Metal Casting
Dr. D. B. Karunakar
Department of Mechanical and Industrial Engineering
Indian Institute of Technology, Roorkee

Module - 05
Permanent Mould And Special Casting Processes
Lecture – 07
Evaporative Pattern Casting And Plaster Moulding

Good morning friends. Today, let us learn about 2 casting process. One is the Evaporative Pattern Casting and the other one is the Plaster Molding. So first, let us learn about evaporative pattern casting and then, we will see the plaster molding process. First, let us see the evaporative pattern casting. What is this evaporative pattern casting?

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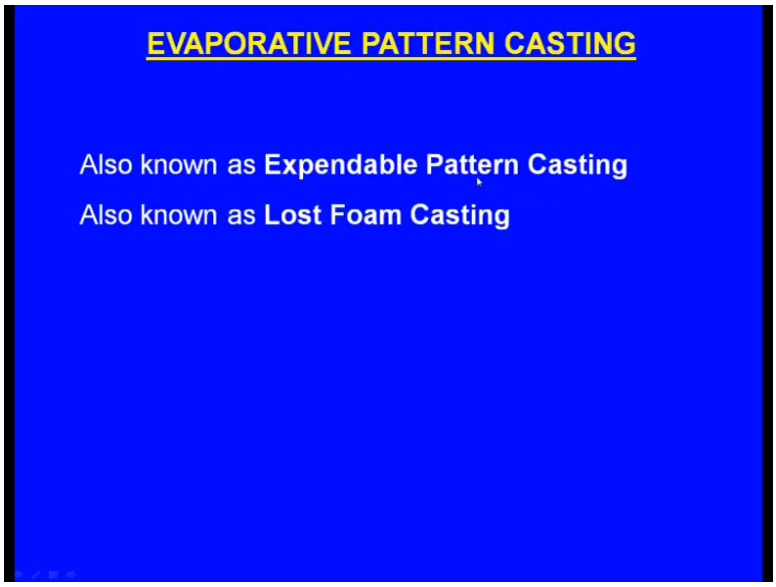

This is also known as Expendable Pattern Casting and this is also known as Lost Foam Casting.

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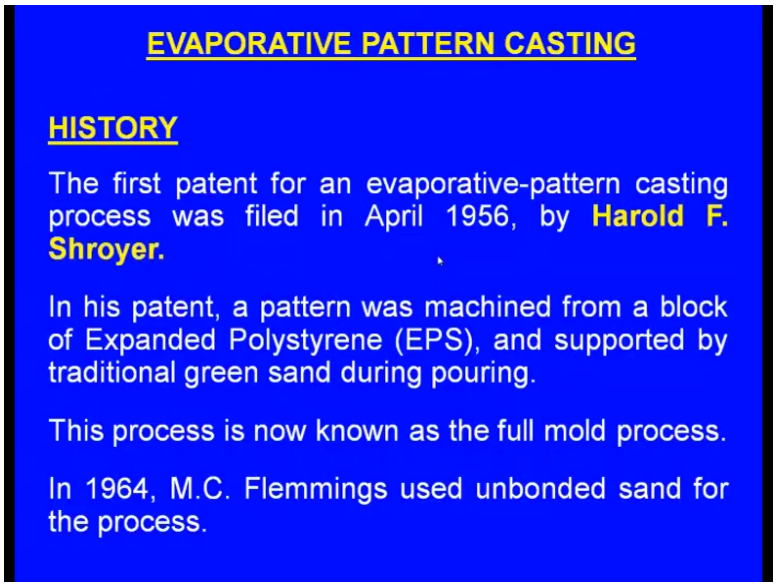

And let us see, before going to the whatsay principle involved in this process, let us see the history. So the first patent for an evaporative-pattern casting process was filed in April 1956, by Harold F. Shroyer. So in this patent, a patent was, a pattern was machined from a block of Expendable pattern Polystyrene pattern and it was supported by traditional green sand during process, during pouring process. Here we can see the pattern was supported by traditional green sand and this process is now known as Full Molding Process. But later, some modifications were done and we will see them later and in 1964, M. C. Flemings used unbonded sand for this process. You see, here the first person the Harold Shroyer used what say traditional green sand for supporting the pattern whereas, in 1964 M. C. Flemings used unbonded clean and dry sand for supporting the pattern.

So that way, the second step was different from the earlier process.

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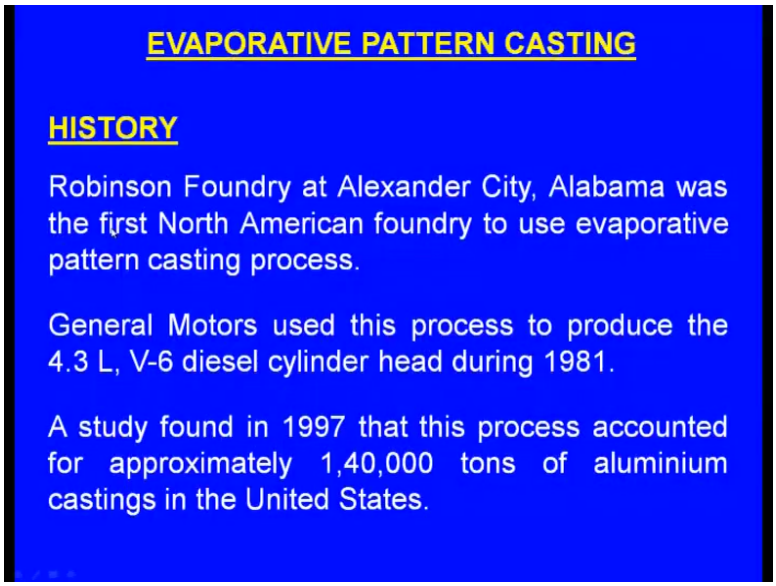

Robinson Foundry at Alexander City, Alabama was the first North American foundry to use evaporative pattern casting process. General Motors used this process to produce the 4.3 liters, V-6 diesel cylinder head during 1981. A study found in 1997 that this process accounted for approximately 1, 40,000 tons of aluminum castings in the United States. Now let us see the principle of this evaporative pattern casting process.

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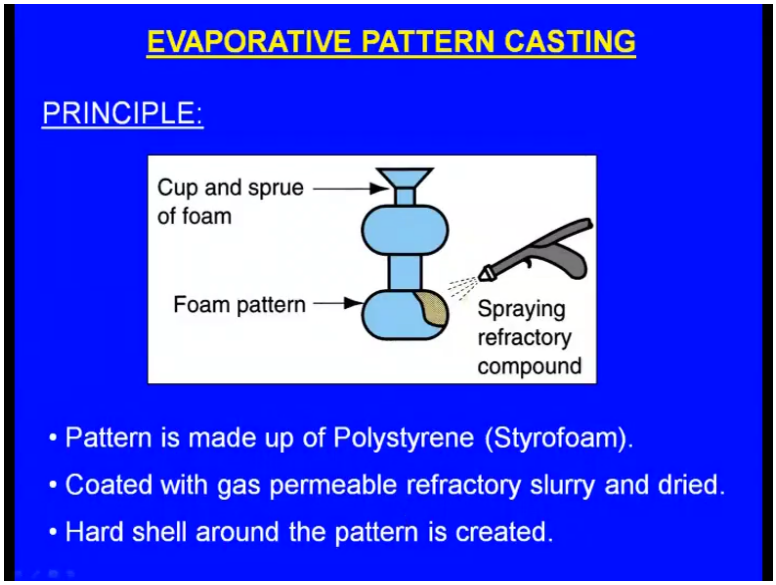

So here, the pattern is made up of Polystyrene or Styrofoam. So this is the polystyrene pattern or the Styrofoam pattern and here we can see the pouring cup is there and this is

the sprue and the whole thing is the pattern, whose shape is similar to the casting which we want. Now we have to make a ceramic slurry or a refractory slurry such that when we apply a coating around this pattern, there will be what say micro, what say pours will be there so that a permeability will be better during pouring, hot gases can escape.

So, it is coated with gas permeable refractory slurry and then it is dried. Then, what happens? Hard shell, thin hard shell around the pattern is created.

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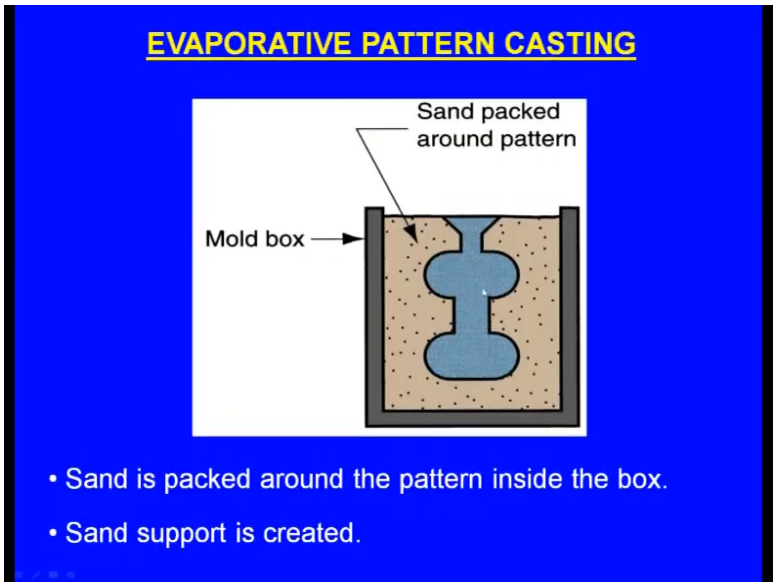

Now you see here, we have to take a molding box, only one modeling box not two boxes. Inside the modeling box, we have to place the pattern remember, this pattern is already coated with a refractory slurry; means a thin coating is created. Now that pattern we have to place inside the molding box. Then, sand is packed around the pattern; dry sand is packed around the pattern. It should be whatsay packed. Then, what happens? Sand support is created around the pattern. Then, what will happen?

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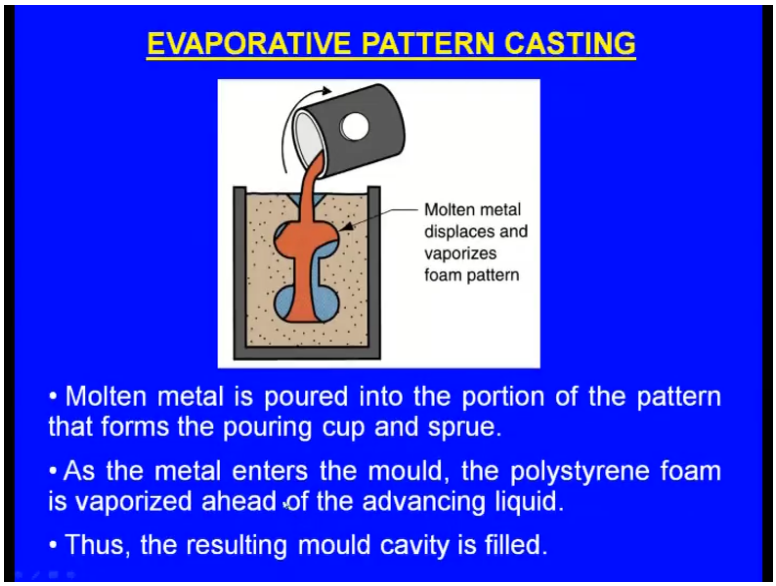

Molten metal is poured into the portion of the pattern that forms the pouring cup and sprue and here we can see this whole thing is the pattern and this is the pouring cup. So this process is somewhat different from the other process. In one sense that in all the previous process so before pouring the molten metal, we remove the, withdraw the pattern from the mould. But here, the most specialized special feature is that we will not remove the pattern from the mold.

Without removing or withdrawing the pattern from the mould, we start pouring the molten metal. So that is the most interesting feature of this process. Now molten metal is poured into the portion of the pattern that forms the pouring cup and sprue. So here, we pour the, we start pouring the molten metal. Then, what will happen? As the molten metal enters the mould the polystyrene foam is vaporized ahead of the advancing liquid. One side molten metal is coming and it is falling on the whatsay polystyrene pattern or the evaporative pattern, then, what will happen? Within fraction of seconds, this pattern will be evaporating. So it will be going in another way, one way it is coming and another way the vapor is going out. Thus, so as we keep pouring more and more metal more and more pattern will be evaporated and it will be escaping. How long this will continue? Till the entire pattern is evaporated, we have to keep pouring the molten metal and till the entire cavity is filled with the molten metal.

