Metal Casting
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Module - 05
Permanent Mould And Special Casting Processes
Lecture - 01
Die Casting Process-I

Good morning friends, in our previous lectures we have learnt about sand casting. We have seen how to make the sand mould, and how to get the sand casting, then we have learnt about casting defects, then we have learnt about melting and pouring practices, then we have learnt about important cast metals and alloys.

Now, today we will switch over to another important face of metal casting; that is the die casting process.

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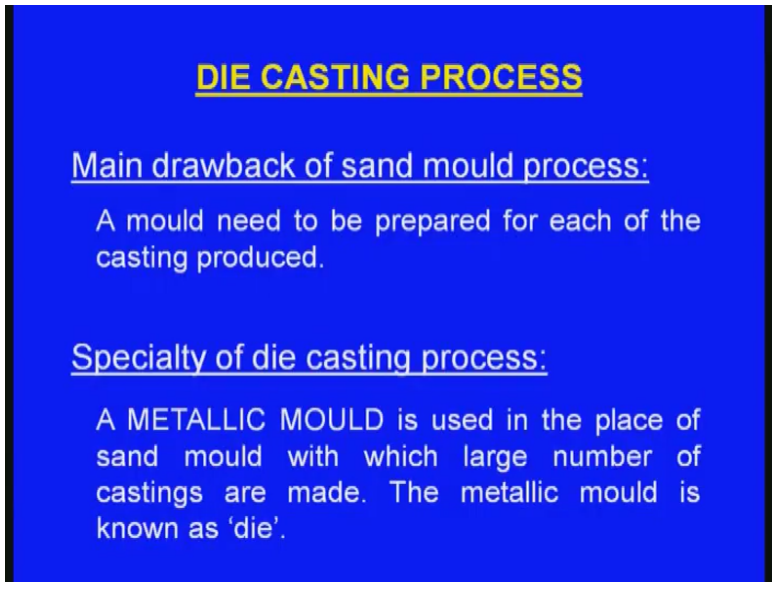

Now, what is this die casting? Why we should go for die casting? Let us see, first of all what is the drawback of sand moulding process? Why we should go, what say live sand moulding, and why we should switch over to die casting.

In the case of the sand casting, a separate mould has to be made in each and every case. If we want to make a sand casting, initially we have to make the pattern, then we have to make the mould, then we pour the molten metal. Once we pour the molten metal once

the molten metal is solidified we break that sand mould, and the mould is no more permanent. If we want to make another casting, again we have to make another mould and we have to pour, likewise in each and every case we have to make a separate mould. So, this involves lot of labour and also it increases the cost of production and also productivity will be lesser.

Now, to overcome these drawbacks, this what say meta die casting has been developed. So, in the case of the now let us come to the speciality of the die casting process, now in the case of the die casting process instead of a sand mould a metallic mould is used in the place of sand mould with which large number of castings are made means this is a metallic mould remember. So, this metallic mould we are not going to break after this solidification of the casting, same mould will be used again and again for making several castings. So, this metallic mould is known as die.

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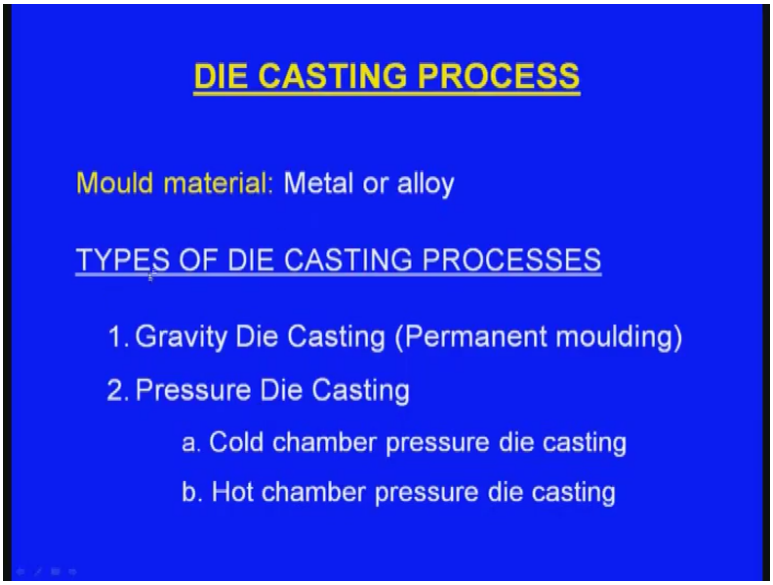

Now, here the mould material is metal or alive. Now, we have seen that in the case of the die casting process a metallic mould will be used and the same metallic mould will be used to make thousands and thousands of castings.

Now, types of die casting process, what are the types? One is the gravity die casting process, this is also known as permanent moulding process, means here no doubt the metallic moulds will be used, there would not be any sand moulds, but molten metal will be poured into this metallic moulds by virtue of gravity. So, that is why it is known as the

gravity die casting, means we would not apply any external pressure. So, that is of the dry ca gravity die casting, the second one is the pressure die casting. In the case of the gravity die casting the molten metal enters into the metallic moulds by virtue of gravity whereas, here in the case of the pressure die casting the molten metal will be entering into the metallic moulds because of the external pressure, we apply.

So, that is why these two are different. Again the pressure die casting is two types, one is the cold chamber pressure die casting, second one is the hot chamber pressure die casting. In the case of the cold chamber pressure die casting, yes there will be metallic moulds will be there, yes we inject the molten metal into the metallic moulds, but we need molten metal we need to prepare the molten metal for that we need a furnace. This furnace is separate from the machine cold chamber die casting machine, it will be away from the machine.

Whereas, in the case of the hot chamber pressure die casting machine, yes again here there will be a metallic moulds, and we apply external pressure to inject the molten metal inside the dies, but the furnace in which we make the molten metal is an integral part of the die casting machine. That way hot chamber pressure die casting machine is different from cold chamber pressure die casting machine.

Now, we will be seeing all this one by one. So, first we will see, gravity die casting or it is also known as the permanent moulding process. Now, what is the history of the permanent moulding process? The first permanent mould castings were made using stone moulds, sometime around 2000 B C. This was in practice even during BC, but that time metallic moulds were not use, people use sand moulds between the sand moulds they were pouring the molten metal by virtue of gravity.

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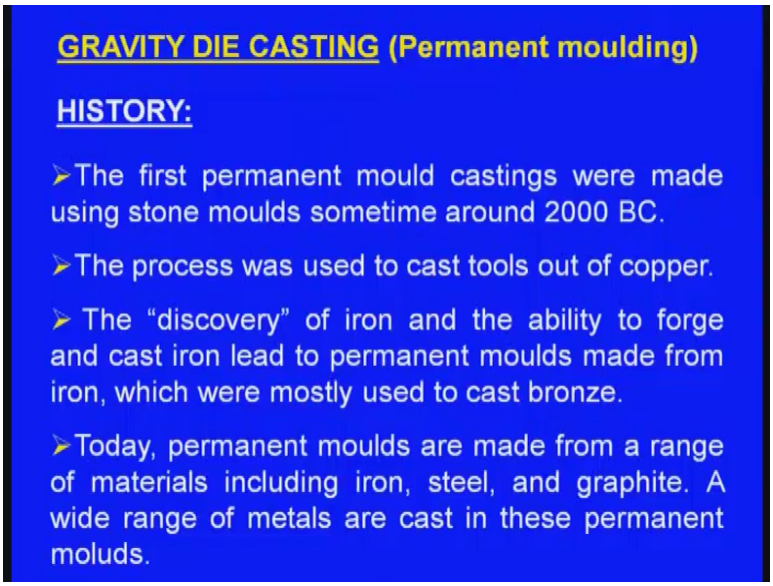

This process was used to cast tools out of copper, those days. Now the discovery of iron and the ability to forge the cast iron lead to permanent moulds made from iron which were mostly used for to cast branch. Now later, men has what say learnt how to melt what say extract iron, how to melt iron, and how to forge iron components, with that they even made permanent moulds permanent metallic moulds made up of iron. So, these were used to cast branch.

Now, what is the status today? Permanent moulds are made from a range of materials including iron, steel, and graphite. So, these are the moulding materials today, the moulding materials mould materials are made up of iron, steel, and graphite. A wide range of metals are cast in these permanent moulds. Now, what is the, what are the what say cast metals, that are what say cast in this moulds several materials, several nonferrous materials can be cast using these, what say moulds.

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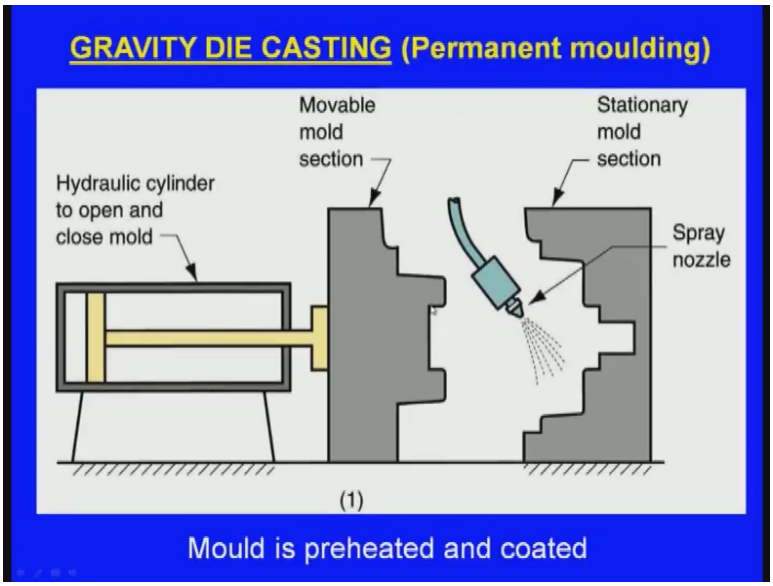

Now, first we will see, we will be learning about the gravity die casting, what are the steps involved in this process, and here we can see there are two moulds will be there. So, these are the metallic moulds. So, one mould is a stationary mold, the other mould is a movable mold. So, here this is the, what say stationary mold, see here this is the cavity; this is the cavity, now this is the movable mold and this is also a cavity, now when we close these two what will happen inside there will be a cavity what say. So, that cavity resembles the shape of the casting which we are going to produced, now initially these two what say dies will be kept apart, then you can see here a spray will be what say put on the cavity surface.

Now, here we can say this is the hydraulic cylinder to open and closed the movable mold. So, this cylinder operates hydraulically and it exerts what say intensive pressure so that this mould will be moving forward and backward. So, initially the mould is preheated and coated, next what will happen these two moulds will be closed.

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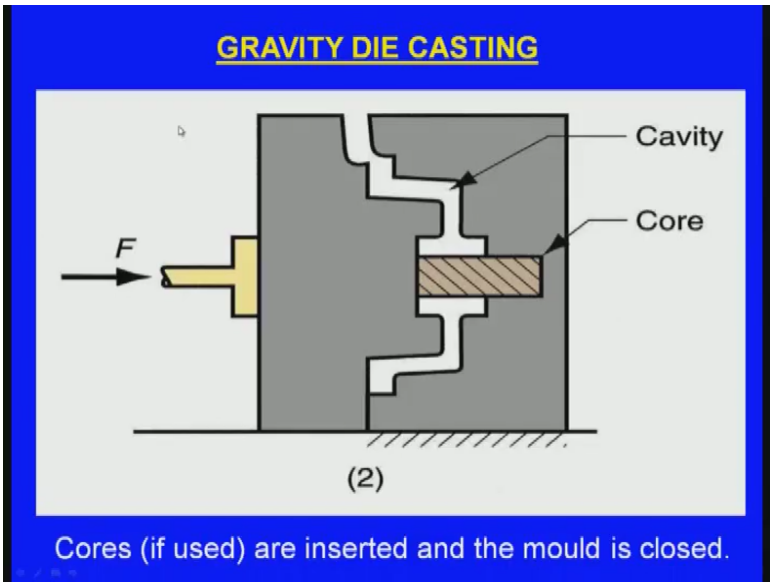

Then what happened see there is a cavity this will be further closed you can see here now it is about to close. So, this will be further close then there will be a cavity is there, you can see this is the cavity. So, this is the; what say shape of the casting which we want.

Now, if we want a (Refer Time: 08:28) inside the casting, we can place a core. So, this is a core. So, cores if used are inserted and the mould is fully closed, then the die will be fully closed again you see here pressure will be applied. So, that die two dies will be closed fully, then what will happen?

