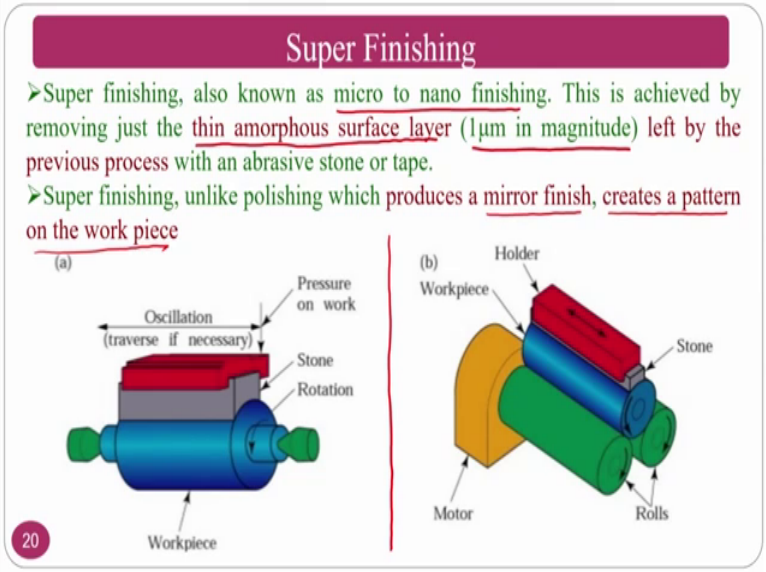

So, super finishing is also known as the micro nano finishing. Thus this is achieved by removing just a thin amorphous layer; that is about 1 micron in magnitude left by the previous process. If at all I want to use the super finishing process, I am going to use the previous process; that is like a grinding or I am going to use the hard turning process. If

at all then I am going to do this finishing process then you can achieve the surface; that means, that whatever the layers that are left by the previous processes can be removed by the super finishing operation.

The super finishing is unlike polishing which produces the mirror finish and creates a pattern on the workpiece; that means, that you have seen the picture. In that picture it has rotating workpiece and a brush type of, that is nothing, but the plunge type of thing is there. So, if it is rotating that only polishes the surface, but also it can generate its own pattern; that is nothing, but the lay predominate direction of the surface finished

People you might have seen in the first or second class, where there directrix and generatrix. So, that directrix will be formed on the, which is like a circle will form on the. Not directrix, it is generatrix which will form on the workpiece surface. There are two varieties. These are the two varieties which are the there in the super finishing operation. One is a plunge type; another one is a roller type will come across that.

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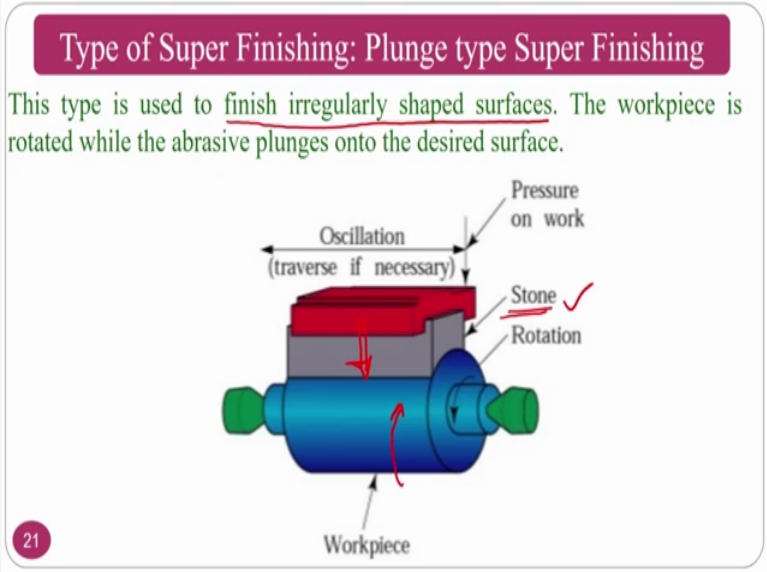

One is a plunge type of super finishing. If you see this type used to finish irregularly shaped surfaces; that means that if you have any type of irregular surface you can go for this particular super finishing type. This workpiece is rotated while the abrasive plunge is into the desired shape; that means, that this is a plunge you are going to apply the pressure on it and you are going to rotate this particular workpiece. So, you will get the finishing operation

So, for this purpose this, whatever the stone which is there, this may be flexible, this may be a solid. At the same time people you can also go for liquid abrasives here by putting it and you can rotate it, people uses like that also. So, you can see some of the advanced varieties of super finishing where they can use the porous stone and they just put the abrasive slurry, then they will, you rotate the workpiece.

Some of the advanced varieties they are doing like this, like we can take the porous plunge and they put abrasive slurry, then rotate the workpiece in the circumstances the finishing will be slightly better. So, there are lot of parameters that place the finishing operation performance like what are the abrasive particle size, carrier, medium abrasive particles concentration. The carrier medium and all those things will play a major role

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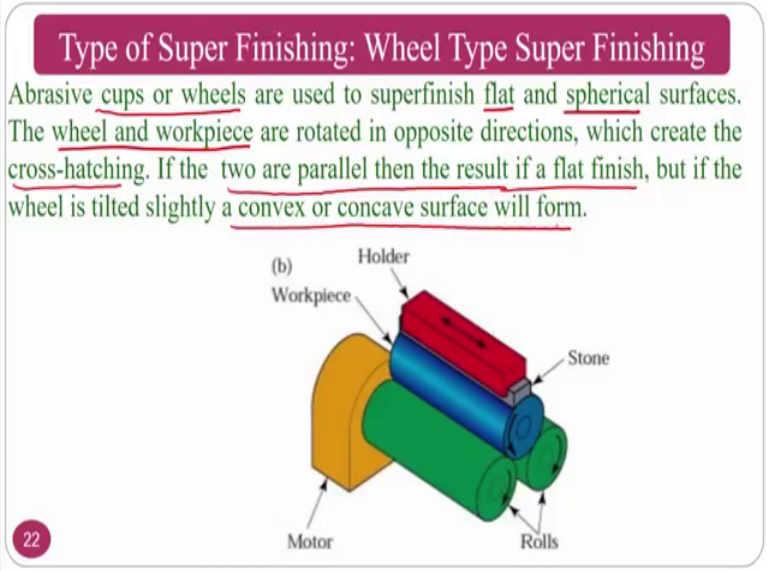

