Metal Casting
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Module – 01
Introduction and Overview
Lecture – 02
Overview of Different Casting Processes – I

Good morning friends. Let us today, see the overview of different casting process. In the previous lecture, we have seen the introduction to the casting process. We have seen how the ancient man has used this casting process to make the rudimentary tools like spear heads, axe heads and arrow heads and so on.

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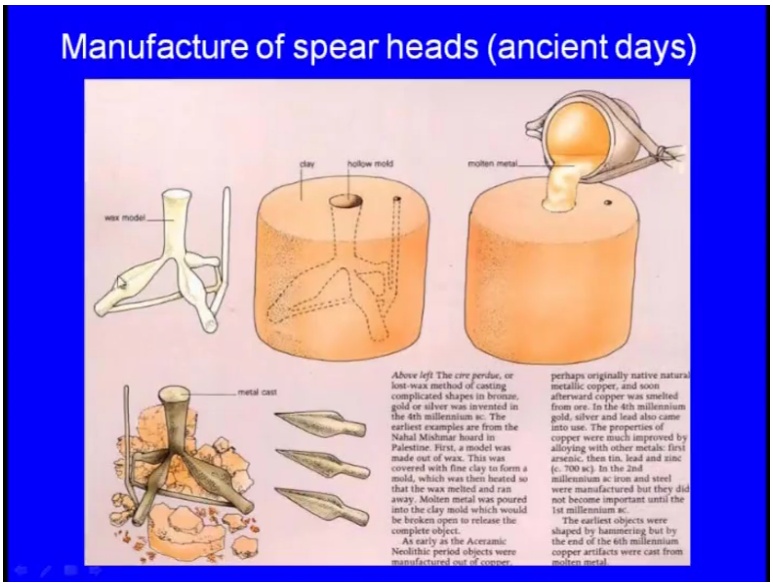

And how did the ancient man make spear heads? Initially he made a wax model of the spear heads, then he made an assembly and he took the sticking sand and compacted around this wax model. He melted the metal and the molten metal was poured into this system and before pouring the molten metal into the system, he has drained out the wax and inside there was a hollow cavity and the shape of that hollow cavity was similar to the shape of this wax model.

Now, after sometime the molten metal has solidified and he has broken the moulding sand around that wax model. Now, we can see here, he has broken the moulding sand and these are the individual spear heads.

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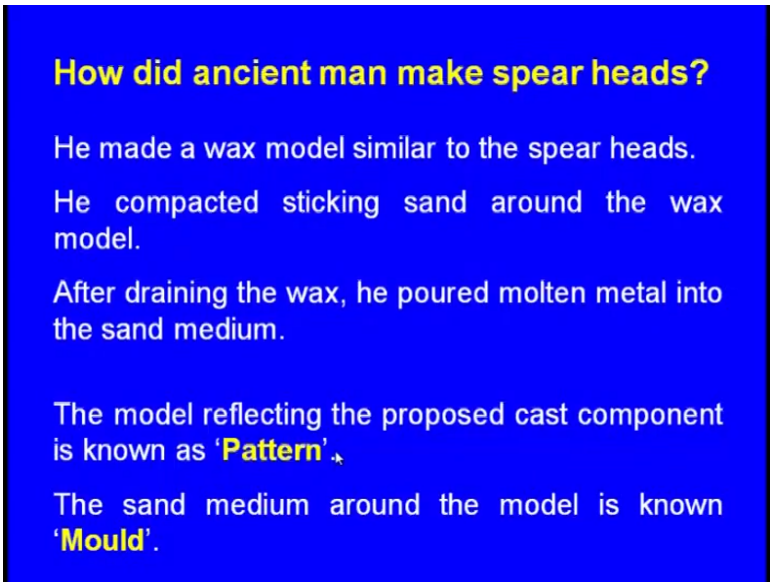

How did ancient man make spear heads? He made a wax model similar to the spear heads. He compacted sticking sand around the wax model. After draining the wax, he poured molten metal into the sand medium. So, this is the simple principle of the metal casting.

The model reflecting the proposed cast component is known as pattern. So, this is a very important term technically. Even today, we call the model which we use to create that cavity it is known as the pattern. Similarly, the sand medium around the model is known as the mould. Later, the wax used by the ancient man to make the pattern was substituted by wood, metal, polystyrene and so on. It does not mean that a wax is out of date, it is still in use. In addition to the wax, wood, metal and other materials are also used as the pattern materials.

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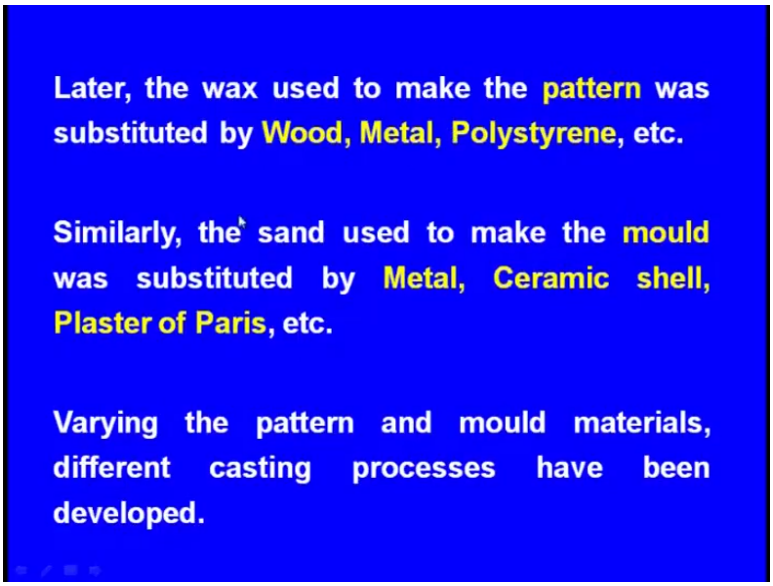

Similarly, the sand used to make the mould was substituted by metal, ceramic shell, plaster of Paris and so on. Even sand is also in use, sand is widely in use. Varying the pattern and mould materials, different casting processes have been developed.

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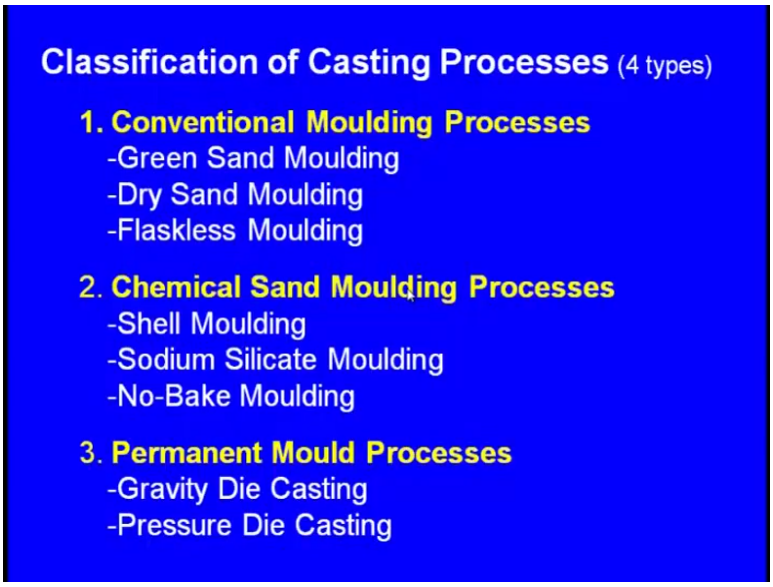

Now, let us again quickly look at the different casting process. We have broadly 4 types of casting process; one is the conventional moulding process, second one: chemical sand moulding process, third one: permanent moulding process and fourth one: the special casting process.

