Metal Casting
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Module - 01
Introduction And Overview
Lecture – 03
Overview Of Different Casting Processes-II

Good morning friends, in the previous classes we have seen the introduction to the casting process and we have also seen a classification of the casting process, and the principle of the metal casting process is very simple. Whenever we want to manufacture a component a similar cavity has to be created in a sand mould are a medium compacted medium and we met the metal and we pour into that to cavity. After solidification we break that sand medium, then we get the solidified component. This is the simple principle of the metal casting and we have seen that the metal casting process has been broadly classified into conventional moulding process chemical sand moulding process permanent moulding process.

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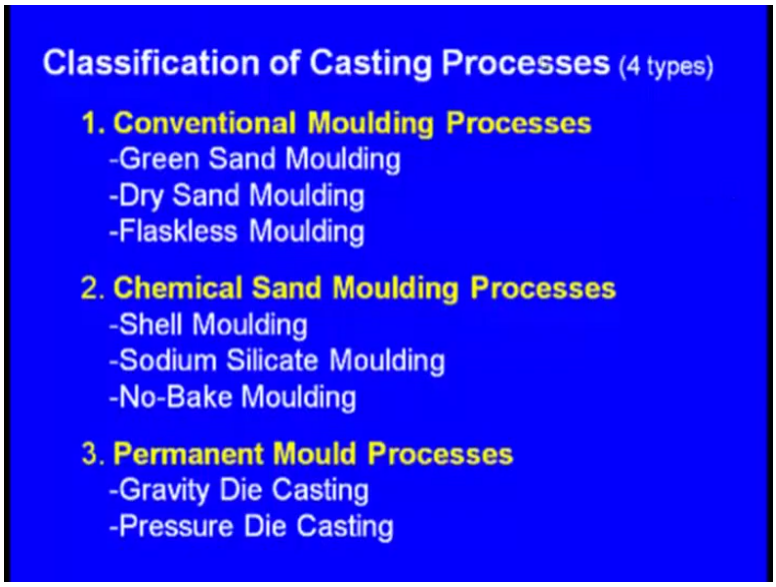

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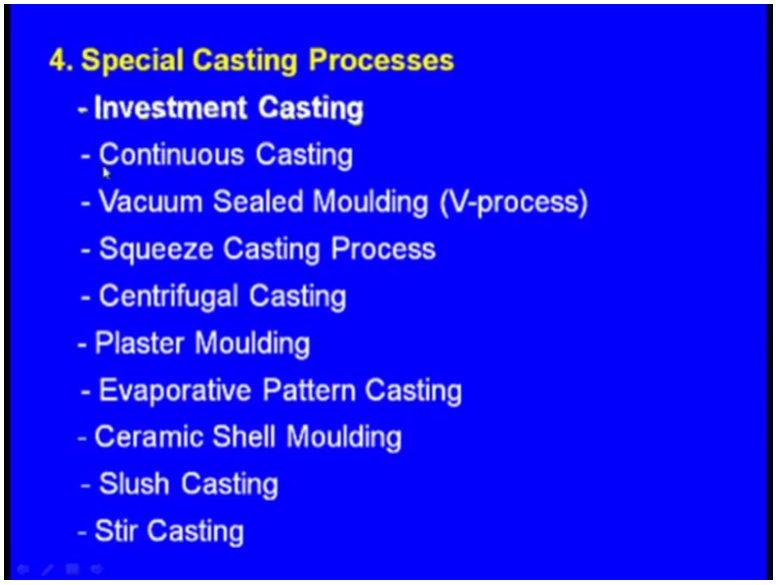

And finally, the special casting process and in the previous class we have seen the conventional moulding process and the sub classifications in it, they are the green sand moulding dry sand moulding and the flaskless moulding.

Coming to the chemical sand moulding process we have seen the shell moulding, sodium silicate moulding and no bake moulding and we have seen that there is a permanent moulding process where the mould is made up of a special steel. So, it will be permanent whereas, in the case of the sand casting process, once we make the mould once we pour the molten metal into the mould, after solidification we break that mould and the mould is no more permanent. Here the mould is made up of a special steel and into that mould we create that required cavity.

So, these are also known as the dies. So, under that we have seen there are 2 types gravity die casting and the pressure die casting; and in the gravity die casting the molten metal flows into the permanent metallic moulds by means of the gravity whereas, in the case of the pressure die casting the molten metal is injected into the cavity which is between these 2 metallic dies by means of an external pressure.

Now, let us see the special casting process. Under the special casting process we have the investment casting continuous casting vacuum sealed moulding these also known as v process. Next squeeze casting process centrifugal casting process plaster moulding evaporative pattern casting, ceramic shell moulding slush casting and finally, the stir casting first let us see the investment casting.

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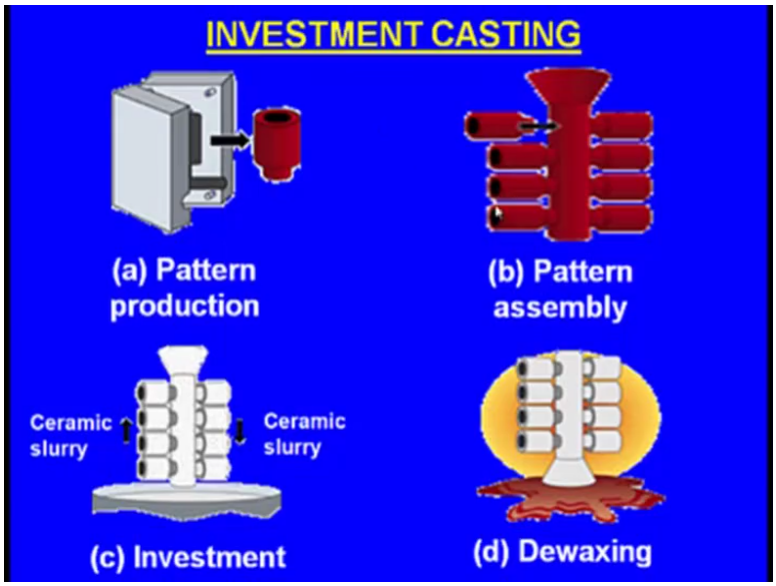

Now, this is the a what say simple principle of the investment casting. Investment casting process means the pattern is made up of wax in the olden days the ancient man when he wanted to manufacture these spear heads or the rudimentary tools, he initially he made a wax pattern around the wax pattern he has compacted the sticking sand later he has heated that to system and the wax has a drained out inside there was a cavity, into that cavity the molten metal was poured.

So, this concept was used by the ancient man though new methods have been developed still this process is not outdated still we are using wax as the pattern material. So, in the investment casting wax is the pattern material of course, the ancient man use the sticking sand around to make the mould whereas, we use the modern ceramic slurry to create the a mould what are there are different steps in the investment casting process. First one is the pattern production, for that there will be a wax injector will be there the they will be wax bath will be there the molten wax will be inside that bath and from that bath the wax will be injected into the wax dies. So, these are the 2 dies.

So, when we close inside there is a cavity, into this cavity the molten wax will be injected and after some time the wax solidifies and the wax pattern will be taken out. Now to gain more production or to increase the rate of production what have what we do is we assemble a similar patterns like this maybe some 10 patterns or 8 patterns together

and they are joined by a central tree or this now also acts as the sprue central tree. So, this is the pattern assembly.

The next step is we prepare a ceramic slurry a thick ceramic slurry we prepare and we give the ceramic slurry coating means this assembly will be dipped into the ceramic slurry we take it out side and we sprinkle the stucco around that and we dry it again we will dip the pattern inside the ceramic slurry take it out and what say apply the stucco and you dry it likewise of the application of the ceramic slurry coating and the stucco and the drying will be done in a cycle maybe 7 8 times, after applying this ceramic slurry and stucco for 7 8 times there will be a thick shell around the wax patterns. Then it will be baked then what happens it will become hard and before that it will be there will be a process called dewaxing process means all the wax which is inside this ceramic shell will be melted and it will be drained out like this here we see the dewaxing.

And in the next stage this is the casting, casting means pouring of the molten metal into the cavity. So, we melt the metal.

