Metal Casting
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Module – 02
Sand Casting Process
Lecture – 05
Moulding Sand Testing

Welcome back friends, in the previous lecture we have studied about different moulding sand properties; we have seen how these properties are going to affect the final quality of the casting. So, it is important for a foundry men to control these moulding sand properties, that is why in this lecture let us see how to test the moulding sand properties. So, this lecture is moulding sand testing.

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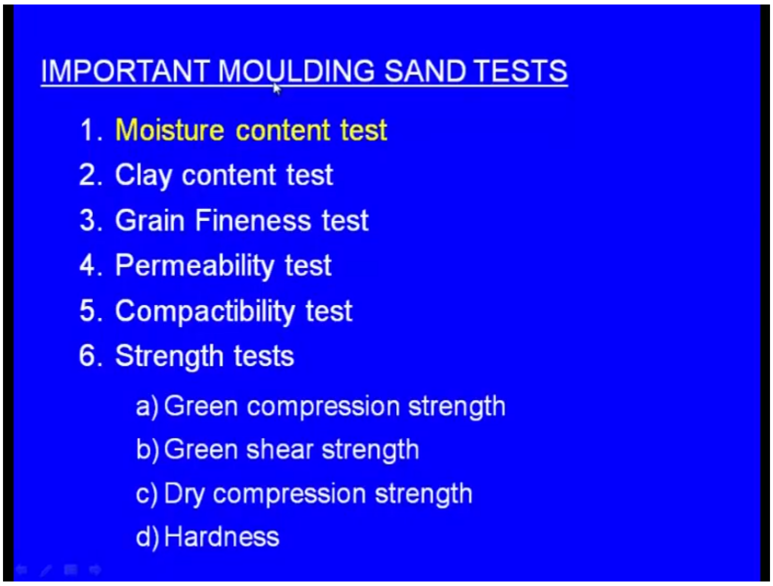

These are the important moulding sand tests, one is the moisture content test another one is the clay content test, next one the grain fineness test, next one the permeability test, next one the compatibility test finally, the strength tests and among the strength test there are 4, one is the green compression strength, green shear strength, dry compression strength and finally the hardness.

Now, let us see these tests one by one, first let us see the moisture content test how to determine the moisture content in a moulding sand. In the beginning we have seen that the moulding sand should contain moisture from 2 to 5 percent, how to know whether it the moisture is between 2 to 5 percent. If the moisture is below 2 percent what can happen, they may not be enough for what say binding or if the moisture content is more than 5 percent, then what happens excessive of steam and hot gases will be produced and because of that there will be blow holes and pin holes on the surface of the casting. So, the moisture content should be optimum. So, how to measure the moisture content in the moulding sand?

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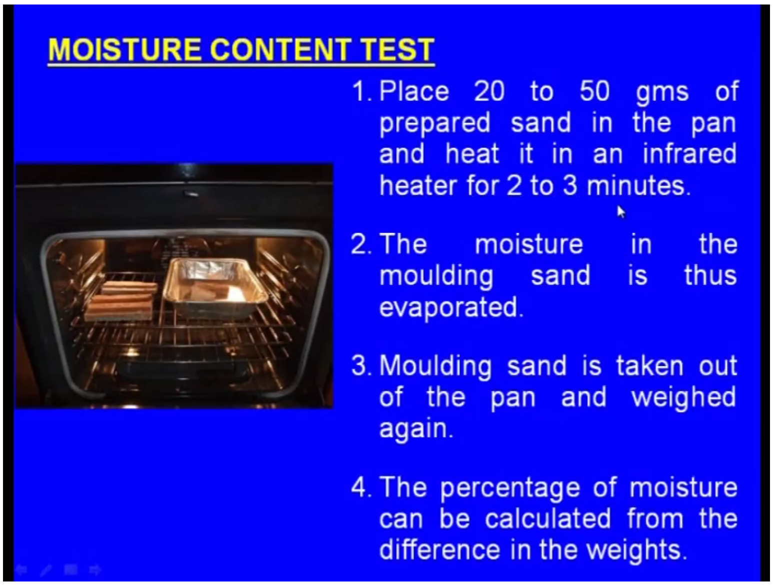

So, this moisture content can be measured using an infrared heater. So, we can see here this is an infrared heater and yes here we can place the sand spaceman.

So, when you keep this what say container with the sand, the green sand inside this infrared heater may be after few minutes the moisture will be dried out; then we can find out the moisture content. So, this is the procedure place 20 to 50 grams of prepared green sand the pan and heat it in an infrared woven for about 2 to 3 minutes, then what happens the moisture in the moulding sand is evaporated. So, initially we have weighed it may be it may be say about 22 or 50 grams of the sand, now the moulding sand is taken out from the pan and it is weighed again, the percentage of the moisture can be calculated from the difference in the weights.