Now, the resulting mould cavity is filled with the molten metal.

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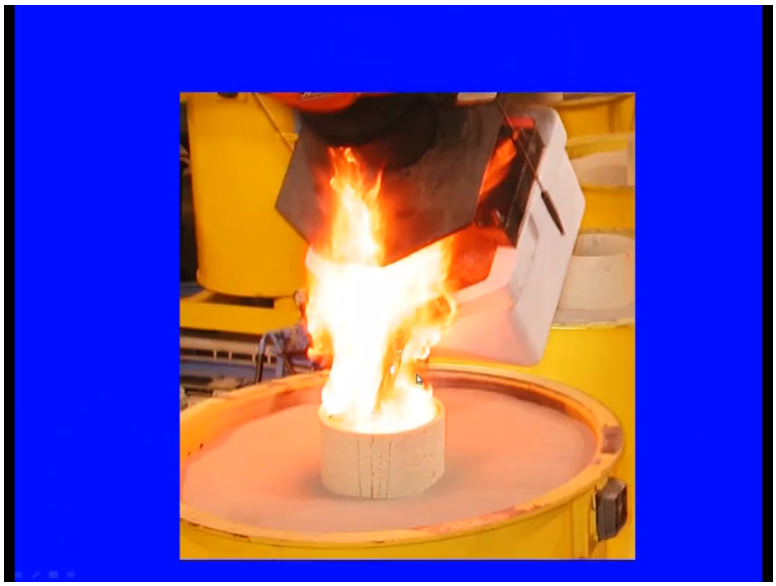

Yes the pouring looks like this.

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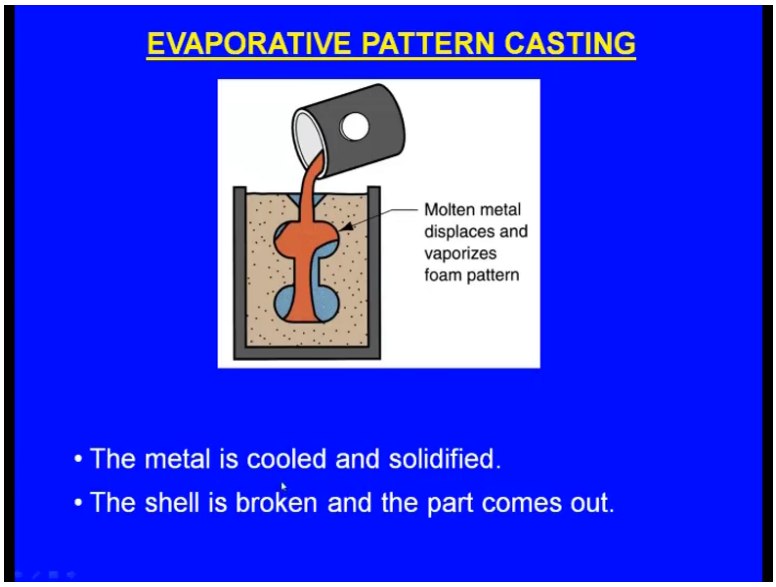

Now after that the metal is cooled and solidified. The shell is broken and the part comes out means after that even we remove the molding box. Then, we whatsay this sand it is not whatsay sand mixed with the clay. So no need to break it as we do it in this case of the green sand and the automatically once we remove the molding box, even the sand just falls down because it is clean and dry sand. Then, this shell is to be broken; this shell

is to be the thin shell which is which we created around the pattern should be broken. Then, what happens? The part comes out, the casting comes out.

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Now, these are the advantages of evaporative pattern casting. Used for precision castings of ferrous and non-ferrous metals, both ferrous and non ferrous metals can be cast using this evaporative pattern casting and not only that, very precision castings can be made. Precision means with extreme what say dimensional accuracy and very good surface finish and complex shapes can be obtained.

Next one high dimensional accuracy can be achieved. Thin sections can be cast. So this is a special feature which we have seen in the case of the investment casting process. But investment casting process is a time taking process and this process takes less time and here also we can obtain the thin sections. Next one complex shapes can be cast. So this is also a special feature which we which we can see in the case of the investment casting process. So here also we can make the complex shaped components, but with less time. Now another advantage is one piece flask less expensive and easier in the case of the green sand molding generally we use 2 boxes, sometimes even 3 boxes; one is the lower molding box that is known as the Drag, the upper modeling box is known as the Cope. So these 2 boxes must be assembled carefully, otherwise there will be some mismatch will be there. But here, there is no such problem. There is no mismatch between the cope and the drag. First of all, there are no 2 molding boxes. There is only one molding box is

there. So there is no question of mismatch and also the assembly time that will be eliminated.

Next one fewer steps are involved compared to the sand casting process. In the case of the sand casting process, we have to prepare the molding sand, we have to mix the additives, we have to mix the clay, we have to mix the water and that should be mould for a predetermined time, then we have to carry it to the molding shop, then we have to make the mould and it should be compacted, then it should be patterned must be withdrawn very carefully. Again, the 2 molding block boxes should be assembled. So, so much of time is involved in the case of the green sand molding process.

Here a very few steps are involved, just to make the what say polystyrene pattern, then make a what say coating around that and pack it inside the molding box, start pouring that, very simple. No need to mix binders or editors. So in the case of the green sand molding process, we mix the binders and additives. What happens when we mix binders and additives? So these cause pollution inside the plant whereas, in the case of the evaporative pattern casting we do not mix binders or additives. So as a result, there will be clean environment between the plant.

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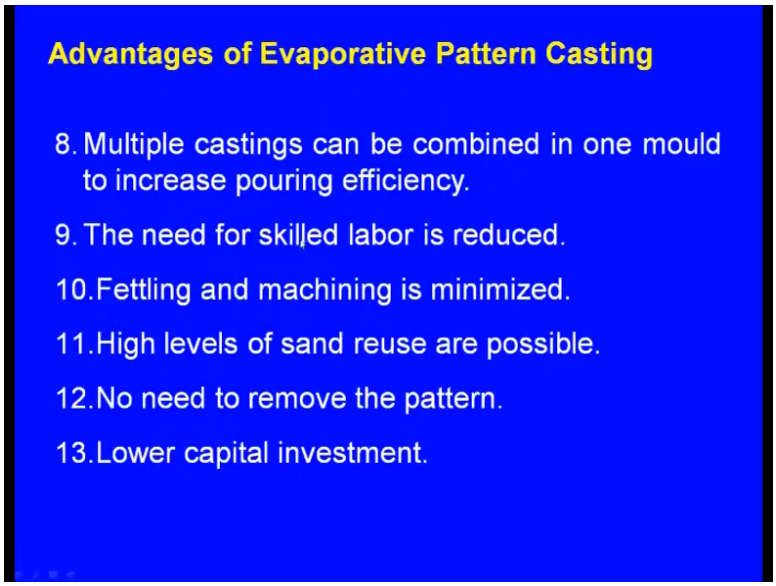

Next one multiple castings can be combined in one mould to increase pouring efficiency. Suppose, if we have want to small castings, so suppose, we want to say 4 or 5 small castings, so no need to make 5 what say moulds. So, all these can be joined together,

assembled together for all these whatsay 4 patterns, they all can be what say kept inside a single molding box and it can be compacted with the mould sand. Then simultaneously, molten metal can be poured means simultaneously we can get castings of 4 or 5 castings.

So, no need for skilled labour. Once they are skilled labour, they will be demanding higher remuneration. Next one fettling and machining is minimized. So this is another drawback in the case of the green sand molding. Fettling means after this solidification is over right; we have to break the sand. So that is the shakeout. Then, metal will be solidified inside the raiser; metal will be solidified in these sprue and in the gating system. So this must be cut off. So that is the fettling process. So sometimes, what say labour have to be used for that per purpose or what say heavy machines have to be used and that consumes time. So that is minimized or eliminated in the case of the evaporative pattern castings.

Now, high levels of sand reuse are possible. In the case of the green sand molding, so the sand cannot be used for infinite times, one it can be used for certain number of what say moulds after that it has to be discarded. Whereas, here, thus, we are using dry sand so high levels of sand reuse are possible. Next one no need to remove the pattern.

In the case of the green sand molding, we withdraw the pattern, for that a skilled labour is required; very carefully use to withdraw the pattern. So that requires skill not only that that takes time sometimes, this is done by machines. So these machines are expensive. So here there is no need to remove the pattern. While, the pattern is still inside the mould, we keep pouring the molten metal. As we keep pouring the molten metal, the pattern evaporates and escapes from the other side.

So no need to remove the pattern. Now lower capital investment. We do not require heavy equipments for this process. So this is these are the advantages of the evaporative pattern casting process

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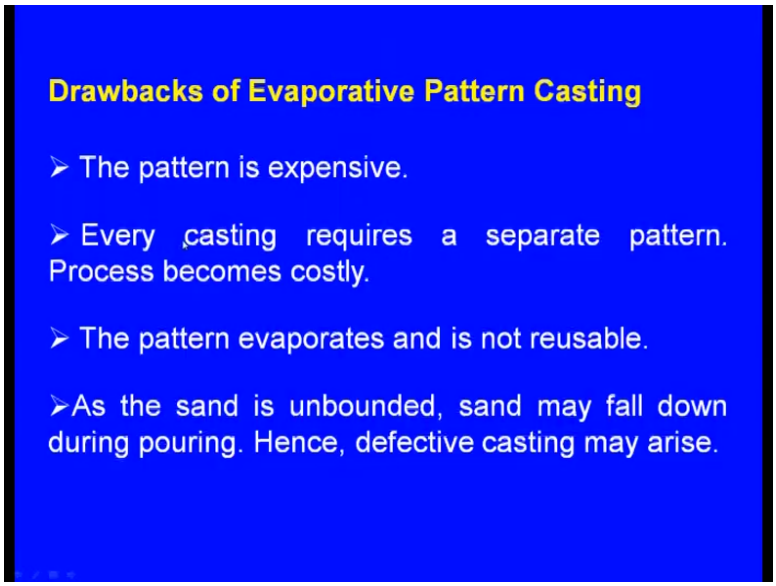

Now let us see there are drawbacks also. What are the drawbacks of evaporative pattern casting? The pattern is expensive. Next one every casting requires a separate pattern and the process becomes costly. In the case of the sand casting process, most of the times we use wooden we use a wooden pattern or a metallic pattern. So those patterns can be used for making thousands of what say castings, but here one pattern can be used to make only one casting. So that is a drawback. The pattern evaporates and it is not reusable. In the case of the green send molding, the same pattern can be used for making several molds or for getting several castings and here it is not possible.

Even in the case of the investment casting for each what say casting we make a wax pattern, but that wax can be recovered, the same wax can be melted and it can be used for making another wax pattern. So, that way in the investment casting process, the wax is reusable whereas, in the case of the evaporative pattern casting, the pattern is not reusable. Why? Because it is evaporating. As the sand is unbounded, sand may fall down during pouring. So here in the case of the whatsay the first person the Shroyer, he has used the green sand, but later people started using the unbounded sand. So this unbounded sand sometimes it may fall down during pouring. Then, that be the case a defective casting will arise. In addition to this, what are the other drawbacks? So during pouring of the molten metal, the pattern evaporates and it escapes through the pouring (Refer Time: 14:03). What is that? That, these fumes will cause whatsay environmental pollution. So this is another drawback of this evaporative pattern casting process.