Again in the conventional moulding process, we have the green sand moulding. Green sand moulding means where there is moisture that kind of sand is known as green sand. Dry sand means the moisture will be dried out in an oven. Flaskless moulding means no moulding boxes will be used.

In the second category we have the shell moulding, sodium silicate moulding, no bake moulding and in the permanent moulding process we have the gravity die casting and the pressure die casting. Die casting means, just now we have seen, the ancient man has used the moulding medium as the sand. Sand was the moulding medium. In this die casting, the moulding medium is a special alloy. In the case of the sand casting, after solidification of the molten metal we break that sand, whereas, here the same metallic mould will be used for making thousands and thousands of components.

So, that is the special feature of the die casting because we use a special spin for making this mould we also call it as the permanent moulding process. Again in this, there are 2 types; one is the gravity die casting, in which we pour the molten metal into the metallic mould by means of gravity, we do not use any external pressure whereas, in the second category pressure die casting; means we apply some external pressures to inject the molten metal into the metallic moulds.

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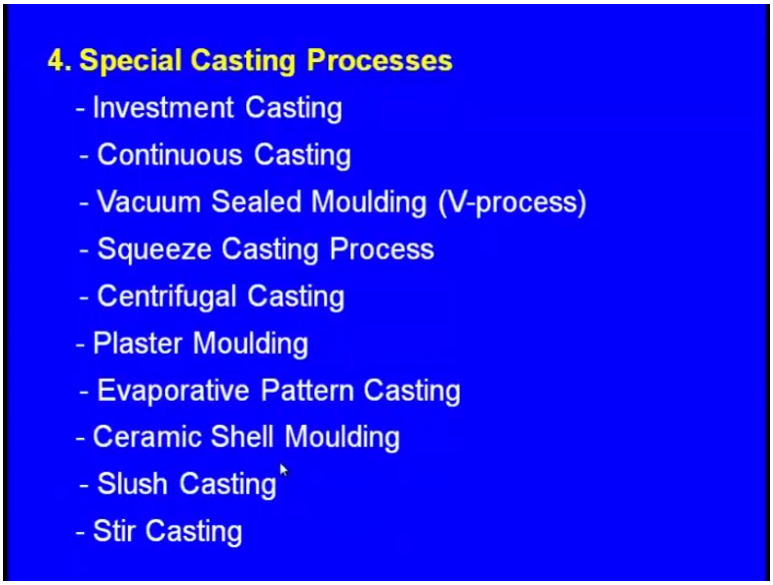

And we have the special casting process. These are the investment casting process, continuous casting process, vacuum sealed moulding process, it is also known as V-

process, squeeze casting process, centrifugal casting, plaster moulding, evaporative pattern casting, ceramic shell moulding, slush casting and finally, the stir casting. We will be seeing all these; just we will have a overview of all these process now.

First let us see the green sand moulding. As I already told green sand moulding means yes this mould is made up of sand and moisture is always present, that is the meaning of the green sand moulding.

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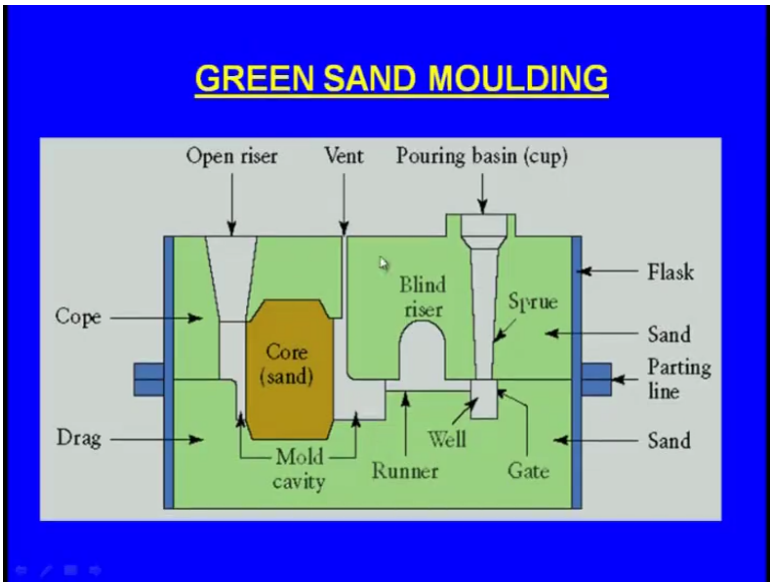

Here, we can see the typical setup of a green sand moulding. In the green sand moulding there will be generally there will be 2 moulding boxes. Here you can see a yes one moulding box is there and here you can see another moulding box. The lower moulding box is known as drag, the upper moulding box is known as cope and here we can see inside there is a mould cavity is there.

Suppose, this is a cylindrical cavity, now, inside the cylindrical cavity we want to make a hollow cavity, a hollow space in the casting. Now, what they have done is, they have kept a core here; sand core means, core means a its an object made up of sand most of the times and it is kept inside the cavity now what happens the molten metal flows around this sand core like this and finally, it rises. After it solidifies, we get a casting with hollow space inside. That is the purpose of the core.

Now, let us see how the molten metal is poured. So, this is the cavity which is meant for making the casting and this is a riser and this is the pouring basin and this is the sprue and this is the pouring well. Now, the molten metal is poured into the pouring basin here. The molten metal slowly flows, this vertical passes is known as sprue. The molten metal passes through the sprue and it falls on into the this is a well, it falls into the well. Then, here there is a horizontal passes it is known as runner. The molten metal flows into the runner, then it enters into the mold cavity, it flows around the sand core, finally, it rises through the open riser.

Once it rises through the riser, it's an indication that the cavity is full with the molten metal. Then we stop pouring the molten metal. After sometime, yes, the molten metal solidifies and we break the sand and take the casting outside. But, after we take the casting outside, there are some extra projections are there. This is the open riser. So, this is not part of the casting. Similarly, this is the runner, this is not part of the casting and this is the sprue, your vertical passes, there also molten metal solidifies, that is not part of the casting. So, all these unwanted projections will be cutting, then we will be getting the final casting and it has to be cleaned and it should be finished then it will be handed over to the customer.

So, this is the overview of the green sand moulding. We will be learning in detail in the subsequent lectures.

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So, we can see here, this is the green sand mould. You can see here, this is the drag and this is the cope; drag means lower moulding box, cope means upper moulding box. Most of the times we use 2 moulding boxes and here you can see, yes, this is the sprue. Sprue passes is inside and this is the pouring cup. When you pour the molten metal it flows inside the mould cavity and once the cavity is full with the molten metal and it rises through the riser, here we can see a riser.

So, this is the typical what say setup of the sand moulding boxes.