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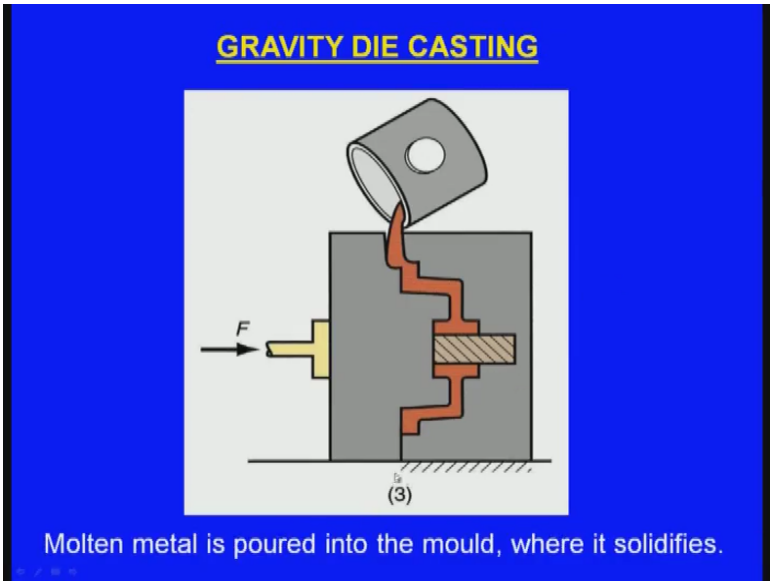

Here, you can see that dies are fully close and there is no gap between the fixed amount and the movable mould. Here, you can see there is no gap. Right, now the molten metal is poured into the mould where it solidified. So, this is the, what say crucible in which there is molten metal, now the molten metal is being poured. Now, the molten metal enters into the cavity. Yes, it flows around the core then it comes down, then after sometime the molten metal will be solidifying.

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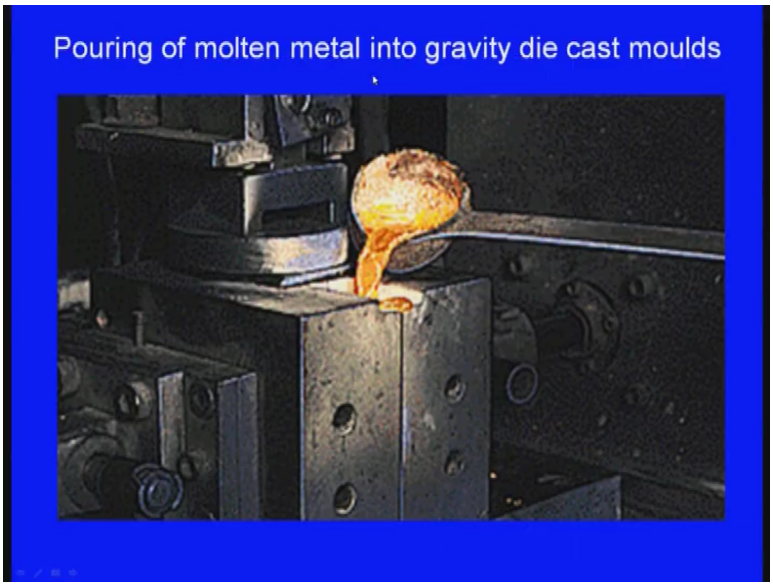

And here we can see pouring of molten metal into the gravity cast moulds, it is being poured. So, this is one die and this is one die.

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Now, this is the ejected casting permanent mould right, here we can see you can see aluminium pistons. So, these are made by what say permanent moulding.

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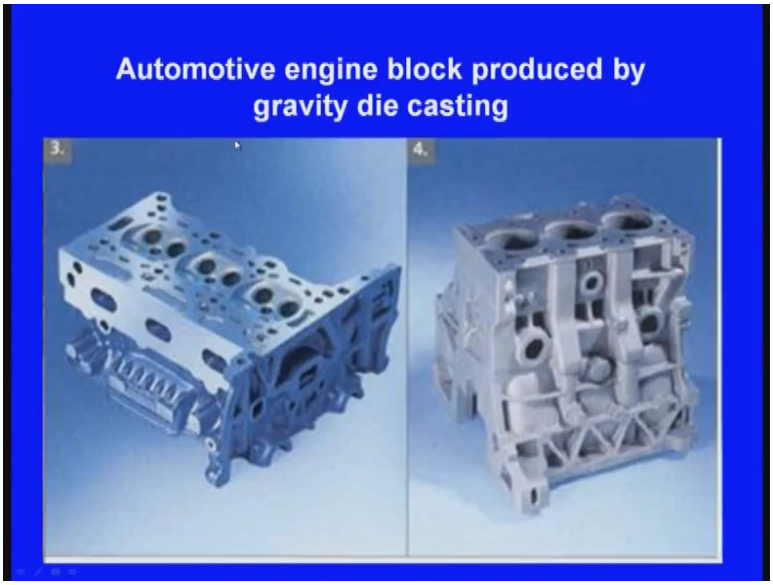

And we can see here automotive engine blocks produced by gravity die casting. So, these are the engine blocks which has used; which are used in the automotives. So, these engine blocks are made by permanent moulding process.

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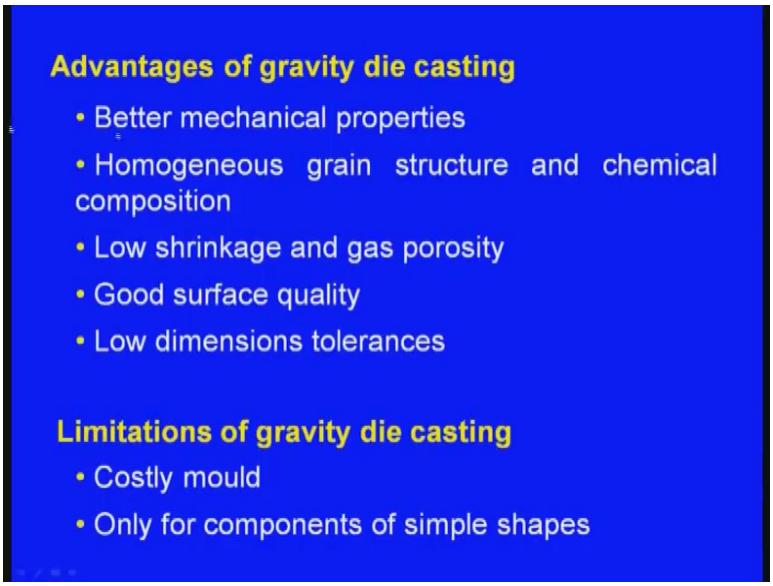

Now, let us see the advantages of gravity die casting, better mechanical properties. Why? the molten metal is being poured into the mecha what say, metallic moulds then what will happen the cooling rate will be faster. Once the cooling rate is faster, we get the mechanical properties. Now so, better mechanical properties are obtained in the gravity die casting.

Next one, homogeneous grain structure, and chemical composition can be obtained. Why? Because we exert pressure, and because of this pressure the molten metal will be trapped between the two dies that is how we get the homogeneous grain structure, and chemical composition. Next one, again low shrinkage and gas porosity, in the case of the conventional sand castings what will happen? There is always a chance for the shrinkage cavities. Now here, the shrinkage cavities cannot form rarely they form why? Why there is no shrinkage cavity, because we are exerting external pressure on the molten metal see if there is any shrinkage that will be nullified. So, that is the shrinkage cavity and also even if there is a gas porosity same thing ca can happen because we are applying external pressure this what say, gas tiny gases that are present inside the mould will be inside the metal will be escaping. So, low shrinkage and gas porosity.

We get the final; next we get the good surface quality, why? If we use the sand mould what will happen the, what say mould surface will have a rough texture because how why how this what say, sand mould is made it is made up of sand. So, because of this

sand grains present on the surface that texture will be rough even. Finally, even this rough texture will be transformed to be transferred to the casting. That is how the surface roughness of a sand casting will be very poor, but here we are not using a sand mould we are using a metallic mould metallic mould thus inner surface what say will be having a very good fine surface finish then you to such a mould when we pour the molten metal the casting will also have a very good surface quality.

Next one, low dimensions tolerances in the case of the sand casting because there is a rough surface and the casting. So, we need to machine. So, we give the machining allowance, that is how there would not be any what say there will be lesser dimensional tolerance. Whereas here, in the case of the die casting already they mould what say, metallic mould is very small. So, minimum machining will be done sometimes no machining then, what will happen? That there will be closer dimensional tolerance there will be very good dimensional accuracy.

So, these are the advantages of gravity die casting. Next one, we will see the limitations of gravity die casting. One is the costly mould, making this mould is not that much easy not that much cheap, if it is a sand mould within one hour one can make and what say, the cost involved may not be very high, but here the material is costly we use special alloys. So, that way the material is costly and making is not that much easy sometimes the what say, that alloy will be tough to mission we need to use what say, a advanced machining process in which case the machining would be expensive, machining would be difficult, and it will be laborious, and it will be time consuming. So, that is how the cost of making the mould will be going up. So, that is how we can conclude that it is a costly mould.

Next one, only for components of simple shapes, complex shapes cannot be obtained using gravity die casting or the permanent moulding process.

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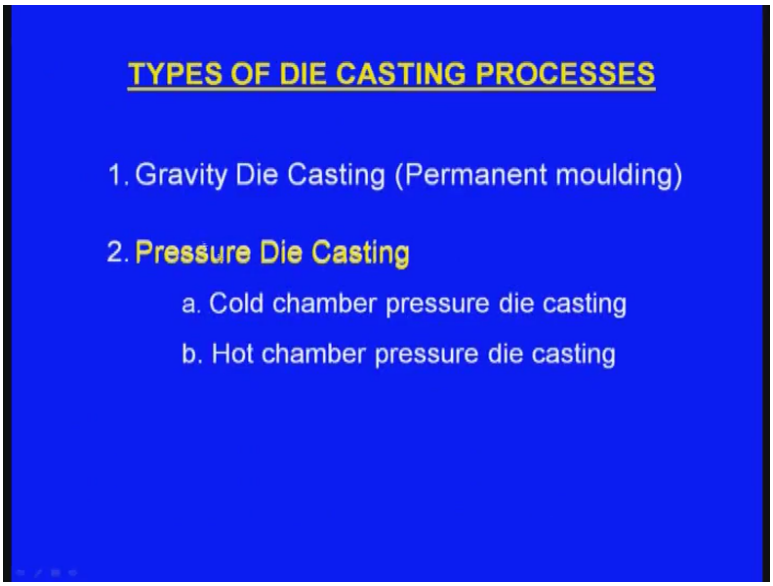

Next one, we have completed the gravity die casting. Next one, we will see the pressure die casting. Again, the pressure casting is sub classified as cold chamber pressure die casting, second one is the hot chamber pressure die casting.

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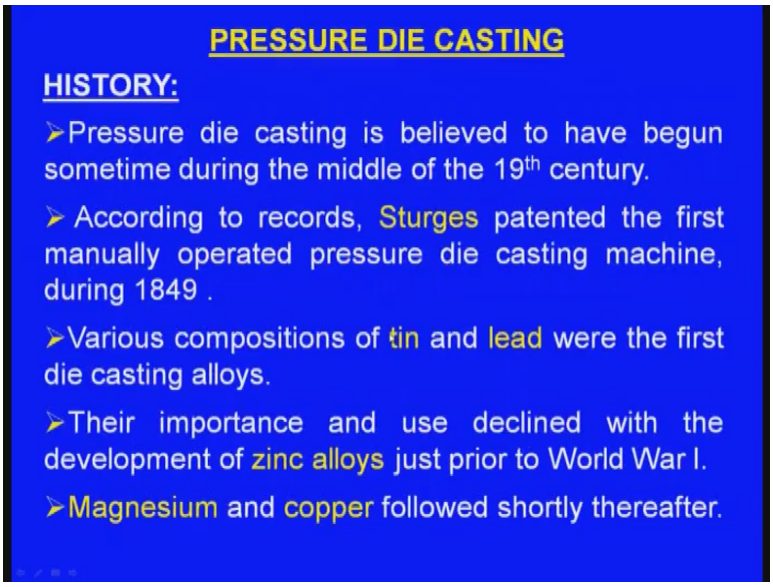

First, we will see the cold chamber o pressure die casting. Pressure die casting is believed to have began sometime during the middle of the nineteenth century it is not very old, it is only what say, hundred years old about hundred years old.

