Fundamentals of Manufacturing Processes
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Lecture – 11
Steps of Casting Process

Hello, I welcome you all in this presentation related with the subject fundamentals of the manufacturing process and in this presentation I will be talking about the steps related to the casting process. We know that the casting is the fastest way of achieving the final shape as desired using a simplest approach were in the molten metal to be used for making the product is used, far this purpose their certain steps which are followed.

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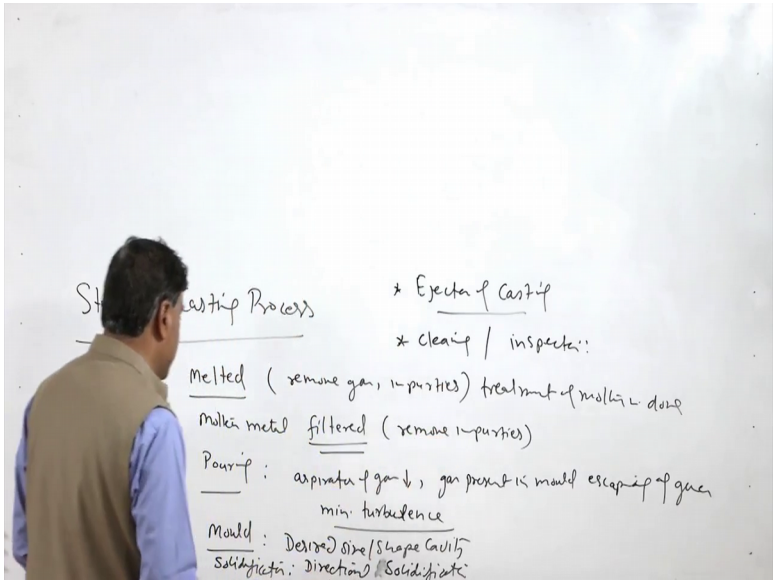

We can say steps of casting process this is just you can say the brief over view of the casting process. The first is the mud metal which is selected for the casting purpose is first of all melted, and this molten metal one it is melted to avoid a to remove the gasses and impurities the treatment of the metal is of the molten metal is done, degassing, fluxing etcetera are the part of the things.

This molten metal is filtered this filtering can be in mould or out of the mould process just to remove impurities, dross, dresses, oxides etcetera and then this molten metal is poured. So, pouring in pouring of the molten metal is done in such a way that it an

expiration of the gases is less as well as the gasses presents in the mould gets enough a space or time to escape.

Escaping of the gases from the mould is important to avoid the gassiest effects and it happens with the minimum turbulence so that aero zone of the mould and interaction with atmospheric gasses is minimum. These are the things which are kept in mind while pouring, then pouring into the mould, mould is what does the pour mould is of the desired size and the shape cavity in which the molten metal is poured. So, that the molten metal takes the shape of the mould and after this the solidification proceeds a heat is extracted by the walls of the mould, as soon as the temperature reaches to the solidification temperature commencement solidification begins.

Solidification is normally desired to be of the directional type directional solidification is desired. So, that all the impurities gases are automatically it starts floating or they get the passes to escape from the molten metal and whatever cavity is formed in this case due to the shrinkage of the molten metal that is filled in effectively by the molten metal from the riser. It is preferred that directional solidification is achieved through the proper temperature gradient with in the mould, once the solidification is completed than we try to eject, ejection of the casting or removal of the casting from the mould.

So, depending upon the type of the mould either ejection may be mechanized or the mould needs to be broken to take out the casting, an after ejection it involves cleaning and inspection of the casting. Cleaning primarily involves the removal of all fins, extra productions, gates, righteous, which are solidified and are still attached with the casting needs to be taken off by cutting or using the sandblasting dumpling etcetera different methods are there and the inspection will help us to see if the castings are having any in defect or they are a good condition based on that that they are processed for further a steps.

These are the 4 of 5, 6 major a steps related with the casting now how to achieve all this and how these are executed. So, that the sound casting is achieved that is what we will be saying in detail this was just the over view of the steps related to the casting process.