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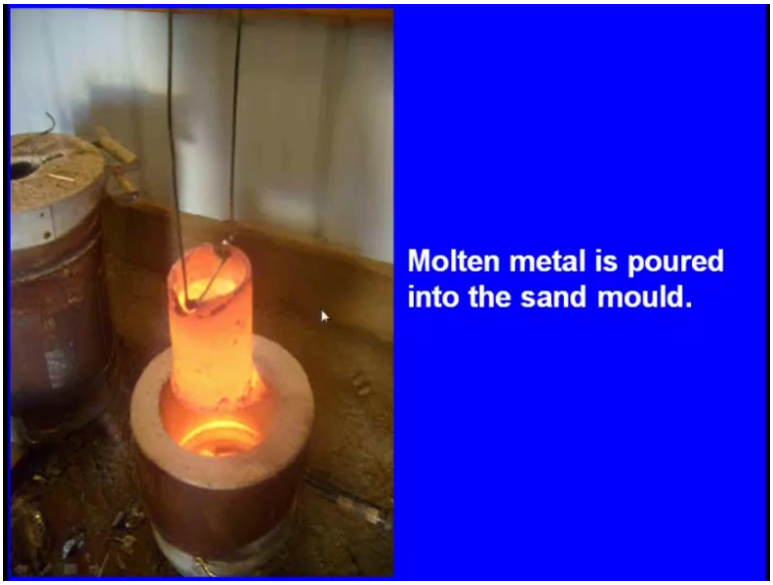

And here we can see the molten metal is ready for pouring.

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What are the advantages of the green sand moulding? Most metals can be cast by this technique. That is the advantage, except a very few alloys. Most of the metals and alloys can be cast by this method. Pattern costs and material costs are relatively slow. Most of the times the patterns are made up of wood, it is very cheap and it is very easy to make the pattern. That way the costs involved in the making of the pattern is very low. Next one; no limitation with respect to size of the casting; A very small casting can be made by green sand moulding or sand moulding and is very big sand casting which weighs about 5 tons can also be made by sand casting. So, there is no limitation with respect to size of the casting.

These are the demerits of the sand moulding. Poor surface finish of the casting. We are pouring the molten metal into the sand mould and the molten metal occupies inside the sand mould and what is the surface of the cavity? It is very irregular because of the presence of the rough sand grains. Because of these irregularities, even the casting will develop a irregular casting surface. So, that is how we get a very poor surface finish on the casting. So, in this case we have to machine the casting, then only we get the required surface finish.

Next one: poor geometrical accuracy of the casting. The mould cavity may not be exactly same as that of the casting geometry. Sometimes it will be little larger than the size of the casting. In such a case, again we have to machine so that, the geometry and size of the

casting will be same as the required geometry. In such a case again we will be machining. So, machining is required to achieve the finished product.

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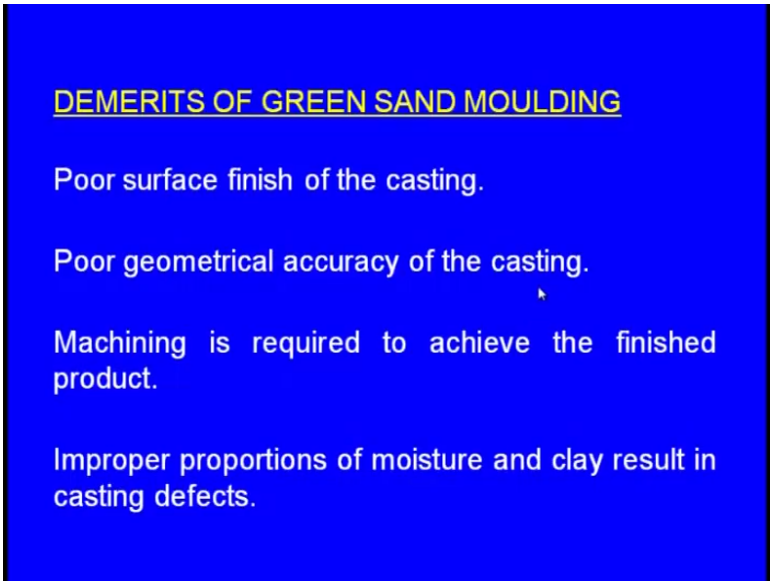

Next one: improper proportions of moisture and clay result in casting defects. Most of the times this moisture immediately comes in contact with the molten metal and it turns into vapor and this vapor, yes, most of the times goes out through the riser hole and also we make some wind holes. Even the sand has some property called permeability. Because of this permeability the hot gases are able to pass through the neighboring grains of the sand particles. Sometimes, if the sand is tightly compacted, the hot gases cannot escape through the neighboring grains. In such case, the sand has a poor permeability. In the bitter case the steam and the hot gases that have generated will be, what say, accommodated inside the moulding cavity, in such a case we get certain defects like the blow holes, we get.

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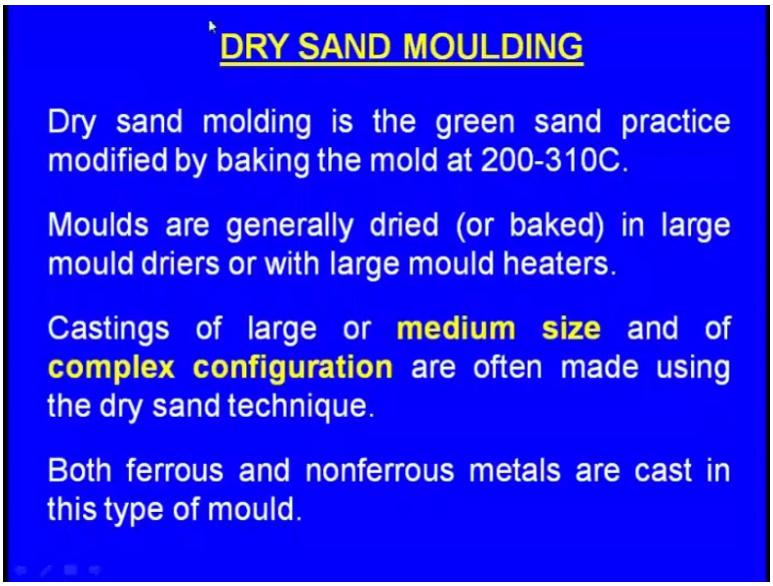

Next one let us see the dry sand moulding. Dry sand moulding is similar to the green sand moulding; the only difference is the moisture will be dried out.

The dry sand moulding is the green sand practice modified by baking the mold between 200 to 310 degrees centigrade, so that, the moisture inside the mould cavity will be evaporated. The moulds are generally dried or baked in large moulds driers or with large mould heaters. Castings of large or medium size and of complex configuration are often made using the dry sand technique. Both ferrous and nonferrous metals are cast in this type of mould. So, that is all about the dry sand moulding. The ingredients of the both the green sand moulding and the dry sand moulding are almost same. The only difference is, in the case of the dry sand moulding, we evaporate the moisture by baking the mould and by drying it.

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These are the advantages of the dry sand moulding.

Defects that arise due to moisture will be eliminated. Just now we have learnt that, in the case of the green sand moulding because of the moisture or because of the excessive moisture, excessive vapor on hot gases will be generated and if they cannot escape from the mould cavity, they will be taking place inside the moulding cavity and they result in the defects. This won't arise in the case of the dry sand moulding. No gas defects.

Similarly, we can see the demerits of the dry sand moulding. Drying of the mould requires ovens and consumes excessive power. It takes time we have to put them in the baking ovens, it consumes power and also it takes time. That's the demerit of the dry sand moulding.