According to the records, Sturges patented the first manually operated pressure die casting machine, during 1849. So, this man has patented the pressure die casting various compositions of tin, and lead were the first die casting alloys, initially pressure die casting was meant for casting tin and lead components. Their importance and use declined with the development of zinc alloys later zinc alloys were develop. So, slowly people started even making zinc castings using pressure die casting process.

Next to finally, magnesium and copper alloys were used, using the they were cast using the pressure die casting process. Now, pressure die casting again is sub classified into two types one is the cold chamber pressure die casting and the second one is the hot chamber pressure die casting. In the case of the cold chamber pressure die casting, the furnace which is meant for melting metal is away from the this machine, it is not an integral part of the machine. Whereas, in the case of the hot chamber pressure die casting machine the furnace which is meant for melting the metal is an integral part of the machine. So, that way these two are different.

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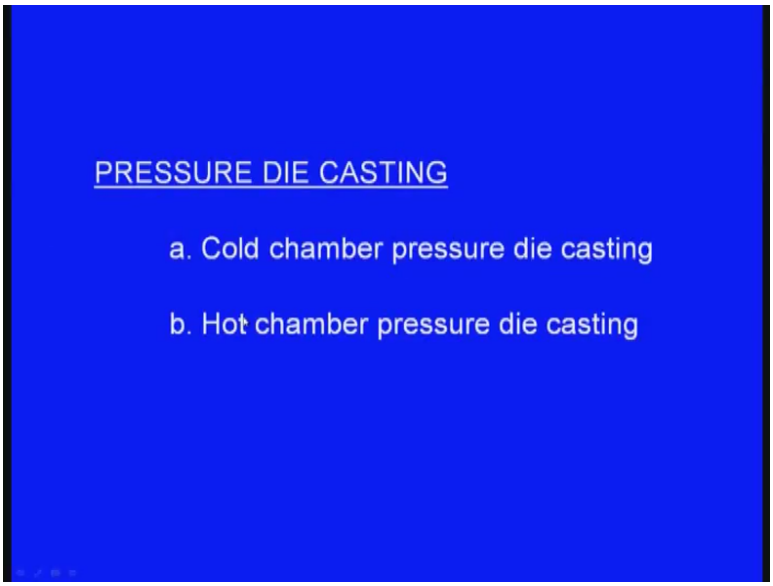

First, we will see cold chamber pressure die casting process, now this is the schematic diagram of cold chamber pressure die casting process. What is there here? Here, we can see this is the there again there will be metallic moulds will be there die means metallic mould. So, here this is the fixed die and this is the movable die and each die has a cavity

both the fixed die and the movable dies they have cavities engraved inside. So, when we close these dies together inside there will be a cavity, here we can see there is a cavity.

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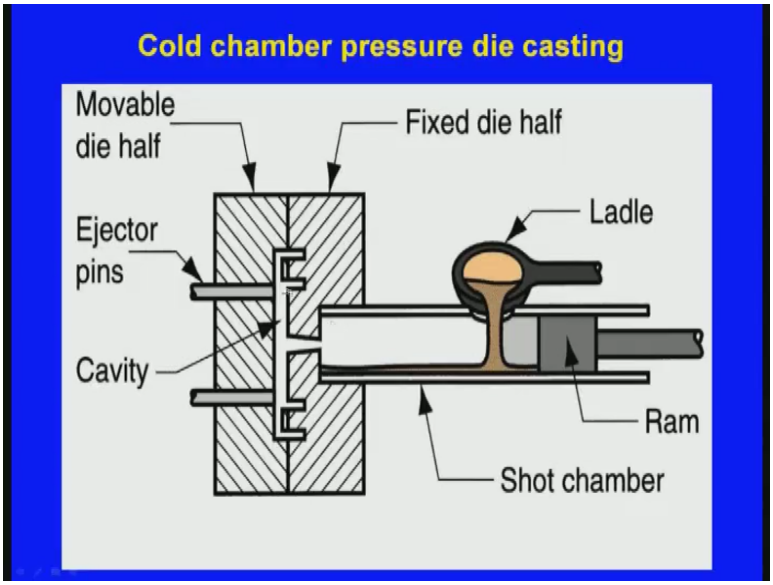

So, this is the shape of the casting which we want, now these are the ejector pins and this is the cavity, now this is the shot chamber let us say cylindrical shot chamber, now the here we pour the molten metal molten metal and here we can see this is the ram after the molten metal is poured into the shot chamber, the ram will exert pressure external pressure on the molten metal and the molten metal will be squeezed inside the cavity because of the external pressure that we apply the molten metal will be squeezed, and it will be going inside the cavity like this, there it solidifies.

So, this is the, a simple principle of cold chamber pressure die casting process, and here we can see the animation of the cold chamber pressure die casting process. And here we can see this is one die, this is the fixed die and this is the movable die, you here we can see this is the cylindrical chamber in which molten metal is being poured, and this is the ram or the piston it is exerting pressure inside the die; inside this two dies, then there it solidifies. And the casting will be taken out.

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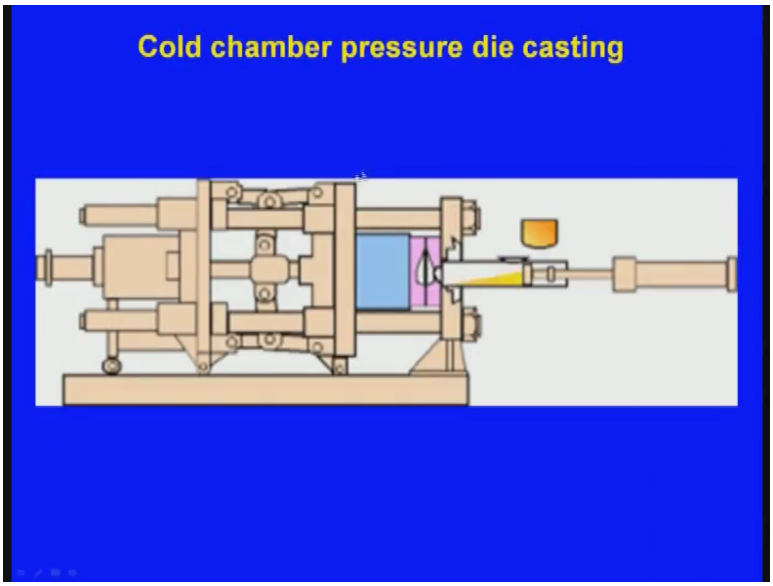

Yes, here we can see, yes this is the casting. Again it will be poured, again it exerts pressure between into the die and casting solidifies and the casting will be taken out.

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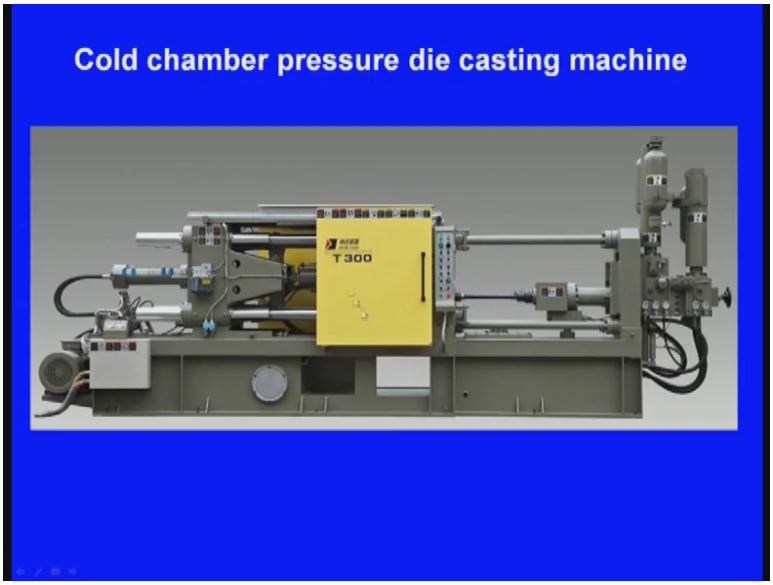

Now, here we can see a cold chamber pressure die casting machine. Another cold chamber pressure die casting machine we can see here, and these are the dies we can see here.

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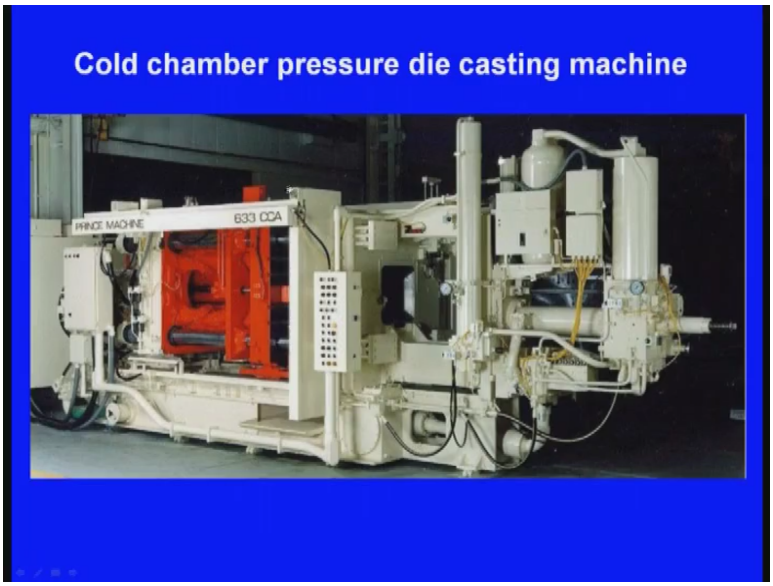

Now, let us see the advantages of cold chamber die casting process. Simple construction, thus cost of the equipment is not very high. What is there? Two metallic moulds are there and yes, there will be ejector pins will be there and a cylinder chamber is there and a piston or a ram and we just pour the molten metal and push it.

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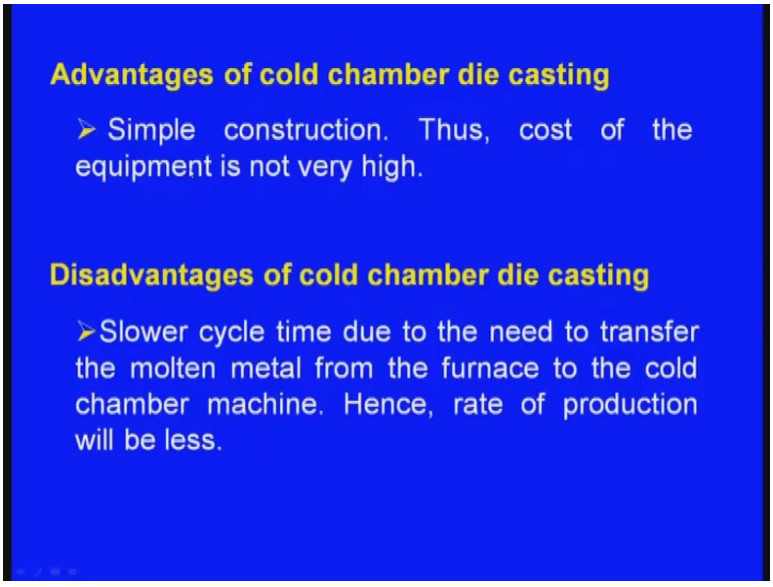

So, it is a simple construction. Then what are the disadvantages of cold chamber die casting process? Slower cycle time due to the need to transfer the molten metal from the furnace to the cold chamber machine. What is this? Sometime back, I told you in the case

of the cold chamber die casting process, the furnace will be away from this machine it is not a it is not an integral part of this machine, then what will happen? Every time we have to go to that furnace, tap some molten metal, carry it in your laden, then bring it to the cold chamber die casting machine, pour it, then push it.

In this process what is happening? There is a time delay every time, we have to go to the furnace, carry some molten metal then you pour. That is solve it is the slowers like cyclic time due to the need to transfer the molten metal. Hence, the rate of production will be less. Naturally so, that is the disadvantage of cold chamber die casting process.