The another one is the wheel type or the roller type. So, this abrasive cups are the wheels, basically are used to super finish flat and spherical surfaces. You can go for the flat surface as well as a spherical surfaces using this wheel type super finishing. The wheel and work pieces are rotated in opposite direction, basically the wheel and workpiece normally rotated at the opposite direction which creates the crosshatch pattern in this aspect, what will happen. You can go for the crosshatch patterns on the surface, not only the finishing, but also you can get some pattern

If the two are parallel then the results in the flat finish, but if the wheels is tilted slightly now normal, you can get concave or convex, depend on how you are going to tilde. This

is how the wheel type of super finishing will takes place. There are two varieties one is a plunge type, another one is a wheel type of super finishing and the plunge type uses for its one applications roller type. Also uses for its own applications, if at all I require crosshatch pattern then I keep go for a roller one, if I want the flat then, if I want the normal one then I can go for the plunge one

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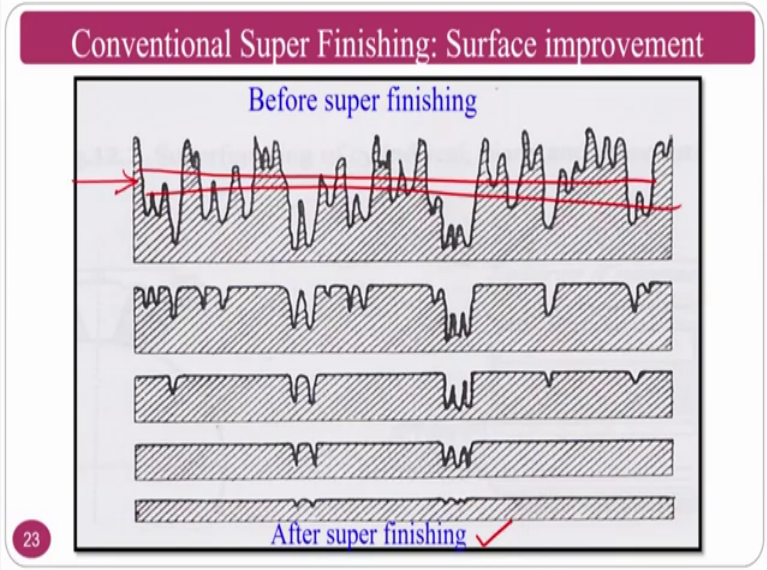

So, before and after what will happen? If I am going to use the super finishing operation, the plunge type if you take, this will erase all by rotation. By rotation what will happen? These are all will go. So, these are all will go in, then you will get final surface finish like after finishing ok, you will get the shearing. Normally abrasive process will shear, always peaks on the surface to get the good surface finish

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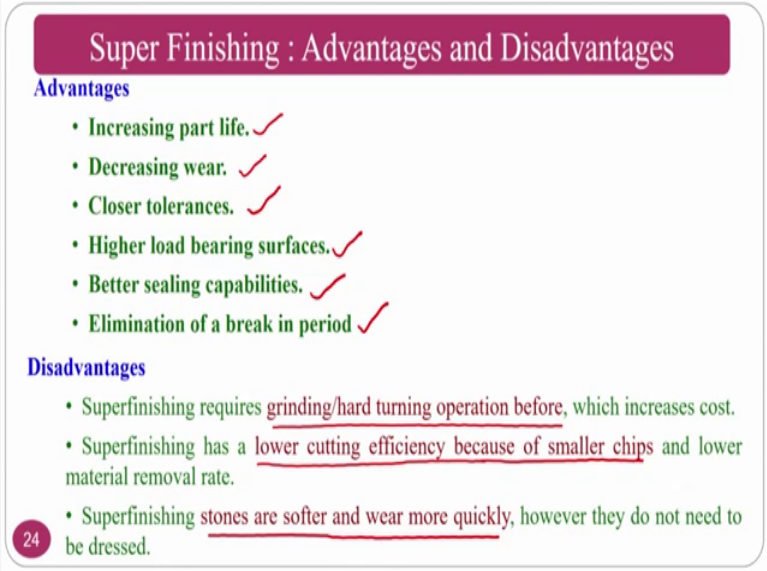

The advantages of the super finishing; It increases the part life; that is the competent life decreases the wear, because your surface peaks are very less. So, the way will be very less close tolerances. You can achieve very better tolerances as per the requirement of the customer high load bearing surface. If the surface roughness is too low what will happen? Number of peaks will be very less. So, the load-bearing area of that particular surface will be increased better sealing capabilities. At the same time you can have the break-in period. So, elimination of break in period

The disadvantages of this particular process; every process will have the pros and cons. So, there is a, there are some disadvantages that is called you need a pre-finishing process or a pre-machined process; like a grinding or hard turning process, then only you can use the super finishing operation. The cutting efficiency is lower, because the chips are very low. You have seen the grinding operation, where chip size decreases from turning to the milling to the grinding operation.

If the chip size decreases what will happen? The specific cutting energy requirements will goes up; that is why the energy efficiency in this particular process will go down, because the chip size in this particular process is still lower compared to the grinding process. So, another disadvantage is the super finishing stones are softer and wears very quickly. These are the three disadvantages of the super finishing process.