Next one; let us see the flaskless moulding. What is this flaskless moulding? In the case of the green sand moulding and in the case of the dry sand moulding, we were using the moulding boxes. These moulding boxes are known as flask moulding flasks. In the case of the flaskless moulding, these moulding boxes are not used.

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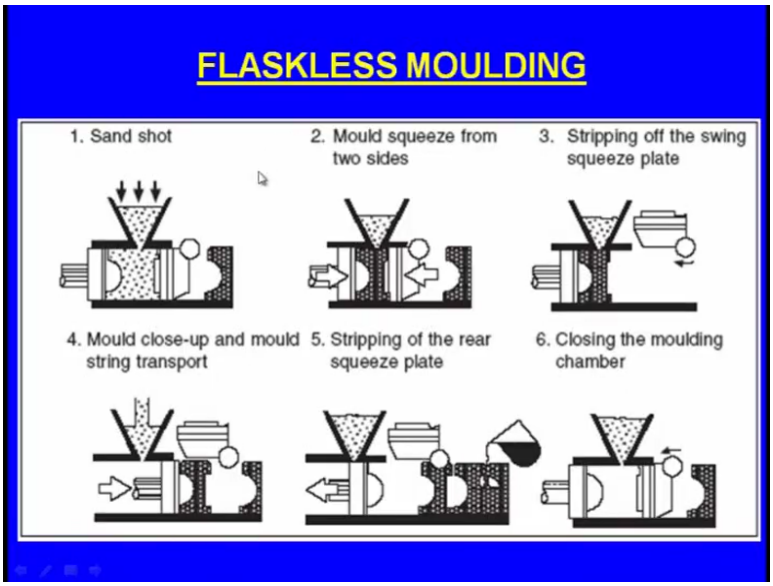

Here, we can see a typical system of the flaskless moulding and here we can see the moulding sand is poured, pushed and into this system and here we can say here is a, what say, ram and it is coming and it is pushing this system. Then what will happen, we can see without a box is a cavity is created inside here, you can see here and again in the similar way the other, what say, a mould is also created in the same way. Finally, yes, we get the here you can see, these 2 moulds, half of the moulds we can see here one half of the mould and here another half, now these 2 are assembled here and the molten metal is being poured. So, likewise, so many moulds are created at a shorter time, at a shorter span without any moulding boxes or the flask. That is a all about the flaskless moulding.

These are the advantages of the flaskless moulding. Rate of production is high because it is a mechanized system and fettling requires a lesser efforts. In the case of the green sand moulding and dry sand moulding, yes, there will be moulding flasks will be there and fettling means breaking that sand and removing the casting outside that is the fettling and the knockout. So, this becomes difficult in the case of the green sand moulding and dry sand moulding whereas, that would be in easier task in the case of the flaskless moulding.

So, these are the demerits of the flaskless moulding; mechanization of the system would be expensive.

Next, let us see the chemical sand moulding process. Among them first let us see the shell moulding.

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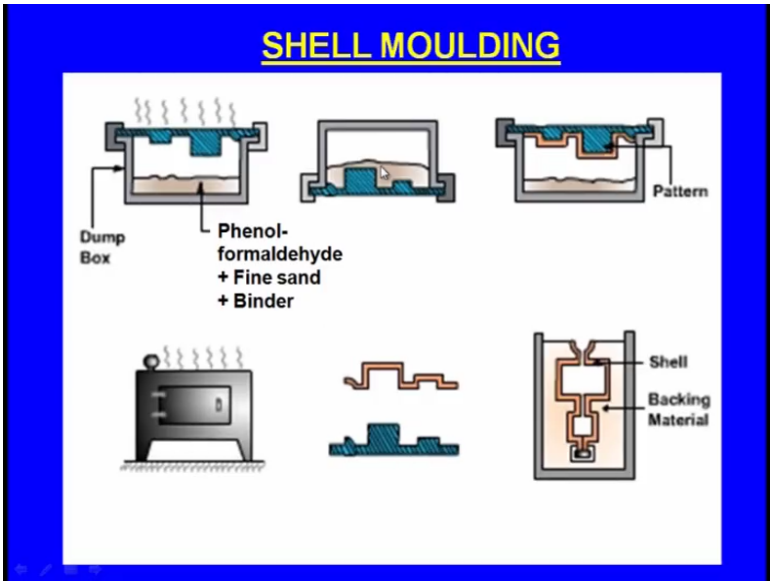

In the shell moulding, we use; we create shells not sand moulds. A thin shells are created and into these thin shells the molten metal is poured. And here we can see on this is a what say a dump box and in this dump box there is a phenol formaldehyde and fine sand and also some binder and here we can see this is the pattern, this is a metallic pattern. This metallic pattern will be heated.

Now, what happens is the box will be made upside down. When it is made upside down these mixture of phenol formaldehyde, fine sand and binder falls on this pattern. Then what happened, a thin layer of this mixture melts and forms a shell around that pattern. You can see again this is made upside down, now we can see here a shell is created and it is sticking to the pattern. Now, the pattern will be cooled down. After it cools down the pattern will be removed. Yes, we can see here, this is the pattern, one pattern then it will be baked in an oven. That is how one pattern is created, not one pattern, one half of the, what say, shell, half of the shell is created.

Similarly, another half of the shell can be created in the same way and these 2 shells are assembled here, we can see here, these 2 are assembled and here these 2 are fastened so that, they will be held tightly together during pouring. Now, again these 2 shells together are kept inside a vertical flask and sand is dumped for the baking purpose, so that, the

shells will be more stronger because of the sand packing. The molten metal is poured through this sprue cup and the molten metal goes into the shells and it solidifies. After it solidifies, we remove this shell and in fact, if we can break the shells and we can get the casting. So, this is the principle of the shell moulding.

And these are the advantages of the shell moulding. Complex parts can be produced. Dimensional accuracy is high compared to the sand moulding a process. Surface finish is good. In the case of the sand moulding, we use the moulding sand and because of the irregularities of the sand brains we get the very poor surface finish on the castings whereas, here we are using a metallic pattern and around the metallic pattern, we are creating this shell and the this shell will have a very smooth surface and because of the smooth surface of the shell, even the casting will have a very good surface finish.

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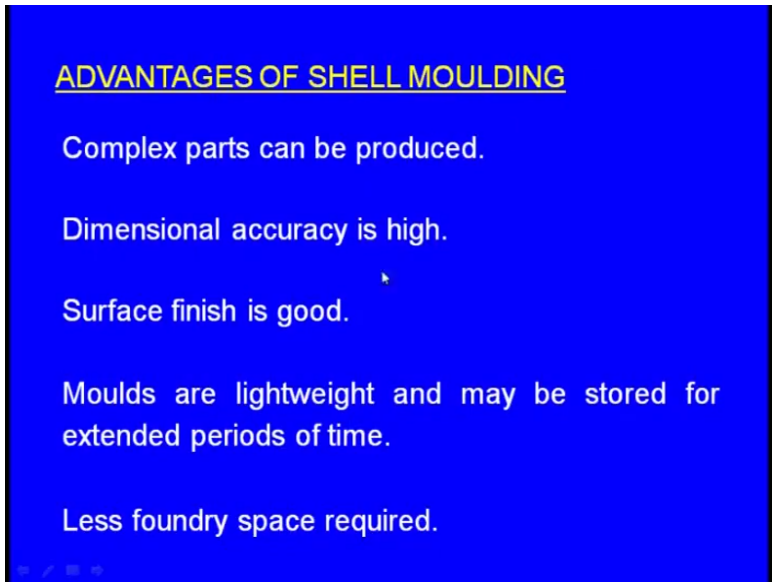

Next one, moulds are lightweight and may be stored for a extended period of time. Moulds means here these are the shells, the chemical shells, these are of lightweight and we can make them well in advance anticipating some kind of a production or an order and when it is required we can take these shells, we can assemble them and we can pour the molten metal into the shells, we can get the casting in a very short time.