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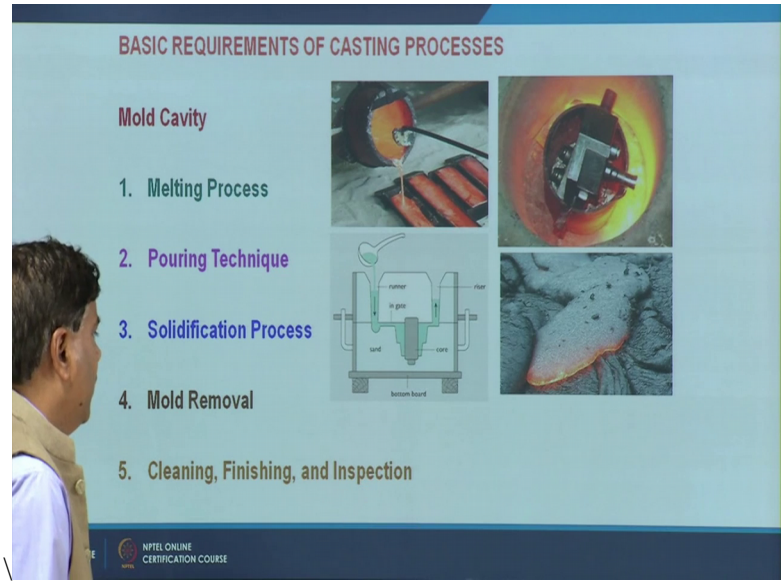

Here what are the steps like this the melting under the melting of the molten melting of the metal is realized using the suitable heating system let may be electric for electric resistance heating best furnace arc furnace or coal fired furnace as per the temperature melting temperature of the metal in process a suitable heating system is used. So, that it is brought to the molten a state and once the metal is brought to the molten a state and it is treated properly what we do this a molten metal is brought from the heating system of the furnace and near the mould.

These are the moulds and in which molten metal is a poured, the here you can see the different the metals inform of the raw material, rods etcetera is heated. So, that it is brought to the molten state their after it is poured into the cavities a mould cavities. So, melting first step pouring into the mould and solidification process we can see here and the solidification there after removal of them all and then cleaning, finishing and inspection.

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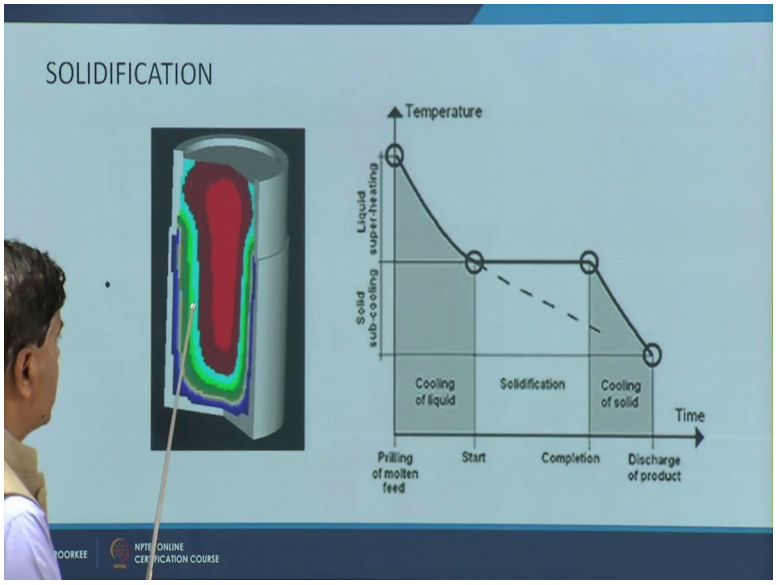

Here what we can see the solidification of course, it begins from the wall of the moulds and then proceeds towards the center, it is always desired that solidification is start from the remotest place and then it ends the next to the riser or the region where from the molten metal is being supplied through the in gates. So, that whatever shrinkage is occurring that is that can be effectively compensated through the supply of the molten metal.