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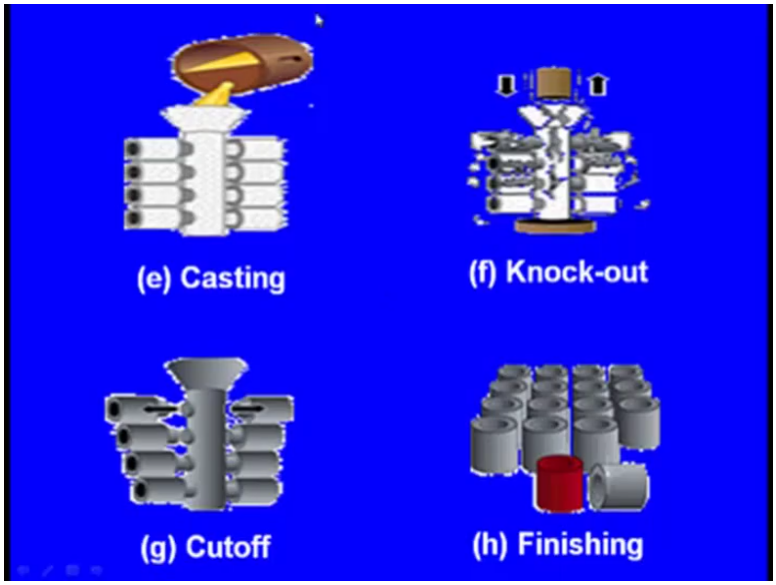

Separately and we are pouring here the molten metal goes inside the a cavity, initially it goes into this central tree that is this sprue then it goes horizontally and it fills all the cavities and after sometimes the molten metal solidifies, after solidification we break this shell the ceramic shell this operation is known as knockout.

Now, initially we have assembled we have taken some 8 10 patterns and we have assembled them, now we need to separate them. So, here we are cutting the individual casting from the central tree here we are cutting. So, this is known as the cutoff, next actually the components produced by the investment casting have a very smooth surface finish, but still a final finish is required here we do the final finishing and also if painting is required we do the painting. So, this is the final stage of the investment casting process.

So, these are the advantages of the investment casting process, we get the very excellent surface finish whereas, in the case of the green sand moulding are the mould is made up of the sand what say, the cavity surface is made by the sand because of the sand grains there will be some irregularities will be there, because of that the cavity will have a irregular surface even the casting will develop a irregular surface, but here we get a very excellent surface finish this is the advantages great advantages of the investment casting process.

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Next one very complex details can be made. So, this method is also used in the a jewellery castings. So, we can see the jewellery castings there will be very complex design will be there, it is very difficult to manufacture this kind of complex design by any other casting methods, but using investment casting this is very easier. Next one very thin sections can be obtained as thin as 0.75 m m, we can make. Next one close

dimensional accuracy you can see the dimensional accuracy it will be 0.08 m m to 0.1 m m this is the dimensional tolerance we can obtain by the investment casting process.

Next one complex shapes can be made, next one no or negligible finishing operation; sometimes no finishing is require maybe few times a little finishing is required now what is the problem? In a sand casting process we make the casting and yes we break the mould and when we take the casting out set there will be a rough surface on the casting. So, to get a very good surface finish we have to machine and we have to spend several hours on the machines to obtain a very good surface finish, but whereas, here in the investment casting process no machining is required sometimes and sometimes a little machining is required.

Next one castings are free from the usual defects, in the case of the sand castings if the moisture is more there will be some gas defects will be there, sometimes this sand will be sticking to the castings. So, these kind of defects will not arise in the case of the investment casting.

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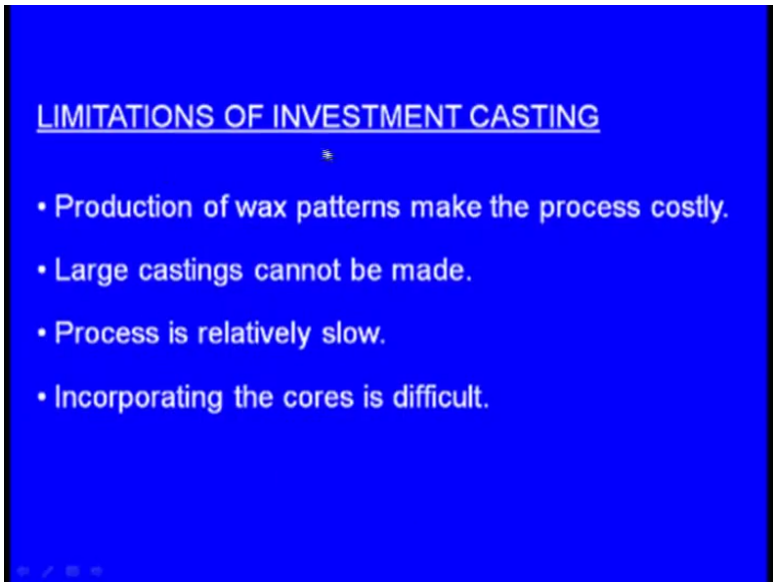

And these are the limitations of the investment casting process. Production of wax patterns make the process costly, wax is costly there are again different wax are there some cheaper wax are there some costlier wax are there most of the times. So, we make blends of these waxes to obtain better properties so that way these pattern waxes are costly and the processes becomes costlier.

Next one large castings cannot be made whereas, in the case of the sand casting process a very small casting can be made a medium size casting can be made and even a very large casting can be made as large as about 5 tons casting can be made by sand casting process, but here very large castings cannot be made and a process is relatively slow why it is slow? Because we are making the wax patterns then we have to assemble them then what we will do we will make the ceramic slurry, this ceramic slurry a preparation itself takes several hours of time then we have to dip the assembly into the ceramic slurry take it outside apply this stucco coating then you dry it, again dip it inside the ceramic slurry apply this stucco dry it like this this cycle has to be done some 7 8 times, each time we have to spend at least one hour for a dipping into the slurry and applying the stucco and drain likewise this ceramic shell preparation takes 7 to 8 hours and incorporating the cores is difficult.

So, these are the limitations of the investment casting process, these are the typical applications jewellery castings can be made by investment casting art castings.

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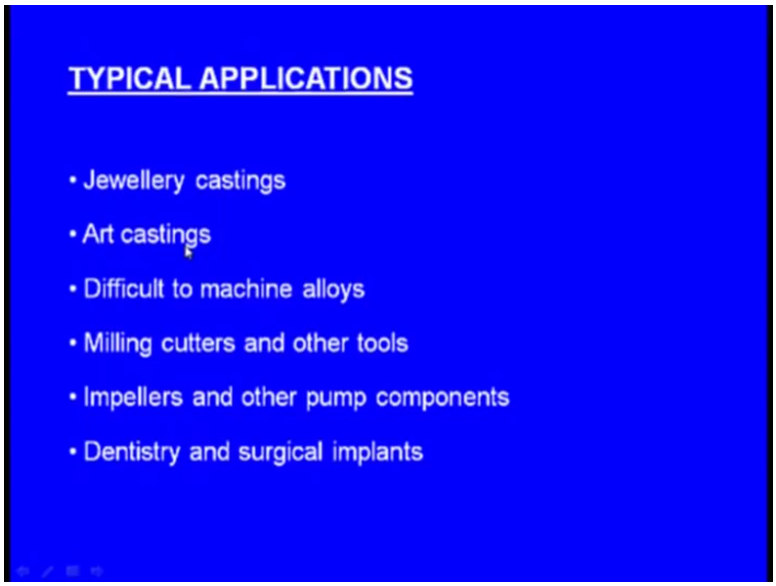

Can be made difficult to machine alloys can be made by investment casting process milling cutters and other tools impellers and other pump components and finally, it is used in the dentistry and surgical implants the artificial teeth are manufactured by the investment casting.

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So, we can see here these are the jewellery items. So, these are manufactured by investment casting and here we can see these are all the jewellery components sometime back we have talked about a central tree.

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So, this is that central tree or this sprue and through this they are pouring the molten metal and. So, these are all the individual castings of course, finally, they will separate all these individual castings. So, these jewellery items are manufactured by investment casting.

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And here we can see these a steam turbine blade which is used in a thermal power plant, you can see this is the turbine blade it is a very huge turbine blade and you can see these are all the blades these are all the blades and all these blades are manufactured by investment casting.

Because these blades will have a very complex geometry and if you manufacture it by any other method they require the machining and it is very difficult to machine such a complex geometry, that is why these are manufactured by investment casting process and here you can see this is a milling cutter.

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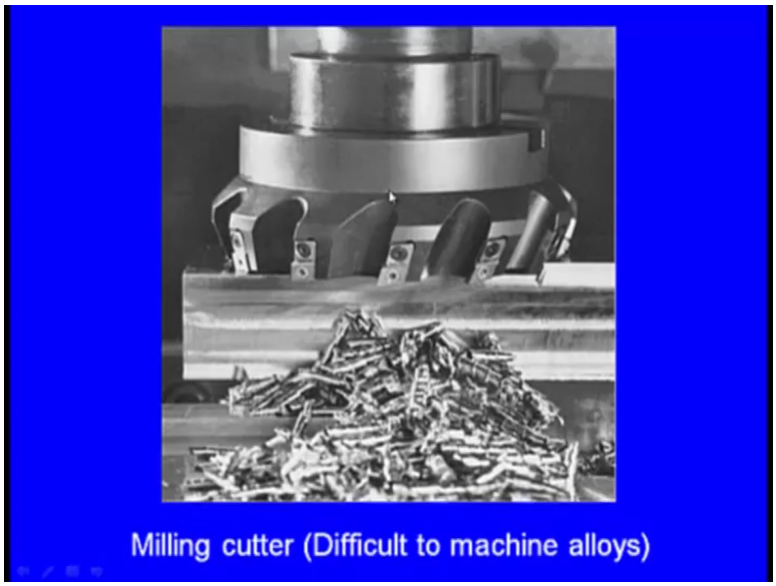

This milling cutter is made up of difficult to machine alloy; most of the times it contains large amount of tungsten and it is very difficult to machine this kind of steel, now this milling cutter is manufactured by investment casting.