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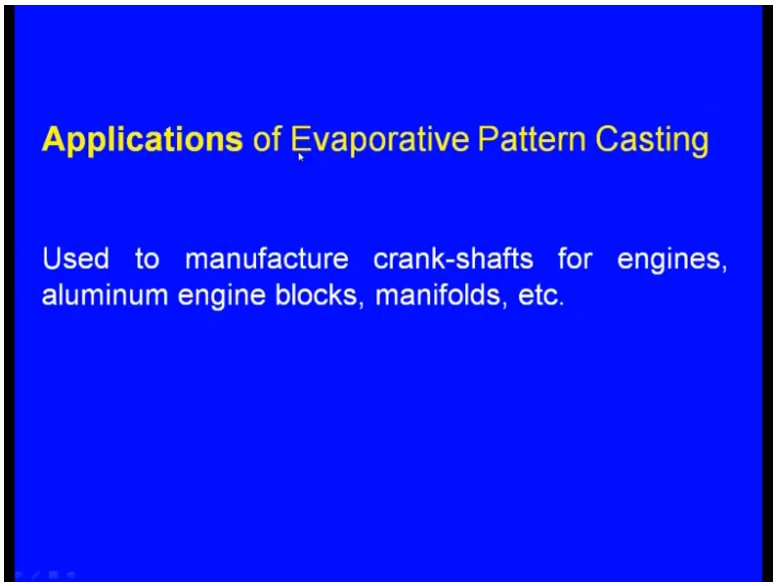

Now these are the applications of evaporative pattern casting; used to manufacture crank-shafts for engines, aluminum engine blocks, manifolds and so on. In fact, nowadays, evaporative pattern casting is used for more and more applications.

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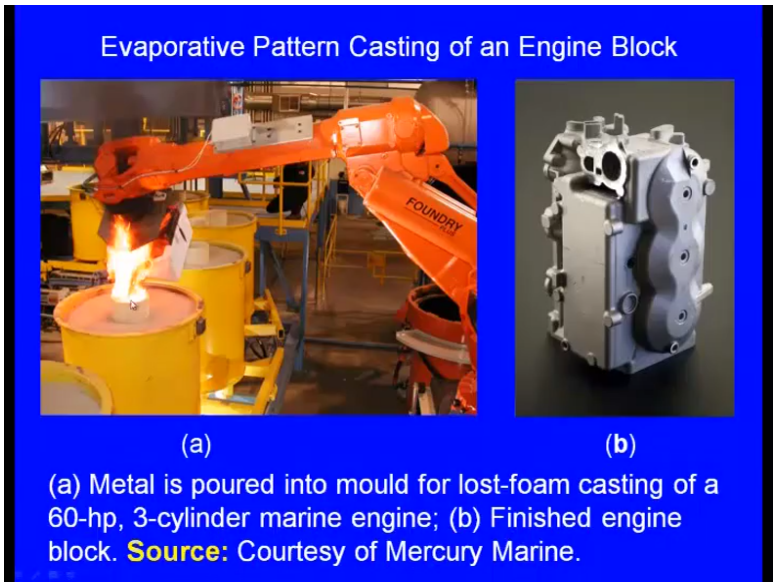

Now here, we see a drain what say real application for making engine block. So this is the engine block. So here we can see, metal is poured into mould for a last firm casting of a 60-hp 3-cylinder marine engine. Here we can see one a one mould box is there, only one molding box and this is the pouring cup and the molten metal is being poured and as

it is being poured, the vapor escapes and finally, it fills. After solidification, we have to whatsay remove this box and we have to remove this sand. Then, we have to break the whatsay shell, a thin shell which we have created with the ceramic slurry, refractory slurry then finally, we get a casting like this.

So, this is a real practical application of the evaporative pattern casting.

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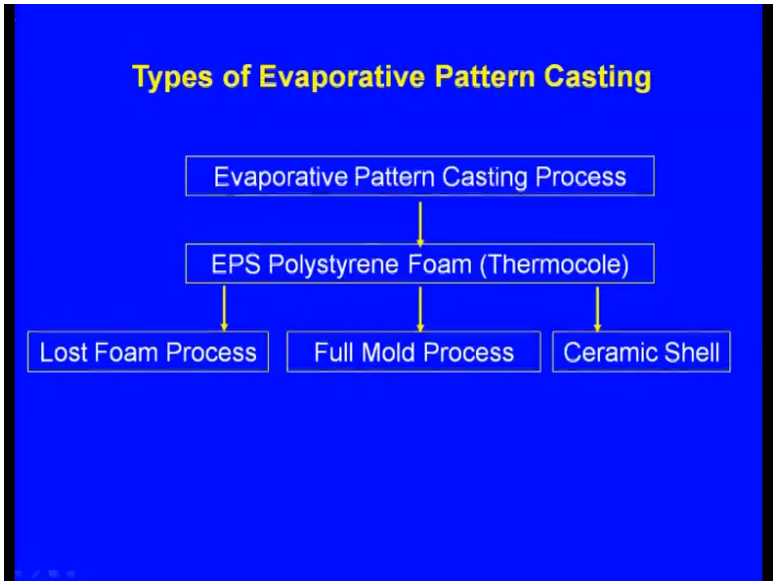

Now, these are the types of evaporative pattern casting. So in this evaporative pattern casting process EPS Polystyrene Form or the Thermocole is used as the pattern material. Now broadly this can be classified into 3 types. One is the Last Foam Process means this is the one which is widely used nowadays. The second one is the Full Mould Process which was used in the beginning, but now also it is used and finally, the Ceramic Shell process.

Now, we will see all these one by one very briefly. Now what is this Last foam process?

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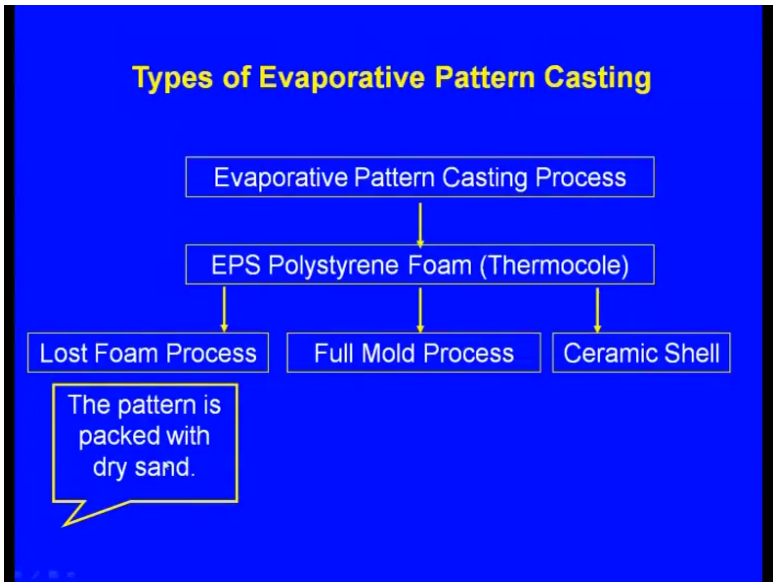

The pattern is packed with the dry sand. Sometime just now I told you this process is widely used nowadays. So in this process, no doubt the pattern is made up of the evaporative pattern right. So, but, after making, the ceramic shell around the pattern, the pattern is packed with the dry sand.

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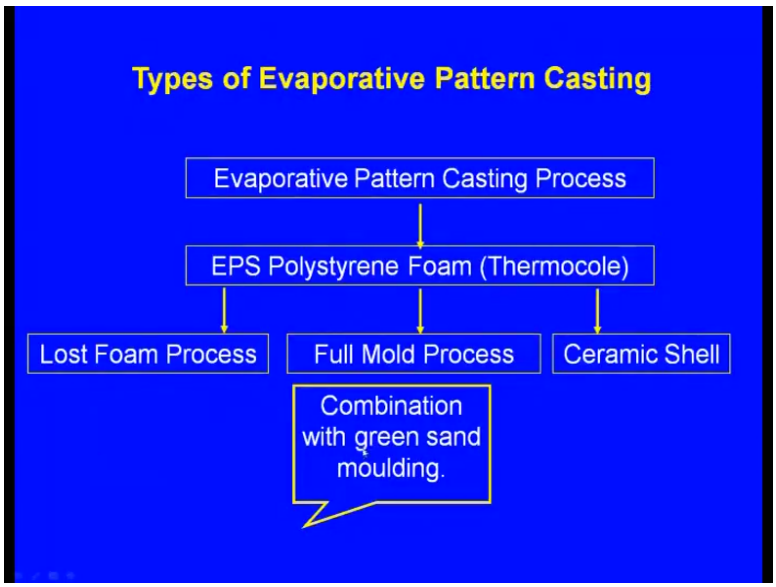

In the case of the full mould process, the pattern is packed with the green sand molding process. So that way, this is a combination with green sand molding. And let us see what is this ceramic shell?

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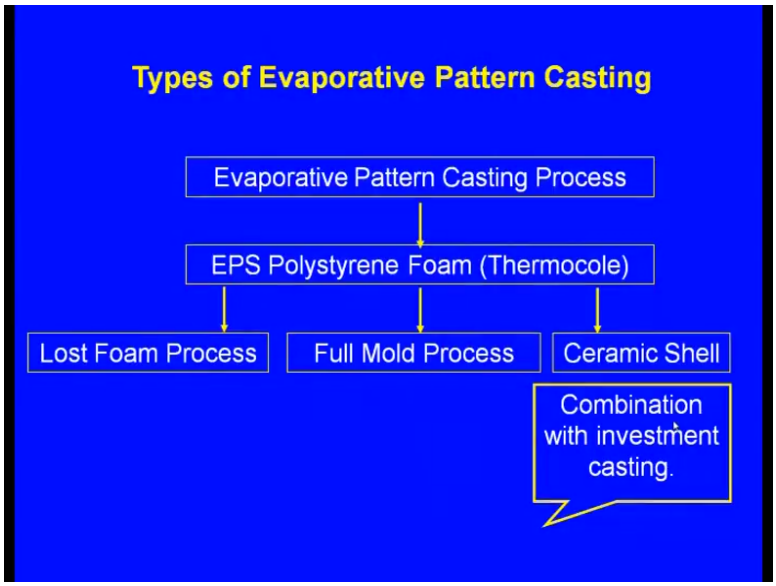

So this is a combination with investment casting process means what is that? Here in the case of the investment casting process, we make a whatsay ceramic shell thick ceramic shell around the wax pattern. That too this ceramic shell is made say 5 to 7 times, a coating is given, the refrain refractory slurry is made and the wax pattern will be dipped into that and it will be taken out and your stucco is rained on that, again it will be dried then, again it will be dipped in to the slurry taken out, stucco is sprinkled on that and it will be dried. Like that, this process will be continued for 5 to 7 times means 5 to 7 times, this will be dipped in the ceramic slurry and it will be dried.

In the same way here also thick shell is created around the polystyrene pattern, evap evaporative pattern. Then the whatsay we keep pouring the molten metal. So it is a combination with the investment casting process. So these are the 3 types of the whatsay evaporative pattern casting process.

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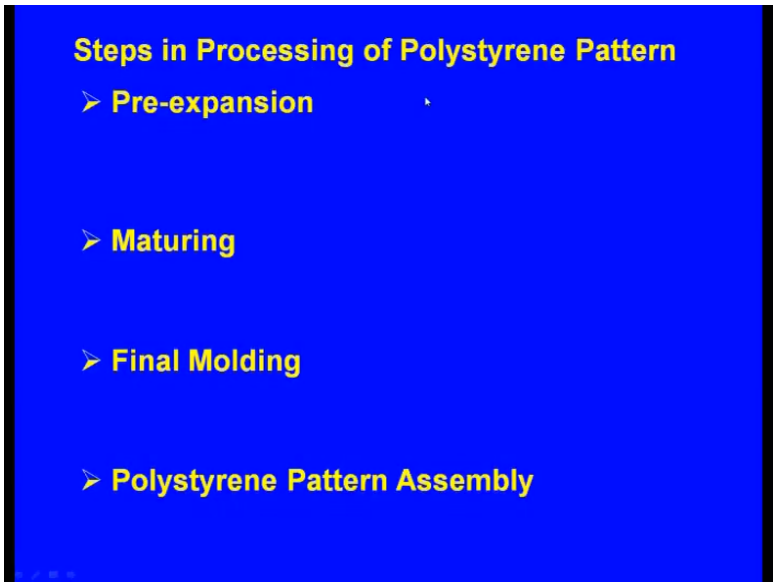

Now the steps in processing of the polystyrene pattern, so these are the steps for processing the polystyrene pattern. One is, the first step is the Pre-expansion, second step is Maturing, third step is Final Molding, fourth step is Polystyrene Pattern Assembly. Now let us see what are these.

