Principles of Casting Technology
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Lecture – 10
Technology of Molding
Sand preparation and reclamation

Welcome to the lecture on Sand preparation and reclamation, under the technology of mold making. Basically what we have studied that sand is one of the primarily used molding material in foundry industries. As we have also discussed that huge quantity of sand is used for producing a casting may be about ten times or so, the sand has to be used and only then the economics in casting can be justified.

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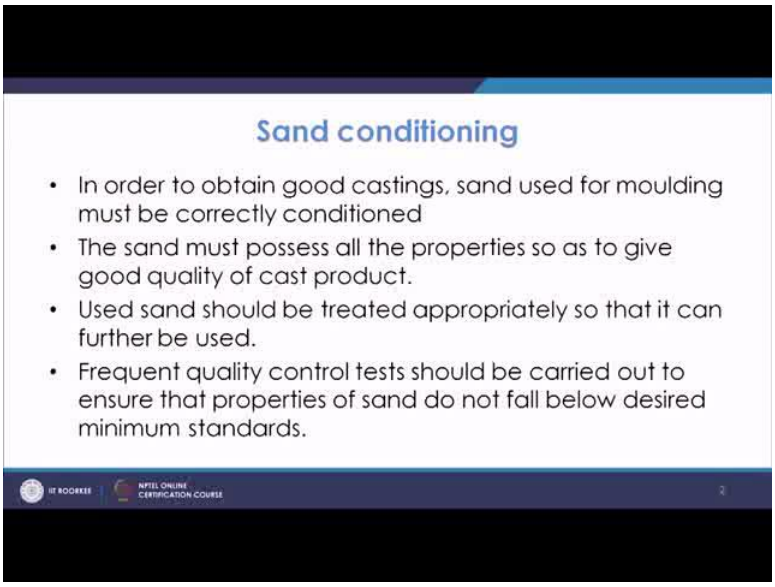

Now, what do you mean by sand conditioning or how to reuse the sand that we will study in this lecture.

What is sand conditioning? Means in order to obtain good castings, the sand used for molding must be correctly conditioned. It means that when we are using the sand for the mold and when the fettling is done on the casting the sand has to be removed, this sand loses some of the properties and if it has to be reused, it must be reconditioned or there must be the additions of something, there must be in maintenance of certain additives or addition of certain binders. So, that it is property is again suitable for being cast into it.

The sand must possess all the properties, as to give good quality of cast product, good properties. I mean the property which is desired for a sand mold is first is the refractoriness, the refractoriness must be adequate once we use the used sand.

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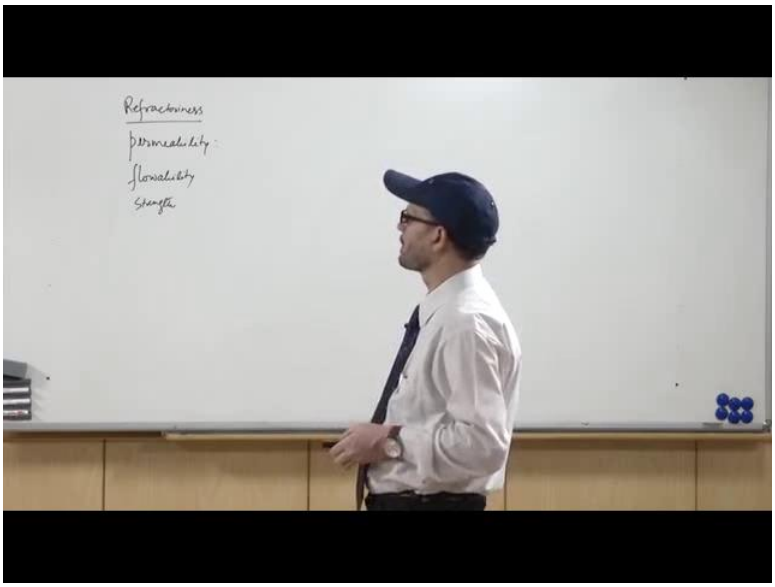

Why it is so, because when we use the used sand, basically the sand which is in intimate contact with the casting that normally gets fused. Also we are using at many places the fine sands sometimes to increase the strength or sometimes to increase the surface finish. The refractoriness of the sand decreases, also when we are taking this sand out there are chances that they are lumps formation. We are breaking it during the breaking the sand particles get crust or they are broken to tiny sizes, their size reduces and as the size reduces the refractoriness value decreases. When we are going to use the, or we are going to reuse the sand, then refractoriness has to be maintained by controlling the type of sand grains like, we may have to add fresh sand grains of optimum size of larger size so that the refractoriness is maintained, because we know that refractoriness is varying with the size of the sand, larger the sand particle size more will be the refractoriness.