So, here we can see this is an art casting.

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Now, you see its complex features, if you make this by any other casting process it will have a rough surface. Once there is a rough surface we need to machine it, now it is not possible to machine this under a machine, but when you make this using the investment

casting process the way already we get a very smooth surface. So, there is no need to machine it. So, investment casting is also used in the art castings, next one let us see the continuous casting process.

So, this is the typical set up of the continuous casting and here you can See this is the molten steel and this in between there is intermediate to reservoir is there this is known as the tundish.

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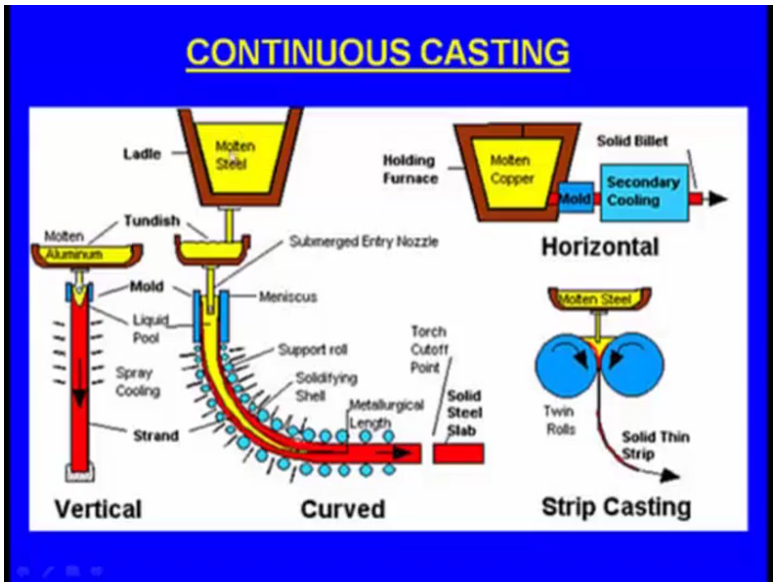

Tundish and here we can see there is a die and the molten metal from the ladle it flows into the tundish and from the tundish it is flowing through the die, then what happens and here initially there is a slab is there solid slab and this solid slab or the stopper will be here at the beginning and the molten metal flows and it flows through the die and immediately there will be cooling system will be there, and because of the cooling system and it solidifies and it falls on the stopper and the stopper slowly comes down and it slowly comes down and it goes like this and even the solidified billet it comes like this.

And after it comes to a particular distance it will be cut, at an equal distances or at intermediate distances it will be cut. So, this is the simple principle of the continuous casting and here we can see the horizontal continuous casting.

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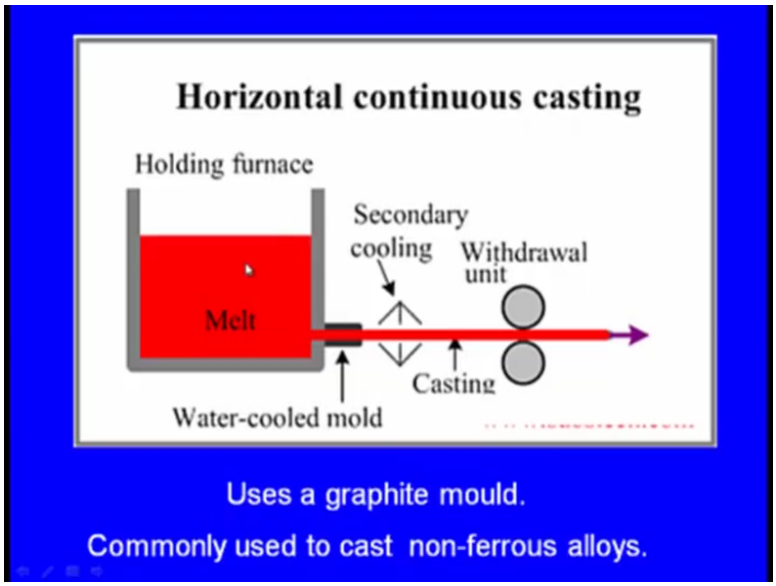

Here we can see this is the holding furnace and this is melt means the molten metal and this is the mold and the molten metal is going out and here we can see the cooling system is there and because of the cooling system and its solidifies, and here we can see these are the rollers and these rollers they take the solidified casting away from the furnace and the solidified casting goes in this direction and here the mould is made by a what say graphite mould, it is commonly used to manufacture non ferrous components non ferrous castings.

These are the advantages of the continuous casting process.

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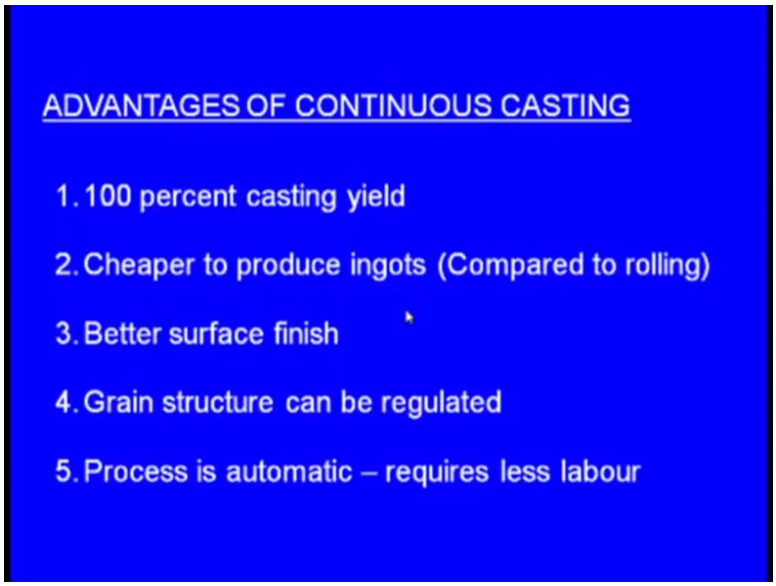

We get the 100 percent casting yield, first of all what is meant by casting yield. Suppose in by if you make a casting by green sand moulding suppose if the weight of the casting is 100 kgs, we pour more than 100 kgs of the molten metal because the molten metal occupies into the sprue and also into the riser. So, if we want to make a casting of 100 kgs about to 125 kgs of molten metal we pour into the cavity.

So, that is way in such a case the yield will be 70 to 80 percent and here the yield is 100 percent that is the a benefit. Next one cheaper to produce ingots. So, most of the times we produced the ingots by continuous casting and we get a better surface finish and grain structure can be regulated. As soon as it enters into the mould there will be cooling system because of this rapid cooling the grain structure will be improved the process is automatic it is a mechanized system that is why it requires less labour, and here we can see these are all the aluminum ingots manufactured by continuous casting.

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And here we can see these are these are the.

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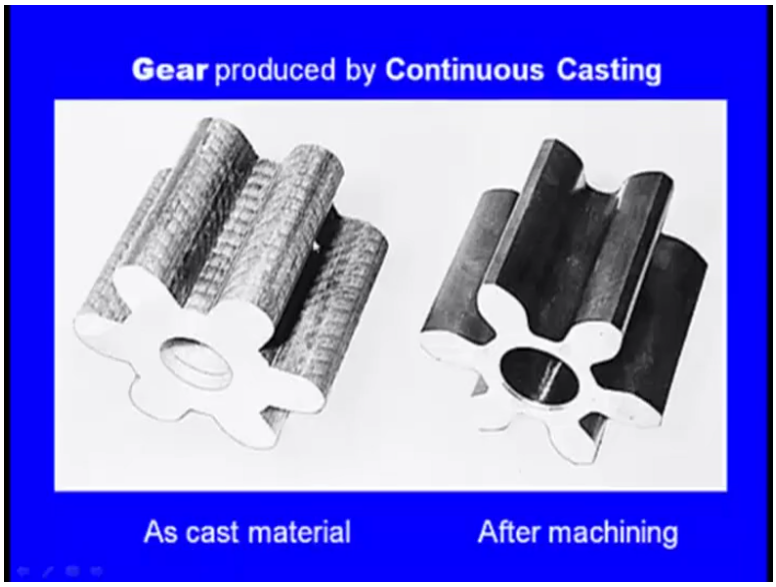

gear blanks this is a gear blank, this was manufactured by continuous casting means inside there is a mould in the cross section of the mould was similar to the gear blank profile and this is the as cast material afterwards it was machined and after machining we got a gear like this. So, gears are also manufactured by continuous casting.