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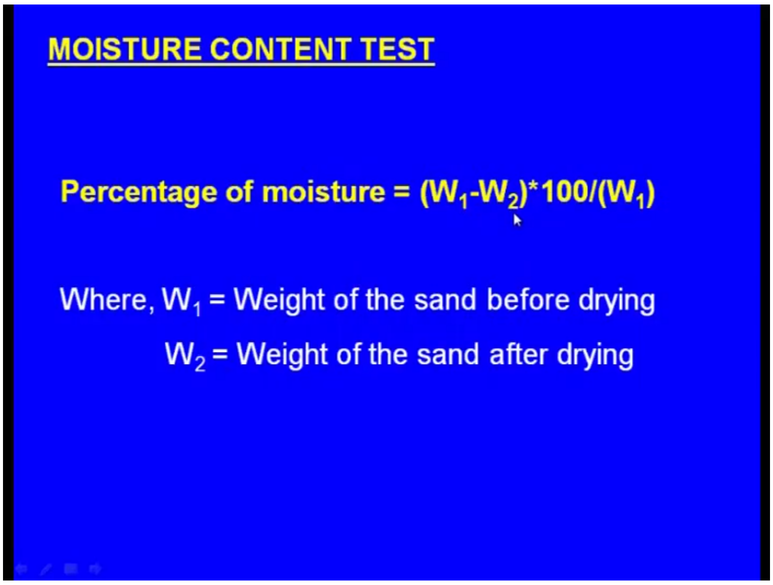

The percent of the moisture is equal to w1 minus w2 multiplied by 100 whole divided by 100, what is this W 1 and W 2? W 1 is the weight of the sand before drying, before we kept inside the infrared woven and what is W2? It is the weight of the sand after drying, difference of these weights multiplied by 100 whole divided by initial weight of the sand gives the moisture content. So, this is the old and traditional method of finding the moisture in the green sand, recently a new techniques have been develop that is the rapid moisture teller.

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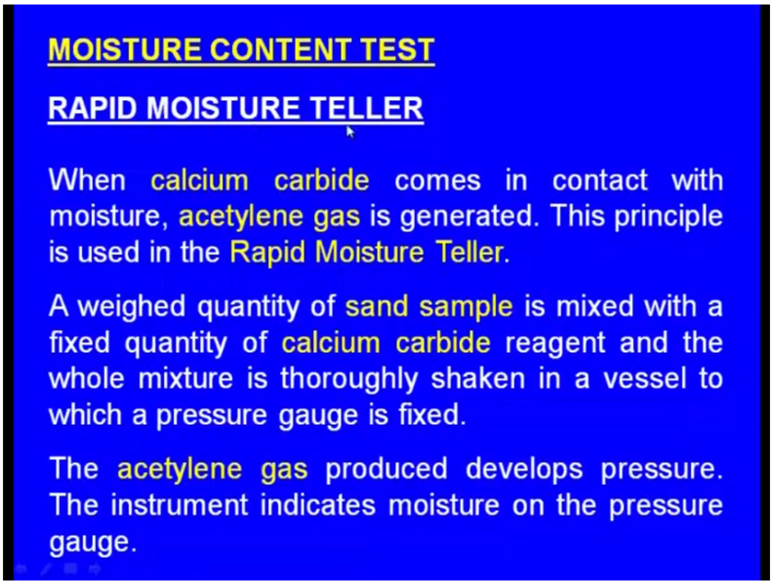

So, this is the new technique develop right, so if the process of the infrared woven it to takes what say we need initially we need to weigh the sand, then we have to put it inside the woven and heat it about 2 to 3 minutes again take it out and again weigh and we have to make some calculation that way it takes about 10 minutes totally whereas, this rapid moisture teller tells us within a minute how? So, this is small equipment, so when calcium carbide comes in contact with the moisture acetylene gas is generated so this is well known to us, now this principle is used in the rapid moisture teller.

Now what we will do a weighed quantity of sand sample is mixed with a fine fixed quantity of calcium carbide reagent and the whole mixture is thoroughly shaken in a vessel in which pressure gauge is fixed. Now we are what say making me calcium carbide react with the moisture of the green sand and accordingly acetylene gas is produced, now what is the amount of acetylene gas produced it depends upon the moisture content of the moulding sand.

Now, the acetylene gas produced develops pressure the instrument indicates moisture on the pressure gauge. So, this pressure gauge is calibrated so right. So, accordingly we can know the percentage moisture in the moulding sand, so this takes very less time that is why it is known as the rapid moisture teller.