This we can see here this is simply showing the kind of the thermal curve or the cooling curve for the pure metals as well as for the always. So, here we can see this is the temperature of the molten metal which is poured into the mould cavity and then temp due to the extrusion of the heat or transfer of the heat from the molten metal towards the through the mould walls heat is transports. The temperature of the molten metal gradually decreases until it reaches to the solidification is start temperature. So, here at this temperature solidification common says than it progresses at a constant temperature for pure metals as well as for the eutectic systems and then once the solidification ends we can see here the temperature again is starts coming down.

This the first phase is the cooling of the liquid metal and then solidification this region correspond to solidification and then third region is corresponding cooling of the solid. So, basically shrinking case takes place in both the cases the cooling of the liquid metal when the shrinkage occurs due to the cooling of the liquid metal basically this kind of the shrinkage is taken care of the taken care of by feeding the molten metal from the riser and the shrinkage of the of the casting which is occurring in the solid state due to the

cooling from the certification temperature to the room temperature this kind of shrinkage is taken care of by suitable design of the pattern by giving the shrinkage allowance to the pattern. So, that even after the shrinkage we have a casting of the required size.

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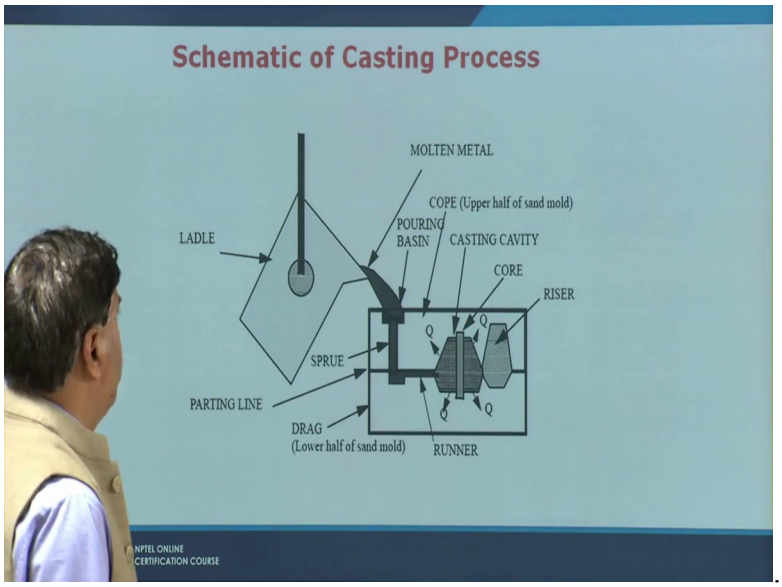

Schematic this is as a whole it shows the different components relate to the casting process here this is the ladle which is used for transporting the liquid metal from the performance to the mould location and then the liquid metal from the ladle is fed into the pouring basin. Pouring basin is the channel which will be suppurating which will be basically acting as a reserve wire of the molten metal to feed the same to the mould cavity and the pouring basin also separates out all the impurities and inclusions oxide says etcetera. If they are present in the molten metal then from molten metal from the pouring basin is fact to the is sprue and then from the sprue it goes to the runners and through the runners it is it enters into the mould cavity and in the mould cavity here this is the mould cavity and here there is a riser is, there is a riser this is the riser and this is the core.

So, for making the cavity in the castings core is a used, so that this core can be taken of subsequently, when the molten metal fielding the core presence of the core how to avoid the feeling of the molten metal in this a region and this core is taken out the subsequently on the solidification of the casting. And when the solidification in course of the solidification when there is shrinkage of the molten metal the shrinking that shrinkage as

taken care of by feeding the molten metal from the riser to the casting and that is how the casting is obtained this entire arrangement is a the mould it is made of the 2 portions one is the core and this is the upper portion of the mould and the drag is the lower portion of the mould, these are the different element or the parts relating to the casting process.