Next one, it requires a less foundry space. In the case of the green sand moulding or the dry sand moulding different what say a shops will be there, pattern shop will be there, next sand control shop will be there, moulding shop will be there, melting shop will be

there, fettling shops will be there, machining shop will be there, all these are all the different sections of the sand moulding process. It requires lot of space whereas here there is no need to mix the moulding sand, there is no need to control the moulding sand, there is no need to make the sand mould, only thing is we have to make the shells. So, that way it requires a less space compared to the sand moulding process.

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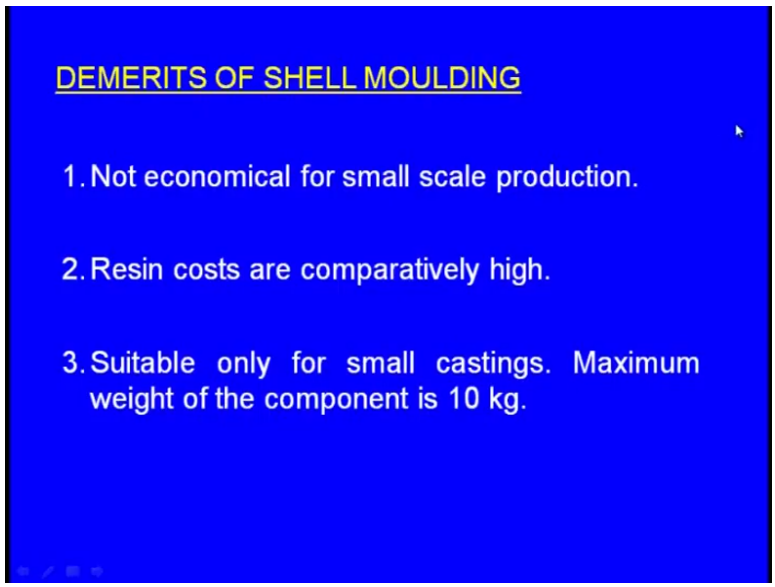

These are the demerits of the shell moulding. This is not economical for small scale production, because the pattern is a metallic one some most of the times very complex parts are made. So, to make this metallic pattern one has to put lot of efforts and after putting lot of efforts, if one has to make only a few castings maybe 10 or 20 then all the hard efforts that are invested for making that pattern are of no use. So, that is why whenever we are making this pattern with putting lot of efforts it should be meant for making large number of castings not for small number of castings.

Next one, these resins are comparatively costly. That is why the process is costly. Next one, suitable for small castings, very big castings cannot be made. Whereas, in the case of the sand castings, small castings can be made, medium castings can be made and very large castings about 5 tons can also be made, whereas, here the maximum weight of the component is about 10 kgs, more than that it is very difficult to cast the components.

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Next, let us see the sodium silicate moulding process. Sodium silicate moulding process, in this we use the fresh silica sands and we use a binder that is the sodium silicate. It's a liquid and this fresh silica sand sodium silicate will be mixed together. Next, this mixture is to be hardened means this will be kept, this sand will be you know what say packed around the pattern, then the sand has to be hardened. For the hardening purpose we use the carbon dioxide gas, Portland cement, blast furnace slag and few more materials are there. Then once we pass the carbon dioxide or mix the Portland cement it will be hardened.

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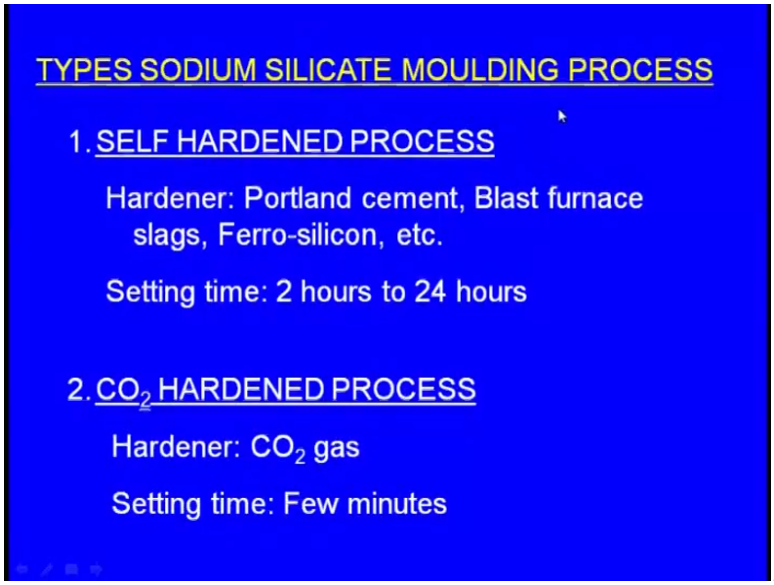

So, types of sodium silicate moulding process; one is the, self hardened process. In the self hardening process, we mix Portland cement, blast furnace slag or the ferrosilicon to the mixture of the sodium silicate and the fine silica sand. Because, we are mixing this Portland cement or the blast furnace slag, it automatically hardens, but only thing is, it takes more time. It takes from 2 hours to 24 hours time.

And in the other case, the mixture is hardened by passing carbon dioxide gas. We mix the sodium silicate and fine silica sand, pack it around the pattern. Now, you pass the carbon dioxide gas through this mixture, within few minutes this mixture will be hardened.

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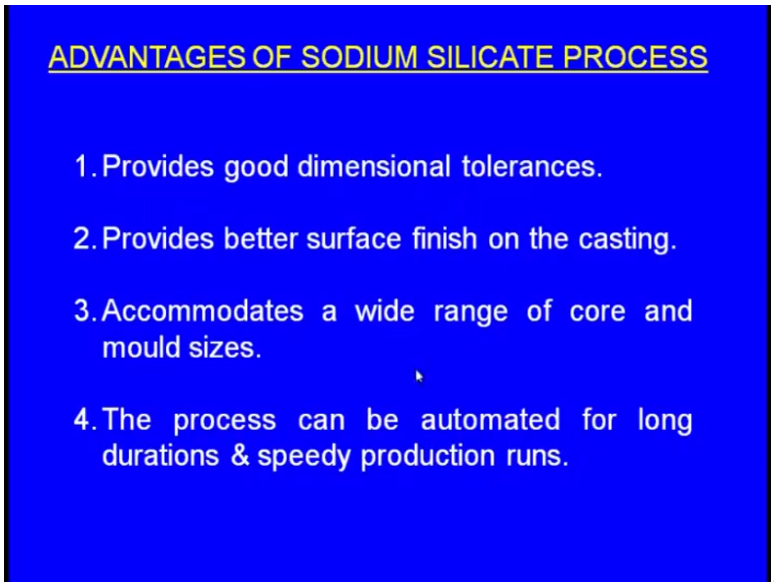

So, these are the advantages of the sodium silicate process; provides good dimensional tolerances. Next one provides better surface finish on the casting compared to the conventional sand moulding process. Accommodates a wide range of core and mould sizes, the process can be automated for long durations and speedy production runs. This can be used for making the moulds; this can also be used for making the cores. Most of the time, this process is used for making the cores. So, this cores can be made well in advance and they can be stored and when there is a requirement immediately this cores can be brought and they can be kept inside the mould cavity.