Next let us see the clay content test. So, it is very important for us to control the clay in the green sand again. So, when we are talking about the clay yes initially we will be mixing the clay or it is also known as the binder and remember among this clay or the binder the most important binder is the Bentonite, now in the previous lecture we have seen that as we keep pouring the molten metal into the mould, as we keep reusing the sand again and again what happens? Part of the clay or the part of the binder which is close to the mould wall will be heated above 500 degree centigrade.

Once it is heated above 500 degree centigrade it loses all it is binding properties, it cannot create cohesion anymore between the neighbouring sand grains, but physically it is present. So, now we need to what say distinguish between what say actual clay or the active clay or the total clay. Now let us see how to measure clay contest, so clay content means there are 2 terms is it the total clay which is what say some of the active clay and the dead clay or there is the another test in which we only measure the active clay, first let us see how to measure the total clay content right. So, this is the what say an instrument used for the total clay content right.

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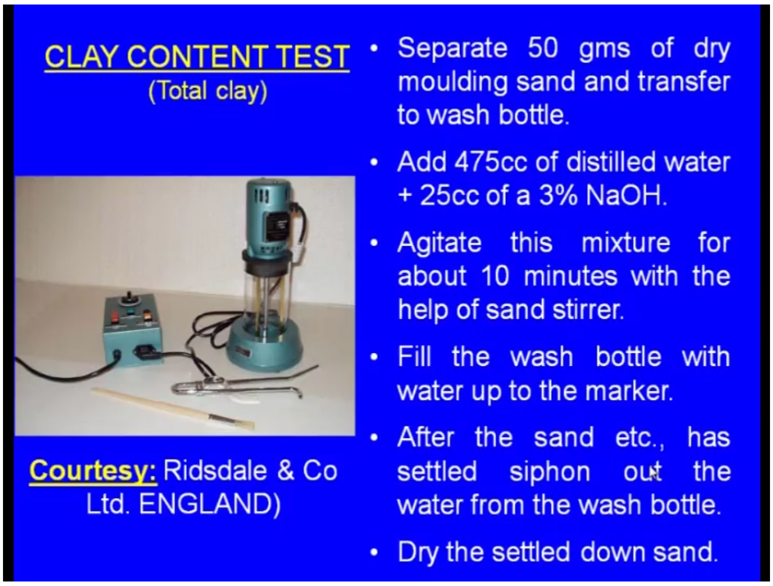

So, this is the equipment now this is used what we do is, we mix the sand in a container with water and we stir it using this equipment. So, this is the way separate 50 grams of dry moulding sand and transfer to wash bottle right, next one add 475 cc of distilled water plus 25 cc of 3 percent NaOH sodium hydroxide. Now hesitate this mixture for about 10 minutes with the help of the sand stirrer this is the sand stirrer. Next one fill the wash bottle with water up to the marker, after the sand has settled right siphon out the water from the wash bottle; now after we stir some time right remember we have mix the sodium hydroxide.

What does this sodium hydroxide do? It separates the clay particles from the sand grains and sees that it ensures that the clay is settle down sorry clay will be floating and the sandal will be settle down. Now while the clay is still what say mixed with the water will be siphon it out using a siphon, now what is there inside the bottle only the water not the water only the fine and clear clean base sand is there, clay has already been siphoned out. Now this sand is to be dried out remember in the beginning we have taken 50 grams of the sand.

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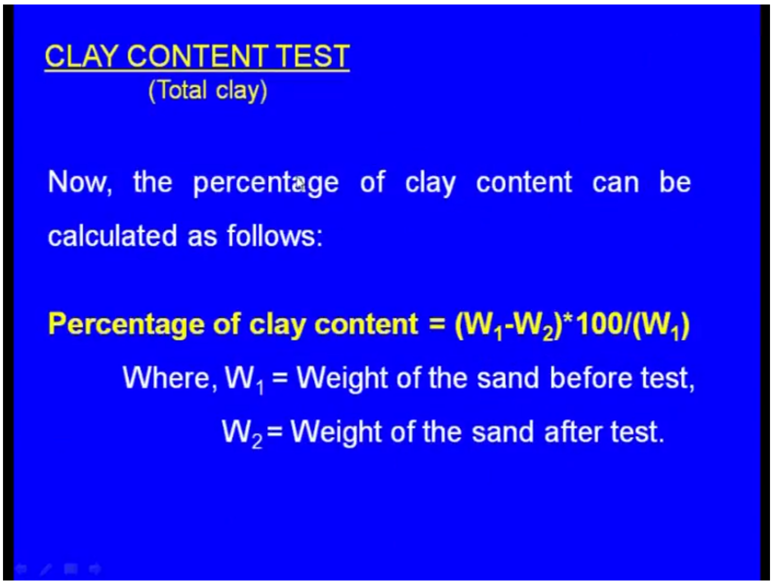

Next one now the percentage of the clay content can be calculated as follows right, percentage of the clay content is equal to W1 minus W2 into 100 whole divided by W1.