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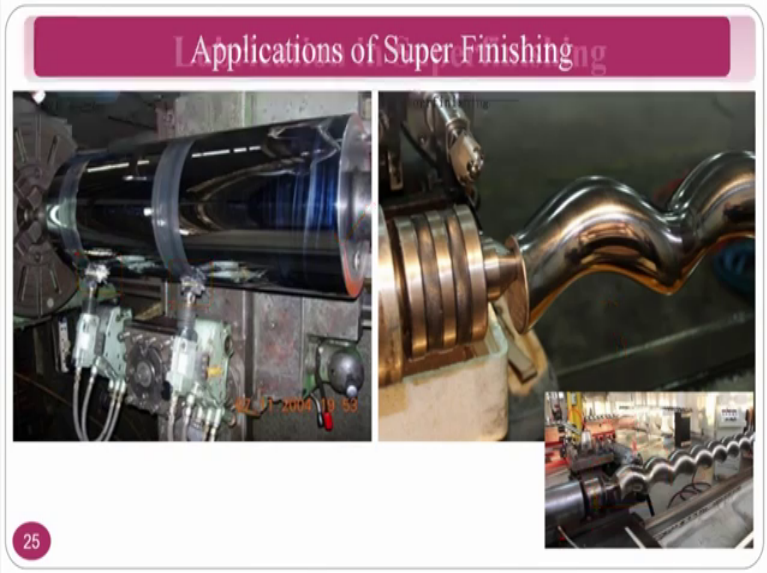

If you see the applications of the super finishing process you can see how the super finishing processes taking care by the brush. This is the workpiece which is very shining and these are the brushers which are there and these are the multiple processor finishing the surface.

So, you can see how the surface is looking like a, it is looking like a mirror surface. You can also go for the irregular shapes. This is the overview. The bottom one is just a over overview, wherein if you see a particular portion then you can see here. So, this is how the mirror like surface finish, you can achieve in the super finishing operation

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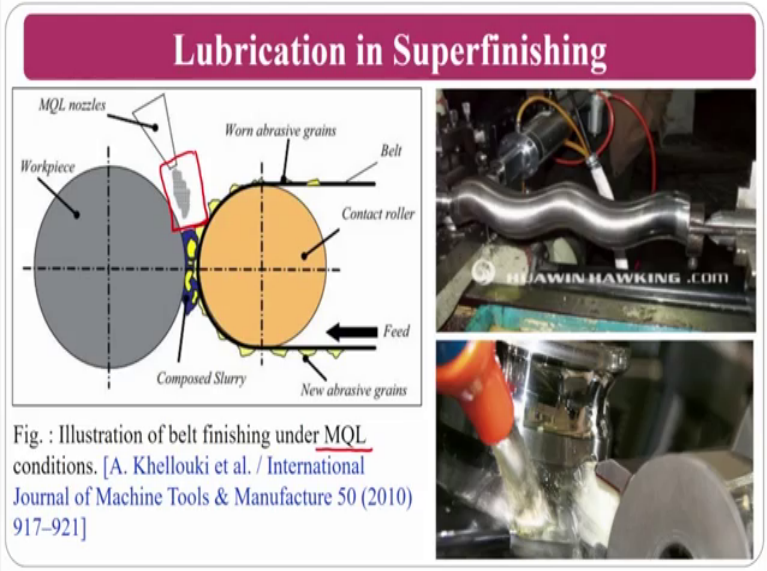

Coming to the machining fluids are the lubricating fluids or the finishing fluids, you can you can, normally the machining fluids in the super finishing operation. Basically it goes by the lubrication, because finishing action takes place by the friction or abrasion action. In that circumstances, the heat generation is much much less for that purpose. Obviously, the person has to go for lubricating type of cutting fluid rather than cooling type ok

So, mineral oil thing, you can go and even people can go for MQL also you can see the mql also, people are using, but only thing is that, I strongly suggest with main small knowledge is that you can go for the pure lubricants even if you are going for the minimum quantity lubrication application also. So, this may increase or enhance the process efficiency. So, those people who are interested to take the research in the super finishing is a good area. You can try with the MQL, as you are one of the thing like sustainable super finishing operation.

So, take the plunge type or roller type whatever is suitable to your nozzle application, where you can put a nozzle and all those things, plunge type slightly may be difficult. So, you can go for the roller type and you can take up how the performance of the super finishing process from the point of the surface roughness achieved. You can talk, you can go for variation of the air pressure or the concentration of your cutting fluid are different. Different types of lubricants you can use and many many things you can play. This is about the super finishing process. Now, we move on to sand blasting. The sand blasting

is one of the mass production process ok.

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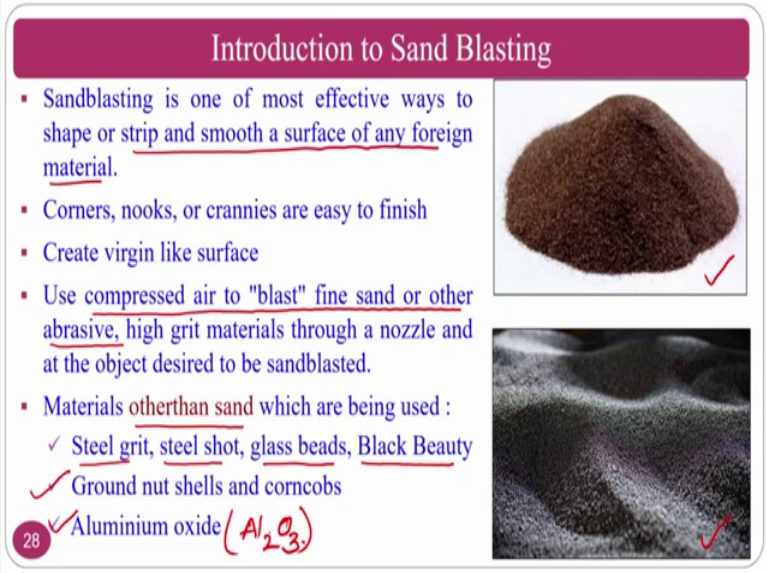

So, if you see sand blasting, normally it uses the sand particles which are senior. Sand blasting is one of the most effective way to shape or strip or smooth surface by any foreign material. Normally this process you can give the some shaping or normally if there is a big castor product is there, if I want to remove some casting layer, the surface of the casting product you can use this sand blasting.

This process can be used to finish the nooks and crannies and you can also generate virgin like of surface, not the virgin surface. So, you can use the compressed air to blast the fine sand or other abrasive particles. What I mean to say is that, there will be compressed air, there will be sand. You just mix internally and send to the component to be finished at with very high pressure. So, that the finishing will takes place all the that particular object or product

Materials other than the sand can be like a steel grits, steel shots or glass beads, the groundnut shells, many things you can use aluminium oxide; that means, that the Al2O3 also you can use, but depend on your requirement of your particular application.