In that case your refractoriness can be maintained by properly adding adequate amount of sand of proper size and also proper purity level, because refractoriness also depends upon the purity of sand. Suppose we are using the molding sand and it is silica based sand, the pure silica percentage must be maintained, so that you have adequate refractoriness.

Similarly other property is permeability. As we discussed, it may happen that when we are going to reuse the sand, the permeability of that reused sand will be less. Because the materials which are responsible for the generation of force because of which permeability is improved that may be lost. This permeability has to be maintained, by properly adding proper additives. So, that the permeability is proper, you have to also see that how the sand grains distribution is there, because sand grains distribution also affects the permeability. Permeability has to be controlled, other properties are like flowability. So, you have to see that it has proper flowability proper binder or water is there, that it can go inside the mold at all the points. All these properties like you have the strength which is there, which is proper strength is there. These properties, the sand must possess all the properties so as to give good quality of cast product.

We know that these properties are required because, if they are not met, they are going to affect the quality of the cast product. Used sand should be treated appropriately so that it can further be used. Now the sand which has been used, and if you we want to further use it, we have to treat them appropriately. The treatment involves the removal of foreign elements, the removal of lump formed, the addition of proper amount of binders or additives. Basically the sense of this statement is that you have to treat it in such a way that it can further be used.

Basically the purpose is that you have to use this sand again and again, for finding the economy of the process you have to treat that appropriately. Then frequently control test should be carried out, now when we are going to reuse the sand then we have to ensure, that quality of the sand is maintained at it is level which is required for giving a certain quality of the product. There are many types of quality control tests like, sands permeability, hardness, flowability or toughness all that is required. These tests quality control tests must be carried out like proper temperature, they must be maintained so that once you are going to re use it, in future many times then their effect on the quality of cast product should not be seen in an adverse way.

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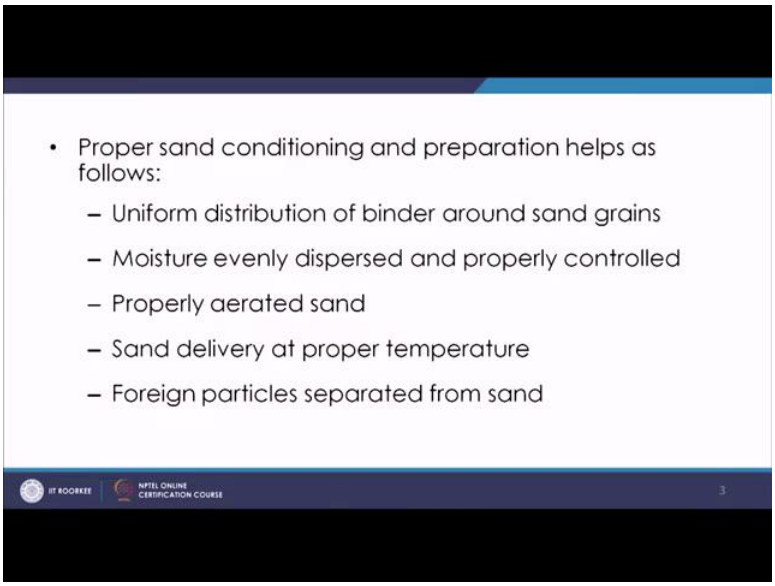

Proper sand conditioning and preparation helps as follows. If we do the proper sand conditioning it helps us in following these like, uniform distribution of binder around sand grains, when we are going to further use the used sand we have to ensure that there is uniform coating of binder around this sand grains. For that we take that and we go to the equipment where this mixing is carried out and it is ensured that the binder envelops all the sand particles, so that they can bind with each other.

Moisture evenly dispersed and properly controlled, you have to see that moisture is evenly disturbed, I mean dispersed this is required because it will affect the flowability of the sand and also it effects the strength which is generated. You have to see that the moisture or sometimes the water which you are adding in case of clay bounded sand that should be properly distributed, and controlled.