Next one the vacuum sealed moulding process, this is also known as v process and this was recently developed in Japan what is the principle of the vacuum sealed moulding?

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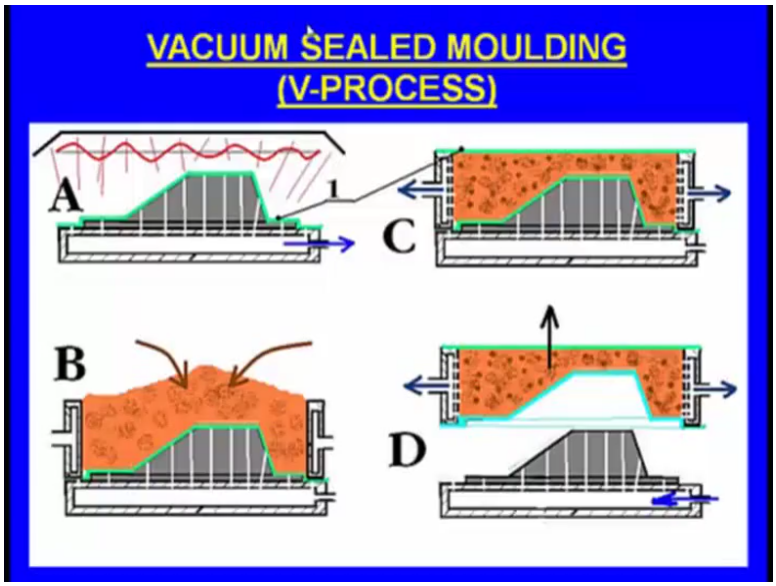

Here we use vacuum to bind the or to hold the moulding sand whereas, in the case of the green sand moulding we will used to mix some binders and place moisture. So, that some binding action will be developed between the moulding sand and such a sand we what say place inside the moulding box and when we compact yes we get a moulding cavity and here we want use the what say clay or any binder even the moisture we want use, we use a fine and dry sand and here we use vacuum to hold the sand.

So, here we can see here is a platen, here is a platen and this is the pattern this is the pattern and here you can see a green colored one. So, that is a polymer film. So, what we do is. So, on the bolt we place the pattern and here we put the polymer film, and here we seal it and here also we seal it. Now we apply vacuum here, when we apply vacuum what happens the vacuum sucks the polymer film. So, because of that the polymer film will be strictly adhering to the pattern surface. Now both this yes now we place a moulding box on this board in the moulding box we place the now you we place the moulding sand here we can see here we place the moulding sand after placing the moulding sand the x sand will be removed.

Now, again we can see here let us come here, here again we can see green colored one. So, we place a again a polymer sheet here and you seal it here, you seal it here and here there is another vacuum pump is there and here we apply the vacuum then what

happens? The vacuum sucks the polymer film because of that it goes what say closer to the pattern and the sand here will be tightly sticking to the pattern it will not be shaking.

Now, what we do afterwards remember that we have used the 2 vacuum sources, one to what say this one in the initial stage to make the polymer film and here to the pattern surface and another polymer we have kept on the sand and again here we have operate the vacuum the first vacuum we release. When we release the first vacuum what happens the pattern will be coming out of the mould.

Now, we can see here this is the mould and here it is closed by the polymer film and here it is also closed by the polymer film and the vacuum is tightly holding the moulding sand. So, that is how we made the one what say half of the moulding boxes or one moulding box or the drag box, again in the same way we make the cope box also then we assemble these 2 together and of course, when we make the cope box there will be a provision for pouring the molten metal. Then we molten metal the molten metal goes inside the cavity and it is solidifies. After it solidifies then in the case of the sand casting we have to break it and we have to apply external pressure for the knockout purpose, but here just we have to release the vacuum; then we release the vacuum automatically the sand will be falling down and we get the solidified casting.

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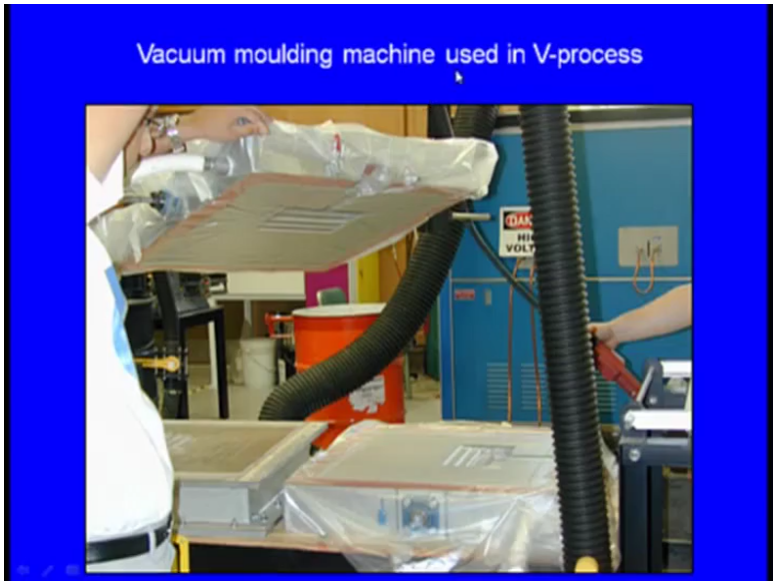

So, here we can see this is a Vacuum moulding machine used in the V process and here we can see vacuum is used and yes we can see the polymer film. So, these are the advantages of the vacuum sealed moulding process.

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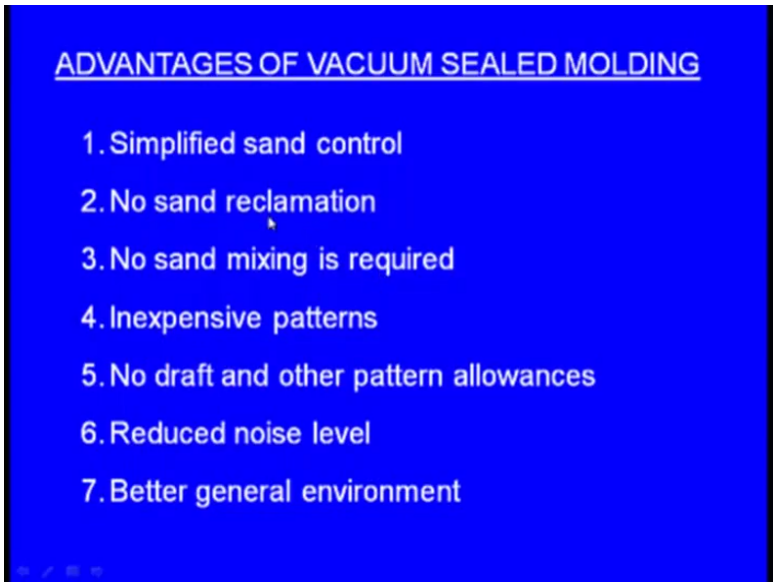

One is the simplified sand control; in the case of the green sand mouldings we have to add the binder, we have to add the additives, we have to mix the moisture then we have to mix it thoroughly this takes time and very carefully these ingredients have to be controlled if the moisture is more there will be a problem, if there is a binder is more there is a problem, if the mixing time is not proper is not sufficient again there will be a problem, but here there is no question of mixing additives to the sand. We take the fine and dry clear sand there is no question of preparation of the sand that way there is a simplified sand control.

Next one no sand reclamation; reclamation means when it is about to be spoilt we take it and we see that it is again used. So, such a case arises in the case of the sand moulding. So, part of the sand will become useless or when it is the whole thing is becoming useless, we may put efforts and see that most of the sand will be reused so that operation are that process is known as the reclamation.

So, here the question of reclamation does not arise, the moment you release the vacuum automatically the whole sand falls down and we get the casting the sand as it is we can use it again for the making the next casting. So, the third is the no sand mixing is

required. Next one the inexpensive patterns patterns are not expensive, no draft are other pattern allowances. In the case of the sand moulding process that what say pattern will have a tapper. So, that it will be withdrawn from the mould, here or later that tapper has to be machined here no such tapper or draft need to be given means afterwards we do not have to put efforts to remove that taper on the machines.

Next one reduced noise level; in the case of the sand moulding process to prepare while we are making the preparing the sand there will be a noise and here there is no question of such noise and when we are compacting the sand in the case of the sand moulding there will be a noise here there is no such noise. So, here there is a reduced of noise level; next one better general environment. In the case of the sand casting process we mix the clay and when you after solidification when we break this sand a dust will be raising here such problem does not arise.