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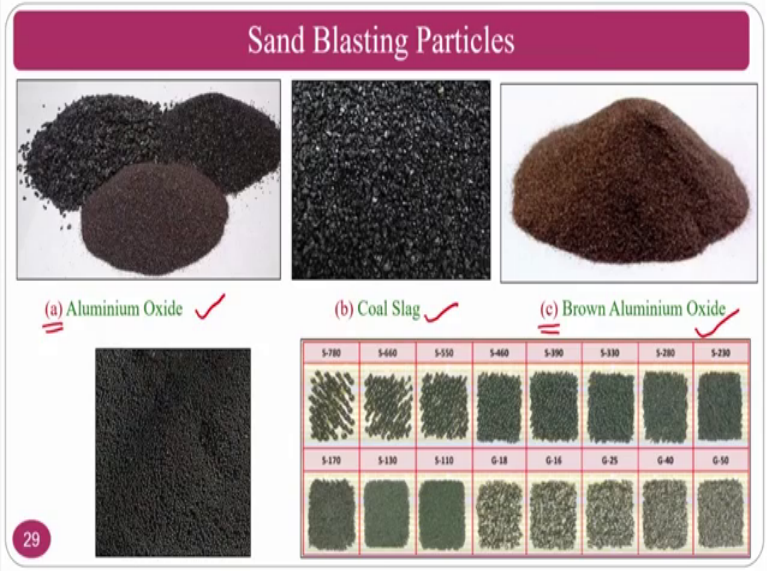

So, the particles, the particles you can use variety of particles here, you can see the sand particles different different the type of abrasive particles like Al2O3, coal slag, brown aluminium oxide. This is the black aluminium oxide, this a will be black aluminium oxide and c will be brown aluminium oxide.

You can also go for beads like of thing. So, you can see these are the spherical bowls where you can do the burnishing operation, see sand blasting, you can do by, it is one type of burnishing operation whenever you just impinge this particles with high pressure on the workpiece what will happen? This will go and deform the surface roughness peaks which are formed during the previous process; this is how the sand blasting works

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The main purpose of the sand blasting is, it is used to clean the work pieces and also use for removing the impurities and the suspended particles. You can see here, these are the rings of the vehicles before and after. So, how it is clean perfectly, so that you can reuse this one by painting it again and again clearly, you can see here the difference between before and after, this is before, this is after.

So, how beautiful the sand blasting worked here before and after. So, you can remove the rusted; that is oxide layer clearly gives like a virgin surface, it is may not be a virgin surface, it looks like a virgin surface sand blasting.

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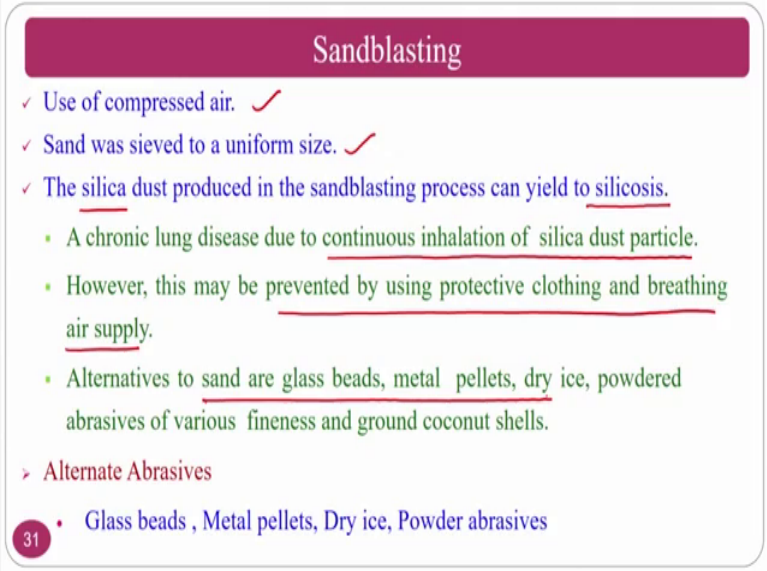

It uses the compressed air at the same time, it is you take the abrasive particles you see with as per your requirement what is the size that you want and all those things then you can go for the using in the sand blasting, basically sand is a silica. So, on a silica dust the basic problem with this one is silicosis problem. So, the this is a chronic lung disease due to the continuous inhalation of silica dust particles, because you are sending with high pressure gas along with the silica dust; that is the sand, what is the problem people if they are not going to use proper precautionary things like mask operon and all those things what will happen?.

The silica particles, the dust will go into the lungs of the person; however, this prevented by using a protective clothing and breathing supply. So, if at all the people take care or the operator take care about its operon mask and all those things you can prevent it. Alternatives to send are glass beads metal pellet us dry ice, many things also can be used like these are the particles that you use.

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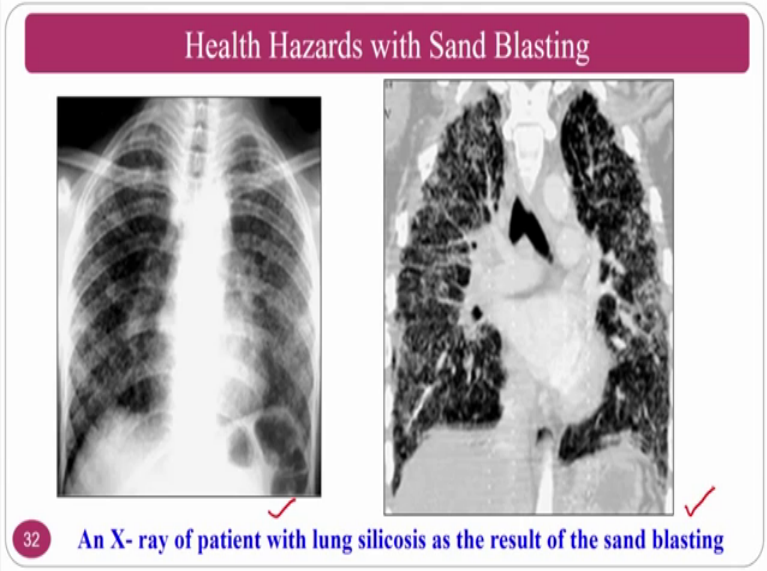

If you see the lungs, this is the x-ray of a patient with the lungs silicosis are the result of the sand blasting. Basically this is the normal one and it is silicosis affected one, you can see people whoever watching or listening to the course, you should careful about the operator. If you tomorrow you may become engineers, so you should provide the operators with proper attire, proper mask, proper dress and all those things.