Where W1 is the weight of the sand before the test and W2 is the weight of the sand after the test, but remember this is the test for finding out the total clay content, but for us total clay what say content is not so important, but what is the active clay because part of the clay becomes the dead clay. So, what is the active clay, so for that we need to conduct another test. So, this is the clay content to test for the finding out the active clay, the test which we have conducted previously is to that is the test for finding or the total clay.

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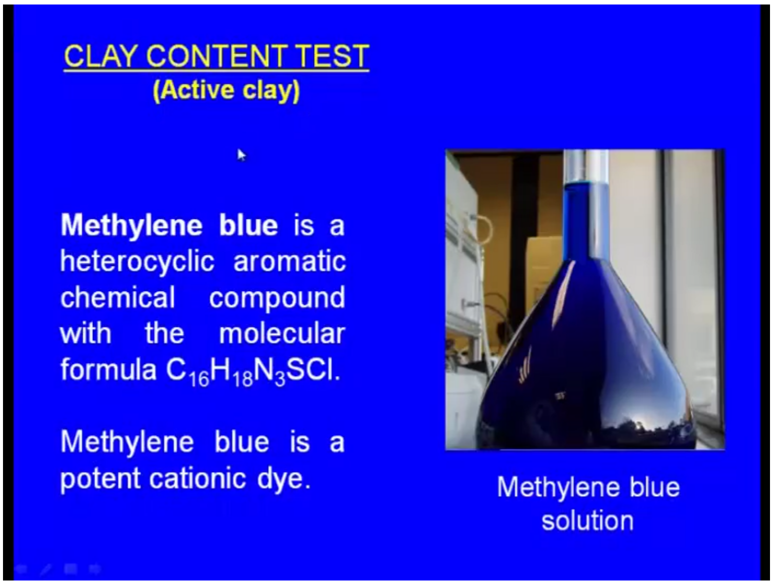

Whereas, the this test we will be using for finding or the active clay right. So, here we use the Methylene blue, what is this Methylene blue solution?

It is what say heterocyclic aromatic chemical compound with the molecular formula, C16 H18 N3 SCl. So, this is a chemical formula of the Methylene blue. Now Methylene blue is a potent cationic dye now how to proceed how to conduct this test.

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So, we have to use an apparatus right. So, this is the apparatus used for the Methylene blue test, in which we will be finding out the active clay content.

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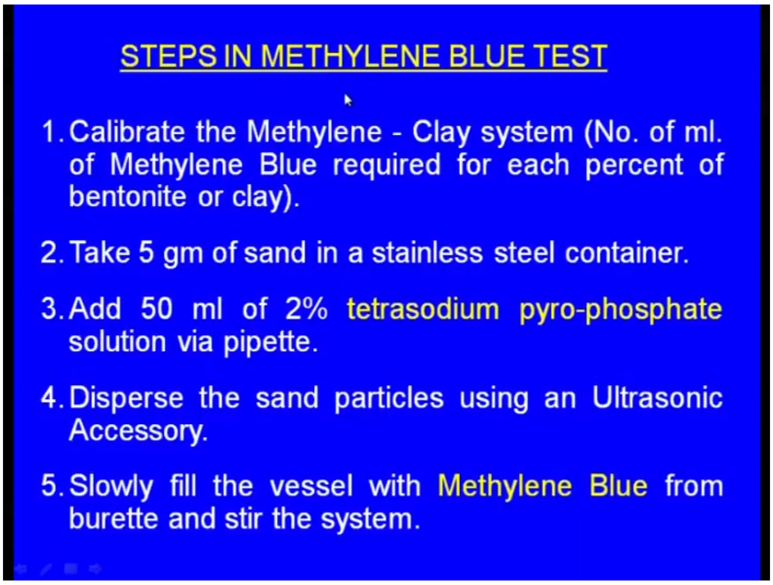

Steps in Methylene blue test, first one what we have to do is we have to calibrate the Methylene with the clay system. So, this Methylene blue solution reacts with the active clay, so as long as the active clay is present right. So, this Methylene blue will be reacting and we cannot see any Methylene blue and it is effects.

Now, what is happening is what say we will be calibrating, say for this much of what say active clay, this much of Methylene blue will be required for reaction, for this much of clay this much of Methylene blue is required. So, this way what they with prior experiments we have to calibrate the Methylene clay system. Next one in the second step so the first part is the calibration second part is the take 5 grams of the sand in a stainless steel container and 50 ml of 2 percent tetra sodium pyrophosphate solution via pipette, disperse sand particles using an ultrasonic accessory right. So, slowly fill the vessel with the Methylene blue from the burette and stir the system.