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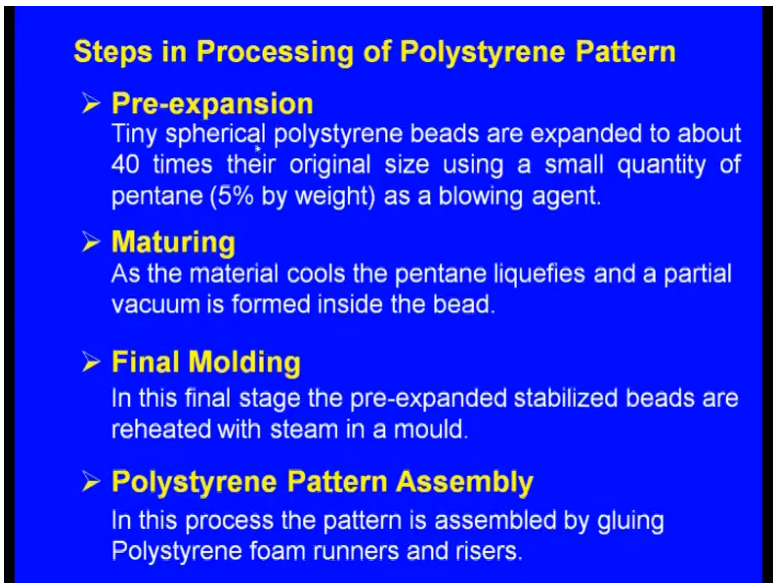

In the case of the Pre-expansion, Tiny spherical polystyrene beads are expanded to about 40 times their original size using a small quantity of pentane and its proportion is 5 percent by weight as a growing agent. Now the second step is the Maturing. What is this?

As the material cools the pentane liquefies and a partial vacuum is formed inside the bead. Next one the third step is the Final molding, in this final stage the pre-expanded stabilized beads are reheated with steam in a mould and the next step is the Polystyrene pattern assembly, in this process that pattern is assembled by gluing polystyrene form runners and risers. Sometimes, even if the size of the casting is small several patterns are joined together and assembled. So, that comes under the polystyrene pattern assembly.

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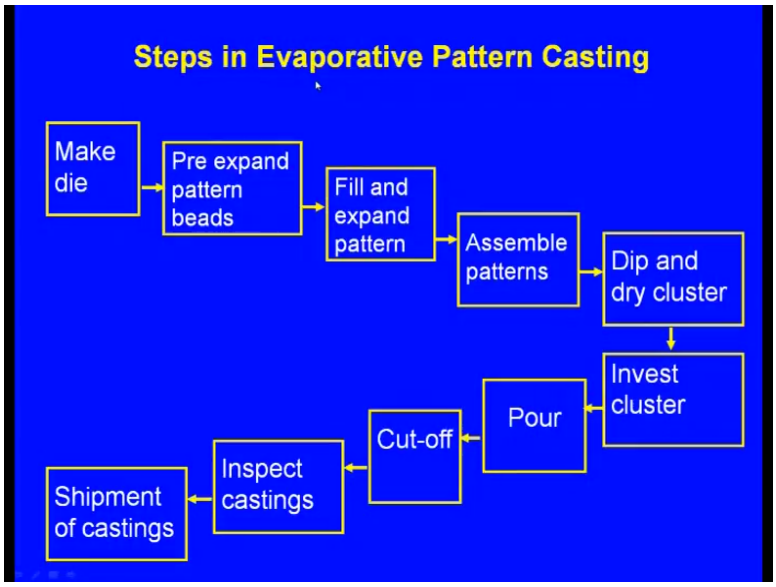

Now, these are the steps involved in the evaporative pattern casting process. First step is Make the die, second step pattern expands pre expanded what say pattern Pre expand pattern beats. First step is Making the die, second step is Pre expand pattern beads, next one Fill and expand patterns, third step Assemble patterns, fourth step Dip and dry cluster. We have to make the ceramic slurry. So in that ceramic slurry, the assembly, are the patterns will be dipped and it will be clustered.

Clustered means what if there are several patterns they will be assembled together, if it is a single pattern as a whatsay a raiser and a sprue are to be glued. So that also comes under this clustering. Next one Invest cluster, so we have to make the ceramic what say shell around that. Next one Pouring, while pouring the whatsay pattern evaporates and comes out and molten metal fills that mould and it solidifies. Next step is Cut-off if there are more castings, multiple castings so this should be cut-off and if even if it is a single

casting the raiser and the sprue must be cut off. Next step is the Inspect castings, finally Shipment of the castings.

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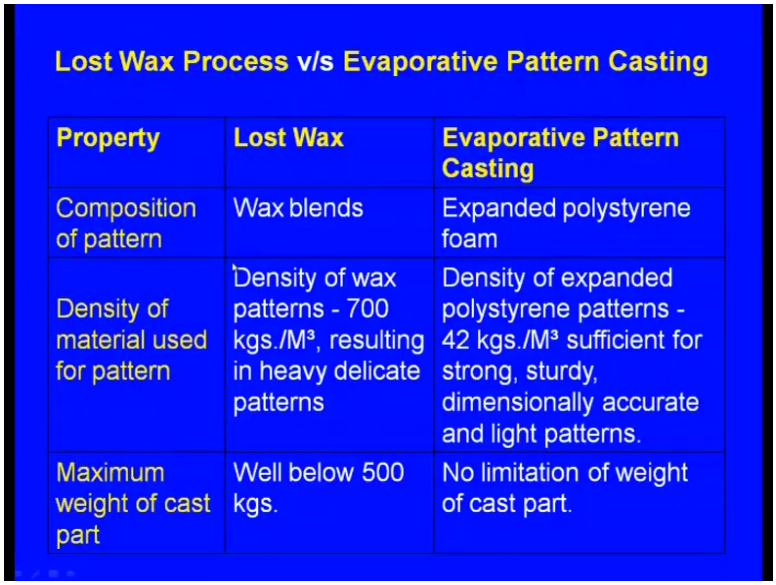

Now, let us see a comparison between Lost Wax process and the Evaporative pattern casting process. Lost wax process means it is the investment casting process and here, this is our present topic the evaporative pattern casting process in what way these can be compared and which one is better, let us see. Now composition of pattern first, what say comparison. In the case of the lost wax process or the investment casting process the pattern is made up of wax blends backs. Generally this, a single wax is not used; several waxes are mixed together and a blend is made. So pattern is made up of wax blends whereas, in the case of the evaporative pattern casting the pattern is made up of expandable expanded polystyrene foam.

Next one the next comparison is the density of material used for pattern. In the case of the whatsay the investment casting process, density of wax patterns is 700kgs per cubic meter. What happens if that be the case? The patterns will be very heavy; handling of the patterns would be difficult whereas, in the case of the evaporative pattern casting, density of expanded polystyrene patterns is 42kgs per cubic meter. The weight of the pattern or the density of the pattern is drastically reduced in the case of the operative pattern casting process. Sufficient for strong because the weight is less because the density is less does

not mean that the pattern is too delicate. They are strong enough, sturdy, dimensionally accurate and light patterns.

Now next comparison is maximum weight of the cast path. It is well below 500kgs. Even 500kgs nowadays, is the extreme case but, in the case of the evaporative pattern casting process, no limitation of weight of the cast part.

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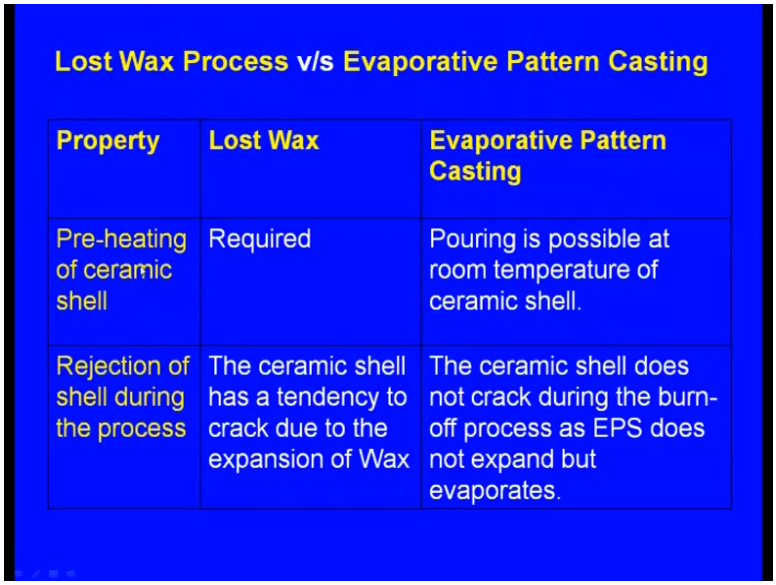

Next one preheating of the ceramic shell, in the case of the lost wax it is required. Sometimes what will happen? During preheating the ceramic shell can crack whereas, in the case of the evaporative pattern casting process, pouring is possible at room temperature, no need for preheating the shell.

Next one rejection of shell during the process, in the case of the lost wax process or the investment casting process, so the ceramic shell has a tendency to crack due to the expansion of the wax whereas, in the case of the evaporative pattern casting process, do you think that the expansion of the shell takes place or the expansion of the polystyrene takes place? No, because without what say any preheating, we straightaway pour the molten metal, as the molten metal is entering into the whatsay mould the pattern evaporates and escapes. So there is no question of the expansion of the shell, so no question of the cracking of the shell, so no question of rejection of this shell during the process.

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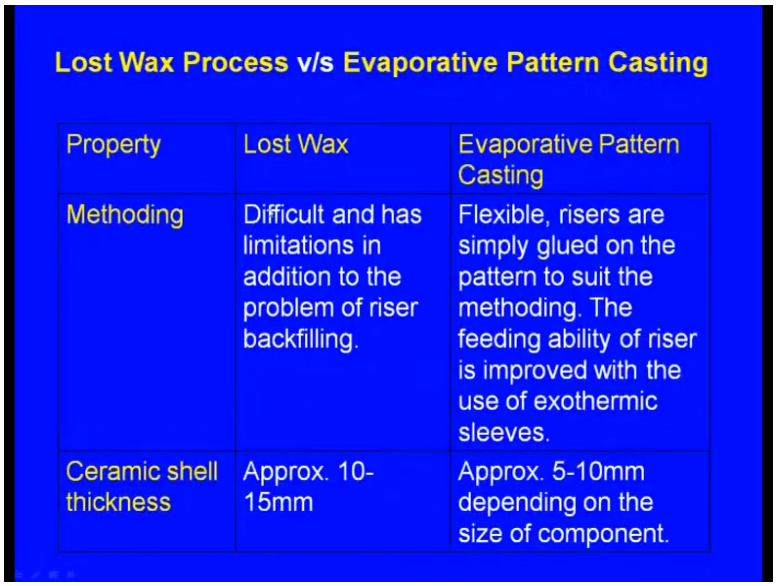

Next one methoding, in the case of the lost wax process, it is it is difficult and has limitations in addition to the problem of raiser back filling. In the case of the evaporative pattern casting, flexible, risers are simply glued on the pattern to suit the methoding. The feeding ability of raiser is improved with the use of exothermic sleeves. Next one in the case of the lost wax process, the ceramic shells thickness is 10 to 15mm means to make this 10 to 15mm thickness of shell, we have to mix mix what say dipped wax pattern into the ceramic slurry 5 to 7 times. Again generally, people make to say 2 types of these slurries one is the extremely fine slurry and another one is the coarser slurry. Initially, one has to dip the pattern into the fine slurry then, into the coarser slurry. Every time one has it has to be taken out and the whatsay stucco has to be sprinkled, it has to be dried out, again it has to be dipped into the slurry. So it is a time taking process. This process takes a lot of time, several hours of time whereas, here the shell thickness is only 5 to 10mm, depending on the size of the component and in the case of the investment casting process to achieve this 10 to 15mm thickness, several hours are required. That much time is not required in the case of the evaporative pattern casting process.

So far, we have seen a several comparisons. In all these case comparisons, we have seen that you evaporative pattern casting is superior to the investment casting process or the lost wax process.