So, that the operator will be safe and operators family will be safe. It is not the operators health or something it is the family, please consider this as a humanitarian grounds and you can tell the operators that this is what the difference, if you wear, if you do not wear and all those things, because sustainability or the sustainable manufacturing is what a all people want.

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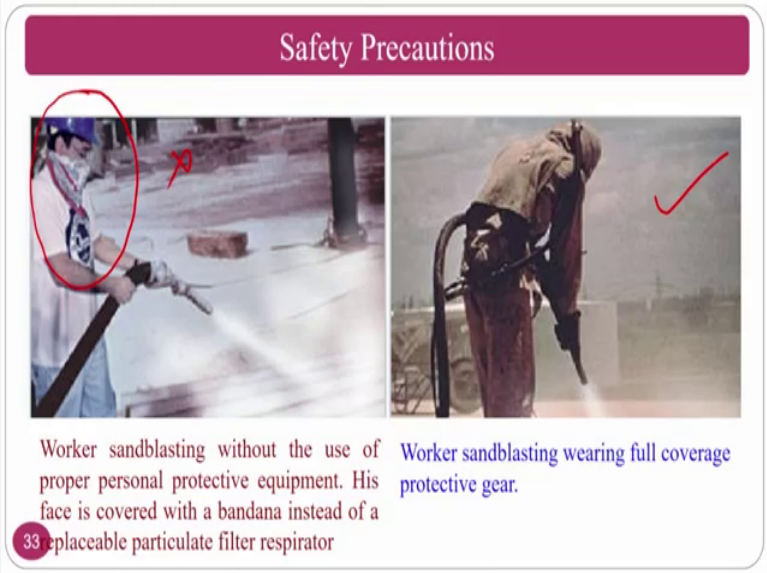

The safety precautions what you can suggest to the operators is this is how one should not use this is the wrong way I mean to say the application I am not saying this is how the wearing and all those things is not the right way this is how you can use the operon. So, if you can properly wear and all those things attire mask and everything this is the good way ok. So, suggest the people that this is what if at all you are going to work in the sandblasting area.

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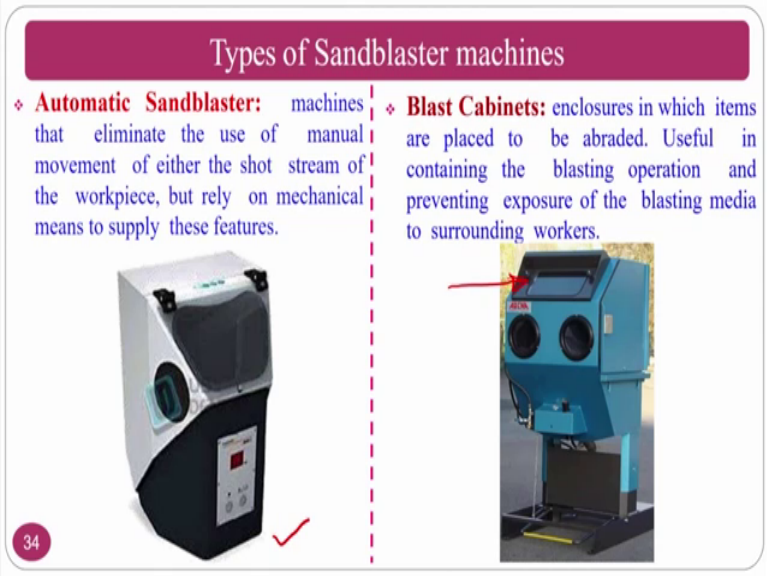

So, other things are, there is no involvement of the operator, you can do directly

automatic sandblastings are there. So, these machines are available, you can, the company can purchase. At the same time the people, if at all the component has to be handled there will be a glove box based cabinets are there. Like if you see in a clean rooms you will have a glove boxes and all those things. Similarly sand blasting you can do inside the glove box are the cabinet, so that there will not be much problem and you can do the, even the operator can see from the screen. So, these are the some of the advancements in the sand blasting.

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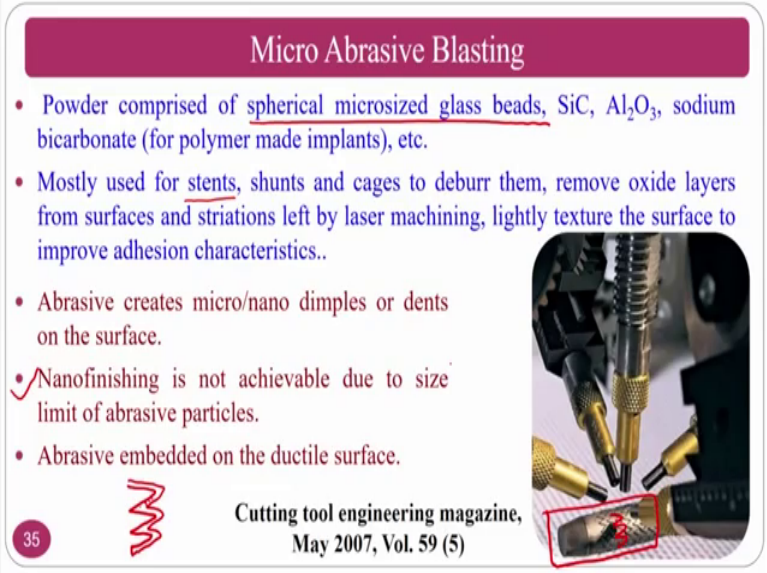

So, there is another one concept called micro blasting are the. Here also one people can go for the sand blasting and other things. So, powder compressed of spherical microsized glass beads, like a silicon carbide Al 2O 3 and all those things. Normally this micro sand blasting are used for mostly for biomedical applications; like stents shunts and all those things ok, used for finishing applications; like nano-finishing.