Properly aerated sand, a common practice is that when we go for molding after adding the binders and the additives aerasor is carried out, and there is aerator to do it. So, air is passed through it to ensure that each of the sand grains are separate from each other. Otherwise there may be long formation before the mold making itself and may affect the properties like, permeability or a strength. We have to see that the sand which is further going to be used, it is properly aerated. Sand delivery at proper temperature, there is certainly mechanism to see that the proper temperature of the mold is there, proper temperature of sand is there that is delivered further use.

Foreign particles separated from sand, the sand which is used once for casting purpose in terms of molding sand, when we are taking the casting out of this it contains a number of foreign impurities foreign particles, I mean apart from sand and that is like you may have nails, you may have chills, you have runners or engages all these things and then you also add many additives. That may be in different forms, those which are undesirable have to be screened out which has to be removed. Basically you have to see that all the foreign particles mostly metals, metal parts or other parts which are to be removed they must be removed from that portion.

Now the sand preparation, while going for sand preparation, you have to be carefully to see that how in a controlled manner you should prepare the sand. Because the preparation of the molding sand very much as a say on the quality of the cast product.

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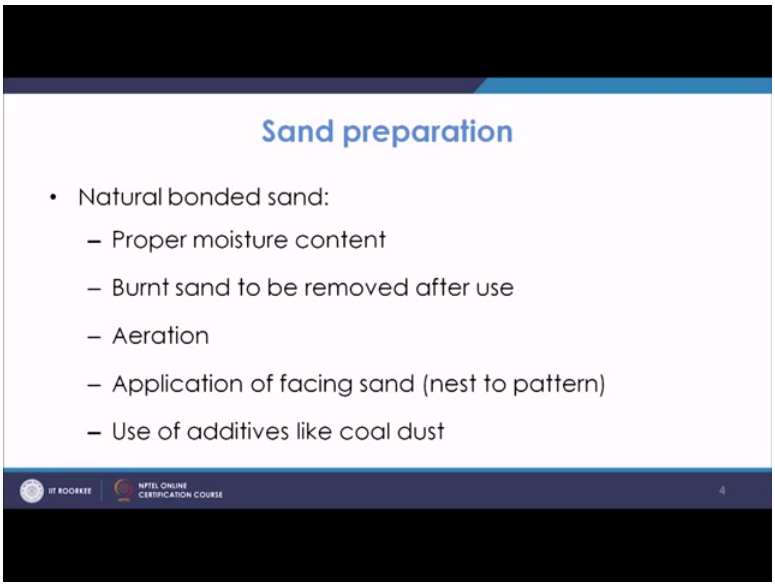

For natural bounded sand you have to see that there is proper moisture content, which is may be 2 to 5 percent of moisture is there you have to control that moisture content. Burnt sand has to be removed after use. You have to see, that the burnt sand which looses it is color, which looses it is refractoriness has to be removed; otherwise it will decrease the bulk quality of the sand used for the bulk quantity. This burnt sand which is normally immediate, in the immediate viscidity of the cast surface that is to be removed.

Aeration is to be done, so that all the sand grains are separated before being put in the molding box and being rammed, proper aeration is to be carried out. Now many a times

we use the facing sand next to the pattern. What we do is when we are going to further use the used sand, used molding sand. Then next to the pattern we always put facing sand, that the surface finish is proper. So, that facing sand we have to always supply mu and this facing sands will be used.

Use of additives like coal dust, you can have other additives also which has to be used for attaining a specific objectives like proper finish good horse strength, good moldability, good ease of removal. There are many additives that have also to be used.