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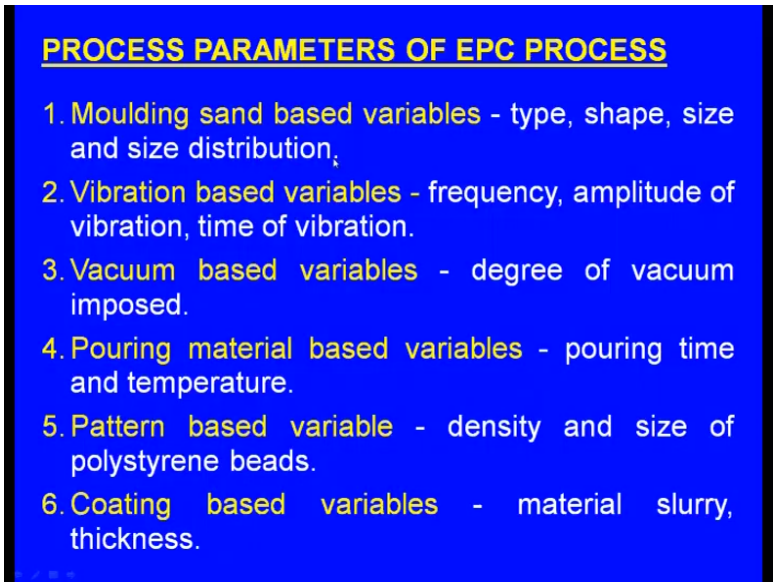

Now, what are the process parameters of the evaporative pattern casting process? So these are the there are 5 types of the parameters. First step is the Molding sand based variables, second one is the Vibration based variables, third one is the Vacuum based variables, fourth one is the Pouring material based variables, fifth one pattern based Variables, sixth one Coating based variables and in the first one that is the Molding sand based variables- type of molding sand, shape, size and size distribution. What is the shape? Is it angular sub angular or round? So that is the shape of the whatsay is molding sand and the size. What is the mesh size and size distribution? So these come under the molding sand based variables.

Next one Vibration based variables- frequency, amplitude of vibration and time of vibration. So after the sand is compacted, inside the sand what say molding box so it is vibrated. So that sand settles stone inside the molding box because it is not a green sand, it is a dry sand. So that is why it is given vibrations. Now the frequency of that vibration, amplitude of the vibration and time of the vibration these come under the vibration based variables.

Next one Vacuum based variables- degree of vacuum imposed. So the that is the only variable among the under the vacuum based variables. Next one Pouring material whatsay based variables- pouring time and temperature. Next one Pattern based variables- density and size of the polystyrene beads. Finally, coating based variables-

material slurry and the thickness under the drain what say drying time. So these are all the processes what say parameters of the evaporative pattern casting process. So with this, we are completing the evaporative pattern casting process.

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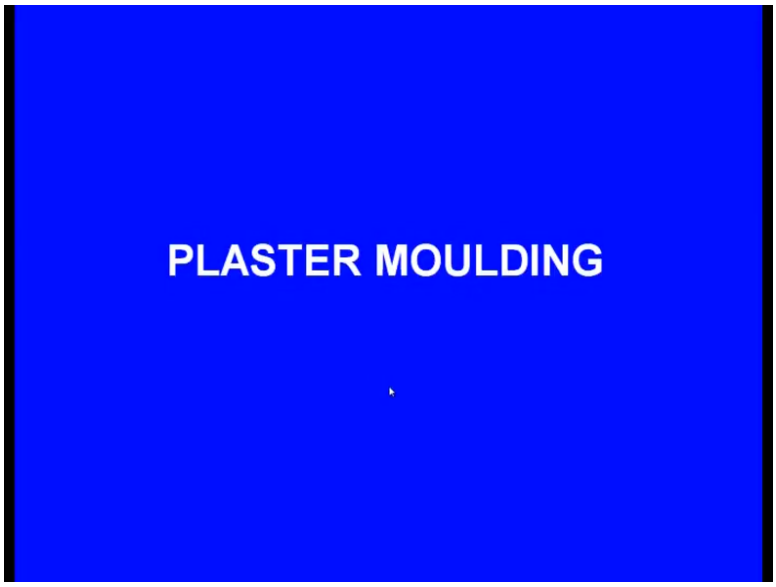

Now let us see the plaster molding. Now before learning the plaster molding, let us see the history.

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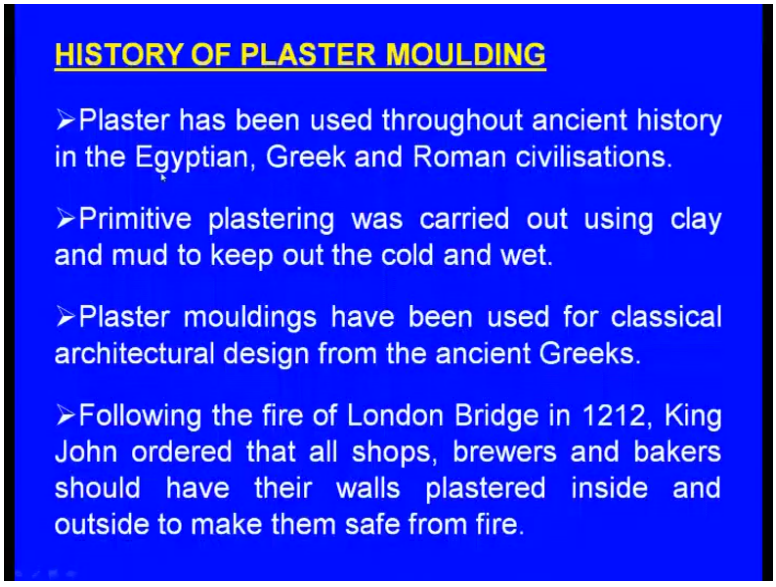

Plaster molding right, plaster has been used throughout the ancient history in the Egyptian, Greek and Roman civilizations. Primitive plastering was carried out using clay and mud to keep out the cold and wet.

Plaster moldings have been used for classical architectural design from the ancient Greeks. Now following the fire of London Bridge in the year 1212, King John ordered that all shops, brewers and bakers should how their walls plastered inside and outside to make them safe from fire. So from this we can see, this plaster has been used for centuries for several purposes.

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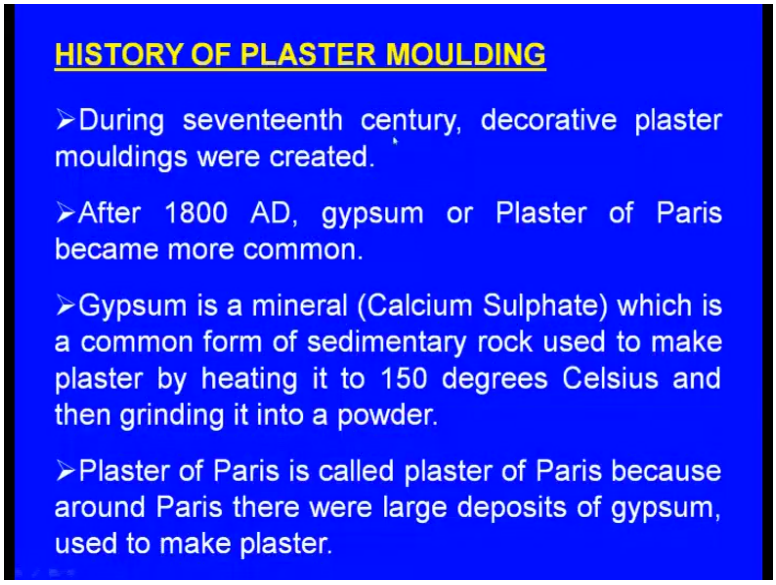

During seventeenth century, decorative plaster moldings were created or the items these were created. After 1800 AD, gypsum or Plaster of Paris became more common. So in the beginning what was the material used. So it the they people have used clay and mud as the plastering material, but later you can see in the 1800 AD, gypsum or Plaster of Paris became more common. Gypsum is a mineral Calcium Sulfate which is a common form of sedimentary rock used to make plaster by heating it to 150 degrees Celsius and then grinding it into a powder. Plaster of Paris is called Plaster of Paris because around Paris, there were large deposits of gypsum used to makes this make this plaster, that is why it is known as the Plaster of Paris.

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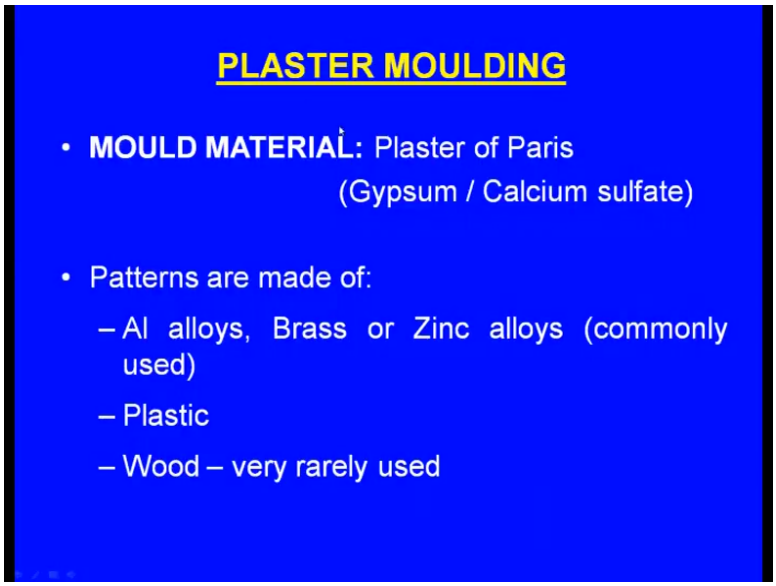

Now in the case of the plaster molding, what is the molding material? The molding material is just like in the case of the green sand molding, what is the mould material? It is the green sand. Similarly, in the case of the plaster molding the molding material is Plaster of Paris or it is the Gypsum commercially and chemically it is the Calcium sulfate. Now what is the material of the pattern? Aluminum alloys, Brass or Zinc alloys. Sometimes, Plastic is used and rarely Wood also used. Now there are 3 types of whatsay process under plaster molding.

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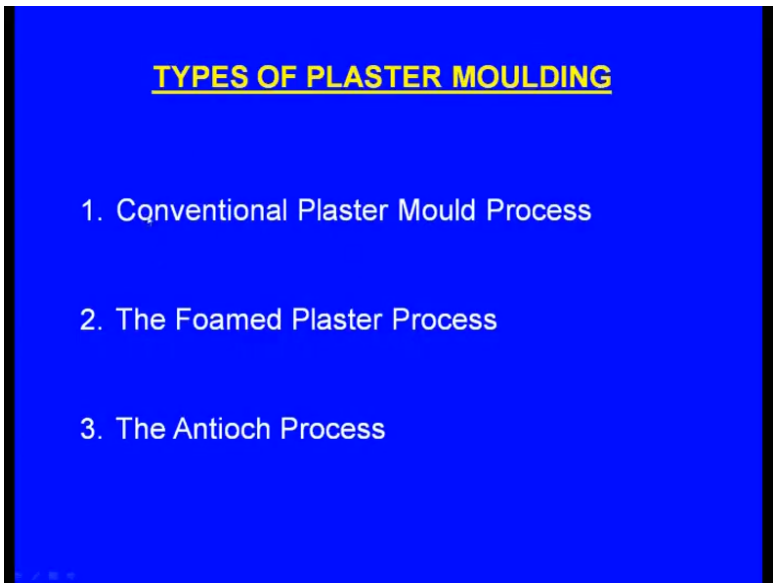

One is the Conventional Plaster Mould Process. Second one is The Foamed Plaster Process. Third one The Antioch Process. We will see all these one by one. First let us see, the conventional plaster mould process.

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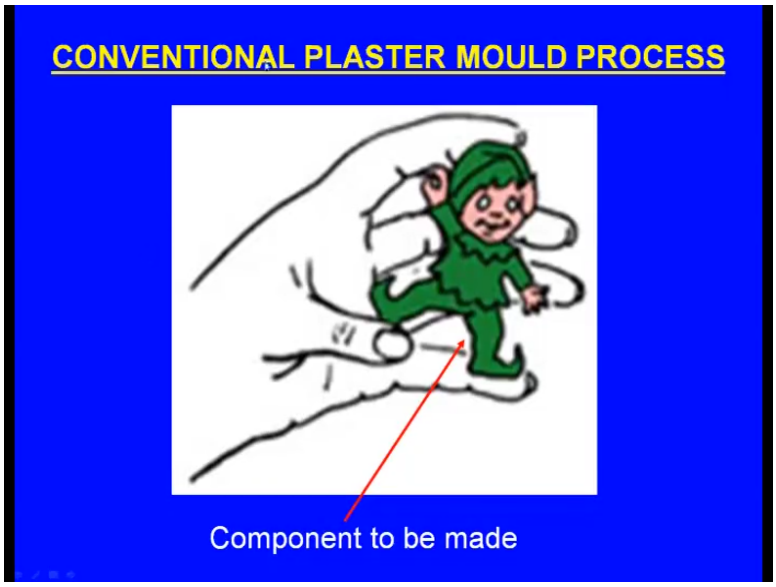

Now in this process suppose this is the component to be made. So, this whatsay a pattern should be like this. A metallic pattern or a wooden pattern should be like this. So, this is the pattern.