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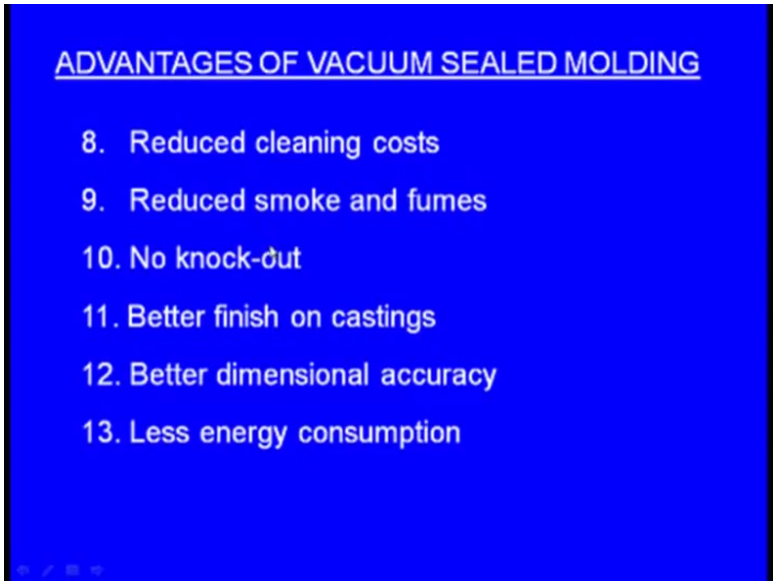

Next one reduced cleaning cost in the case of the sand casting process, because we are mixing the clay water and other addictives the sand casting will have a dirty what say what say film around that, this has to be cleaned. In the case of the v process question does not arise the casting will be very clean next one reduced smoke and fumes there is in the case of the sand casting process, when we pour the molten metal into the cavity yes there is moisture in the mould because of the moisture immediately the moisture will

turn into vapor and the vapor will be coming out. So, that causes some kind of what say inconvenience to the operators.

So, here such question does not arise, next one no knockout process what is this knockout in the case of the sand casting process, after we pour the molten metal after solidification is over we have to break it we have to put the physical efforts or we use the machines to break the sand. So, this is known as the knockout, here we that question does not arise. Next one better finish on the castings, next one better dimensional accuracy we obtained in the v process next one finally, the less energy consumption.

So, these are the advantages of the vacuum sealed moulding process.

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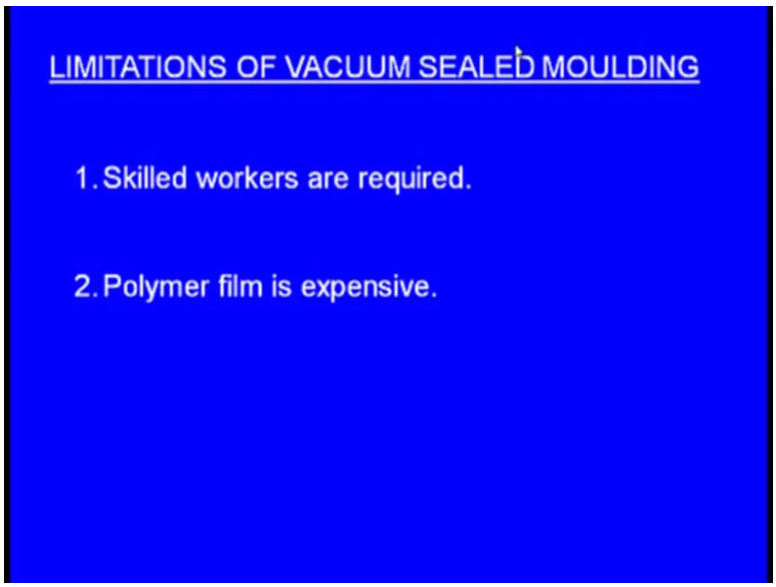

Next let us see the limitations of the vacuum sealed moulding in this process the skilled workers are required, because the vacuum has to be applied in the right time and also it should be applied for the right duration. So, this requires skill, next one the polymer film is expensive and for each casting we have to use new polymer film, once we use polymer film for one casting. So, that is that cannot be used for the next casting. So, that way the process becomes expensive.

Next let us see the squeeze casting process.

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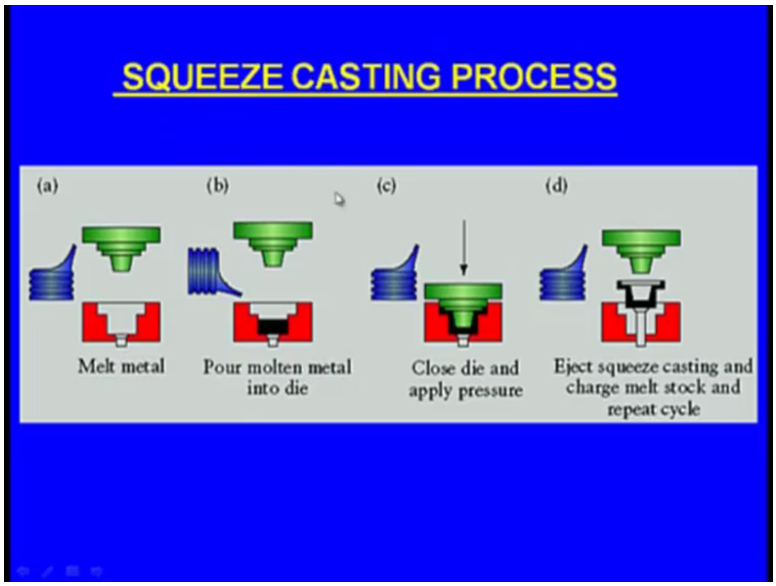

So, this is the simple principle of the squeeze casting process, in the squeeze casting process we get the mechanical properties better mechanical properties, and here we can see this is the a mould, this is the mould right and here the molten metal is coming it is ready and yes the molten metal is poured into the die. So, this is the die or the permanent metallic mould and this is the you can see this is the ram and this is the ram will be coming down you can see here. So, the ram is pushing downwards and the molten metal is trapped between.

In fact, here we have shown a very simple what say geometry, sometimes the casting will have a complex geometry and very thin fins what say complex films will be there and the in the ordinary casting process, it the metal may not flow into these complex details, but because bend the metal is still in the liquid state, we are applying external pressure by means of this ram.

So, all these thin fins complex films will be filled by the molten metal, after solidification what we do? Is this ram comes up and this solidified casting will be ejected like this. So, this is the simple principle of the squeeze casting process, it is a well known fact that we get better mechanical properties with the forging why because we apply the mechanical pressure the grain structure will be improved the same thing happens here.

So, this is a kind of mixture of casting and the forging process.

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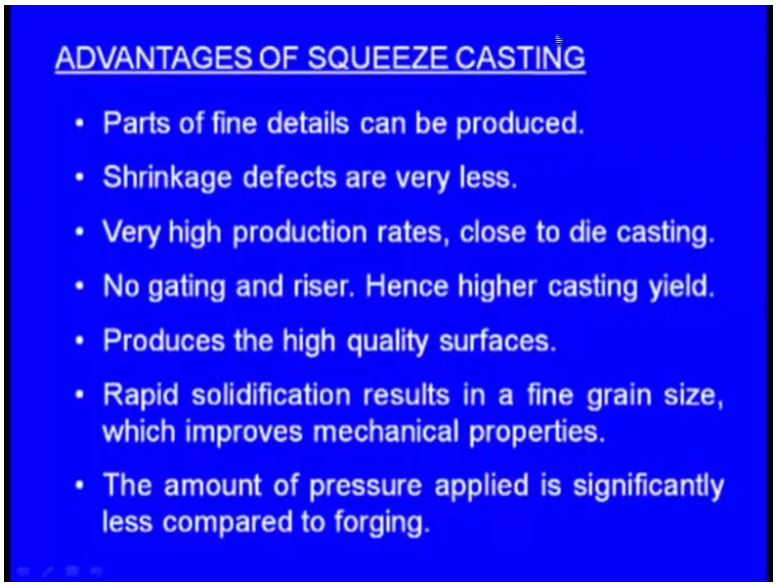

So, these are the advantages of the squeeze casting process parts of fine details can be produced. As I already told because we are applying the external pressure right the molten metal fills the fine details and the complex details without any difficulty. Next one shrinkage defects are very less, shrinkage means internal hollow cavities inside or externally then we are applying the mechanical pressure externally. So, these what say possibility of creation of these internal or external cavities will be minimized.

Next one very high production rates close to die casting, next one no gating and riser and hence higher casting yield here we do not see any sprue are any riser or runner that is why we get the higher casting yield, it produces the high quality surfaces. The surface will have a very what say smooth surface there will be a smooth surface, rapid solidification results in a fine grain size which improves mechanical properties because we are pouring the molten metal into a metallic die and there will be a cooling system because of that here will be rapid solidification, because of the rapid solidification the mechanical properties will be improved.