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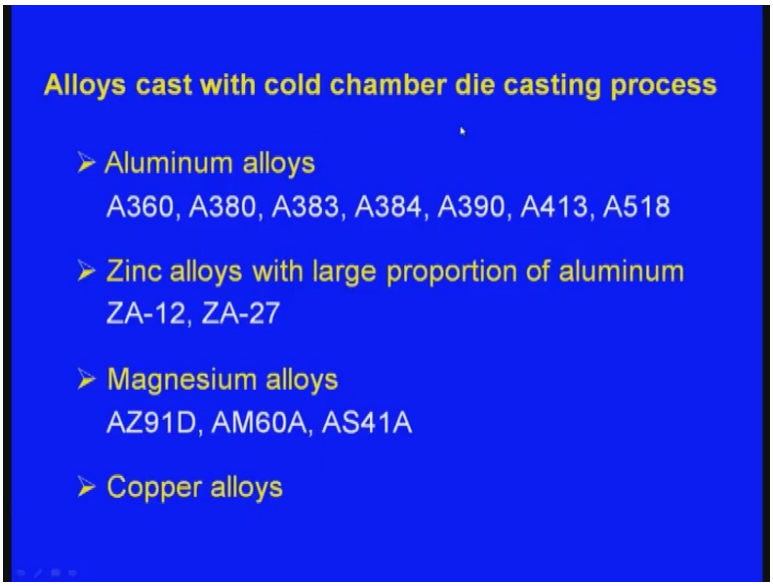

Now, let us see the alloys cast with cold chamber die casting process, A360, A380, A383, A384, A390, A413 and A518. So, these are the alloys which are cast using the cold chamber die casting process. Next one, what are the alloys in among the zinc alloys? What are those alloys? Let us see among the zinc ZA-12, ZA-27 are the zinc alloys which are cast using the cold chamber die casting process.

Coming to the magnesium alloys, among the magnesium alloys AZ91D, AM60A, AS4S41A. So, these are the magnesium alloys which are cast using cold chamber die casting process, coming to the copper alloys of course, coming to the copper alloys. So, most of the copper alloys can be used, can be cast using the cold chamber die casting process. Now, these are the applications of cold chamber die casting process.

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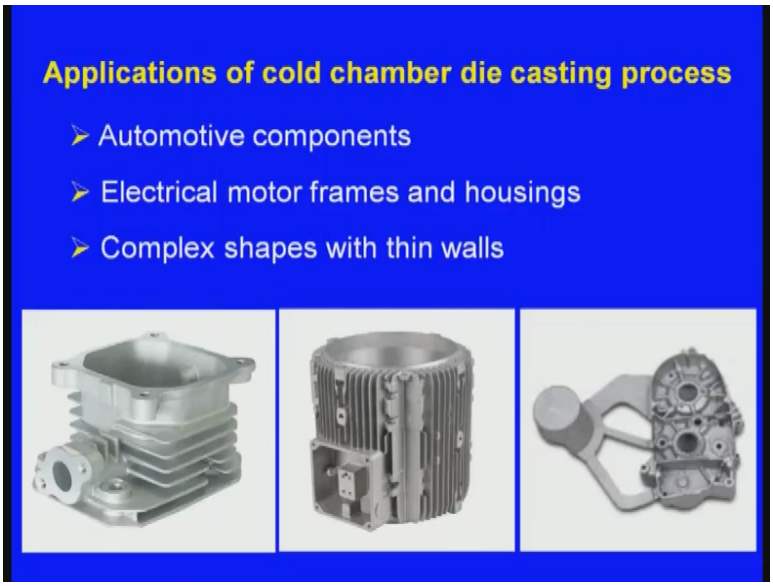

This process is used to make automotive components. You can see here this is an automotive what say component. So, this is made up of cold chamber die casting process. Next one, it is used for making electrical motor frames, and housings and here we can see this is a electric motor housing. So, this is made by cold chamber die casting process. Next one, complex shapes, and thin walls, here we can see there are complex shapes and also thin walls. So, this component is also made by cold chamber die casting process.

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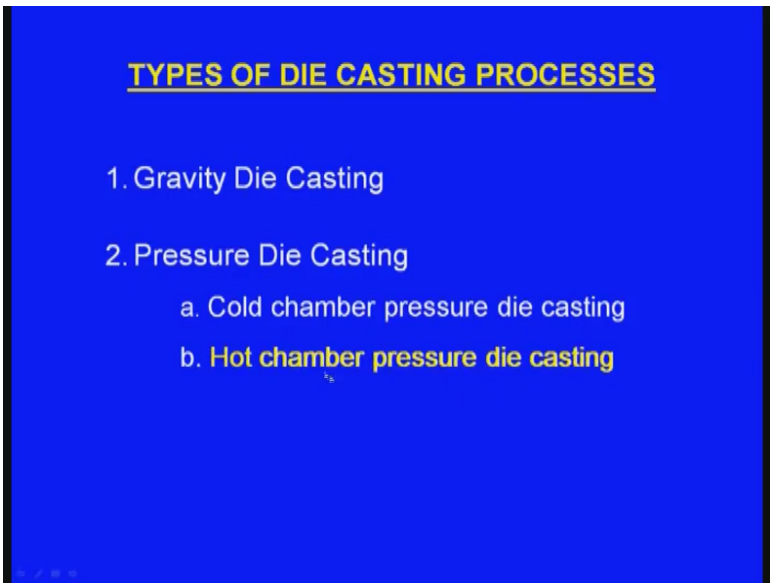

Next one, we will see hot chamber pressure die casting process. So, first of all before going again it has got two sub classifications, before going to sub classifications we must be what say, again I must remind you that, hot chamber pre pressure die casting; means the furnace for melting the molten metal is an integral part of that machine. Again it is sub classified as gooseneck air injection type, and the second one is submerged plunger type. So, first we will see the gooseneck air injection type, hot chamber pressure die casting machine.

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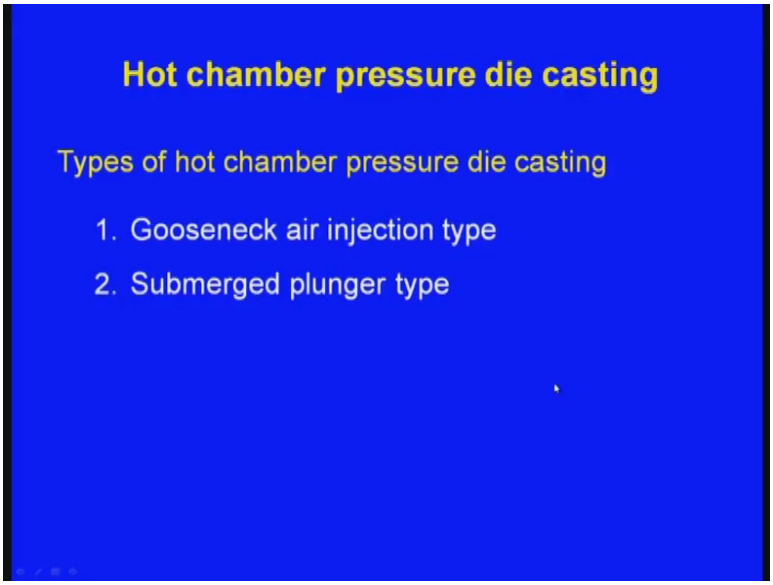

Now, here again as usual what is the; what is a hot chamber pressure die casting process? The furnace meant for melting the metal is an integral part of the machine see this is that machine hot chamber what say, pressure die casting machine and here we can see this is the furnace.

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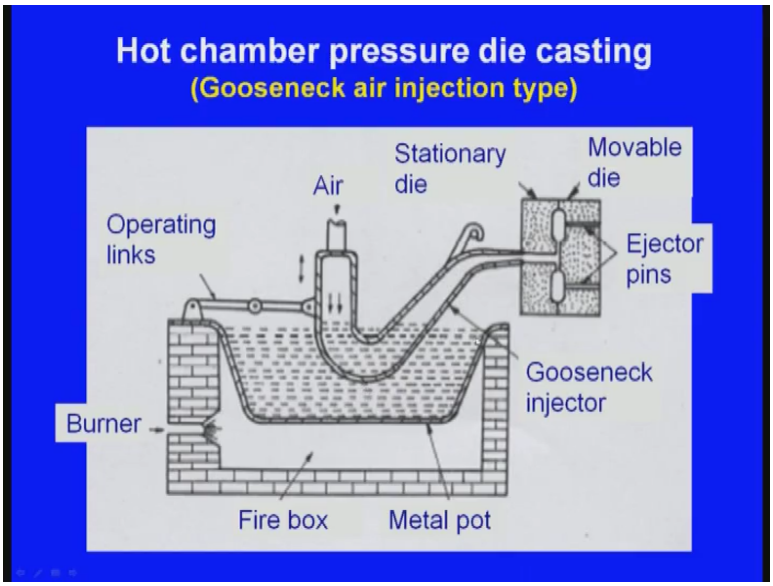

So, you can see here the, here is the molten metal and initially the metallic blocks will be kept inside this furnace in this what say, metal pot. Then here, there is a fire box using this fire box there will be coke or oil it will be burnt and because of that the molten blocks will be melted and there will be molten metal will be there. So, here we can see that the what say, furnace is an integral part of the machine.

Next, we can see here there is a gooseneck what say; cylindrical chamber is there gooseneck chamber is there. Now, the molten metal will be entering into this cylindrical cha what say, cylinder from this pot it enters, then what will happen? Air will be coming and air exerts pressure on the molten metal the molten metal will be slowly it will be transferred it will be transferred. In fact, it will be pushed and it will be coming up to here you can see, and here we can see this is the stationary die, and this is the movable die of course, we can see ejector pins are also there. So, this is the gooseneck injector.

So, the initially the molten metal from the metal pot will be transferred to the gooseneck injector. And because of the a right, because of the pressure exerted by the a the molten metal will be injected into the what say, cavity between the two dies. What will happened then? It solidifies between the molten metal solidifies between the two dies, and there will be a cooling system, because of the cooling system the molten metal quickly solidifies and after the cooling is over the this is the movable die and because of the ejector pins it comes out and the casting will be taken out.

Again, it will be closing same thing will happen, again the molten metal from the metal pot enters into the gooseneck injector, a air will come, and because of the pressure of the air, the molten metal will be injected into the cavity between the two dies. So, this process goes on, and no need to carry the molten metal from a faraway place, then you pour it, no, such business is not there. That is how the rate of production will be faster in the case of the hot chamber pressure die casting process.

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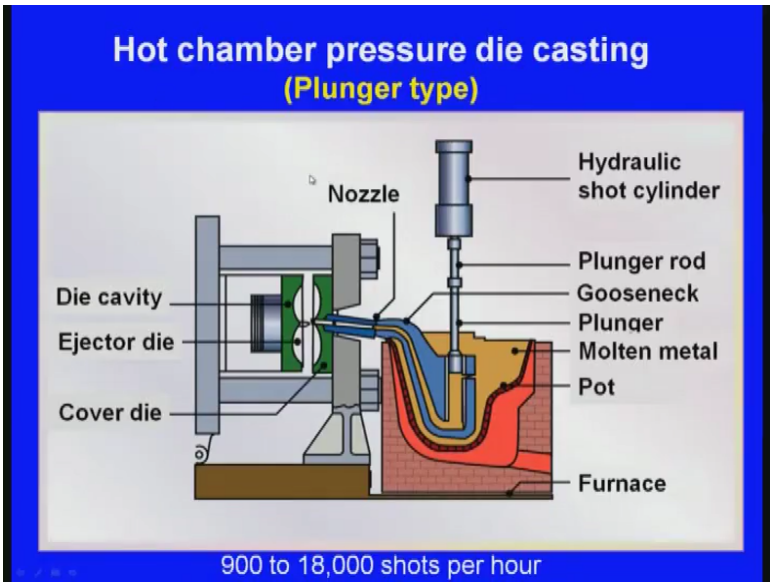

And now, let us go to the second type that is the plunger type hot chamber pressure die casting process. In the case of the gooseneck air injection, so we are sending what say, pressurised air to inject the molten metal into the metallic dies. Now, there is sometimes there is a risk that this air contains oxygen and this oxygen may react with the molten metal and causes oxidation that is why people have also developed the another type that is the plunger type. So, here no air injection will be there, there is no air instead of air there will be a plunger will be there.

Now, how to study this? So, this is the again we must know that, hot chamber pressure die casting means the furnace meant for preparing making the molten metal is an integral part of the machine. Now, this is that furnace, here we can see this is that furnace. So, this is that what say furnace spot right. So, this is the furnace and here we can see this is the refractory what say, lining will be there. So, that it can with stand very high temperature.

Now, this is the pot; this is the pot inside that pot we place the metallic block what say, block initially. Now, there will be heating system will be there and because of that heating system the metallic blocks will be melting and there will be molten metal will be there. Now how to study the next parts? So, here there is a hydraulic short cylinder is there. So, this comes down and goes up hydraulically it can exert very high pressure.