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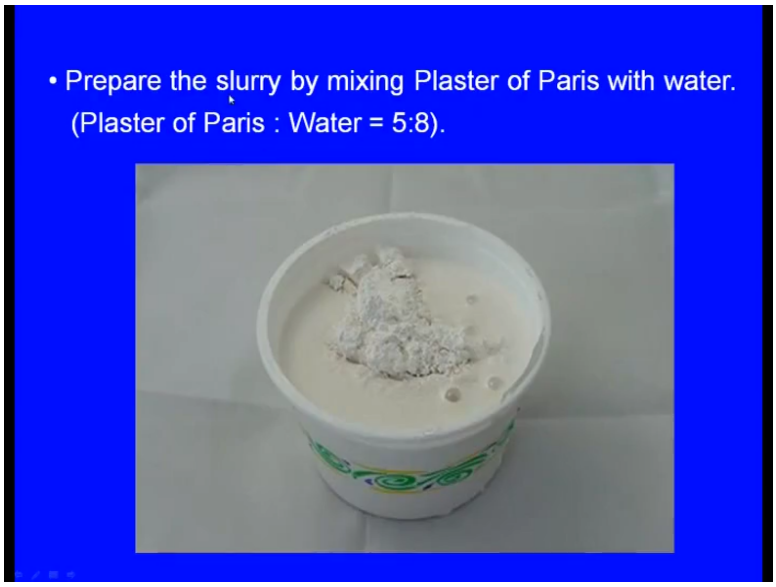

Now prepare the slurry by mixing Plaster of Paris with water. So that is the first step in the conventional plaster molding process. Now Plaster of Paris and water proportions are 5:8 means Plaster of Paris should be 5 parts and water should be 8 parts. So prepare that slurry by mixing these two ingredients.

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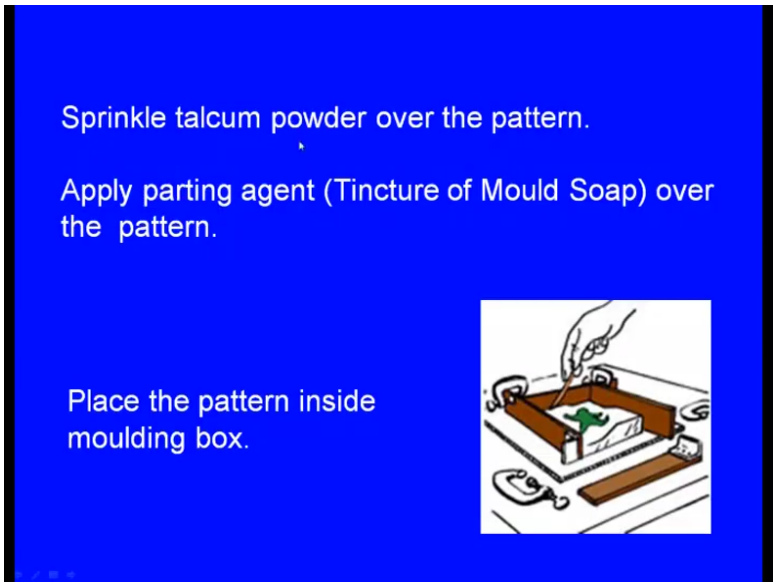

Second step sprinkle talcum powder over the pattern. So this is the pattern, over the pattern sprinkle talcum powder. So that, the slurry, may not be sticking in to the pattern. Next one apply parting agent Tincture of Mould Soap over the pattern. So this also will enable us to prevent the sticking of the slurry with the pattern. Now place the pattern inside the molding box. So this is the molding box, inside this molding box, place the pattern.

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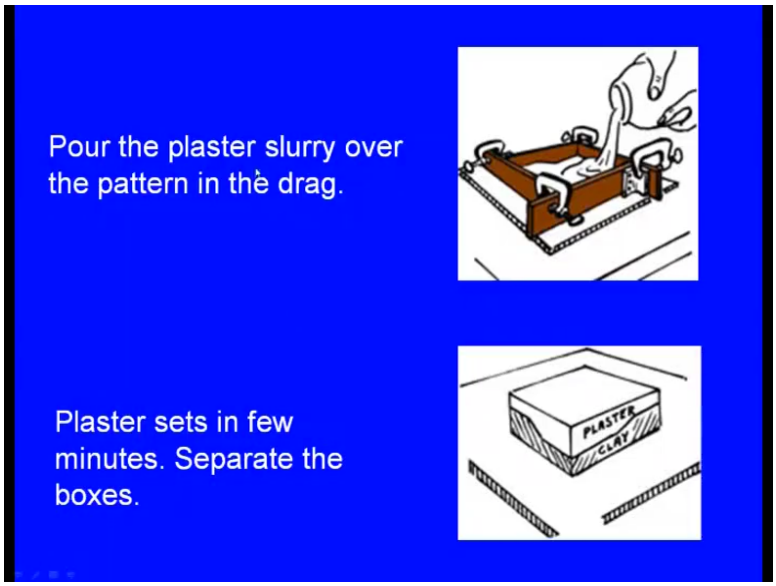

Now pour the plaster slurry over the pattern in the drag. So inside there is already a pattern, now around the pattern, we have placed with the molding box. Now pour the plaster, plaster slurry over the pattern in the drag molding box. Now this plaster will be setting in few minutes, after that the on the 4 sides, there are 4 what say boxes are there right. So these must be separated.

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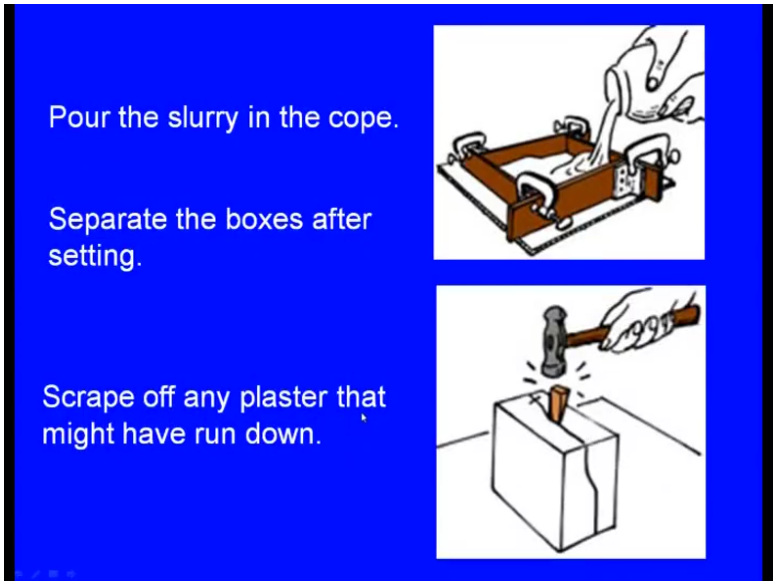

Next one pour the slurry in the cope. In the similar way, we have to make the cope also. Now again 4 boxes will be kept, now pour the slurry in the cope. Separate the boxes after

the setting. Now you see this is the mould. Now scrape off any plaster that might have run down, if any plaster is unnecessarily occupying anywhere that must be scrapped off or that must be broken and eliminated.

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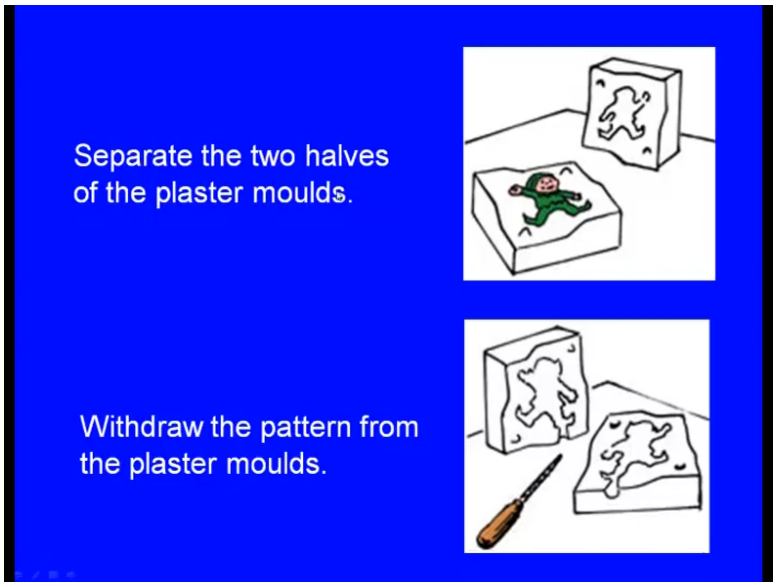

Separate these two halves of the plaster molds. So these must be separated. Now pattern is still inside, you can see. Now withdraw the pattern from the plaster moulds, this pattern is withdrawn, using a screwdriver or somewhat say appropriate tool.

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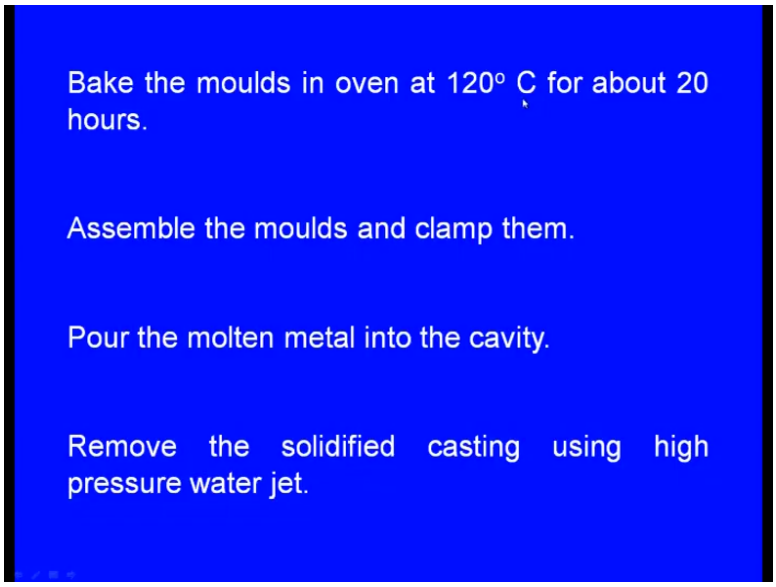

Bake the moulds in an oven at 120 degree centigrade for about 20 hours. So this must be baked. So that the moisture will be evaporating and also the plaster moulds will be hardened. Assemble the moulds and clamp them. After that these 2 moulds must be assembled and they must be clamped together. Pour the molten metal into the cavity after pouring after so right, after solidification; remove the solidified casting using high pressure water jet.

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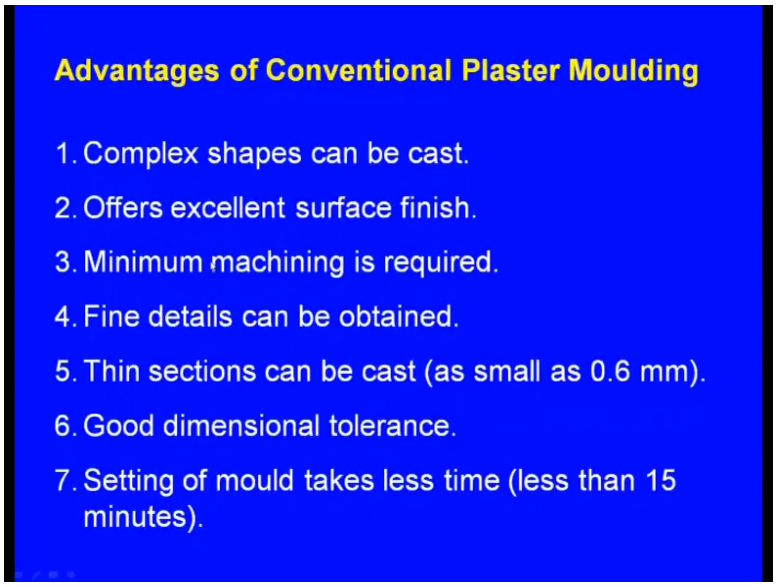

Now these are the advantages of the conventional plaster molding process. First one is complex shapes can be cast successfully cast. So this feature we can see only in what is investment casting or die casting. So here, complex shapes can be easily cast and offers excellent surface finish.