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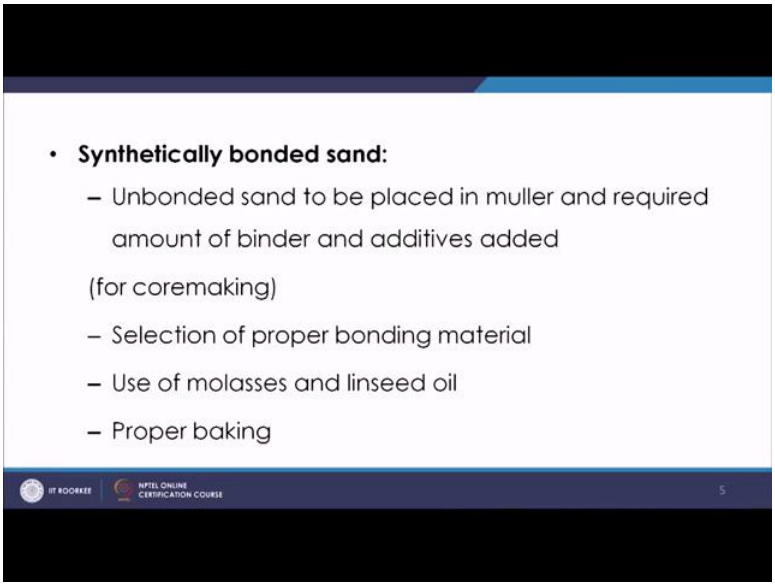

Now in these case of synthetically bounded sound sand, now, in that case unbounded sand to be placed in muller, and required amount of binder and additives added, if you have the unbounded sand, then you have to put is that in the muller, and required amount of binder and additives are to be added. That it again has the property to get binded and give the proper strength. In case of mold making and in case of core making you have to select proper bounding material, which is normally not the clay in case of core making. We use the oils organic materials, organic binders; then you use the molasses and linseed oil in case of core making. Proper amount of these molasses and linseed oils are to be added. That it will be pass the specific property, and also in case of core making there is an important process known as baking. Baking is to be carried out for 200 to 300 degree centigrade, for 1 to 2 hours, proper baking is also to be ensured. Then only this core will be good to be used.

Sand reclamation, now let us see, what is sand reclamation. Sand reclamation is nothing, but treatment of used molding sand that it regains original condition and it can be used again and again with minimum addition of new sand.

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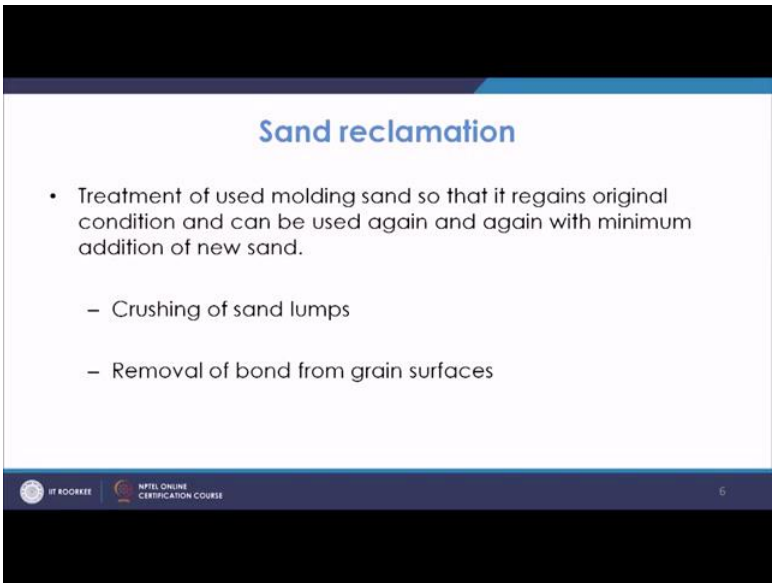

As we discussed, this process of using this sand again and again so that there is, I mean continuation in it is properties, maintenance of the properties. So, that it can further be used and give the same quality of product every time. This is known as sand reclamation.

In the sand reclamation, you have to do something. So, that the sand can further be used among them the important once are like crushing of sand lumps, many a times you have sand lumped formation, this lumps are to be removed, using the screens or it has to be broken that we will study later. These lumps are adversely affecting the quality of the molding material, if they go into the molding material. Then removal of bond from grain surfaces, you have to remove that bond which is there on the grain surface, that it becomes fresh and further it is freshly coated. So, that bonding develops further, so you have to that removed also.

Now type of facilities or equipment required for this sand reclamation depends on certain factors.