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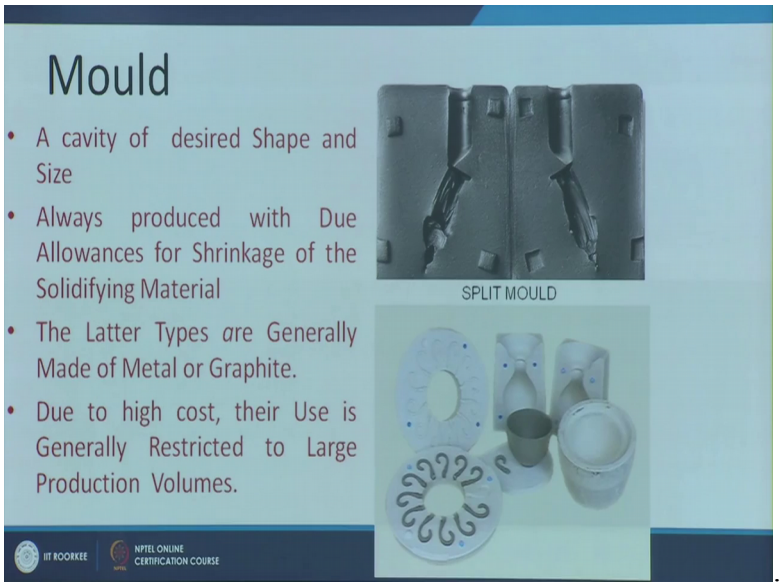

Here the mould you can say mould is the cavity just to familiarize the different terms which are relating to the casting process mould a this is a split mould and these are you can say this is the mould cavity and this is through which region through which molten metal will be fed in to the cavity and these are the different types of the moulds which are used for making divinity of a the products.

Mould is basically cavity of the desired shape and size always produced with the due allowances for the shrinkage of the solidifying metal and the latter of the types means the shrinkage the latter types are generally made of the metals and the graphite means these moulds are made of either the metals or the gray fight due to the high cost there uses generally restricted to the large production volume. Means if the volume of the casting is the limited volume of the casting which is to be produced means number of castings to be made is limited, then will you send a moulds if the number of castings to be made a very large then the metallic moulds are used. As a part of the melting we know that the melting involves the melting of the metal as well as it is treatment.

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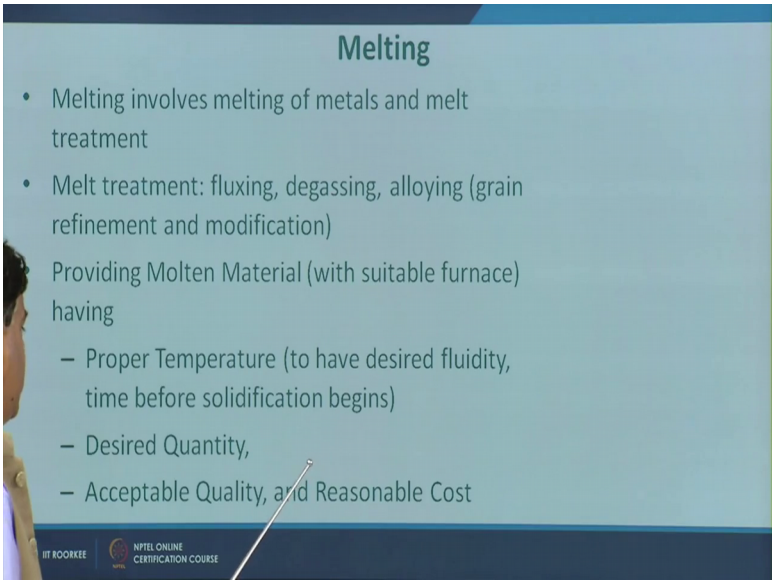

Treatment is basically the purpose of treatment is to get the right quality and the right quantity of the molten metal which can be fed into the mould cavity, that the casting of the desired quality can be achieved. Basically melt treatment involves the fluxing, degassing and alloying for achieving the desired grainy structures, the desired properties can be achieved. So, here if we see, there are 3 types of the flux martin metal treatments fluxing, degassing and grain refinement oblique modification.