Next one minimum machining is required. Fine details can be obtained. Next one thin sections can be cast as small as 0.6 millimeters and this process offers a good dimensional tolerance. Setting of mould takes less time less than 15 minutes time. Now, what are the limitations of conventional moulding process?

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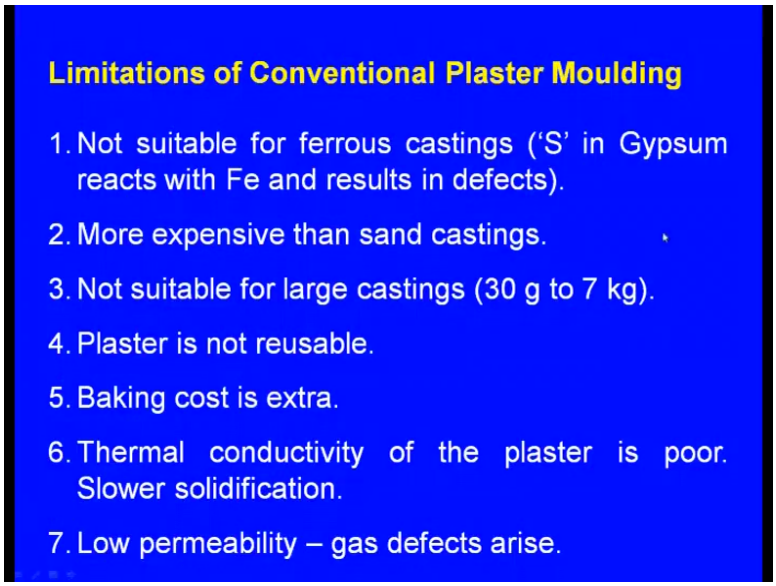

Not suitable for ferrous castings the sulfur in gypsum reacts with iron and the results in defects. So this Gypsum contains sulfur. So because of that there will be some defects will be there, so not suitable for making ferrous castings. More expensive than sand castings, in the case of the sand castings the same sand can be used for making several castings whereas, in the case of the plaster molding, we have to use the Plaster of Paris and once we use it and that is all; we have to break it and that cannot be used again. So it is more expensive than the sand castings. Not suitable for large castings 30grams to 7kgs whereas, in the case of the sand castings, even a 10 tons casting are nowadays made using sand castings. Plaster is not reusable. So that increases the cost of the production.

Next one baking cost is extra. Thermal conductivity of the plaster is poor, so slower solidification. So the properties may be affected. Next one low permeability- gas defects arise. What is this molding medium? It is the Plaster of Paris. So it is less permeable during pouring or during solidification, if any hot gases are arising so they cannot escape through the molding medium. So it is, it has got the low permeability. So hence, there will be gas defects. Now let us see the second process, the foamed plaster process.

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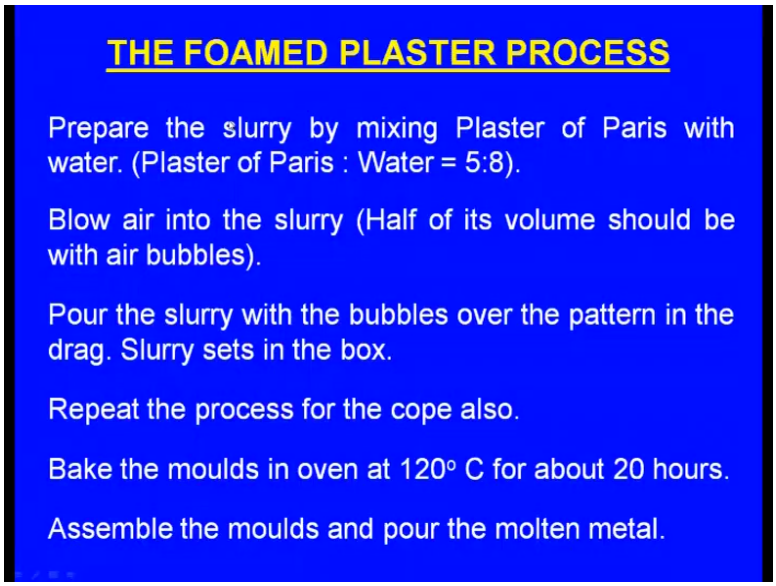

The foamed plaster process is a modification of the conventional molding process, conventional plaster moulding process. In the case of the conventional plaster molding process, the first one, what was the drawback? It has got the very less permeability. It does not allow hot gases to escape through the plaster mould. So to overcome this whatsay drawback, this limitation, some modification has been done. Finally, people arrived at the foamed plaster process. So it is similar to the earlier one, but some modification is there. What is that? We will see. Prepare the slurry by mixing Plaster of Paris with water and the Plaster of Paris and water proportion is 5:8 means whatsay proportion of the ingredients is exactly same as that of the earlier one.

No now here the modification comes into picture. Blow air into the slurry half of its volume should be with air bubbles. So once it the slurry is made, we will be blowing the air into this slurry so that there will be so many bubbles. Half of the slurry is filled with the bubbles. Now while the bubbles are still present in the slurry, pour the slurry with the bubbles over the pattern in the drag. Now the process is similar, same way, only here the whatsay variation is there, blowing air into the slurry. Now pour the slurry with the bubbles over the pattern in the drag. Now slurry sets in the drag box. Next one repeat the process for the cope also. Cope also can be made in the same way. Now bake these 2 moulds in an oven at a 120 degree centigrade for about 2 hours to oh sorry say about to 20 hours. Then what will happen these moulds plaster moulds will be hardened. Then, any moisture is present that will be evaporated. Now inside there were bubbles were

there. Now because of that the bubbles, the air bubbles the permeability will be enhanced, permeability of the molding medium will be enhanced.

Next assemble the moulds and pour the molten metal. The process is same like the first one, only difference is here we blow the air into the slurry. Now what are the advantages of the foamed plaster process?

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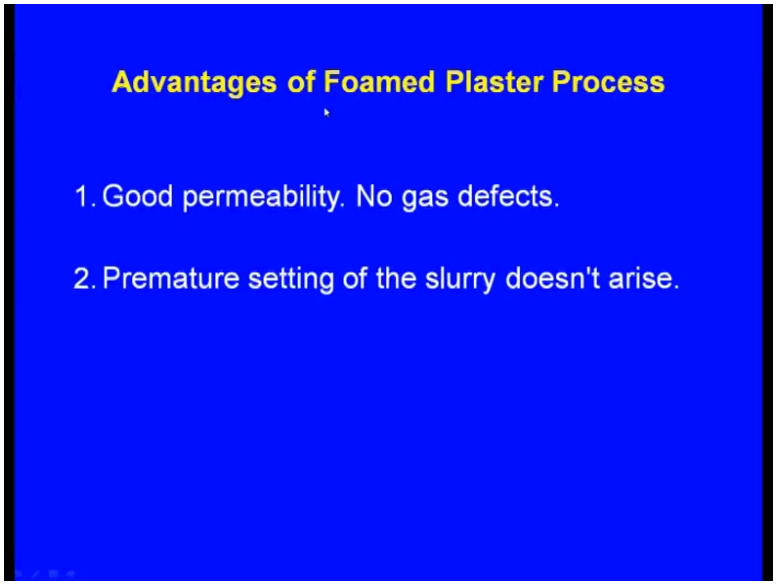

Good permeability, no gas defects. Because we have what say filled half of the slurry with the air bubbles because of that the permeability is enhanced significantly. Next one premature setting of the slurry does not arise; these are the disadvantages of the foamed plaster process.

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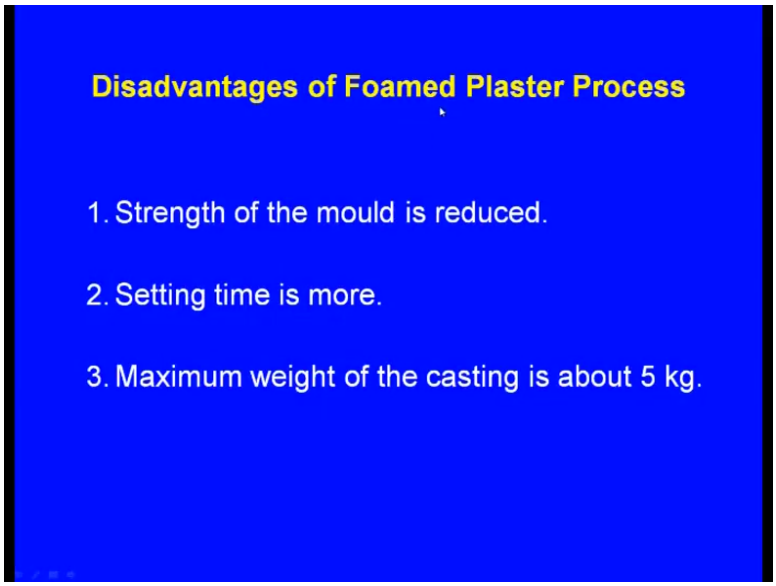

Strength of the mould is reduced. Why? In the case of the first one, the entire mould is filled with the plaster, but here half of the mould is filled with the air bubbles. So naturally the strength will be less. Next one the setting time is more. Maximum weight of the casting is about 5 cases, whereas, in the case of the first one up to 7kgs can be made because here the moulds of the strength is less, so only 5kgs can be made. Finally, the third one the Antioch process, now again, why this Antioch process? plaster of plus what say plaster of moulding is very good it offers very good dimensional accuracy very good surface finish, but the one drawback is the mould or the moulding medium does not have sufficient permeability means it does not allow hot gases to escapes through that.

That is why people made the first what say alteration they mixed the whatsay air into the slurry with the slurry. So they could enhance the whatsay permeability, but what happened? The strength came down. So instead of 7kgs people are able to make only 5kgs casting. So strength came down so, now again, this became a challenge strength. So we people wanted to increase the permeability and also they wanted to increase the strength. So, that is how they landed in the Antioch process. What is this process? In this process strength is enhanced and also the permeability is also enhanced.

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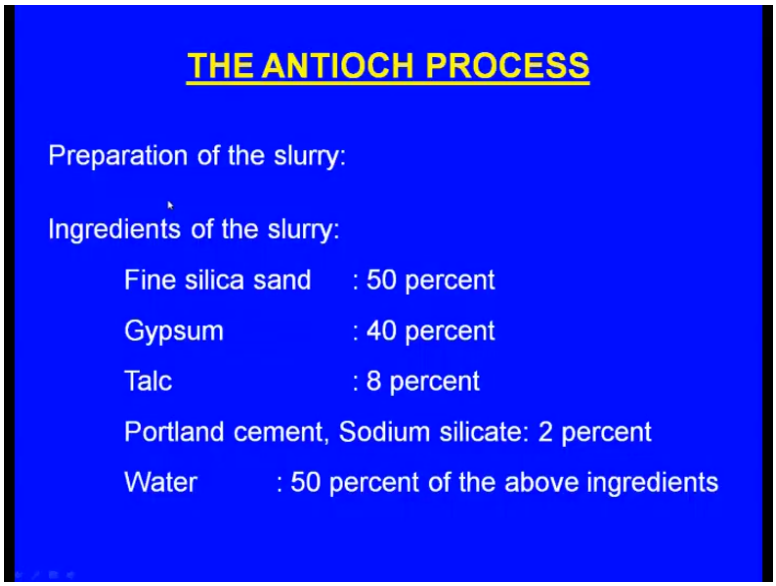

Now preparation of the slurry, first step, now what are the ingredients of the slurry? Fine silica sand: 50 percent. Here we use fine silica sand whereas, in the first 2 whatsay categories we do not use the fine silica sand. Now Gypsum: 40 percent and Talc: 8 percent and Portland cement sodium silicate will be 2 percent. In addition to that 50 per now water will be 50 percent of the above ingredients, you see, even the proportion of the ingredients is different. Here there is a say major difference. Fine silica sand will be 50 percent, gypsum 40 percent and talc 8 percent and this is the 2 percent.