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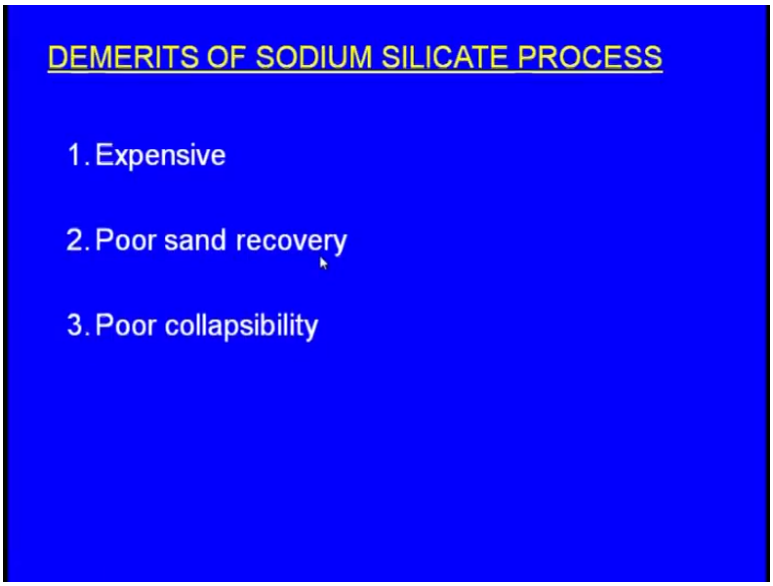

These are the demerits of sodium silicate process. The process is expensive. The sodium silicate solution that is expensive. Next one poor sand recovery; in the case of the green sand moulding, the sand can be recovered. The same sand can be reused for making several times, several moulds we can make with the same sand. Here that is known as the sand recovery. Here the sand recovery is very poor. Next one it has got the poor collapsibility.

After making the mould, after pouring the molten metal, after solidification what we are going to do, we break the sand to take the casting outside. That time, if it is the green sand moulding, we can collapse it very easily, but here it is very hard. It is so hard that it is very difficult to break the mould sometimes; it all depends upon the quantity of the sodium silicate and the amount of the carbon dioxide that we pass. If the sodium silicate and the carbon dioxide that we are passing is not optimum, then it becomes too hard. So, that is why the addition of the sodium silicate and the passing of the carbon dioxide gas should be optimum.

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Our next process is the no-bake moulding. In the no-bake moulding the pattern used is the wood or metal or plastic and what is the moulding material? Fine silica sand and urethane binder. For this purpose, we need a high speed mixture and no hardener is required. Only thing is we need to mix the fine silica sand and urethane and pack around the pattern within few minutes the mixture will be hardened.

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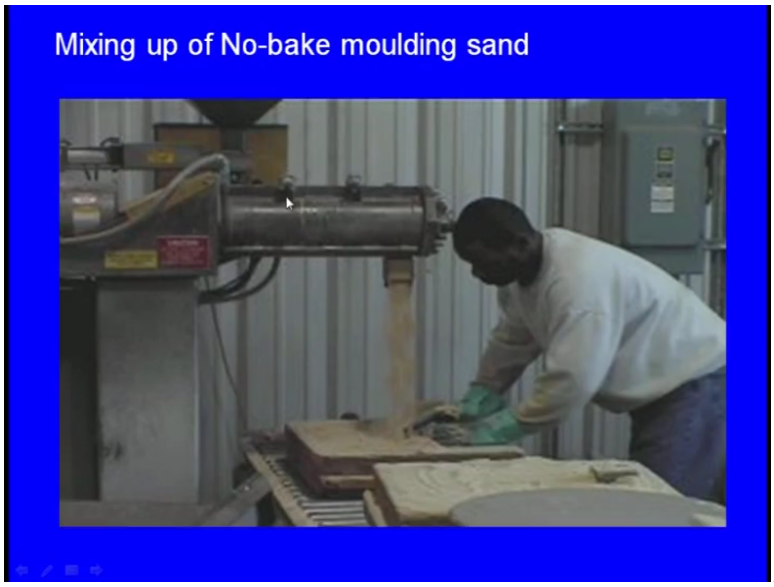

And here we can see this is the high speed mixture of the urethane binder and fine silica sand. As it now here we can see this is the pattern and this is the pattern is inside, this is

the moulding box, as the mixture is falling into the moulding box it is packed and within few minutes it will be hardened and it will be cured. In the case of the sodium silicate moulding, after passing the carbon dioxide gas we bake it, here we do not bake it. That is why it is known as the no-bake moulding process.

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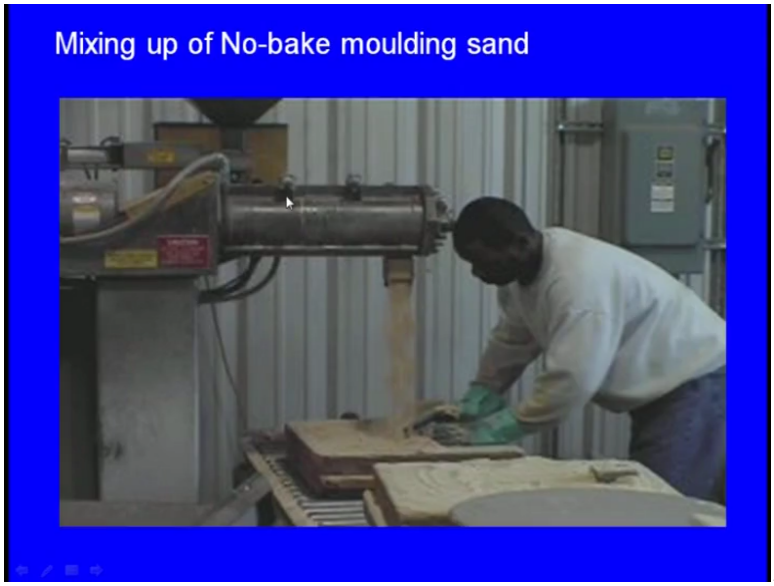

These are the advantages of no bake moulding. We get excellent dimensional tolerance. We also get better surface finish compared to the conventional sand casting process.

Now, what is the demerit of no-bake moulding process? The binder that is the urethane is very expensive.

Next, let us see the permanent moulding process. The name seems to be different. Why the name is permanent moulding process? In the case of the conventional sand casting process, we make a mould by means of the moulding sand, then we pour the molten metal into the mould. After solidification we break the sand. The mould is no more permanent once we break the moulding sand, but here, the mould is made up of special steel. Within that metallic mould there is a required cavity is there and the same metallic moulds can be used for making hundreds and thousands of castings. Because we are keeping the same mould for making several castings, this is known as the permanent moulding process. Permanent moulding process means we use the metallic moulds made up of special steels.

Again in that there are 2 types are there; gravity die casting in which we pour the molten metal into the metallic pours by means of gravity and in other case we pour, inject the molten metal into the metallic boxes by means of the external pressure.