Now, you can see here, the molten metal enters into the here there is a cylindrical what say, chamber is there cylindrical chamber. The molten metal enters into the cylindrical chamber. Once, it enters into the cylindrical chamber, here we can see the gooseneck what say, plunger will be coming down because of the hydraulic what say, pressure once it comes down, what will happen? The molten metal is trapped between the plunger and the dies. Then what will happen? The molten metal will be injected at a very high pressure, yet it will be injected between the cavity of the two dies.

And here, we can see there are two dies, here this is the fixed die and this is the movable die and between the fixed die and the movable die there is a cavity is there, you can see right. So, this is the this is also known as the ejector die; movable die is also known as the ejector die, here there is a cavity.

Now, once the what say, gooseneck plunger what say pushing is push down the molten metal is trapped and it will be injected into the cavity here. Once, the molten metal fills that cavity, yes there will be cooling system will be there. So, this cooling system what say flows around the what say molten metal and the molten metal inside the dies will be solidifying at a very fast rate. Then what will happen? The movable die will be moving this side to the left side then the casting will be rejected.

Again, then it will be closing the same thing again the molten metal will be entering into this, what say cylindrical chamber, right again the plunger will be coming down, the molten metal will be injected into the cavity of the dies. So, this process keeps on going. Now what is the benefit here? Benefit is the chamber is an integral part of the machine. So, no need to carry the molten metal from faraway place and then you pour, no there is no such business automatically the molten metal will be entering into the, what say this seem cylindrical seem. Once, the casting is taken out immediately closes the molten metal enters into that cylindrical chamber it will be pushed the, what say plunger will be coming down and it will be injected.

So, the benefit is the rate of production will be very fast. What is the speed; you can see here 900 to 1800 shots per hour. In 1 hour we can produce 900 to 1800 castings we can produce, what a great speed it is if it is a sand casting in one hour we can produce one casting, but here in 1 hour we can produce 900 to 1800 castings. So, that is the great benefit of hot chamber pressure die casting process.

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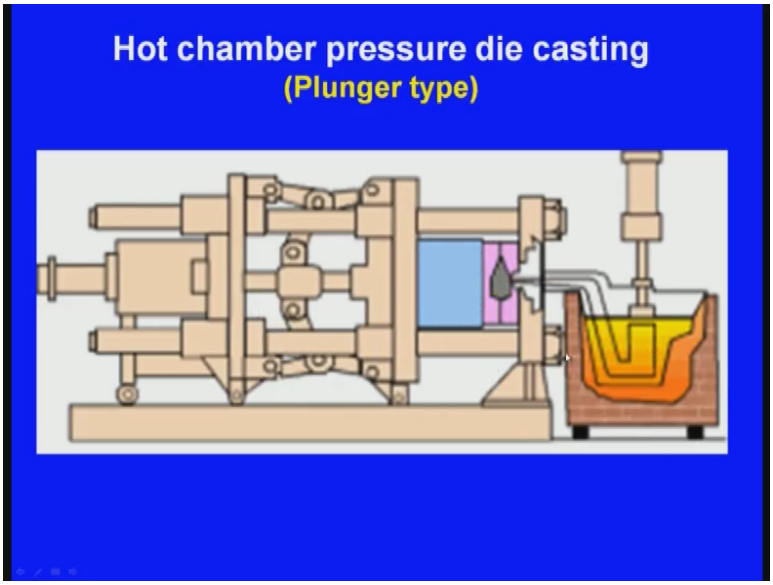

Ha here we can see the animation. So, this is the what say; what say this is the furnace and here we can see the molten metal is going inside, and here we can see the gooseneck plunger is coming down, and these two are the dies the molten metal will be injected inside, immediately there will be a cooling system, to cool the what say casting, and it will be ejected, and the casting will be taken out.

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So, this is the, what say animation of the hot chamber pressure die casting process. And here we can see another hot chamber die casting machine and here we can see 8 ton hot chamber die casting machine, this is the largest hot chamber machine in the world, and it costs about 1.25 million dollars. You can see the height its height its height is doubled than the height of an average men, you can see here maybe it must be the height must be the 12 feet and this is the length.

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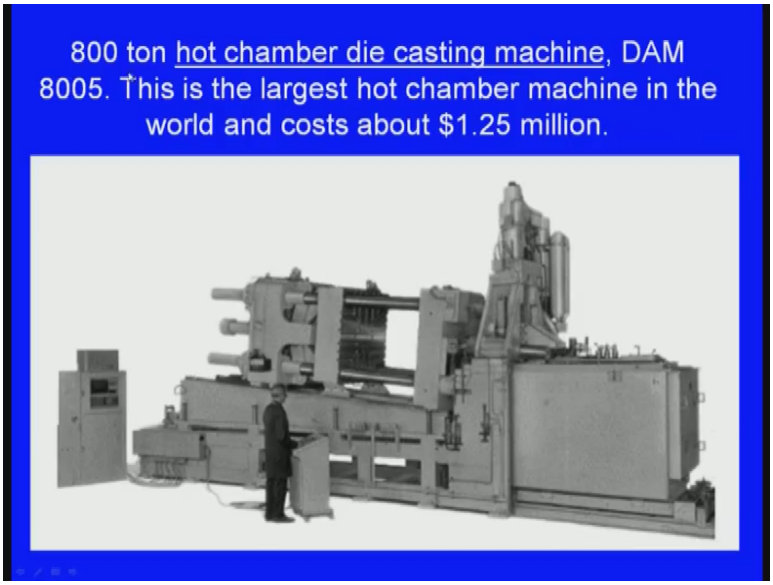

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So, this is the world's largest hot chamber die casting machine. These are the typical die casting mould. So, these are the dies, dies means metals moulds which are used in the dia what say hot chamber die casting process.

When we close this, we can see here these are the, what say this is the male die and this is the female die. The male die has got some pins are there four pins and here there are four holes are there when we close. So, this four pins will be going inside the four holes and there will be a cavity between these two dies, again these are the metallic moulds which are used in the, what say hot chamber pressure die casting process.

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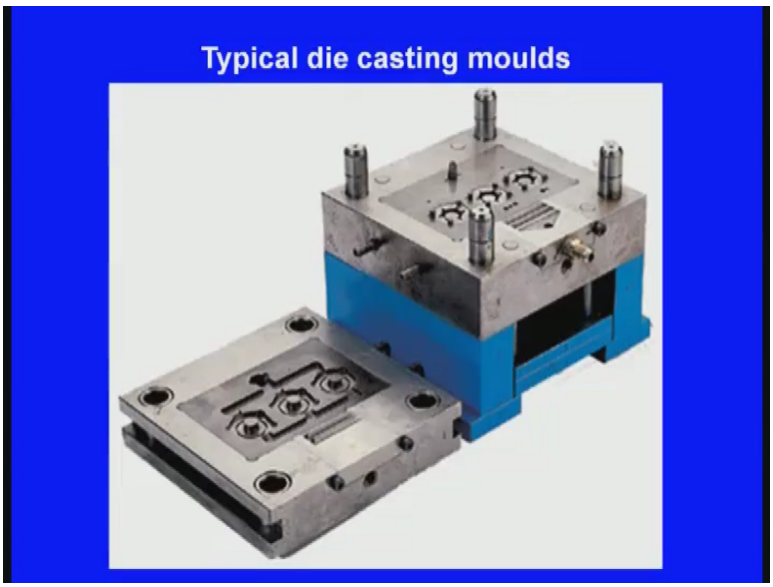

Metallic moulds nothing, but these are the dies, dies means metallic moulds, when we close these two see a there is a cavity. So, these are the dies.

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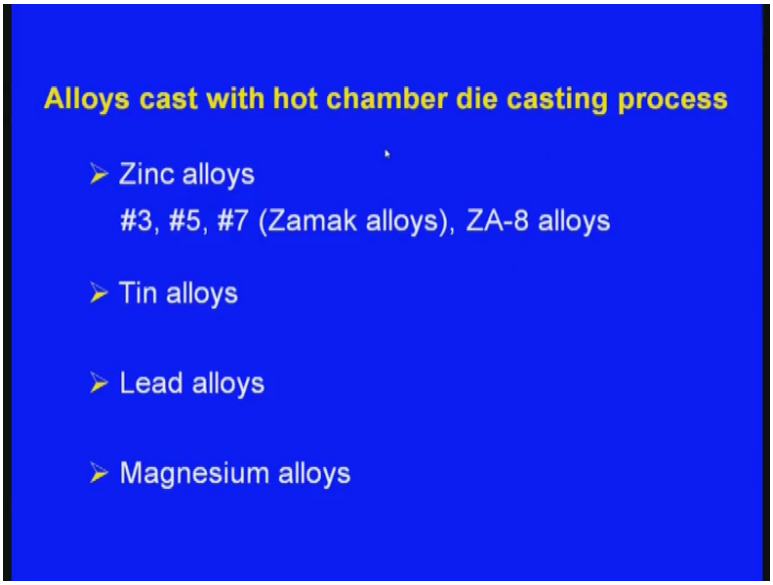

Now, alloys cast with hot chamber die casting process. Zinc alloys can be cast, tin alloys can be cast, lead alloys can be cast, and finally magnesium alloys also can be cast using hot chamber die casting process, and what are those among the zinc alloys, 3 5 7. So, these are the zamak zinc alloys. So, these can be cast using hot chamber die casting process and also ZA-8 alloy can be cast using the hot chamber die casting process.

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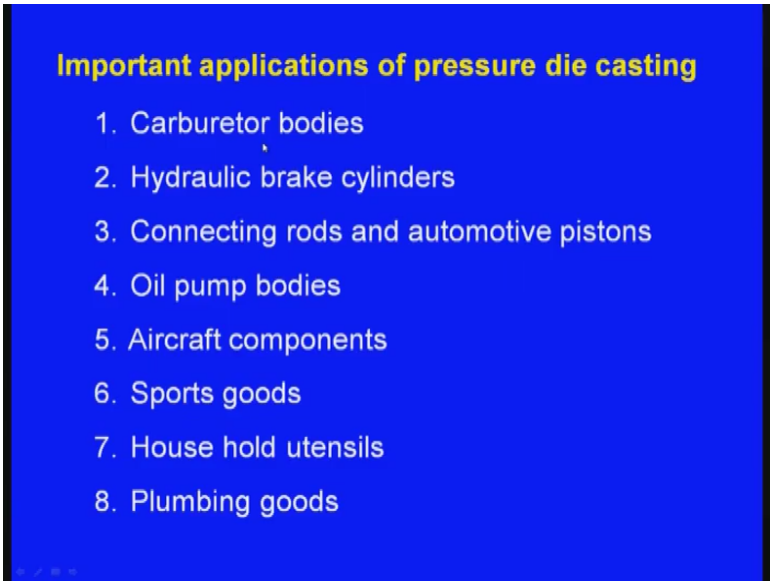

Next one, important applications of pressure die casting process. Carburetor bodies this carburetor bodies are very important components in the automotive especially in the petrol, what say vehicles this carburetor what say mixes petrol and air uniformly. So, this carburetor body is made up of, what say pressure die casting. Next one, hydraulic brake cylinders these are made up of pressure die casting, connecting rods and automotive pistons, oil pump bodies, aircraft components, sports goods, household utensils, plumbing goods all these in fact, these are some examples. In fact, many more components can be made using pressure die casting.

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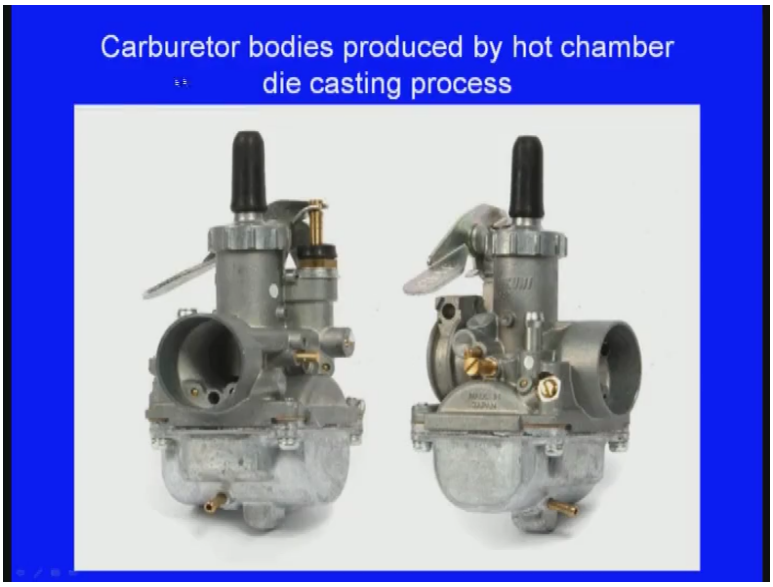

And here, we can see important applications, carburetor bodies produced by hot chamber die casting process. So, these are the carburetor bodies used in the automotives. This is a another component, thin component produced by hot chamber die casting process. So, again this is a, what say cast product of hot chamber die casting process.