Now, we have what say mixture of the sand and the tetra sodium pyrophosphate right, now what is happening is we are dropping Methylene blue drop by drop.

Now remember in this sand what say the active clay is there, but we are slowly dropping the Methylene blue solution, as we keep dropping the Methylene blue solution the active clay readily reacts with the Methylene blue solution and sees that Methylene blue has no effect this process will continue. So, how to know that the clay content is exhausted

Methylene blue is dominating. Using a glass rod remove a single drop of the liquid and place it on a filter paper.

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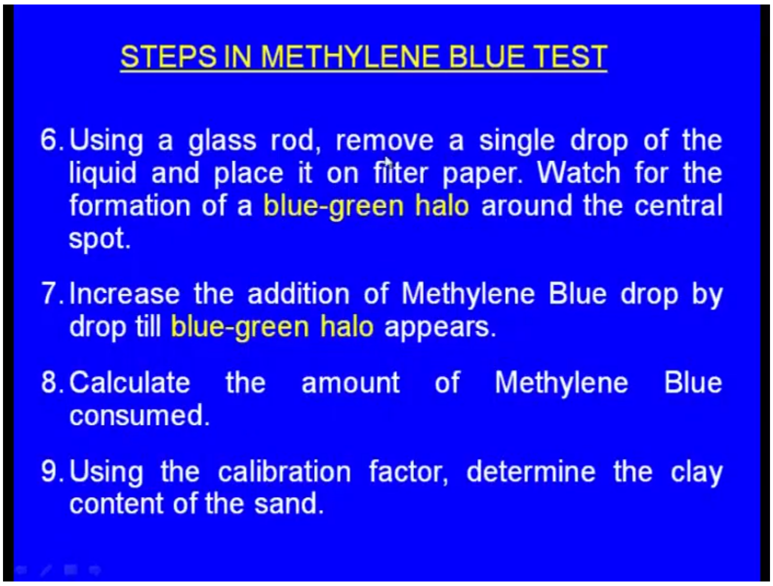

Watch for the formation of a blue green halo around the central spot. So, this is the indication that the active clay is exhausted and Methylene blue is dominating. We have to take a what say glass rod and remove single drop of the liquid and place it on a filter paper. If the what say active clay is exhausted then there is little excess amount of Methylene blue and because of that when you place the drop on the filter paper there will be a blue green halo, means that is an indication that the active clay content is exhausted then we have to stop what say drop in the Methylene blue solution right.

So, if we do not see what say blue green halo increase the addition of the Methylene blue drop by drop till blue green halo appears, once of this blue green halo appears we have to stop dropping the Methylene blue solution. Now we have already calibrated between the Methylene blue solution and the clay content. Now how much Methylene blue is what say consumed, that we have to find out from the burette now from that calculate the amount of from the burette, calculate the amount of the Methylene blue consumed and based on the consumption of the Methylene blue, using the calibration factor determine clay content of the sand. Remember that Methylene blue does not react with the dead clay, it reacts only with the active clay. So, that is how we can find out the active clay in the green sand. Next one let us see among the moulding sand properties let us learn how to find out the grain fineness test.

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So, for finding out the grain fineness test, there will be what says sieve shaker will be there. So, the equipment looks like this there will be different sieves will be there and here we can see different sieves are there right. So, there will be for each sieve there will be a mesh will be there, in one mesh there will be coarser what say holes will be there in some other meshes medium holes will be there and in some other meshes fine holes will be there. So, initially at the top the coarser mesh will be there you can see this one is the coarser mesh. Below that say the mesh me having the little smaller holes will be there below that, likewise there will be more what say more sieves will be there and all these will be arranged one over another.

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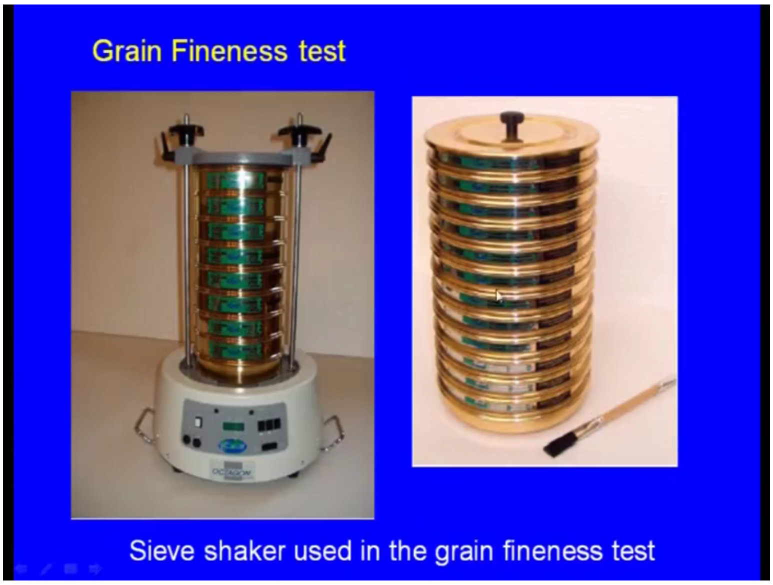