These cannot achieve the nano- finishing, but these are all mostly used for the debarring operation ok. This is the particular component where I want to do the debarring operation, because there is a pattern generated. Whenever a pattern generated, there is a chance of birth generation on surface. people you may not know if this is the surface, if at all I am doing, there will be burs; that means, that un-removed metals are smeared metals, I cannot say smeared. So, the some of the lump of the chip, which is adhered to the side edge is nothing, but the bur ok.

These burs are removed, because whenever assume that this particular is a endoscope or a chronoscope what will happen if there is a bur, what will happen if you a endoscope or a chronoscope. If endoscope goes into the throat what will happen? This particular bur will cut away the soft tissues of the human being for that purpose, you need to do debarring operation; one of the process that you can do the debarring operation is micro blasting.

This is about the sand blasting and one of the advancements is a micro sand blasting are the micro abrasive blasting in the micro abrasive blasting. You do not use the sand; you can use a sophisticated one like silicon carbide, alumina and all those things

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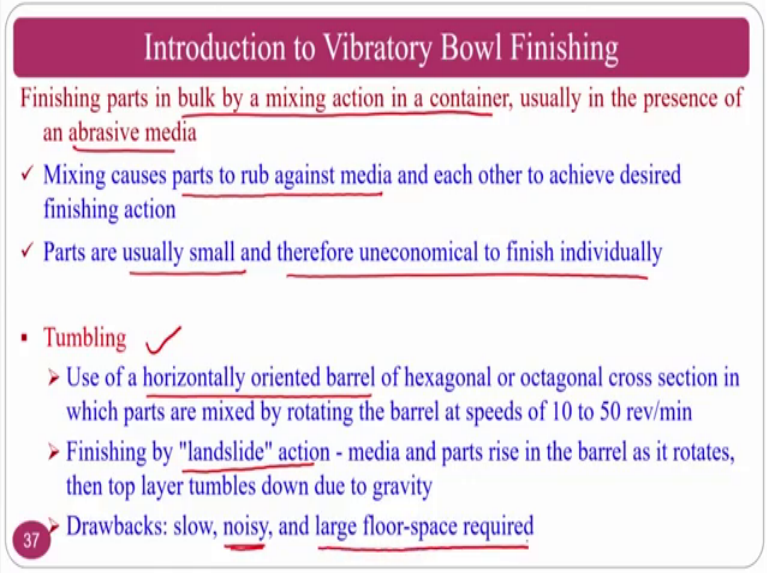

Next one we are going to the vibratory finishing and tumbling process. So, vibratory bowl finishing the finished products in bulk, basically in a container, usually in the presence of a abrasive media. You just put a abrasive media, you put a components, then you apply the vibrations are the oscillatory motion to the bowls mixing causes parts to rub against the media; that means, that abrasive particles are there. This will rub against the components and do the finishing operation; parts are usually very small; therefore, uneconomical to finish individually.

Basically here the components are very small, if at all I want to finish individually that is not economic, the cost of the production, cost of the component goes very high. So, though for that circumstances you can go for vibratory bowl feeding. Another one is

tumbling process, it is normally horizontally oriented barrel basically and if the mechanism will be used like a land sliding. So, whenever you have a abrasive particles as well as the components, you just rotate it, what will happen? land sliding type of material removal action will takes place.

The basic drawback of this process is, this is the slow process at the same time noisy. If at all the tumbling or the vibratory bowl finishing is going on this interaction of abrasive particles with a components, at the same time rotation of the bowls will give large noises and it occupies large floor area also.

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This is the tumbling you can see here, this is the process for the mass finishing and the good shaping process, but not the finishing process I have, a assume that I have a components with the cascade components, I want to remove a layer on top. So, you can go for this, you can get the shape, but not the final finish, assume that if I want the nano-finish you may not achieve, but you can get the similar

So, non-uniform finishing due to random contacts; so, abrasives are loosely bonded; that means, that these are individual and you are rotating it, what will happen? The contact will be random. So, the surface finish that you are going to get on the component will be random ok.

So, this is the one variety; that is called centrifugal disk tumbling. Another one is a

centrifugal barrel tumbling. These are the two varieties one goes vertical, another this is about this axis, another one will go for a horizontal axis; like this is the one axis, this will go like horizontal axis ok.

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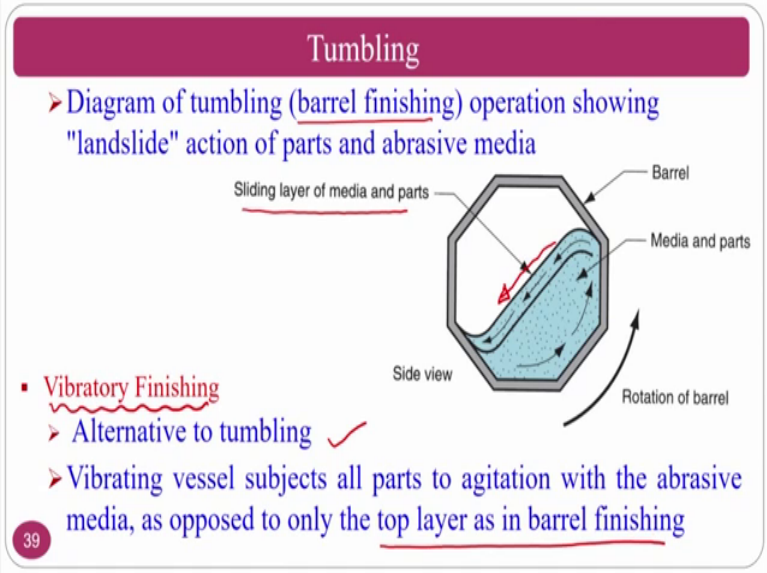

So, this is about the tumbling, again if you see the diagram of tumbling at is nothing, but the barrel finishing operations showing the landslide action. This is how the sliding will takes place; that means, that medium what is the abrasive medium will takes place like a landslide like this and the finishing will takes place

In a vibratory finishing process what will happen? Alternative to the tumbling, this is one of the alternative you can go for and vibratory vessel, subjected to all parts agitation with a abrasive media, opposed only the top layer in the barrel finishing, what will happen? You just put it here and you just rotate it and you will get the finishing process.