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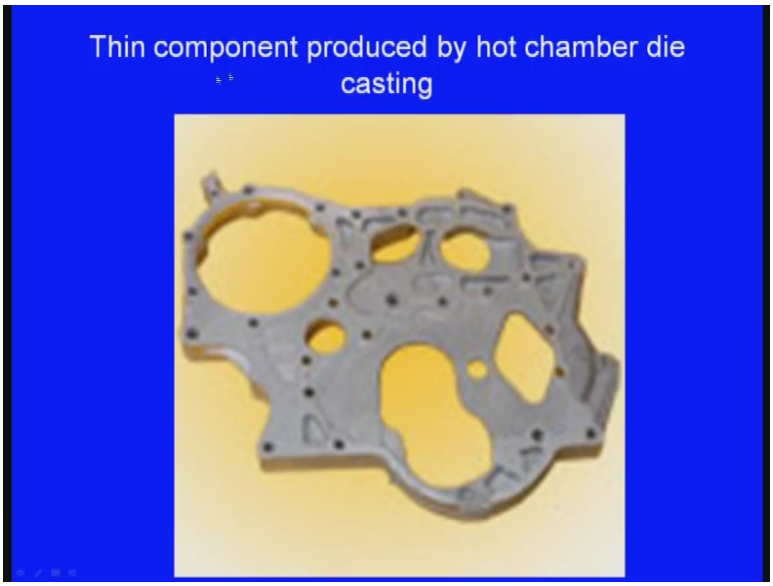

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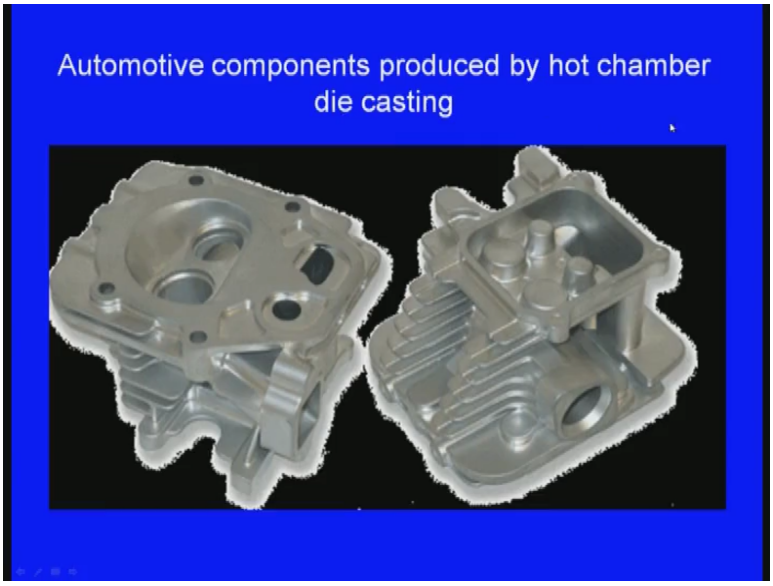

Next one, automotive components produced by hot chamber die casting process. Here we can see these are the automotive components these are produced by hot chamber die casting process. Next one, this is a another component produced by hot chamber die casting process.

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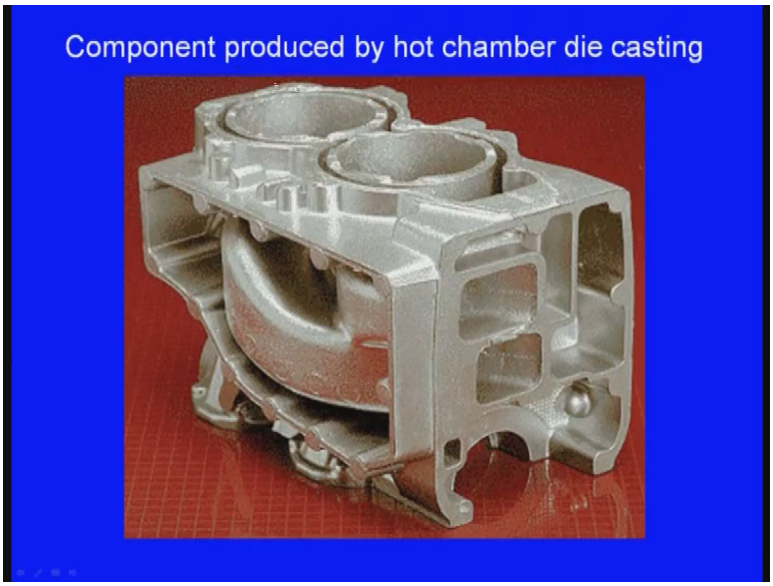

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Next one, we can see here, this is the trimmed brake drum. So, this is made by pressure die casting process this is the male die of center gated brake drum, this is the male die. Now, we can see here more examples. So, all this components are made by pressure die casting process.

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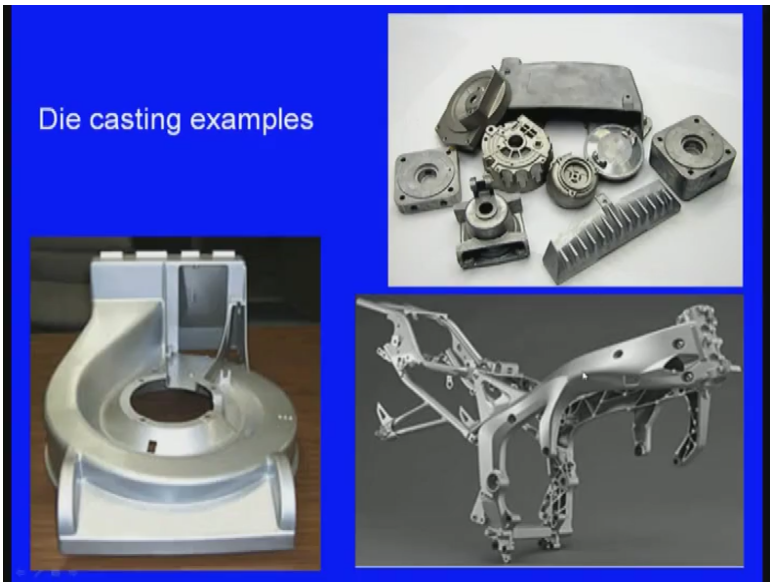

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So, these are the zinc die cast parts, you can see excellent surface finish is there. So, these cast parts are made by hot chamber pressure die casting process.

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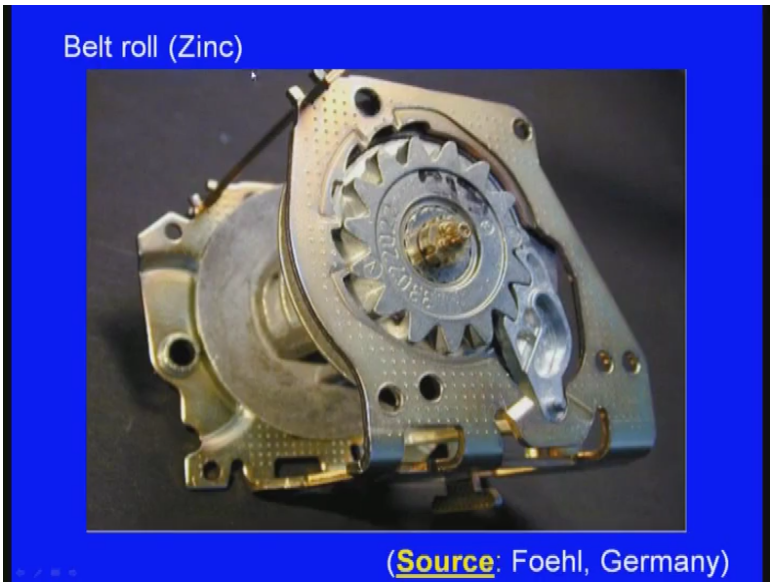

So, this a belt roll it is a zinc, what say casting it is made up of what say pressure die casting process.

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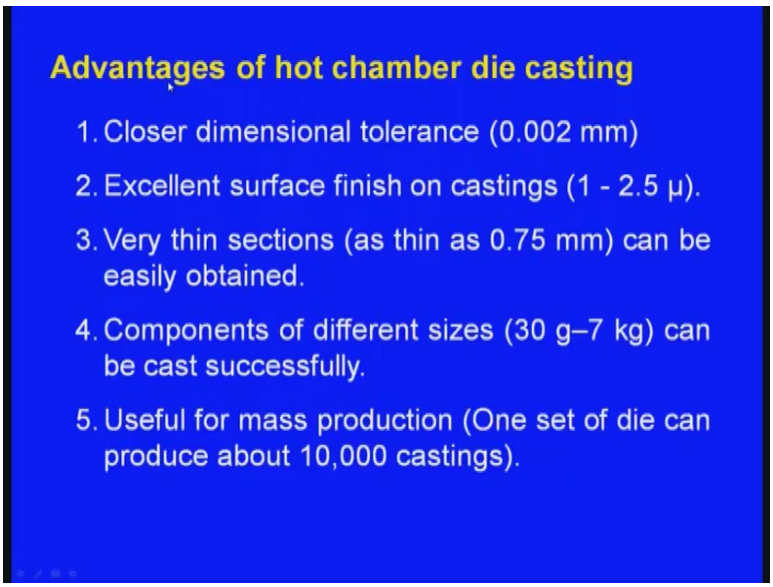

Now, let us see the advantages of hot chamber die casting process closer, dimensional tolerance, what is the tolerance? 0.002 m m excellent dimensional tolerance can be obtained using hot chamber die casting process, excellent surface finish on the castings you can see here 1 to 2.5 microns very good surface finish can be obtain, very thin sections as thin as 0.75 m m can be easily obtained using hot chamber die casting

process. Next one, components of different sizes as small as the 30 grams and as big as 7 kgs also can be successfully cast, useful for mass production, mass means same components produced one after another continuously that is the mass production, one set of die can produce above 10,000 castings. If we make one, what say set of metallic moulds. So, this set of metallic moulds will serve us for making producing 10,000 castings. So, this is the greatest advantage of hot chamber die casting process.

Next one, cycle of operation requires less time, very very less time is consumed in a cycle, faster rate of production, shrinkage and gas porosities can be avoided, why? because we are exerting pressure. So, because of that pressure if there is any shrinkage it will be nullified, if there is any gas porosity it will be nullified. Next one, semi skilled workers can do the job. Why? Because in the case of the sand casting process the pattern has to be with turn if it is the if it is not by done by a skilled person the mould will brake and so many things, but here there is no such thing in given a semi skilled worker can do the job.

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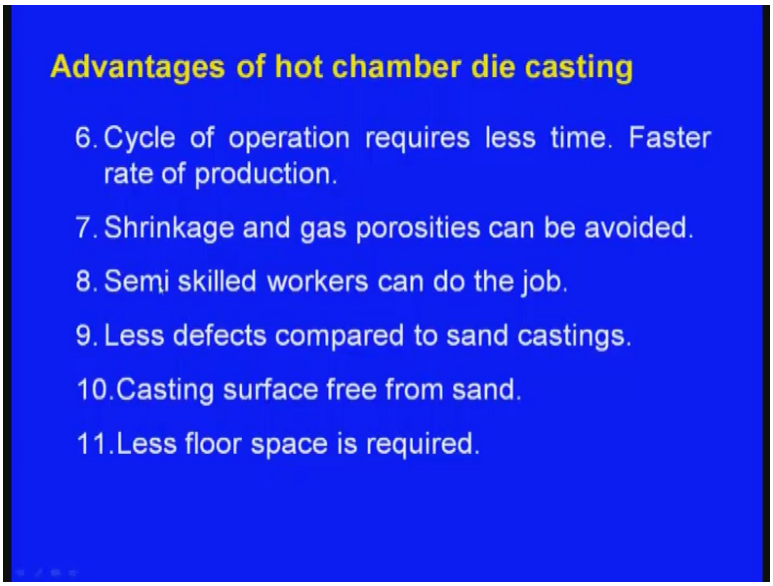

Less defects compared to the sand casting, casting surface is free from sand particles. So, no need to wash, right less floor space is require in the case of the sand casting process, there will be a pattern shop will be there for making the pattern, there will be a moulding shop for making the, what say sand, and there will moulding shop, there will be melting shop, there will be quilting shop, there will be, what say machining shop likewise. So,

many shops will be there and what say sand, what say casting industry requires large space. Whereas, in the case of the hot chamber die casting very less pour space is required these are the limitations of hot chamber die casting.