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The factor is quantity of sand to be handled, how much quantity you want to handle, it is small or larger. Kind of binder and it is quantity, binder may be in organic based or it may be organic based, based on that this reclamation process will vary. Extent of mechanization used in foundry, foundry may be manually operated; mostly manual or it may be automatic semi automatic or fully automatic. And overall economics of sand recycling,

What is the economics? If the sand recycling is too costly, if you are not going to use it for larger run, then you have to see how much it is justified to further use it, because if it is creating a la large amount of cost if it is incurring a large amount of lost, in further recycling it then you have to see it is justification. These things are the factors which are to be considered.

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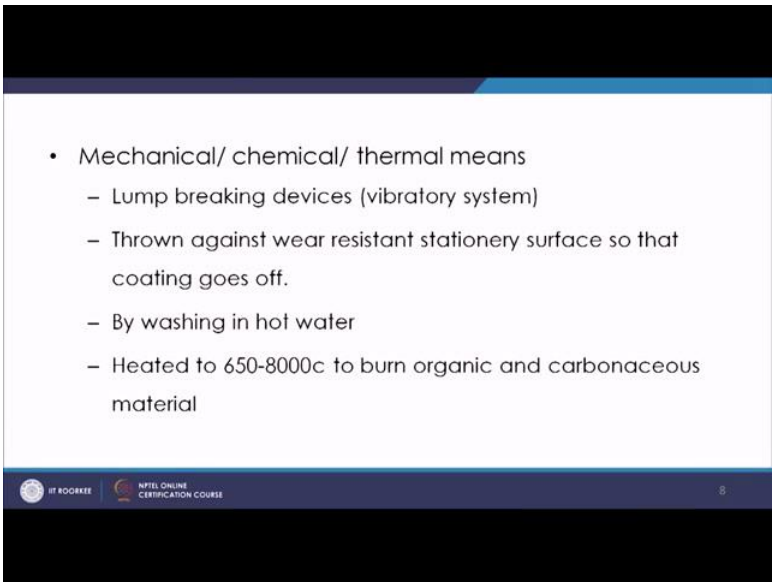

Now what are the means for these breaking of the lumps? The means may be mechanical or chemical or thermal, in mechanical means basically, you have a vibratory system for the lump breaking. So, the lumps go on a system, which vibrates with shakes vigorously, and the lumps are broken. Another way is that these lumps are thrown against wear resistant stationery surface.

They are thrown pneumatically at a high pressure against some very hard surface, wear resistant surface, that these lumps broken. This way you can get rid of the lumps, and the coating goes off. By washing in hot with thermal means, you can wash them in hot water; this may be under the chemical means. So, you can wash them and in hot water. Many a times by washing in hot water, this lumps are disintegrated, and the bound material which is coated on the sand grains they are dissolved. Then many a times the organic and carbonaceous materials are removed by heating it to 650 to 800 degree centigrade. Basically this is how you are getting rid of these binders.

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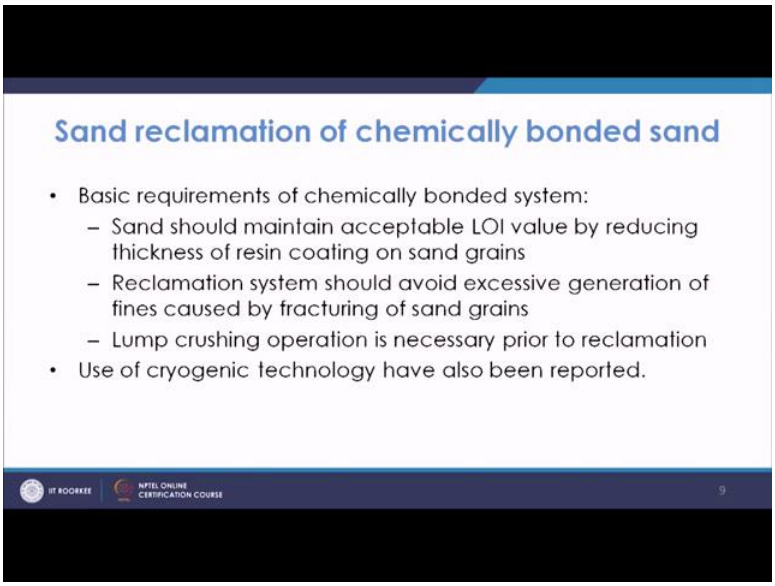

Basic requirement of chemically bonded system, for chemically bonded system, what is the basic requirement, in that, basically you should maintain the acceptable loss on ignition value. This LOI value must be maintained by reducing the thickness of resin coating. You have to reduce that thickness of resin coating and maintain that LOI value. Reclamation system should avoid excessive generation of fines caused by fracture of sand grains.