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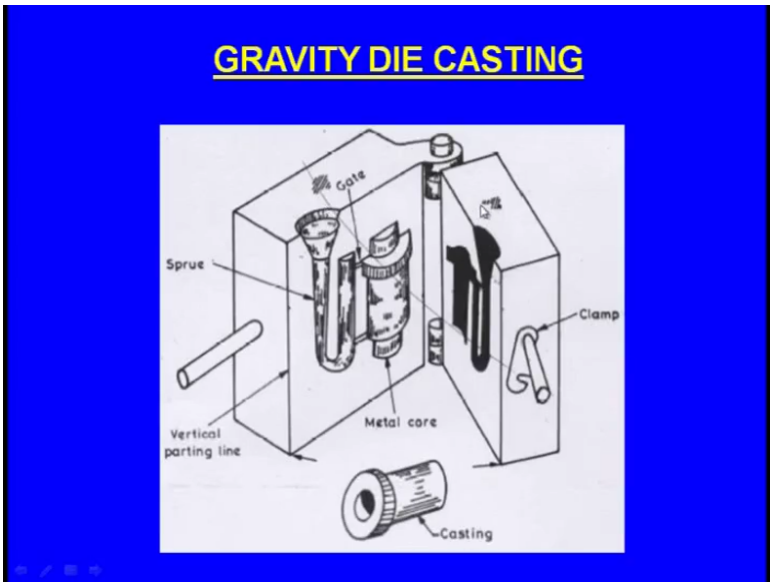

And here, we can see this is the gravity die casting setup and here we can see this is one metallic mould and here this is another metallic mould and this is the casting required. Now, a similar cavity is to be created inside these metallic boxes, half of the cavity is created here you can see and other half of the cavity is created here and there it requires a sprue and pouring cup even half of the pouring cup is created here, you can see and half of the pouring cup is created here. And it requires a sprue; the sprue is also equally divided into the 2 boxes, half of the sprue is created here and half of the sprue is created here.

Now, these 2 moulding boxes will be closed and there is a clamp. Now, we can pour the molten metal into the pouring basin. The molten metal enters into this cavity and fills that cavity and after sometime it solidifies and before we pour the molten metal, we apply some slurry coatings so that, the molten metal will not be sticking to the metallic moulds. After solidification, we remove them and we can take the casting outside. Again apply slurry coating, close the moulding boxes and you pour the molten metal, again we get the same casting. Likewise, the same metallic moulds can be used for making hundreds and thousands of castings.

Here we can see the interestingly feature is we pour the molten metal here and the molten metal enters into the cavity because of gravity.

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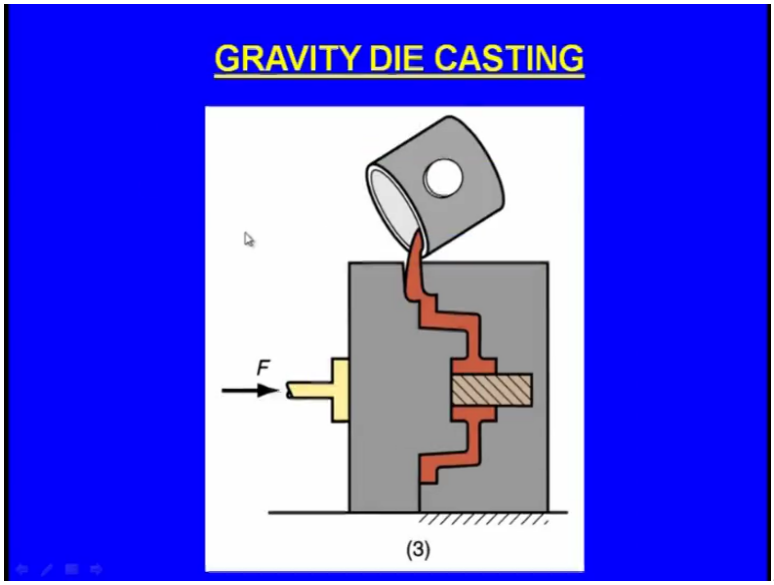

Now, let us see the other process, here also we can see again the gravity die casting. These are this is one metallic mould and this is one metallic mould and this is a core means a circular core the more molten metal flows around the circular core. The molten metal is coming and it is flowing into the mould cavity by means of gravity and after sometime the metal solidifies and we can separate these 2 moulding boxes or these 2 metallic moulds and we get the required casting.

Next one, the pressure die casting; in the case of the gravity die casting, no doubt the moulds are the metallic ones and they are permanent in nature. In the pressure die casting also the moulds are metallic moulds. They are also permanent metallic moulds; only thing is the molten metal is injected into the metallic moulds by applying external pressure.

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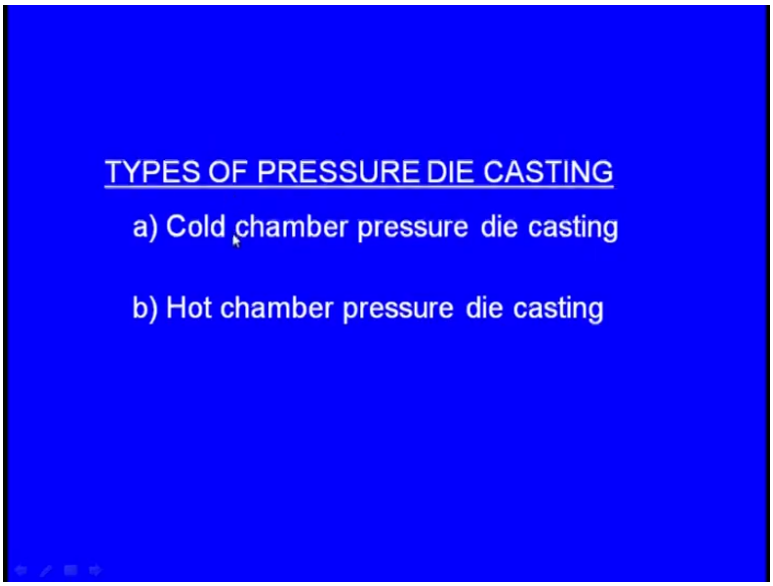

Again it is 2 types; cold chamber pressure die casting and the other one is the hot chamber pressure die casting.

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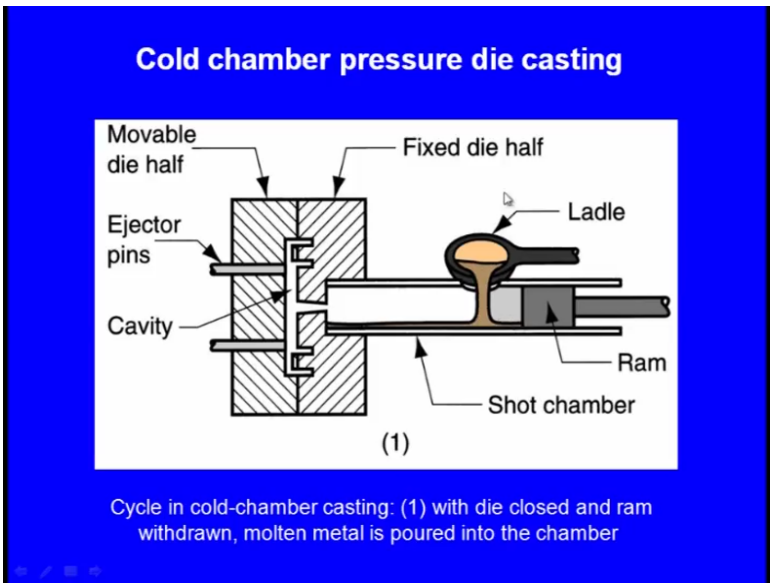

In the cold chamber pressure die casting, we melt the metal away from this machine and we bring the molten metal in a ladle and here we pour. This is one metallic mould and this is one metallic mould and this is the cavity, this is the required casting.