Cost of the equipment is very high, even cost of the die is very high, why? the material we use for the die is expensive, sometimes it is very hard mentioning it is a tough task it requires advanced machines.

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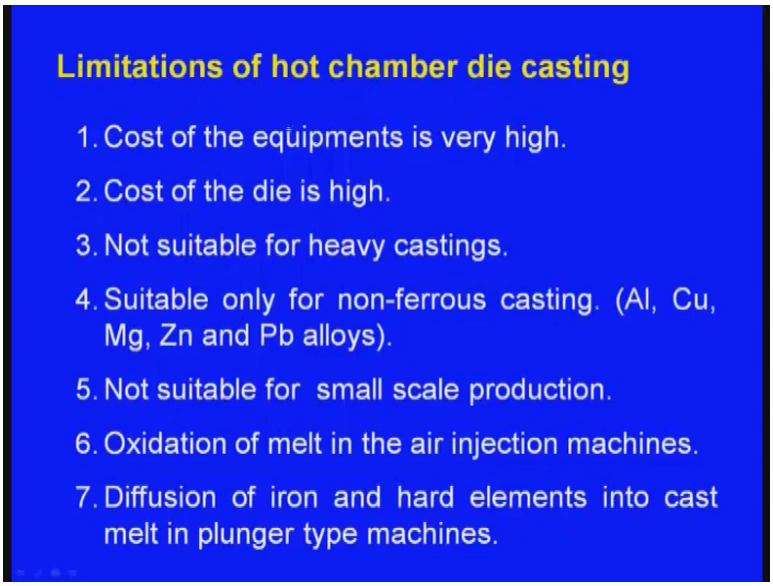

That is how the cost of the die is high. Not suitable for heavy castings, only small casting and medium size castings can be made using hot chamber die casting process. Suitable only for non ferrous castings, you see very important limitation of hot chamber die casting process only aluminium copper magnesium zinc and lead alloys can be cast, what about the ferrous alloys cast iron steel, no, they cannot be cast using hot chamber die casting process.

Not suitable for small scale production, why? making the die is, what say time taking process it is a laborious process, and it would become very expensive after making a set of dies if you make only two three castings then you discard those dies then it is not what say useful. So, not suitable for small scale production, oxidation of melt in the air injection machine. So, this can happen in the gooseneck in air injection type, because we send the pressurised air, so oxygen in the air may react with the molten metal of course,

this may not take place in the case of the plunger type, diffusion of iron and hard elements into the cast melt plunger type machine.

Now, the second type is the plunger type, what say hot chamber die casting process, in this process what we are doing? There will be a plunger this plunger will be pushing the molten metal into the dies. Now this plunger is made up of a special steel. So, it contains certain hard elements like tungsten, molybdenum then what will happen? when it comes in contact with the molten metal, and it is pushing the molten metal inside, the hard elements like tungsten or molybdenum may come out of the plunger they may mix with the molten metal and those elements may go inside the, what say cast component. Then that be the case the property of the casting will be all train. So, diffusion of iron and hard elements may take place in the case of the plunger type machines.

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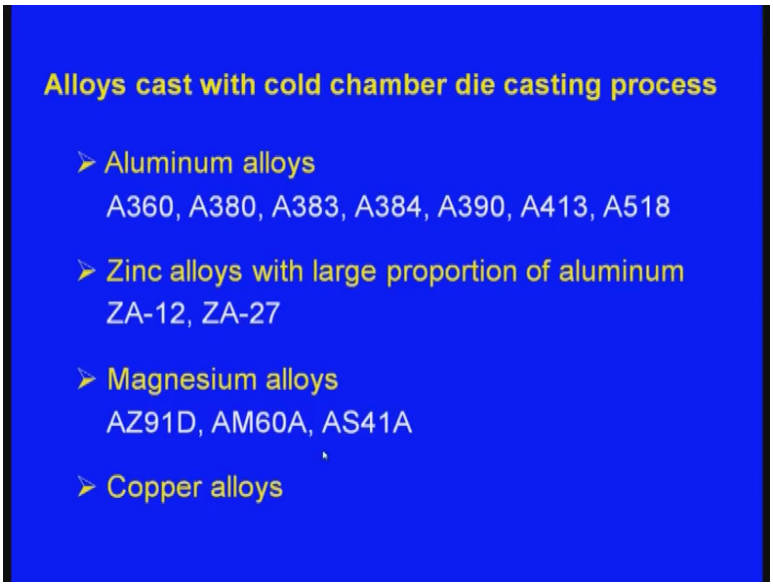

Now, ca alloys cast with cold chamber die casting process. In detail we have seen aluminium alloys A360, A380, A383, A384, A390, A413, A518 coming to the zinc alloys ZA-12, ZA-27 coming to the magnesium alloys AZ91D, AM60A, AS41A and some copper alloys.

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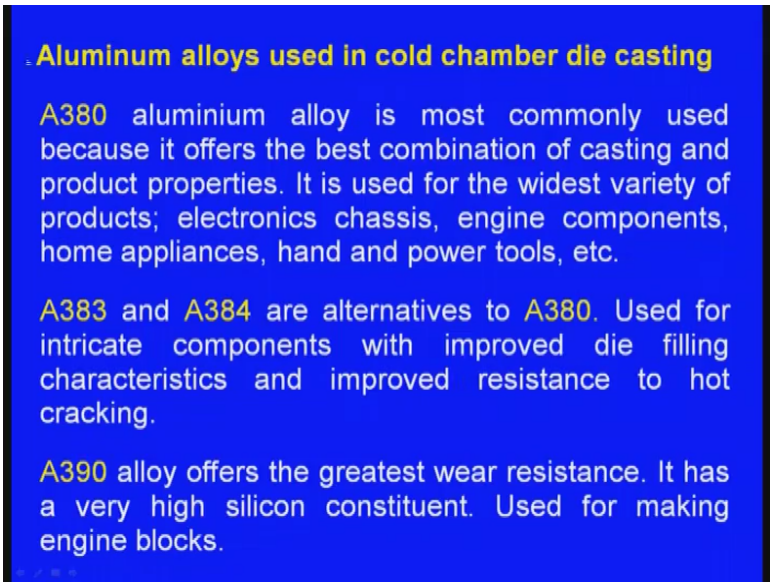

Now, aluminium alloys used in cold chamber die casting machine. So, we are going to learnt few more details about these alloys. A380 aluminium alloy is most commonly used because it offers the best combination of casting, and product properties, it is used for the widest variety of products, electronics chassis, engine component, home appliances, hand and power tools, and so on. So, these are the, what say applications of 380 what say a aluminium alloy

Next one, A383 and A384 are the alternatives to A380 used for intricate components with improved die filling characteristics and improved resistance to hot cracking. Next one, A390 alloy offers the greatest wear resistance. It has a very high silicon constituent. Used for making engine blocks. Once, there is a silicon, what say component once there is a high silicon comp proportion is there, what happens? It enhances the fluidity and also it induces the wear resistances to the cast product.

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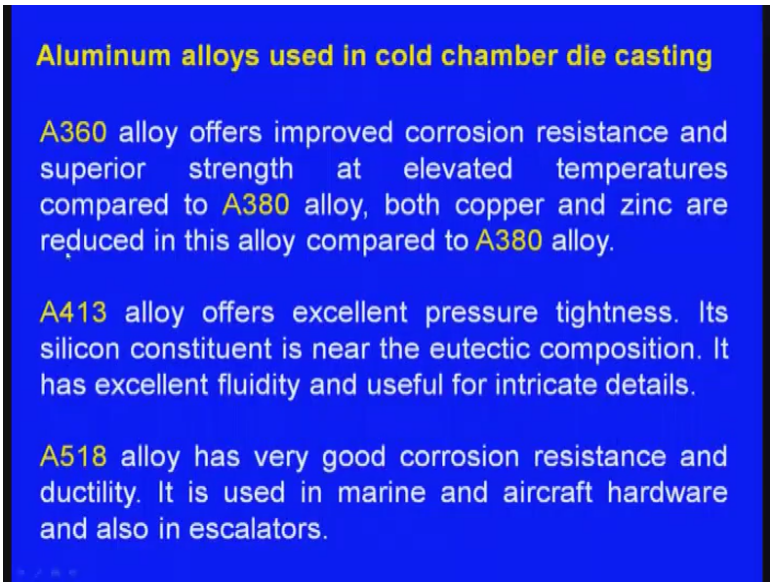

Next one A360 alloy offers improved corrosion resistance and superior strength at elevated temperatures compared to A380 alloy; both copper and zinc are reduced in this alloy compared to A380 alloy. Next one, A413 alloy offers excellent pressure tightness. Its silicon constituent is near the eutectic composition. It has excellent fluidity and useful for intricate details. Here the silicon constituent is at the eutectic composition, means what eutectic composition has the lowest melting point. So, because of the lowest melting point, right it offers higher fluidity.

Next one A518 alloy has very good corrosion resistance and ductility. It is used in marine and aircraft hardware and also in escalators.

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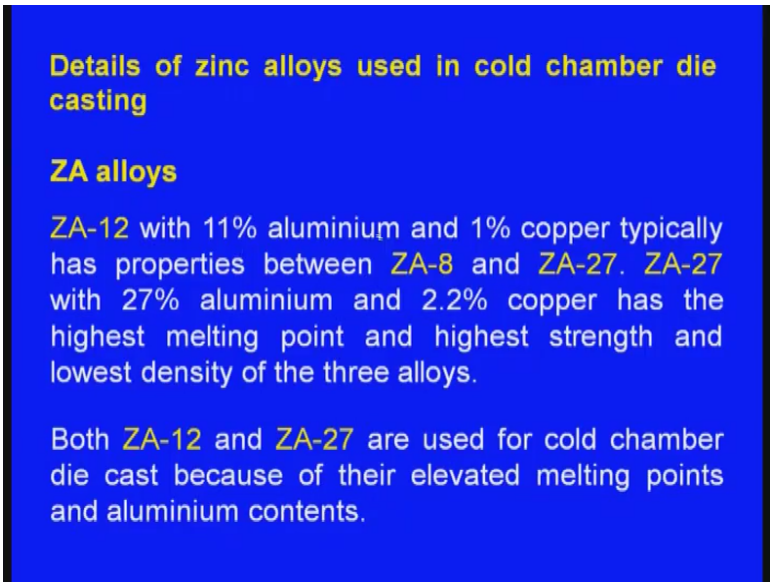

Next one, we will see details of zinc alloys used in hot chamber die casting. ZA alloys ZA-12 with 11 percent aluminium and 1 percent copper typically has properties between ZA-8 and ZA-27 with 27 percent aluminium and 2.2 percent copper has the highest melting point and highest strength, and lowest density of these three alloys. Next one, both ZA-12 and ZA-27 are used for cold chamber die cast because of their elevated melting points and aluminium contents.

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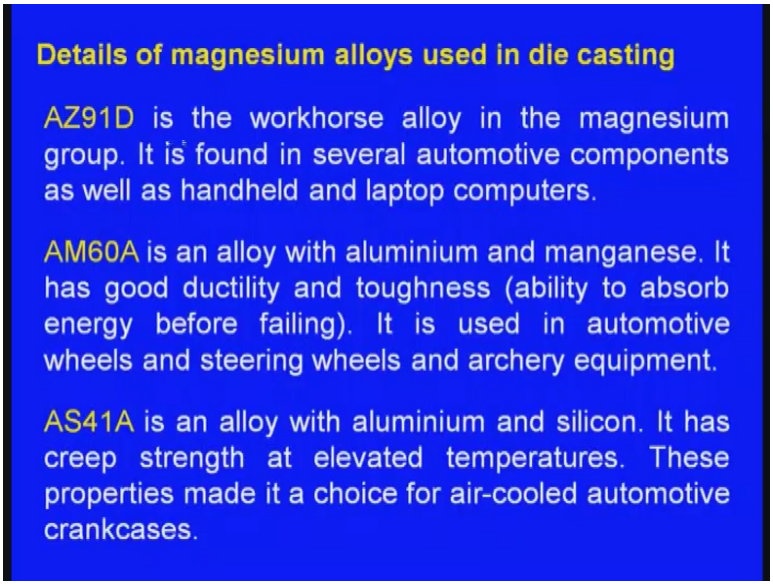

Next one details of magnesium alloys used in the die casting. AZ91D is the most what say useful alloy among the magnesium group. It is found in several automotive components as well as handheld and laptop computers. AM60A is an alloy with aluminium and magnesium it has good ductility and toughness ability to absorb energy before failing, it is used in automotive wheels, and steering wheels, and archery equipment. AS41A is the alloy with aluminium and silicon. It has creep strength at elevated temperatures. These properties made it a choice for air-cooled automotive crankcases.