The amount of pressure applied is significantly less compared to forging, yes by forging we get the better mechanical properties, but the amount of force that we apply is constably very high, but here we have to apply very moderate pressure and we get the better mechanical properties.

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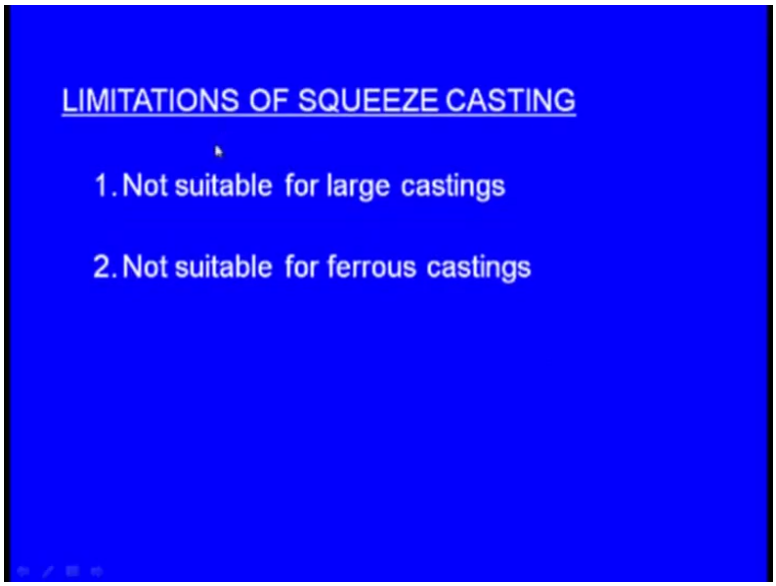

These are the limitations of the squeeze casting process, not suitable for the large castings because the moulds are made up of the a special dies metallic dies. So, very large castings cannot be made, not suitable for the ferrous castings because the metallic dies are made up of ferrous alloys. So, it can be used one way for the non ferrous castings.

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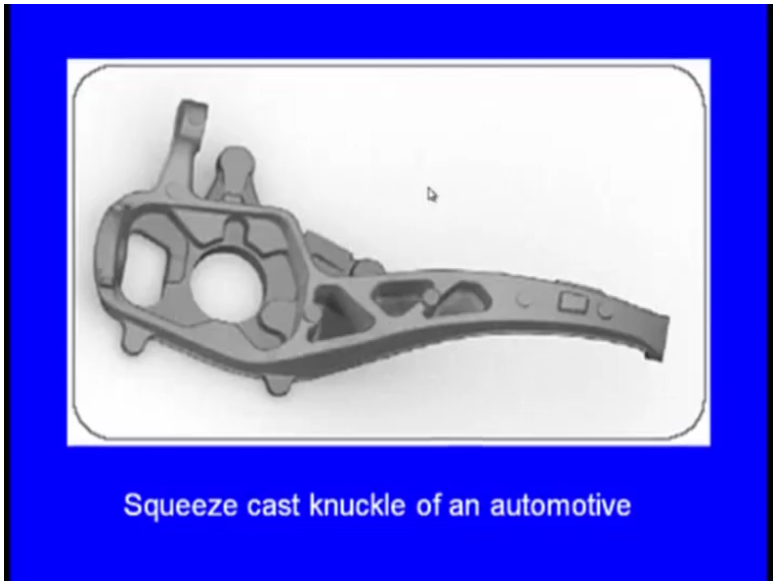

And here we can see the typical what say components produced by the squeeze casting process and this is this squeeze casting knuckle of an automotive.

So, this is manufactured by squeeze casting process and here we can see there is another component.

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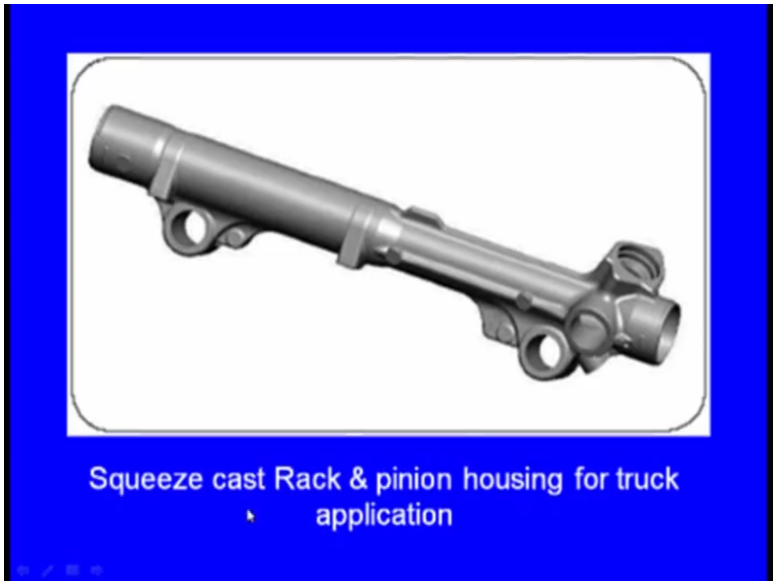

Squeeze cast rack and pinion housing for truck application. So, this is manufactured by squeeze casting process next let us see the centrifugal casting process.

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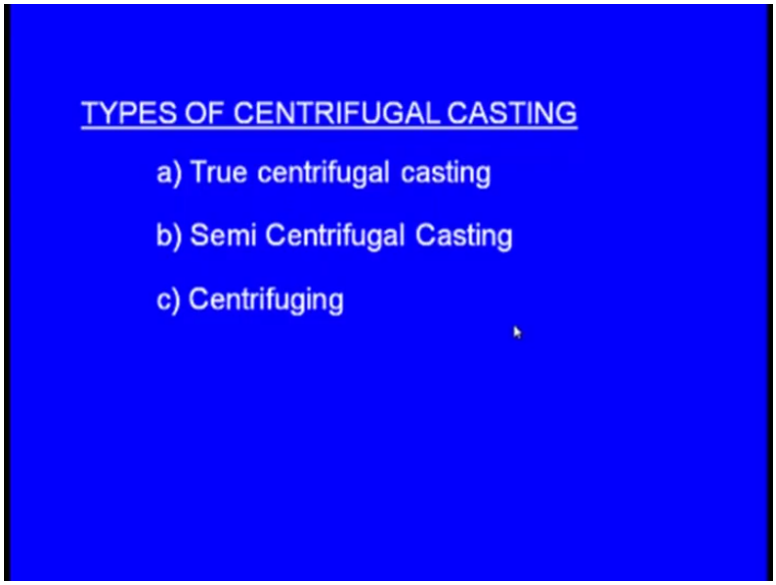

There are 3 types of process in the centrifugal casting one is the true centrifugal casting semi centrifugal casting and the third one is the centrifuging.

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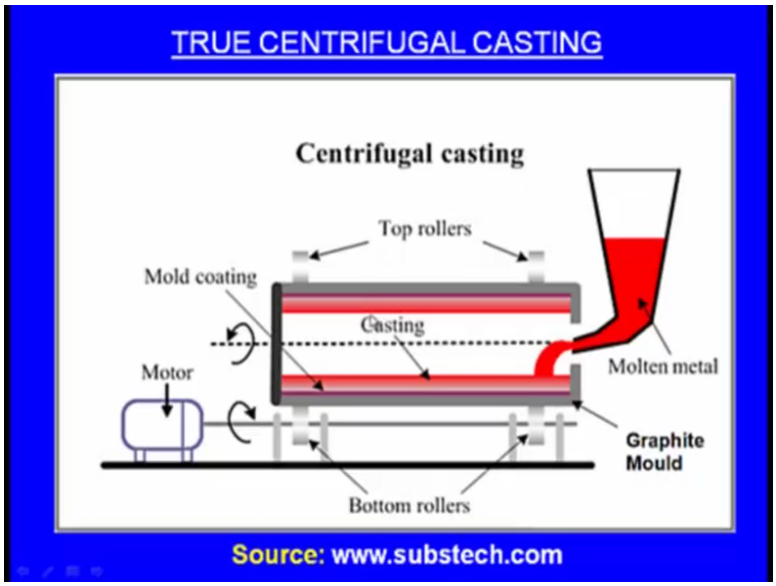

So, this is the centrifugal or true centrifugal casting what is it the principle? There will be a graphite cylindrical mould will be there. So, this is the cylindrical graphite mould the one which is looking in the gray color.

So, this will be what say supported on the wheels bottom or rollers here you can see these are the rollers. In fact, the rollers will be there on the top also and as the motor here we can see a motor as the motor is rotating the rollers will be rotating this roller and this roller and because after this is cylindrical graphite mould will be rotating when this cylindrical graphite mould is rotating and here the molten metal slowly is poured into the graphite mould and gradually the speed of the mould will be increased and the molten metal keeps on coming inside then what will happen? Because of the centrifugal force the molten metal will be sticking onto the walls of the graphite mould, and the rotation continues till it is solidifies till the molten metal is solidified.