In addition to that, there will be water 50 percent of these are overall ingredients then, all these will be mixed together.

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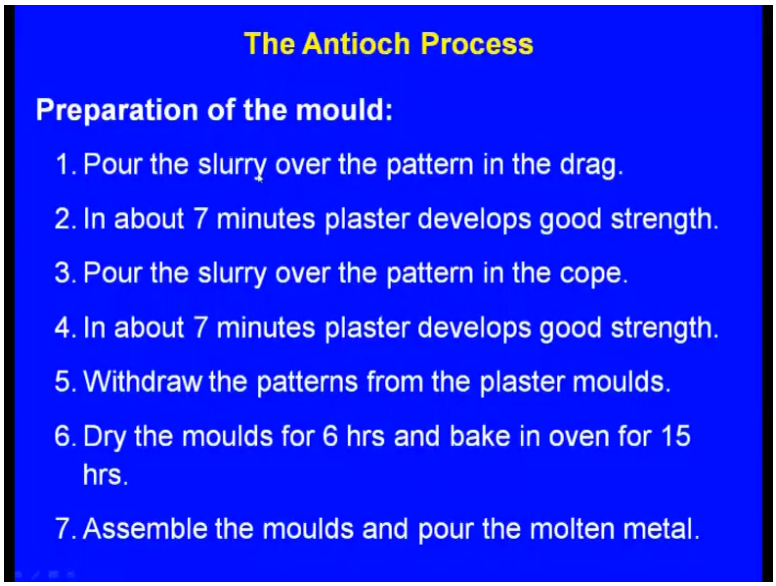

Now preparation of the mould, Pour the slurry after we prepare the slurry, pour the slurry over the pattern in the drag. In about 7 minutes plaster develops and gains a good strength. Pour the slurry over the pattern in the cope also in the same way. In about 7 minutes plaster develops and gets a good strength. Next one withdraw the patterns from the plaster moulds as usual. Now dry the moulds for 6 hours and bake in oven for 15 hours. Assemble the moulds and pour the molten metal.

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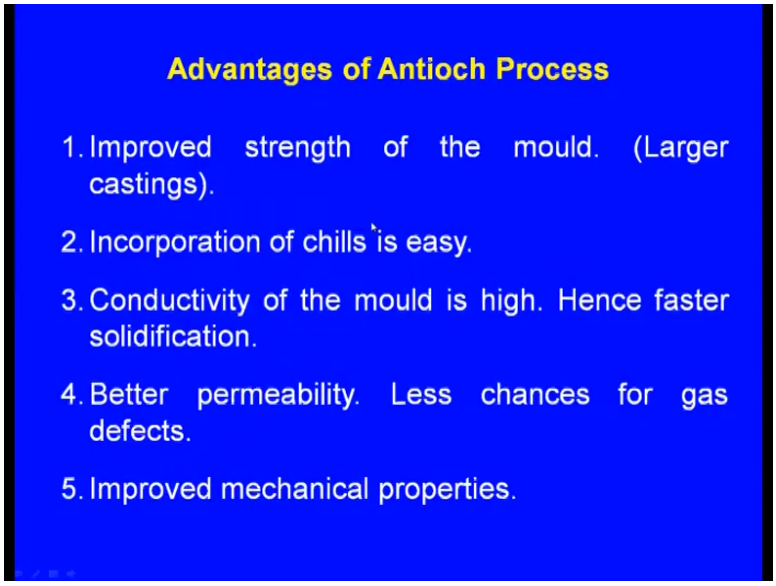

Now, what are the advantages of Antioch process? Improved strength of the mould, larger castings can be made. Why? We are mixing 50 percent of the fine silica sand. So because of this presence of the silica sand, the strength of the mould will be more. That is how, larger castings can be made. Now incorporation of the chills is easy. Conductivity of the mould is very high. In the case of the first one, the conventional moulding process we have seen, the conductivity of the mould is very poor, why? Plaster of Paris offers very poor say poor conduction of the heat. So here because we are mixing fine silica sand conductive of the mould will become high.

Hence faster solidification, once there is faster solidification mechanical properties of the casting would be improved. Now better permeability less chances for gas defects because we are mixing silica sand what happens, because of the silica presence of the silica sand, it leaves some pores somewhere everywhere. So because of these pores hot gases that may arise during pouring or solidification will be escaping through the mould.

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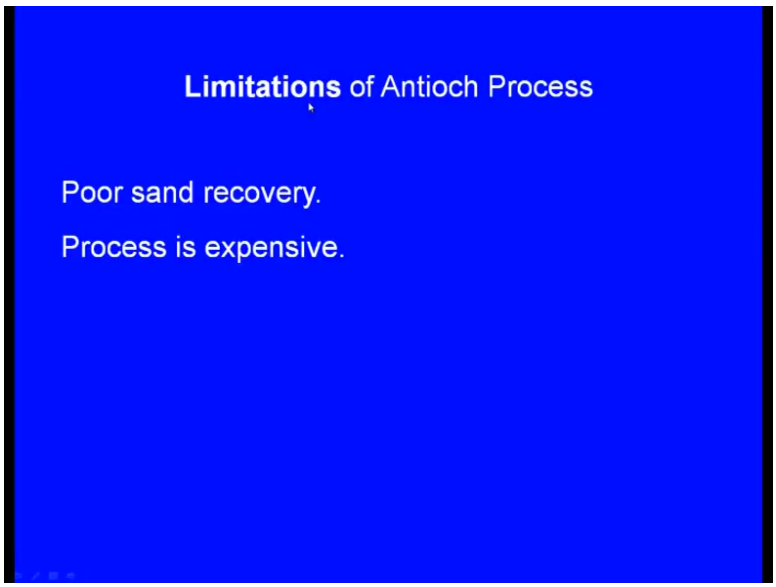

Improved mechanical properties but what are the limitations of this Antioch process? Poor sand recovery. So that is the drawback of this process and process is expensive. Again we have to mix the fine silica sand. It is not in the case of the sand, sand casting process the entire sand can be recovered, only little sand is what is burnt. So there is a sand loss, but most of the times most of the sand is reused it is recovered, but here the

sand recovery is very poor and the process is expensive. We are mixing the plaster and that plaster cannot be used the process is expensive.

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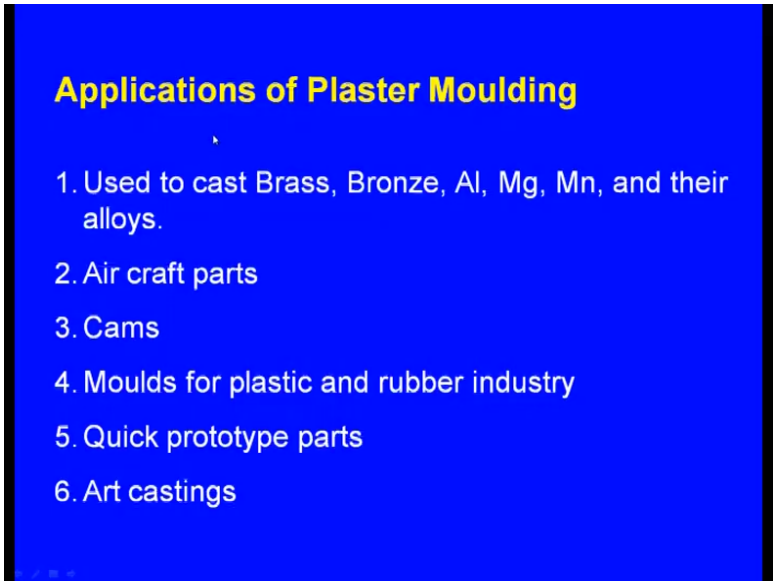

Now these are the applications of the plaster moulding process means overall, overall, so these are all the applications of plaster moulding. Used to cast Brass, Bronze, Aluminum, Magnesium, Manganese and their alloys and remember this cannot be used for making ferrous castings. Now aircraft parts can be made using plaster moulding. Cams can be made. Moulds for plastic and rubber industries can be made and the quick prototype parts can be made using plaster moulding process and also not only that, art castings can be made using plaster moulding process.

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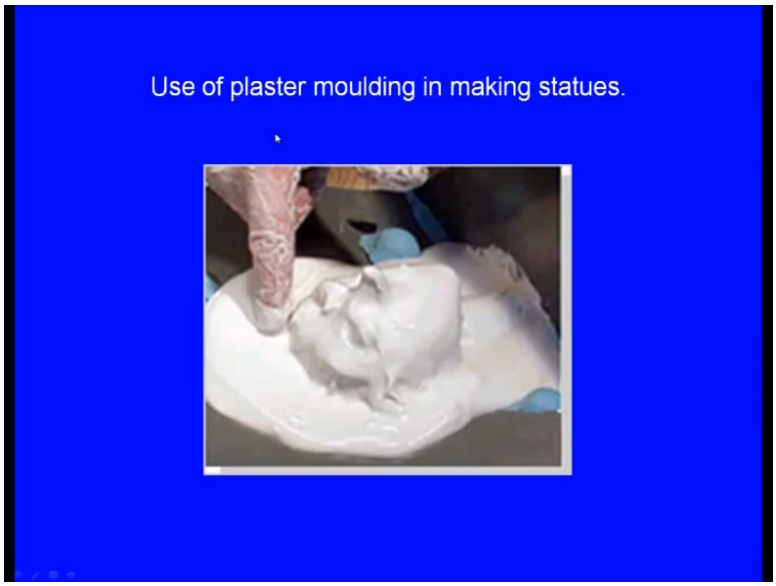

And here we can see, use of plaster moulding in making statues for making art castings. So initially, when one has to make the plaster mould into that plaster mould one has to pour the molten metal then, we get the statues like this.

Friends, in this lecture we have learnt about 2 special casting process one is the types of what say Evaporative pattern casting process. So again, this evaporative in this evaporative pattern casting process, we use the expanded polystyrene of or the foam or it is the thermocole is used as the pattern material. Now this is broadly classified into 3 types.

One is the Lost Foam Process, Next one Full Mould Process and the Ceramic Shell. In the case of the lost foam process, the pattern is packed with the dry sand and this is widely used nowadays whereas, in the case of the full mould process, it is a what say the pattern is supported with the green sand and in the case of the ceramic shell it is a combination of the investment casting process. A thick ceramic shell is created around the polystyrene pattern, similar to the investment casting process.

So that is how we have seen the evaporative pattern casting is superior than the lost wax process or the investment casting process. Then we have seen the plaster moulding. The plaster moulding is whatsay classified into 3 types.

One is the Conventional Plaster Mould Process. The second one is The Foamed Plaster Process and the third one is the Antioch process. In the case of the conventional plaster moulding process, only Plaster of Paris is used. Plaster of Paris and water, plaster of Paris and water, the proportion is 5:8; 5 parts of plaster and 8 parts of water is used to make the slurry and that slurry is used towards a flow around the pattern. Finally, we make the moulds and we pour the molten metal. But the drawbacks of this process is that, it has got the less strength and less permeability.

In the case of the foamed what say plaster process the plaster is made similar to the first one, but here air bubbles are blown into the slurry, 50 percent is filled with the slurry. Then, we this slurry along with the air bubbles is poured over the pattern. So permeability is enhanced, but strength will be reduced in this case. So in the third process again the efforts have been made to enhance the strength also, 50 percent of the ingredients will be fine silica sand and the rest of the 50 percent will be plaster and what say other ingredients.

In addition to this 50 percent additionally will be added what is that 502 percent? Water. Then the slurry will be made. So in the case of the Antioch process because we are using fine silica sand the strength is significantly enhanced. So it can be used for making very big castings and also the permeability is improved. Mechanical properties are also improved as the solidification will be improved. So as the solidification is faster in the case of the Antioch process, but the drawback of this plastering plaster moulding process is that, the plaster is expensive and the plaster cannot be reused. So that way the cost of the production goes up.

So with this we are completing the plaster moulding process also. So we will meet in the next class.

Thank you.