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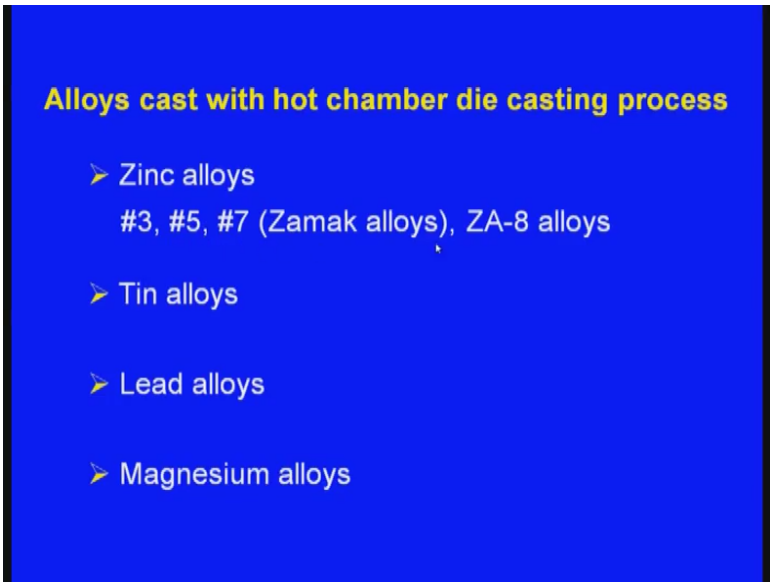

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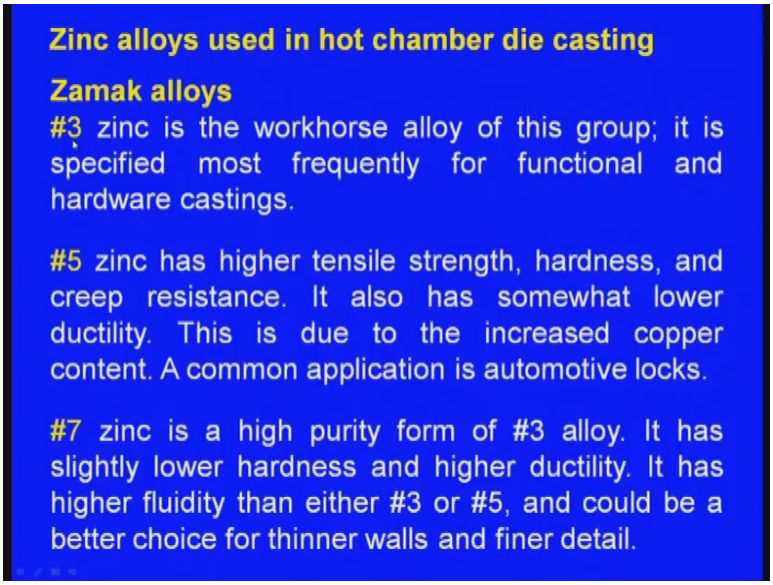

Next one, alloys cast with hot chamber die casting process, in detail we are going to see among the zinc alloys 3 5 7 zamak alloys and ZA-8 alloys. zamak alloys this 3 zinc zamak alloy, is the workhorse alloy of this group, means it is widely used. It is the, it is specified most frequently for functional and hardware castings. Next one, 5 zamak alloy has higher tensile strength, hardness, and creep resistance. it also has somewhat lower ductility. This is due to the increased copper content. A common application is automotive locks. Next one, 7 zamak alloy is a high purity form of 3 zamak alloy. It has slightly lower hardness and higher ductility. It has higher fluidity then either 3 to 5 zamak alloys, and could be a better choice for thinner walls and finer details.

Next one, ZA alloys, ZA-8 with 8.4 percent aluminium and 1 percent copper has the lowest melting point and highest density of the 3 alloys. It has the highest strength and highest creep strength of any zinc alloys.

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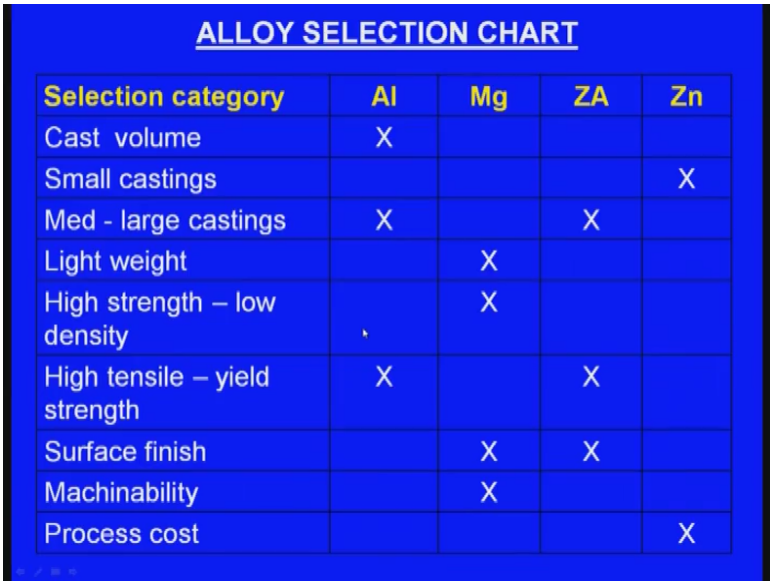

Next one, we will see the alloy selection chart, means which cast alloy to choose for a particular purpose right. So, these are all the, what say are requirements sometimes cast volume or sometimes small castings or medium to large castings, lightweight, lights high strength to low density, high tensile yield strength, sometimes surface finish maybe in important criteria or machinability or process cost.

So, these are our criteria, selection criteria and these are the four types of the alloys. These are the aluminium alloys magnesium alloys zinc alloys zamak alloys and these are

the zinc alloys. if it is the cast volume is important means we are bothered about the, what say volume more volume is to be produced, then that be the case aluminium alloys are to be chosen for our, what say die casting purpose.

Now, small castings, but with you, what say closed dimensional accuracy and what say surface finish that be the case we can go for the zinc alloys. Medium to large castings, then we can use aluminium and ZA alloys, lightweight that be the case magnesium is there, magnesium alloys can be used. High strength to low density is our requirement that be the case, we again magnesium can be used.

Now, next criteria high tensile yield strength that be the case we can use aluminium alloys, we can also use ZA alloys. Next one, surface finish should be good that is our requirement that be the case we can go for magnesium alloys, ZA alloys. Next, machinability should be good, that be the case we can use magnesium alloys. Next one, process cost, that be the case we can go for the zinc alloys.

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Die casting characteristics of Al alloys
1- Most desirable, 5 – Least desirable

Commercial ANSI:	360 360.0	A360 A360.0	380 380.0	A380 A380.0	383 383.0	384 384.0	390 B390.0
Resistant to hot cracking	1	1	2	2	1	2	4
Die filling capacity	3	3	2	2	1	1	1
Anti soldering to the die	2	2	1	1	2	2	2
Corrosion resistance	2	2	4	4	3	5	3
Machining ease	3	3	3	3	2	3	5
Electro plating ease	2	2	1	1	1	2	3
Strength at elevated temp	1	1	3	3	2	2	3

Next one, die casting characteristics of alloys, now here we can see these are the, what say characteristics, resistant to hot cracking, die filling capacity, anti soldering to the die, corrosion resistance, machining ease, electro plating ease, strength at elevated temperature. And these are the different alloys A360, A360.0, A360, 360.0 this is 360 right 380, 380.0, A380, A380.0, 383, 383.0, 384, 384.0, 390, B390.0 now 1 means most desirable for that characteristic 5 means least desirable.

We can see here for resistant to hot cracking, you can see oh, yes 360 and 360.0 is least desirable. Similarly, 360, A360, A360.0 is also least desirable. A380, 3 380.0 we can see it is close to least desirable, same is the case with the A380 and A380.0. 383 and 380.0 again is least desirable. What is good 390 or b390.0 is close to most desirable.

Next one, die filling capacity, when this is the characteristic, now what say A380 and 380.0 is in the middle, again A360 and A360.0 is also in the middle right. A380 and A380.0 alloys are close to most desirable. Whereas, 833, 384 alloys are most desirable; the these are most desirable. Next one, 390, B390 is also most desirable.

Next, anti soldering to the die, that be the case say these two alloys 360 alloys 360 and 3 A360 alloys are close to most desirable whereas, 380 and 380 alloys are most desirable. Next one 383, 384 and 390 these alloys are close to most desirable, coming to the corrosion resistance characteristic, right 360 and A360 are close to most desirable. Whereas, 380 and 3 A380 alloys are close to least desirable, and A383 is in the middle 383 is in the middle, next one 384 is least desirable, and 390 is in the middle

Next one, a machining ease we can see here all this three alloys are is in the are in the middle. Whereas, 383 is close to most desirable, again 384 is in the middle and 390 and B390 are most desirable. Electro plating ease coming to that these two alloys 360 and A360 are close to most desirable, and these three 380, A380 and 383 are most desirable alloys. Whereas, 384 is close to most desirable and 390 is in the middle. Coming to the strength at elevated temperature, 360 and A360 are most desirable whereas, 380 and 380 are in the middle. Next one 383 and 384 alloys are close to most desirable, again 390 is in the middle.

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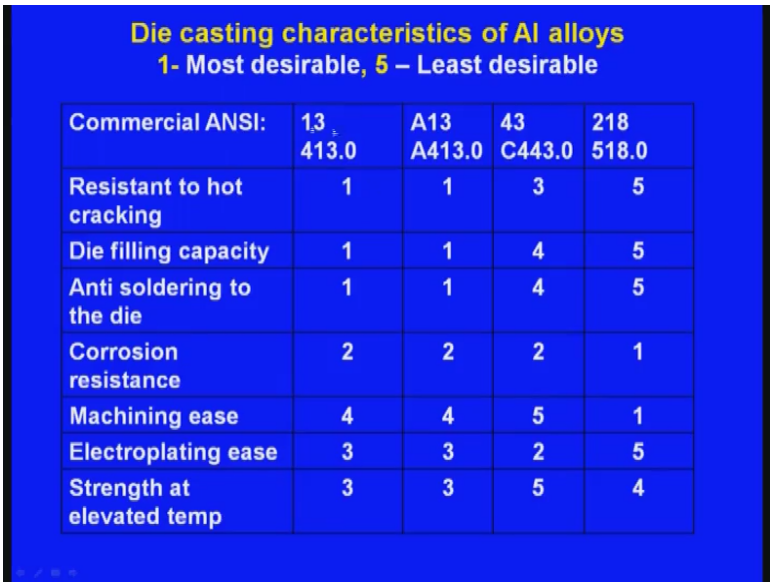

Next one, coming to the few more alloys are there 13, 413, A13, A413.0, 43, C443.0, 218 and 518.0. Coming to this, resistant to hot cracking this alloy is most desirable whereas, 218 and 518 is least desirable. Die filling capacity these two alloys are most desirable. This is close to least desirable, and this is most least desirable. Anti soldering to the die these two alloys are most desirable, and this one is least desirable. Corrosion resistance, these three are close to most desirable, and this is most desirable.

Next one, machining ease these two are close to least desirable, this is least desirable, and this is most desirable. Coming to the electroplating ease, these two are in the middle, this is close to most desirable, and this is least desirable. Coming to the strength at elevated temperatures, these two alloys are in the middle, this alloy is least desirable, and this alloy that is the 218 or 51 518.0 these two alloys are close to least desirable alloys.

Friends, in this lecture we have seen the important classification of the die casting process. We have seen that, die casting process means we use the dies; dies means they are the metallic moulds. So, these metallic moulds will be used for making 1000's and 1000's of casting. We have seen that broadly they can be classified into two types, one is the pressure die casting process, and the second one is the, what say one is the gravity die casting, and the second one is the pressure die casting process. The gravity die casting is also known as the permanent moulding process. Coming to the pressure die casting process, there are two types one is the cold chamber pressure die casting process, and the

second one is the hot chamber pressure die casting process. So, in the next lecture we will continue this die casting process until then.

Thank you and goodbye.