Basically what we have discussed, when we are trying to crush these lumps, then there is generation of fans, fines. And these fines should be minimum, because in many ways they affect the efficiency of the system, with the fines are more the requirement of the binder will be more, if the fines are more that they will affect the permeability, they will affect the strength, fines should be minimum. We have to go for those reclamation processes we should generate minimum number of, minimum amount of fines. Lump crushing operation necessary, is necessary prior to reclamation. Before reclamation you must do the lump crushing operation and see that the lump is removed, you are getting the sand in it is original state as much as possible and to the extent possible you should try to minimize the fines formation.

Use of cryogenic technology have also been reported, recently some research is being carried out and has being carried out, which I reported that even sub zero temperatures treatment he can yield the breaking of these lumps, in many cases where it is not possible

by other ways, this sub zero treatments can go, can you will be used for the reclamation of such sand.

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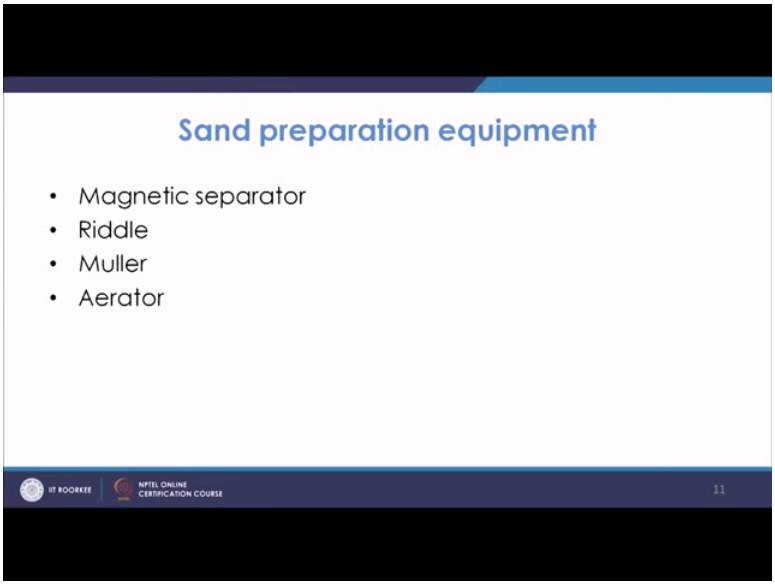

Now we will discuss about sand preparation equipment. Among the sand preparation equipment we use certain equipments; among those equipments we have Magnetic separator, Riddle, Muller and Aerator.

What is Magnetic separator? As we have discussed, when we are removing the sand from the casting after the cast product has solidified. In that case, it may have magnetic particles and it may not have magnetic particles. These magnetic particles like, iron rods or iron shots or nails or sometimes chills you are using or (Refer Time: 23:18) it is parts. All these parts which are made of iron, which are magnetic, they are removed by magnetic separator. In a magnetic separator what happens you have the pulleys. You have pulley, which is magnetized, you have either a permanent magnetic pulley or a electromagnetic pulley, which is magnetized and the sand will be put over it and then it will move on this.

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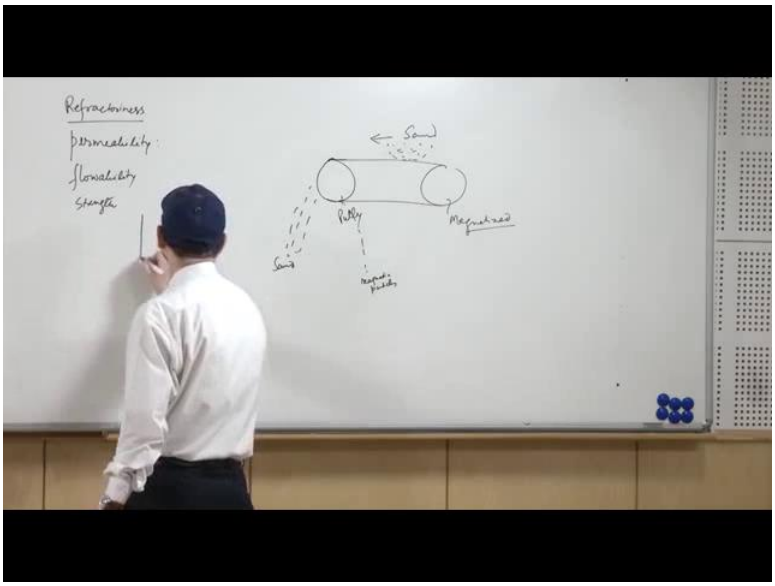