At the bottom there will be a pan and here we can see when all these say sieves are arranged together it looks like this and this is known as the sieve shaker. Now how to find out the grain fineness number? This remember first of all what is this grain fineness number. This grain fineness number tells us how big the sand grains are or how small the sand grains are. If the grain fineness number is very high means the sand grains are very fine sand grains, on the other hand if the grain fineness number is very small it indicates that the sand grains are very coarser sand grains.

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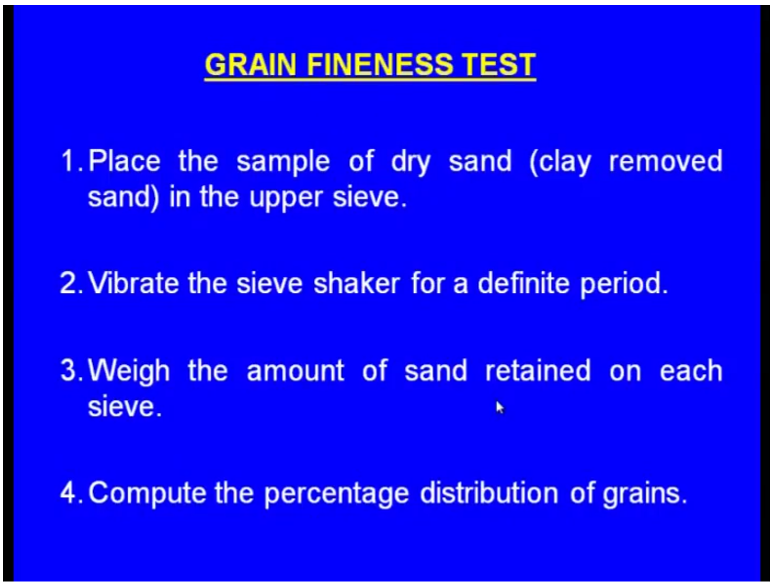

Now this is the way place the sample of dry sand after removing the clay in the upper sieve.

Generally a people place 50 grams or 100 grams place the sample of the dry sand, remember it is dry sand and free from the clay. Next one yes we put it in the here we open this lid and here we places that to dry sand 50 grams or 100 grams, next vibrate the sieve shaker for a definite period yes this can be vibrated, there will be a vibrating system will be there, we can set it to the for vibrating 10 minutes 5 minutes or 15 minutes and this whole structure will be vibrating, now what happens? The sand which we have placed inside slowly it will be coming down and if they remember and this sand may contains different what say grain sizes right, maybe few sand particles or coarser few sand particles are finer and few sand particles are of medium size.

Accordingly the finest particles will reach the bottom pan, whereas the medium sized sand particles will be collected somewhere in the between in between, whereas the coarser particles will be remained in the upper sieves. So, that is how the sand will be distributed in different sieves. Now where now we stop vibrating this sieve shaker, weigh the amount of sand retained on each sieve means we have stop it and we have to remove separate all these sieves and carefully collect the sands that are collected in each and every sieve and we how to very precisely we have to vary sands in all these pans, then compute the percentage of distribution of the grains.

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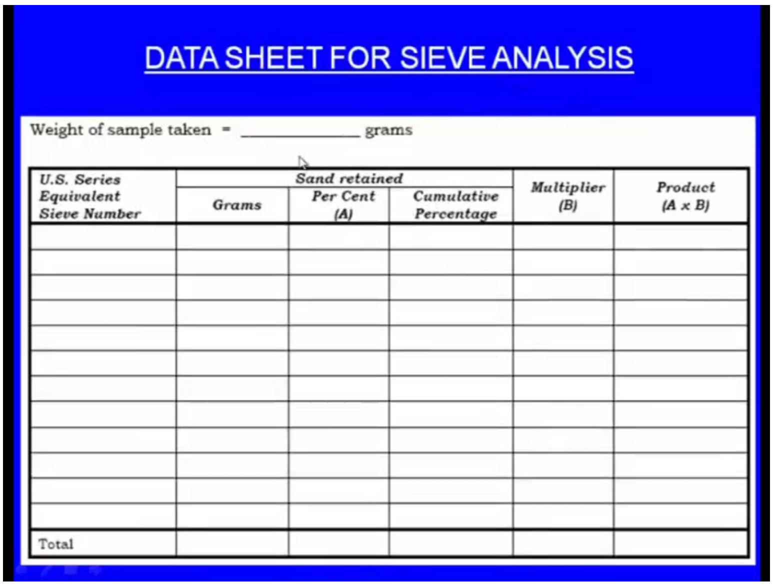
DATA SHEET FOR SIEVE ANALYSIS