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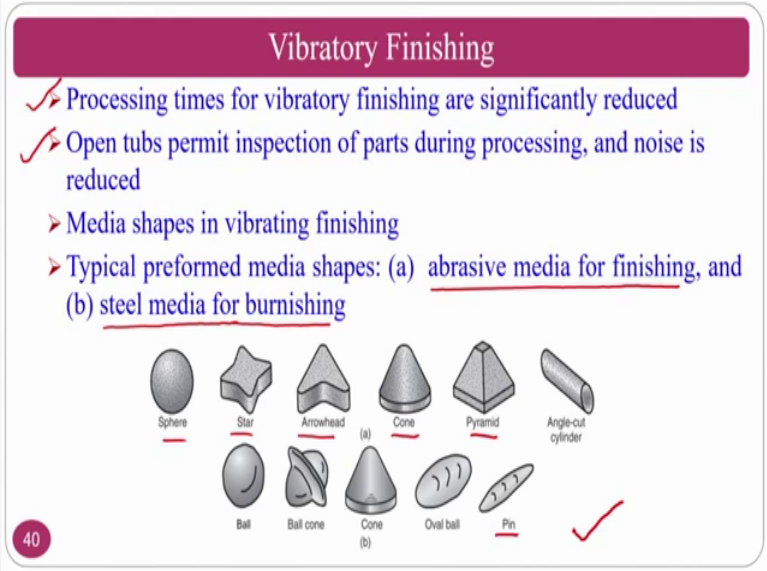

Vibratory finishing, the process times for vibratory finishing a significantly reduced; that means, that the products are finished in a mass production. So, the time will be very less, at the same time open tub permits the inspection of the parts during the processing and the noise is reduced. So, open tub permits the inspection. There are open tub and close tubs are there, so you can go for any type of thing.

Media shapes in the vibrating finishing are like abrasive medium for finishing steel medium for burnishing; that means, you can go for two varieties. If at all my requirement is the finishing process, then I can go for abrasive particles. If at all my finishing is by burnishing, normally I can go for a steel media; that is steels spherical. Bowls are any particular shape that you can generate and use. These are the some of the shapes that are used like a sphere star arrowhead cone pyramid to the pins ok.

Depend on your requirement you can go for these types of shapes, in the, you just put any one type of shape in the vibratory bowl finishing process and you put the competent, then rotate it and this will help. So, how it will help, if at all I want to shear it I have to use abrasive particle. If I want to burnish it I have to use the steel type of particles like this. So, now, we move on to the drag finishing process in the drag finishing process.

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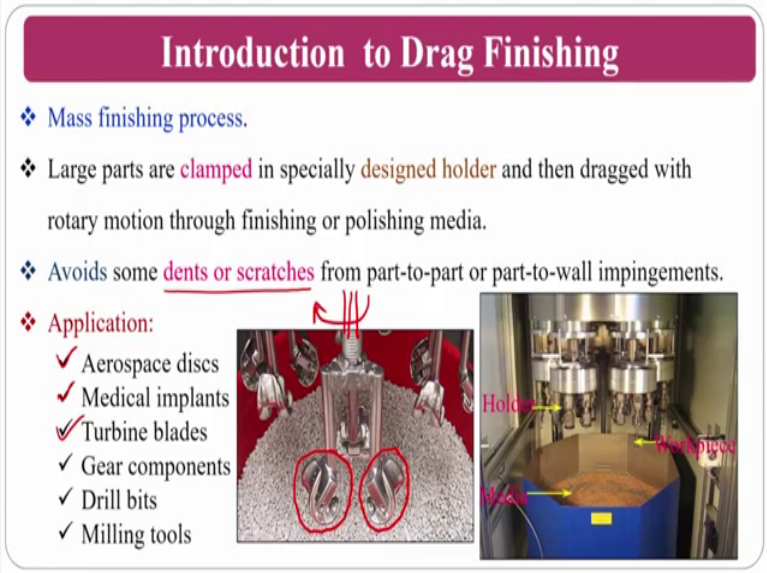

You can see this is also one type of vibratory finishing process, but here the work pieces are held and the abrasive particles are at the bottom. This is also a mass finishing operation. At the same time large parts are clamped in specially designed holders and then dragged with the rotary motion through the finishing or the polishing media. These are the Neem plants, whatever you are seeing is a Neem plant basically and you put it and you rotate with the abrasive particles. So, are the drag across; that means, that your abrasive particles will be also stationary.

Now your abrasive particles are there in the bowl, you put the your implants or you hold your components, then you give certain motion to the whatever the moving objects is there. Assume that this one is a moving one you just give the motion to it, so that abrasive particles will interact with the components.

Like in this case, it is Neem plant and you can do the finishing operation, avoids some dents or scratches from the part to part. The beauty about this particular process compared to the previous process is. In the previous process you are just putting, all assume that I am putting a Neem plant in it, then I am rotating with respect to certain speed what will happen.

There is a chance Neem plant to Neem plant contact also, but this will be not there in that particular operation, because these are fixed to certain particular portion of this rotating part and abrasive particles will have their own finishing action. So, applications normally

medical implants you can do, then aerospace you can do turbine blades, gear components, drill bits many things you can go for this particular operation.