And here, we can see a ram and we pour the molten metal and this is a short chamber is there and we after pouring the molten metal here, we push the ram. The molten metal

will be injected into this cavity and after sometime the molten metal solidifies inside the cavity and we have to separate these 2 dies. This is the fixed die and this is the movable die. These 2 we separate and we get the required casting. Again, the same metallic dies, same metallic moulds, again we close and we again we pour the molten metal and push the ram and we get the required casting. So, this is the cold chamber pressure die casting. Cold chamber pressure die casting means the furnace is away from this machine.

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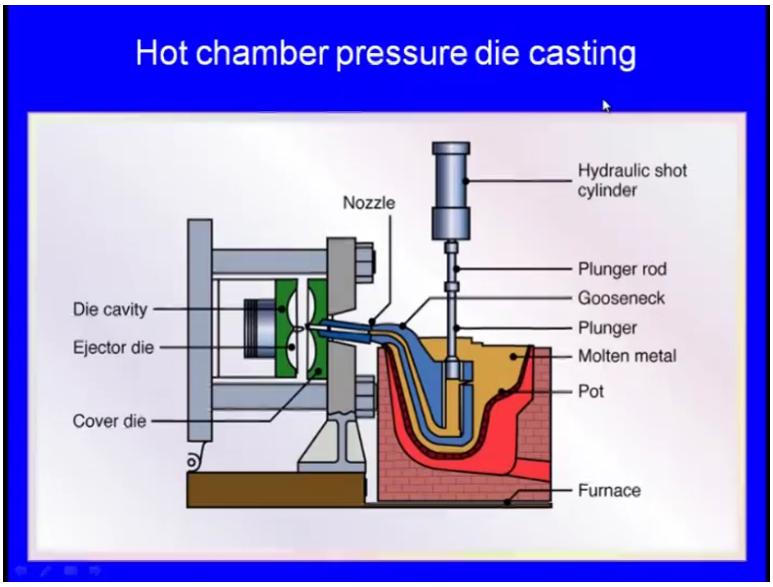

Next one let us see the hot chamber pressure die casting machine. This is also a permanent moulding process. Here also we can we use the metallic moulds and here we can see what is the difference between the cold chamber pressure die casting and hot chamber pressure die casting. In the case of the cold chamber pressure die casting the furnace is away from the machine.

From the furnace, we have to carry the molten metal by means of your ladle and we have to pour it into this machine, whereas, in the case of the hot chamber pressure die casting machine the furnace is an integral part of the die casting machine. No need to carry the molten metal from a different place, in which case there will be a pressure drop and the fluidity comes down and we may not get the required characteristics. Here, we can see the furnace; see furnace is integral part of the machine and here we can see there are 2 dies are there, this is the cover die and this is the ejector die and inside we can see there is a cavity.

Now, you can see this is the hydraulic short cylinder, this is the plunger rod and here we can see the molten metal is here. The molten metal from the furnace enters into this chamber like this and the hydraulic short cylinder pushes the plunger down, because of that the molten metal here slowly it will develop the pressure. Now, it will be injected like this, it goes into the cavity like this and it fills the whole cavity and after sometime the molten metal solidifies. Again, the die will be ejected; die means the metallic mould, the casting will be taken out, again they will be closed, again the molten metal will be injected and it puts down, we take the casting outside, again they will be closed. Likewise, here we can see these are the permanent moulds and these permanent moulds are made to make a hundreds and thousands of castings.

These are the advantages of the die casting. We get closer dimensional accuracy. In the case of the green sand moulding what happens, we make the mould cavity little larger than the required geometry. That is how we do not get the dimensional accuracy in the case of the sand moulding. Here, we get a closer dimensional accuracy and in the case of the sand casting process because of the presence of the sand grains there is a rough surface on the surface, even the casting develops that rough surface.

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Here, we get a very good surface finish, why, because the mould is made up of special steel it has got a smooth surface so, the casting also gets a smooth surface.

Next one: useful for mass production. One set of die can produce about 10000 castings, if we make one set of the metallic moulds, we can make about 10000 of castings. Next one, it requires a less space. Cycle of operation requires is very less. Next one, porosity can be avoided; if there is any gas is present inside, because it is injected the gas will be escaped. Next one faster rate of production, the cycle takes a only a few seconds that is why there is a rate of production is very high. Next one even semi skilled workers can do this job.

Next one less defects compared to the sand castings. In the case of the sand castings, we mix the sand with the moulding sand, sorry, we mix the water with the moulding sand and because of this if the hot gases are not escaped properly what happens there will be gas defects inside the casting or on the surface of the casting. These gas defects are known as blow holes or porosity. These kinds of defects are not obtained in the case of the die casting and casting surface is free from the sand. In the case of the sand casting, the casting solidified, casting will be sticking to the sand and we have to carefully remove the sand; here, there is no question, there is no such question. The solidified casting does not stick with the any sand because there is no sand at all.

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And these are the limitations of the die casting. Cost of the die is very high. Most of the times this die which is a metallic mould is made by a special steel. It is very hard. If we want to make a geometry inside, if we want to make a cavity inside, we have to use a

sophisticated machines it takes lot of time and it requires a higher machining cost, that is why cost of the die is very high. The material is cost, processing cost is very high and it is not suitable for heavy castings, whereas, in the case of the sand moulding heavy castings can be made. Here, only small or the medium size castings can be made. Are suitable only for non-ferrous castings: because the moulds, the metallic moulds are made up of ferrous alloys. So, we can't make the ferrous castings. If we pour the ferrous alloy into the ferrous moulds what will happen, even the moulds may be damaged or they may be melting. So, only non-ferrous castings can be made because non-ferrous alloys their melting temperature is much lower than the melting temperature of the a ferrous metals, ferrous alloys.

Next one, not suitable for small scale production; this making of the die is a very troublesome job, because the die itself is a very hard material and if we have to create a cavity we have to use a very sophisticated machines like a electrical discharge machining and so on. And it requires lot of time; having spent so much of time and having spent lot of money for making, creating that to die if we have to create to make only a say 10 castings or 20 castings it is of no use. We have to produce mass production, then only the cost incurred for the making of the die is worthy.

Friends, today, we have seen the overview of the different casting process. These are the we have seen today, we have seen the conventional moulding process, we have seen the overview of the green sand moulding, dry sand moulding and flaskless moulding we have seen.

Next, in the category, in the chemical sand moulding process also we have seen the shell moulding, sodium silicate moulding and no-bake moulding also we have seen. And in the permanent moulding process we have learnt that, the mould is a permanent metallic one and we want to destroy it after making few castings or after making one casting. The same metallic moulds will be used for making hundreds and thousands of castings. Again we have seen that, in that there are 2 types; gravity die casting and pressure die casting.

And in the next class we will see the special overview of the special casting process.

Thank you.