Weight of sample taken = ____________ grams

U.S. Series Equivalent Sieve Number	Sand retained			Multiplier (B)	Product (A x B)
	Grams	Per Cent (A)	Cumulative Percentage		
Total					

So, this is the data sheet for the sieve analysis right. So, here we can see each sieve has been given a specific number right.

So, what is the sand initially we have dropped right and the percentage we have to enter here, next one is this is the cumulative percentage and say for each what say sieve there will be a multiplier will be there. Now after that there will be a product of A and B means percentage collection of the sand in each sieve, multiplied by the what say this multiplayer product right this is the product A into B. Now grain fineness number it is indicated by GFN.

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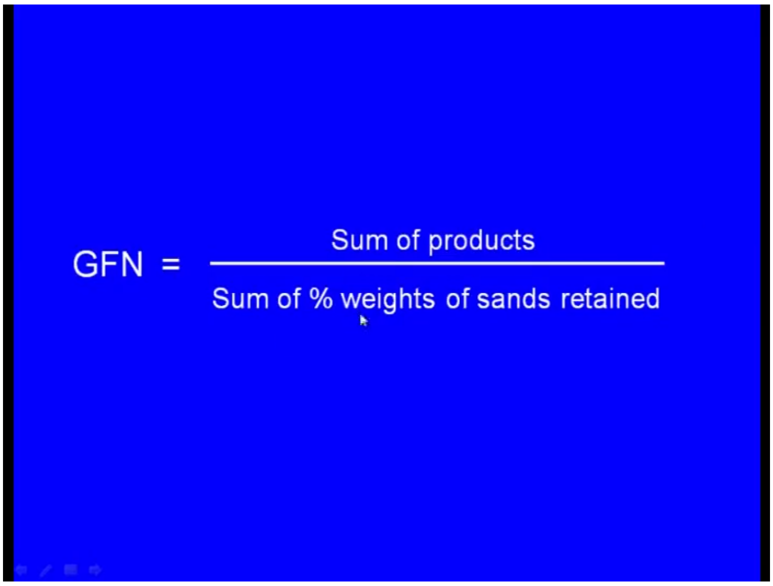

Sum of the products divided by sum of the percentage weights of the sands retains what are these percentage weights and here we can see these are the percentage weights and if we add up these here we get the sum of the percentage weights means.

Sum of these products divided by sum of these percentage weights gives us the grain fineness number that is how we can find out the grain fineness number. Grain fineness number is indicated by or simply is known as the GFN.

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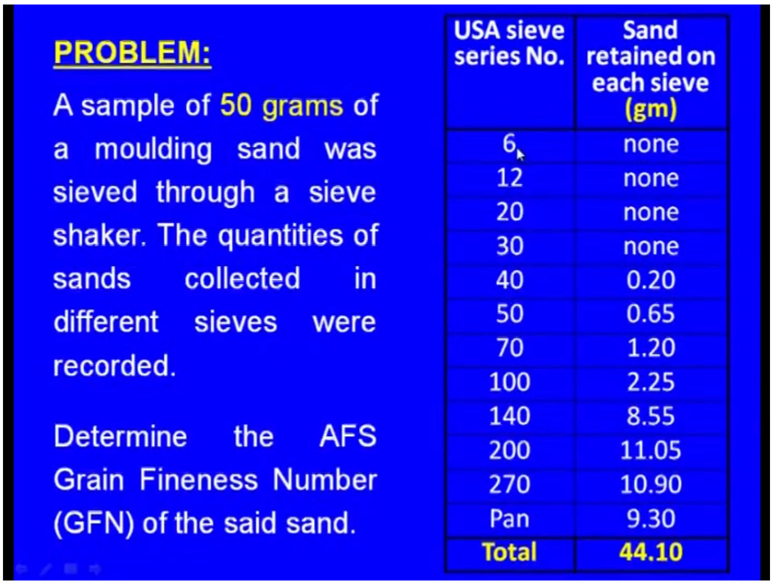