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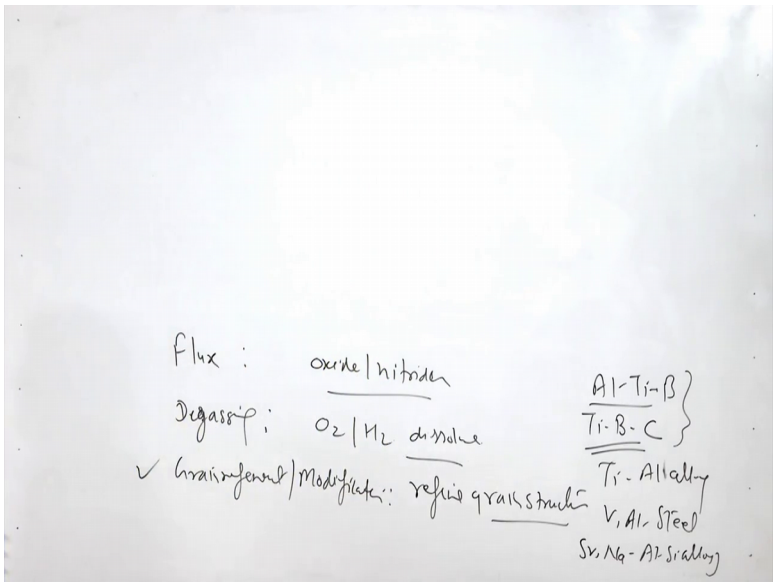

So, are the fluxing, fluxes are used to take care of the like oxides, nitrites and the degassing is used to remove the oxygen, hydrogen, if these are in the dissolve condition. The different compounds are used for the degassing purpose and the grain refiners and

modification this term is basically used to refine the grain structure like titanium is used in case of the aluminum alloys, titanium, zirconium and like vanadium and aluminum is used for the steels and for the modification purpose where in certain consequents are refine like the strontium sodium in case of the aluminum silicon alloys. These are commonly used in the aluminum foundry industry for the grain refinement and the modification purpose.

The common the grain defined as which are used is titanium, boron, carbon and Al- Ti- B these are the 2 common types of the grain definers used in the foundry industry for the melt treatment purpose. The purpose of the melt treatment is providing the molten material with the suitable furnace. So, that the molten metal,, these the scope of the melting like feeding the molten material, supplying the molten metal with the proper temperature. So, that desired fluidity is maintained. So, that the molten metal gets enough time to fill the mould cavity before the solidification begins so that it does not lead to the (Refer Time: 17:38) or the lack of filling kind of the defect or modern metal is fed in the desired quantity or it is available in the desired quantity for filling the mould cavity and, that the desired molten metal can be desired molten metal of the direct quality can be obtained at the reasonable cost.

This is the objective of a the melting, this is how it is a achieved like the vacuum is applied and hydrogen gas is spread this is the ladle for the treatment purpose,. The pouring as I have said this is one of the steps relate to the casting, pouring is pouring technique to be followed helps to introduce the molten metal into the mould cavity, so that the quality castings can be produced and the purpose is to have the casting switch are dense and free from the defect.