Once the molten metal is solidified the rotation of the cylindrical graphite mould will be stopped then this can be separated into 2 halves, then we can get the casting outside because we are applying the centrifugal force on the molten metal. So, this is known as the centrifugal casting process and there is another type semi centrifugal casting process.

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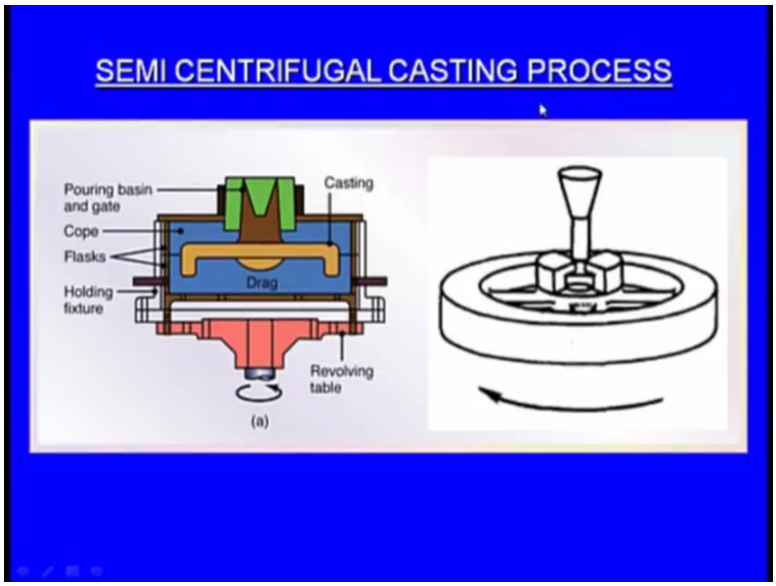

In the semi centrifugal casting process are the system rotates on a vertical axis whereas, in the case of the true centrifugal casting process the mould was rotating on a horizontal axis and here the mould rotates around a vertical axis right.

So, this is the mould cavity, the mould cavity is here and this is the mould and you can see this is the cope and this is the drag yes and the molten metal is poured like this and the molten metal flows like this and it flows like this and then the what say mould will be rotating the mould will be rotating. Now what is the benefit? Because in the case of the conventional sand casting process suppose if the cavity has a small fine feature the molten metal may not flow into that, but here of course, such a small fine feature is not shown here, but then what happens because it is rotating because of the centrifugal force the molten metal will be forced to occupy such small details that is the benefit of this semi centrifugal casting process.

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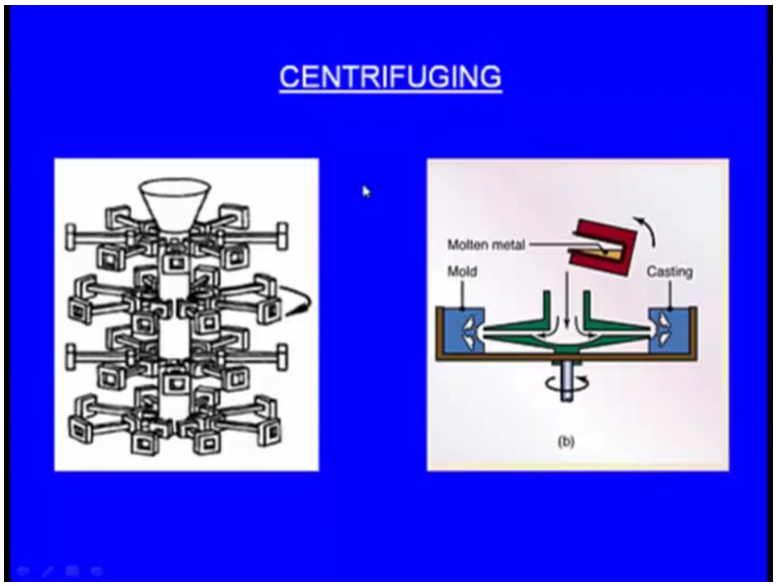

And the third type is the centrifuging and they are centrifuging in the centrifuging also the system rotates about a vertical axis. So, here we can say this is the axis of the system and this whole system rotates now what is this. So, these are all the individual castings. So, these need not be cylindrical, this can be any casting only thing is they have a fine features, they have fine features are small complex features of by conventional casting process it may be difficult for us to fill the molten metal into those fine features, but now what is happening is this is the central tree or the central sprue and all these castings or all these moulds are connected to the central sprue and the system rotates, as it is rotating once we pour the molten metal because of this centrifugal force in if there is a small feature a fine feature molten metal will be flowing into those fine and small features.

So, that is the benefit of the centrifuging. So, there is a difference between the centrifuging and what say semi centrifugal casting correct here we make one casting where as we make so many castings here that is the centrifuging, these are the advantages of the centrifugal casting.

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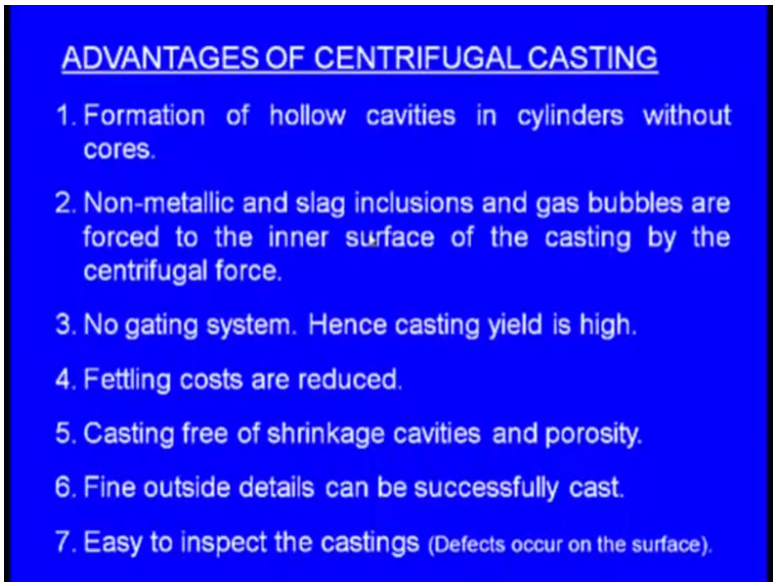

Formation of hollow cavities in the cylinders without cores, if we have to make what say internal cavities in a casting we have to use cores again this cores what are these cores we will be studying in the next lecture. A non metallic and slag inclusions and gas bubbles are forced to the inner surface.

So, even of these what say non metallic slags and impurities, if they are there in the molten metal they will be force to the inner surface of the casting because the centrifugal force falling on them will be lesser. So, they will be collected at the centre of the casting or on the inner surface of the casting we can remove them very easily. Next one here also no gating system that is why the casting yield is very high. Next one fettling costs are reduced next one casting is free of shrinkage cavities and porosities shrinkage means hollow cavities inside the casting are on the surface of the casting. So, these will be minimized porosity means gas bubbles inside the casting are on the surface of the casting. So, this problem also comes down.

Fine outside details can be successfully cast fine outside details it may be difficult for us if it is the conventional sand casting process, but here because we are applying the centrifugal force the molten metal because of the centrifugal force flows into the fine details. Next one it is easy to inspect the castings. So, these are the demerits of the centrifugal casting process.

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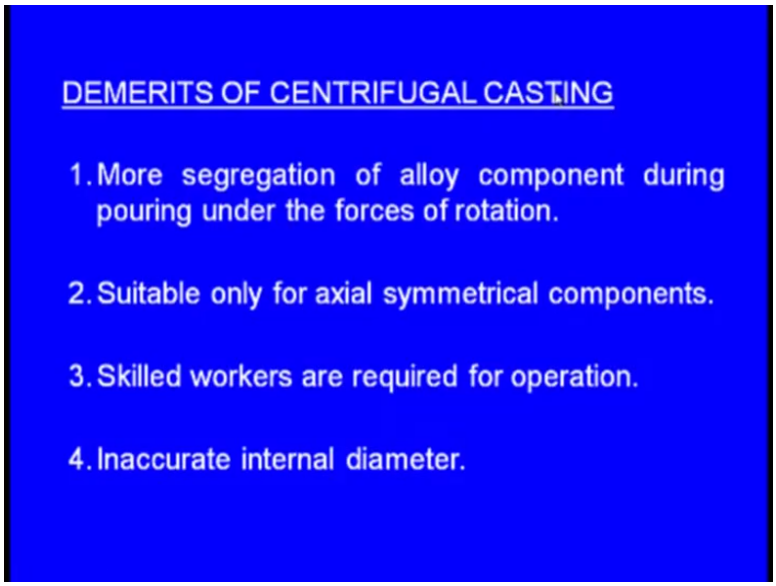

More segregation of alloy component during pouring under the forces of the rotation. Suppose sometimes we pour or the alloys the alloys contains the different metals and suppose if one metals densities more and if one metals density is very less, the centrifugal force falling on these 2 metals will be different because of that the individual metallic components of this alloy may be segregated, which is not required which is detrimental to the quality of the casting. Next one suitable only for axial symmetrical components. So, this is applicable for the what say true centrifugal casting and the semi centrifugal casting.