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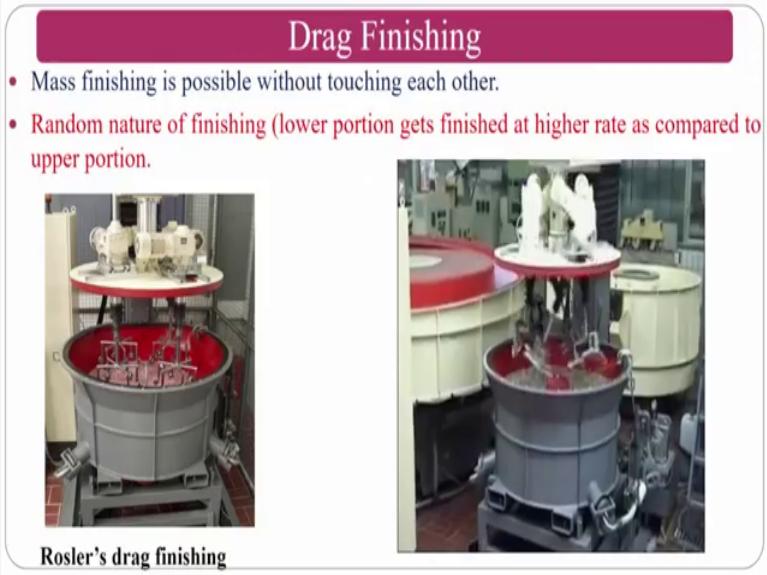

This is a mass finishing operation without touching each other that is good. That is what we have seen in the previous slide also, random nature of finishing is taking place; because this is abrasive particles are randomly oriented.

As you can see here in the previous slide, the Neem plants are on top side, here the components are held inside and now you rotate it. There are separate motors, for each motor is connect here, assume that this motor is connected to this one and you can also see here the video, you might have seen the video how it is rotated and all those things.

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This process normally uses for the edge rounding; like achieving the following, like removes the grinding burs, you in stabilizes the cutting edges and extend the tool life. So, on many applications you can use for this one, normally debarring operation is also.

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Then if you can see here, before processing and after grinding operation and after polishing operation, you can how, how you can change from these to these and these to these. You can see here at the same time tool holder, you can see before and after and the thread cutting tips also ok. These are all the applications of this particular process. This

process can improve the surface quality, reduces the roughness, this is the most important, because of the finishing process the roughness has to go down and improves the chip flow also.

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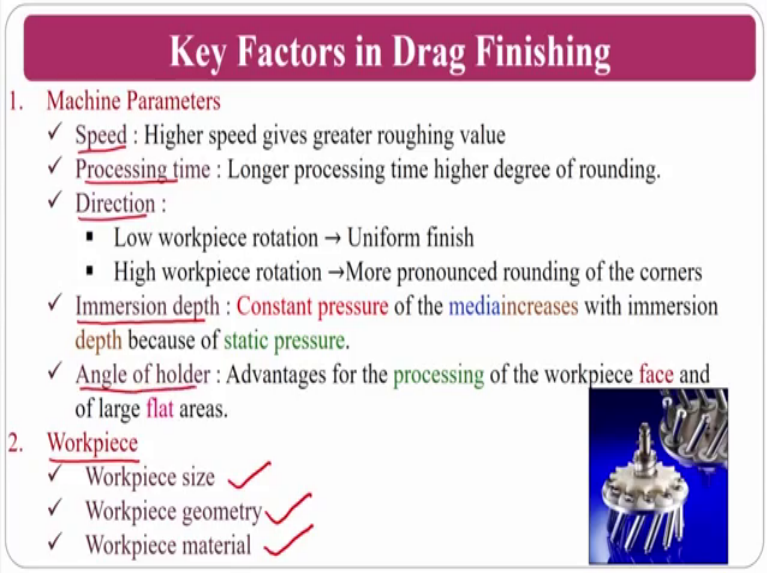

So, the drag finishing process key, a finishing things is a machining parameters like speed, processing time, direction, these are the things. At the same time in the workpiece also, if you see the workpiece size, workpiece geometry, workpiece material, whether it is a ductile material or whether it is a brittle material and all those things you can say, and in the machining parameters you have the immersion depth, how much you are going to immerse, whether you are going to immerse partially or fully; that is all dependent if you take you from the point of drill widths and all those things to be done.

In that circumstance I do not want to finish the shark, there I can go for partially immersing, then the angle of the holder at which angle, whether you want to hold like this or whether you want to hold like this, that all you can play.

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The another key factor is one abrasive medium ok, where you can give H granulates or HSC granulates or K granulates, SIX granulates or QZ granulates, these are the varieties of granulates are there. These are all you can use as your abrasive particles in the drag finishing process.

So, drag finishing process also have some product development type of thing, that is you can develop these type of abrasive particles and you can open your own company for this one. This is not a very big task to develop these type of abrasive particles, you can develop and you can sell to the companies who are going to do the finishing application.

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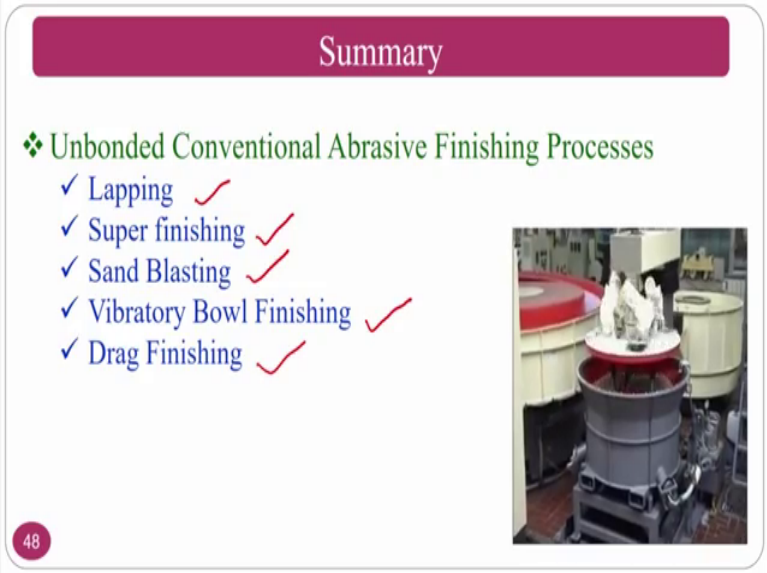

Summary goes like this, we have seen the lapping process, we have seen the super finishing process, we have seen the sandblasting process, vibratory bowl finishing process and the drag finishing process.

These are the finishing process which are un-bonded abrasive processes, which we have seen this un-bonded finishing process and I am thankful for your kind attention for this particular class ok. We will see you; I will see you in the next class.

Thank you.