So what happens? When this belt comes in contact with the pulley, the magnetic particles get attracted to it and they cling on to it. The non magnetic particles like, sand, all that they come here and once they go down, they will fall here. All these sand will fall here. Whereas, the magnetic particle like nails or so, they will come clinging to here and they will fall here, that will be magnetic particles. Basically, you can have the heap of sand or a distance and you can have these iron based particles or iron based pieces of nails or whatever it be, separated and in this fashion you can separate the magnetic particles using magnetic separator.

Next is Riddle. A riddle is basically used even by hand at this smaller level, but if you use the mechanical riddle, where the power is there given by pneumatic system or so, in that case it suffices increases, and you can riddle the sand, you can get this sand basically properly separated of uniform sizes. That can be done by using these mechanical riddles. You use the pneumatic or compressed a system, for this riddles where there is a piston which is going to a flow at small stroke length and the pneumatic system with a help of air basically the sand is thrown and this riddle serve the purpose of sieving the sand of uniform sizes.

Then you have Muller, you know this Muller is serving a purpose of like a needing of the sand. In the Muller, if say cylindrical container, and in that you have two rolls which are connected they are basically on a rocker are assembly.

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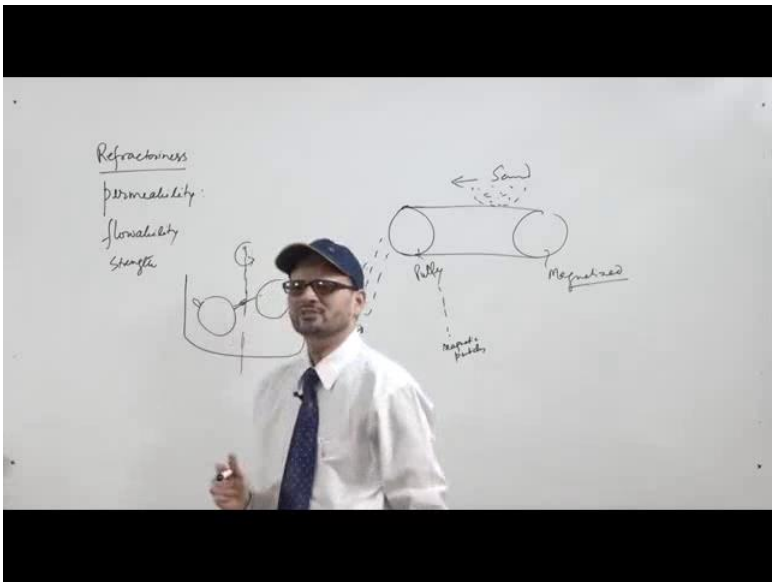

What it does is, basically they move they are rotating about a vertical shaft, about this shaft they are rotating and also a spread is attached on the sides. This is spread basically ploughs this sand which is there in that. Basically it takes the sand and the binder which you are putting in the Muller and it takes and also it has some up and down movement because of this rocker arm set up. This way it goes up and down and a minimum distance also is maintained for the bottom so that it should not crush the sand grains and then it moves, and it properly mixes this sand with the binder. This Muller is used for that purpose.

Then you have aerator, the aerator is used for basically separating the sand grains as we have discussed, the sand grains have been coated with the binders, and once they are going, with the help of their stream, it is thrown and it is ensured that the all this sand grains are separately going out. This way you try to increase the flowability of this sand grains which are coated. These are basically the sand preparation equipment which are used in the case of mold making, and it is ensure that you I mean, for the sand reclamation they are the effective tools.

Apart from that for mold making even you, for hold hand mold making you have different types of tools. That you must have a studied during your 1st or 2nd year courses, in the work shop technology where different are in tools like lifters, swab

dresses and then mold repair all these elementary tools are available for making the mold and repair it.

Thank you.