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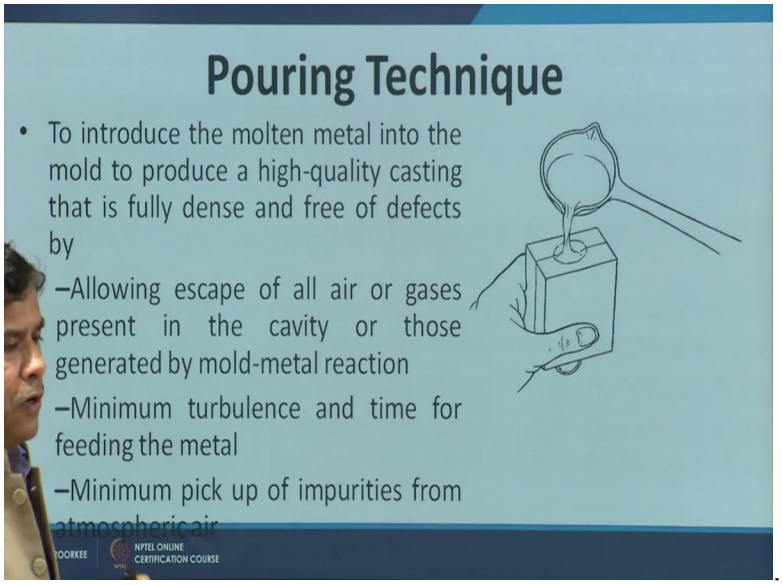

And how this is achieved by permitting the escaping of all air and gases present in the mould cavity are those which are being generated through the mould metal reactions. We know that, the incase of the send mould one our hot molten metal is a fed into the mould cavity the evaporation of the moisture as well as the interaction between the molten metal and the mould a surface leads to the evolution of the gases and these gases must be removed.

Otherwise it these will lead to the presence of the gaseous defects and at the same time it is also expected that when the pouring is done, the pouring is performed with the minimum turbulence for feeding the molten metal and it the pickup of the impurities is minimum when the molten metal is the fed and the mould cavity is filled in the minimum possible time. So, that the commencement of the solidification begins in the different regions all most at the same time. Differential, large difference in the commencement of the solidification time, the different zones increases the defect formation tendency.

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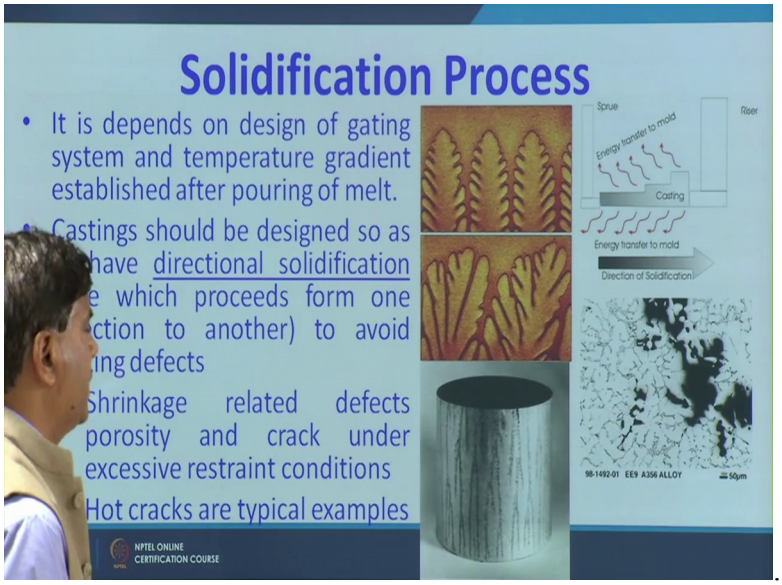

We know that the solidification basically it is desired that directions solidification is achieved in the castings where is solidification it starts from one end and it completes at another end. So, that the defects can be avoided and the (Refer Time: 20:17) related to the shrinkage such as the shrinkage cavity and the cracks under the excessive restraint conditions, hot crackings are the typical examples which otherwise will be leading to the number of issues.

In case of the when the direction solidification is not achieved then these are the issues which are encountered, proper solidification means the (Refer Time: 20:43) solidification depends on the design of the getting system and the temperature gradient established after pouring of the molten metal. Efforts are always made to locate the riser as well as use the chills if required in such a way that the suitable temperature gradient is established. So, that the direct direction of the solidification can be achieved where is solidification begins are from one end it completes at another end and it progresses from progresses in one direction.

All the issues related with the shrinkage and hot cracks can be taken care of. This is where the solidifications proceeds we can see here solidification in the starting from the bottom and it is progressing in this direction. These are the daedric arms which are normally observed in case of the cast components and if it is not performed properly then it will lead to have the number of had defects and the shrinkage, porosity within the casting.