Next one skilled workers are required for the operation; say the mould has to be rotated in the right time and it should be rotated at the optimum speed and it should be stopped at the right time. So, this needs skill. So, that is why skilled workers are required for this operation, and next one we get the inaccurate internal diameter. If the 2 of the mould are not what say coupled properly at such times we get the inaccurate internal diameter.

So, these are the typical components produced by the true centrifugal casting process.

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We can see. So, these are all the components produced by the true centrifugal casting process. Next one let us see the plaster moulding process in the plaster moulding process we use the plaster of Paris.

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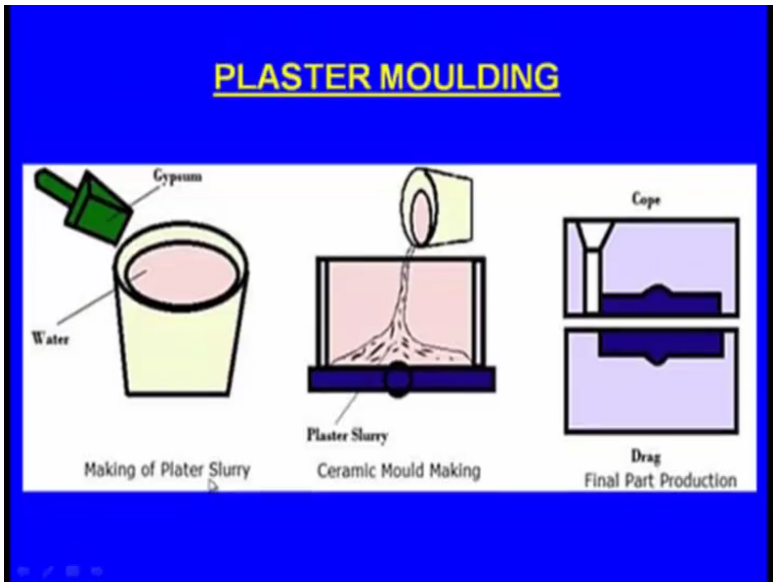

So, initially we have to prepare the plaster of Paris, these also known as the gypsum commercially. So, this will be mixed with water and we prepare a what say slurry plastic of Paris or the gypsum slurry we prepare in a container and we yes we place the pattern here. So, this is the pattern and we pour the what say plaster of slurry here around about

the pattern and after sometime the plaster of Paris slurry will be solidified, after it is solidified we remove the pattern in the same way we prepare the other half of the pattern also a such time we also make a provision for the what say sprue or the pouring cup. So, that the molten metal can be poured and when we prepare both the halves of the patterns we assemble them yes we are assembling here.

So, this is the drag. So, this is this part this deep blue colored one is made by the plaster of Paris and you can see here, these also made by plaster of Paris and these 2 will be assembled now the molten metal will be poured into this assembly and after solidification we break this plaster and we get the solidified casting, these are the advantages of the plaster moulding process complex shapes can be cast.

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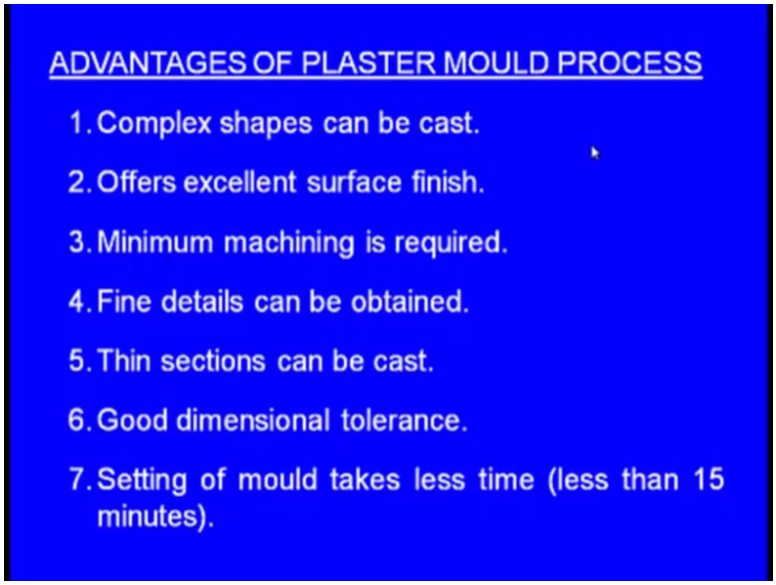

Offers excellent surface finish what is the mould made up of? It is not the green sand mould, it is made up of plaster of Paris. The plaster of Paris will have a very smooth surface and because of that even the component cast component will have a very good surface finish and that is why minimum machining is required, fine details can be obtained because of this process, next one thin sections can also be obtained and we get good dimensional tolerance setting of mould takes less time less than 15 minutes time.

So, these are the advantages of the plaster moulding process.

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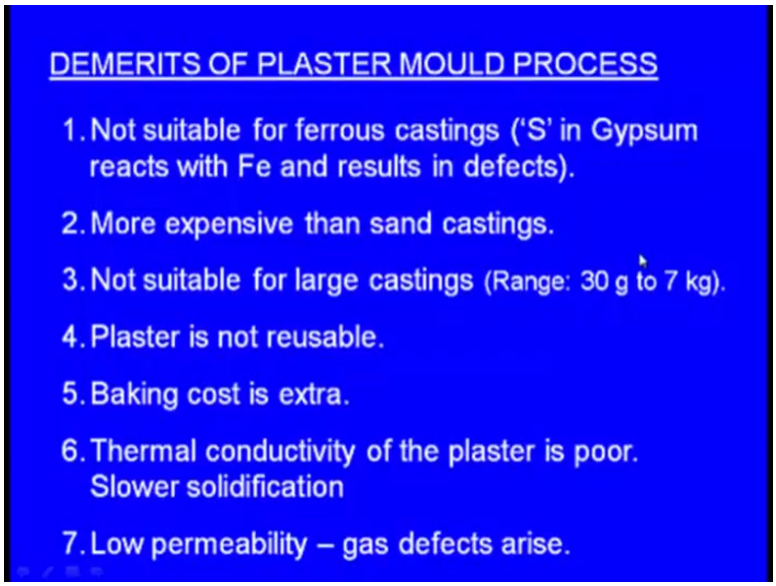

These are the demerits of the plaster moulding process, not suitable for ferrous castings. The sulfur they gypsum contains sulfur this sulfur reacts with iron and results in defects that is why this process cannot be used for making ferrous castings. This is more expensive than sand castings in the case of the sand casting process we use the moulding sand we take the fine sand mix with the binder and is additives and the moisture you mix it, and the same sand can be used for making several castings where is here once we make a what say plaster mould that can be used only for making one casting afterwards one we have to break it and that plaster cannot be used again, that is way it is more expensive than the sand casting process not suitable for large castings. This can be used for making small castings and also to some extent medium sized castings say may be 30 grams to 7 kg beyond that it is not possible to make the castings with the plaster moulding casting process.

Next one the plaster is not reusable like the sand in the sand casting process no it is not reusable, next one it has to be baked after the plaster is set around the pattern it has to be baked. So, for that we have to use an electrical furnace and also that consumes time means production time is increasing. Thermal conductivity of the plaster is poor whereas, the thermal conductivity of the sand medium is very high here the sand moulding medium is the plaster of Paris its thermal conductivity is poor that is how the solidification takes lot of time, as the solidification is taking lots of time the mechanical properties that are likely to be obtained will be poor.

Next one low permeability what is this permeability ability of them what say what say mould to know the hot gasses to passed through that when as it if it is the sand casting process, there would be what say between the neighboring sand grains there will be a some gaps will be there, through these gaps the hot gases pass through the sand mould whereas, in the case of the plaster mould. So, the such what say pores will be very less that is why there will be low permeability, what happens if there is a low permeability? The hot gases that are developed inside will be accumulated inside the mould cavity. So, that results in the casting defects.

Hence today we have seen few special casting process, we have seen the what say investment casting process, continuous casting process, vacuum sealed moulding squeeze casting process, centrifugal casting and the plaster moulding process. And in the next lecture we will see the evaporative pattern casting ceramic shell moulding slush casting stir casting and also the economics and the overview of the and over all comparison of all these process we will see in the next class.

Thank you.