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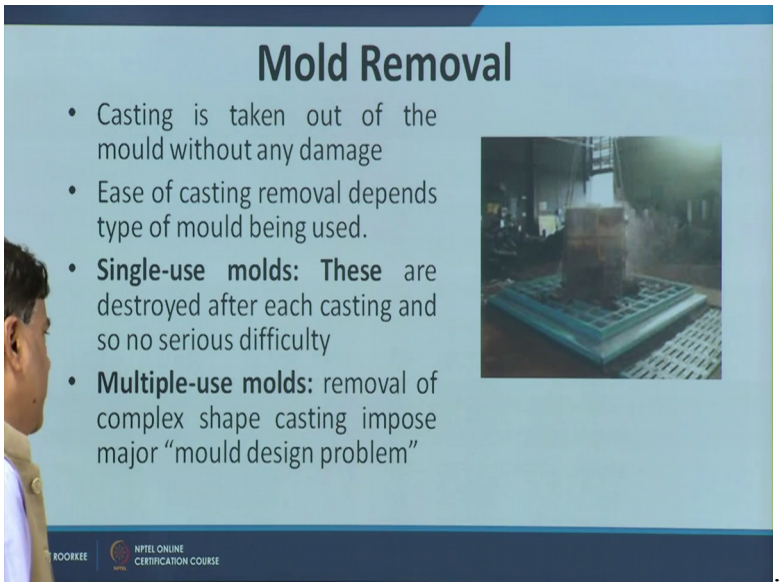

After the solidification the castings need to be removed from the mould and, depending upon the type of the mould being used whether it is expandable or nonexpendable. In case of the expendable moulds the moulds is to be broken to take out the casting and in nonexpendable mould simply the casting is ejected from the mould cavity. So, this diagram typically shows like the sand moulds are used for making the mould cavity and then breaking the mould is involved for taking out the casting from the mould.

Casting is taken out of the mould without any damage that is one of the purposes is of for the casting rule depends on the type of mould being used, single use moulds these moulds are destroyed after each costing and, there is no major problem. But in case of the multiple use moulds like in metallic moulds are die casting processes, the casting need to be ejected properly using the mechanics arrangement, removal of the complex shapes, impose is actually the problem in removal of the casting after the solidification in case of the multiple use moulds or were the metallic moulds are used.

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The castings are taken out by breaking this sand moulds are the moulds which are used for once the or otherwise the castings are ejected through the mechanized arrangement, in case of the metallic mould or the permanent mould, casting process. Once the casting is available since whenever the casting is a ejected it has number of undesired features associated with like the fence, unnecessary projected material, parting line material, the gating molten metal certified in the gating system and the riser all these are under undesirable parts are related to the solidifying casting. These must be taken care of and for that purpose only we need to remove all these undesirable parts from the casting and then remove the unnecessary fence and projections and for that purpose cleaning is required.

Extra material that remains attached with the casting in the form of the solidified metal at the gate and riser along with the parting line also metal is remains metal remains attached may with the casting. This mould material adhered to the casting of the surface if like the sand mould the surface fuses with the molten metal due to the poor effectiveness then that metal also remains attached with the casting and that must be removed and taken care of. All these materials should be removed from the finished casting so that the desired one final casting can be taken can be achieved. And once the casting is clean there number of methods like the cutting, tumbling, shot blasting etcetera are used for the cleaning purpose and once the casting is clean and finished it is used for the inspection purpose whether it is sound or not. Like say this is the sprue and these are the difference

undesirable a parts which are associated with main casting which must be removed and taken care of.

So, here I will conclude this presentation in this presentation I have talked about that the major steps relate with the casting and that they are 5 major a steps like the melting of the molten metal, then pouring of the molten metal and then the development of the mould cavity, solidification, cleaning and removal of the unnecessary parts attached with this followed by the inspection. So, here now I will thank you for your attention.