Now let us take a problem; a sample of 50 grams of moulding sand was sieved through a sieve shaker, the quantities of sands collected in different sieves were recorded. Determine AFS grain fineness number of the sand and what are the quantities of the sands collected in different sieves. So, these are the quantities of the sands, remember the different sieves are assigned the different numbers, the first sieve is assigned the number 6, the second sieve is assigned number 12, third sieve 20, fourth sieve 30, fifth sieve 40, sixth sieve 50, seventh sieve 70, eighth sieve 100, ninth sieve 140, tenth sieve 200, eleventh sieve 270 and the finally, the pan will be there. So, totally including the pan there, will be 12 sieves will be there of course, pan cannot be considered as the sieve with excluding the pan there will be 11 sieves will be there. Now in these sieves, these are the sands collected in the right in the first I think first 4 sieves there was no sand was corrected, next one in the war say 40 is excessive means the sieve with the number 14 0.2grams were collected.

Similarly, in the sieve with number 50 0.65 grams were collected, similarly in the sieve with number 70 1.2 grams were collected, similarly in the sieve with the number 100 2.25 grams are collected and in the sieve with number 140 8.55 grams are collected in the sieve with number 200, 11 0.5 grams are collected and with the last sieve with the number 270, 10.9 grams are collected and finally in the pan 9.3 grams are collected and these are the total we can see 44.1 grams are retained or collected right and there will be a loss will be there because say some sand grains will be trapped between the meshes and when we separate the meshes and we when we what say take them out some sand particles are tapped and they would not come out, that is how though we have what say taken 50 grams and finally if we add up all the sands which we take from different sieves it will be less than 50 grams.

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USA sieve series No.	Sand retained on each sieve (gm)	Percentage of sand retained (A)	Multiplier (B)	Product (A×B)
6	none	0.0	3	0
12	none	0.0	5	0
20	none	0.0	10	0
30	none	0.0	20	0
40	0.20	0.4	30	12
50	0.65	1.3	40	52
70	1.20	2.4	50	120
100	2.25	4.5	70	315
140	8.55	17.1	100	1710
200	11.05	22.1	140	3094
270	10.90	21.8	200	4360
Pan	9.30	18.6	300	5580
Total	**44.10**	**88.2**		**15243**

Now this is the given data so this is these are the right AFS sieve numbers these are all and this is the these are the sand what say amounts collected in different grain what say sieves and in the first 4 sieves no sand is collected and these are the sands collected in different sieves. Now this is the percentage of the sand retained, now what is the amount of sand that we have taken? We have taken 50 grams of sand, now what is the in 50 grams of the sand.

So, this is the amount of sand contained 0.2 grams and if you want the percentage, it will be 0.4 grams and here in the sieve with the number 50 0.65 grams are were retained. Now what is the percentage 1.3. Similarly here it is 2.4 and here it is 4.5 and here it is 17.1, 22.1 right. 21.8 and 18.6 and this is the sum of the what say amounts of the sands retained in different sieves, that the percentage what say of the retained sands here. Now here we can see an important curve that is the multiplier; for each sieve there is a particular multiplication factor right.

For the first sieve the multiplication factor is 3, for the second sieve means with the sieve number 12 the multiplication is factor is 5 and for the third sieve the multiplication factor is 10 and for the fourth sieve the multiplication factor is 20 right. For the see what say sieve with number 40 the multiplication is 30, for the sieve with number 50 the multiplication factor is 40 and for the sieve 70 the multiplication factor is 50 for the sieve 100 the multiplication factor is 70, for 140 sieve the multiplication factor is 100, for 200 sieve the multiplication factor is 140, for 270 sieve the multiplication factor is 200 and for the pan the multiplication factor is 300 and It is easy to remember these multiplication factors.

For example, I will show you see here we can see it this is the multiplication factor, say for example, you consider this sieve with 270 what is it is multiplication factor? 200, that 200 is the previous sieve number. You see this is the previous sieve number similarly for 200 meshes. sieve the multiplication factor is 140, but you see what is this 140 is the sieve number of the previous sieve number you see similarly for 140 sieve, the multiplication factor is 100 and what is that 100 it is the sieve number all right the previous sieve number. You see like this likewise it is easy to remember these multiplication factors, now in the last column we are finding out the product A into B.

Where A is the percentage of the sand retained in each sieve B is the multiplication factor which is assigned for what say each and every sieve, now here we are making product A into B. Now the total the sum of the product is 15243, the sum of the percentages of sands retained is 88.2 now we will find out the grain fineness number, grain fineness number is equal to sum of products divided by sum of percentage weights of sands retained, what is the sum of products? Sum of products is this much 15243 and what say sum of percentage of the sands retained is 88.2, so yes now we have substituted those values in this formula.

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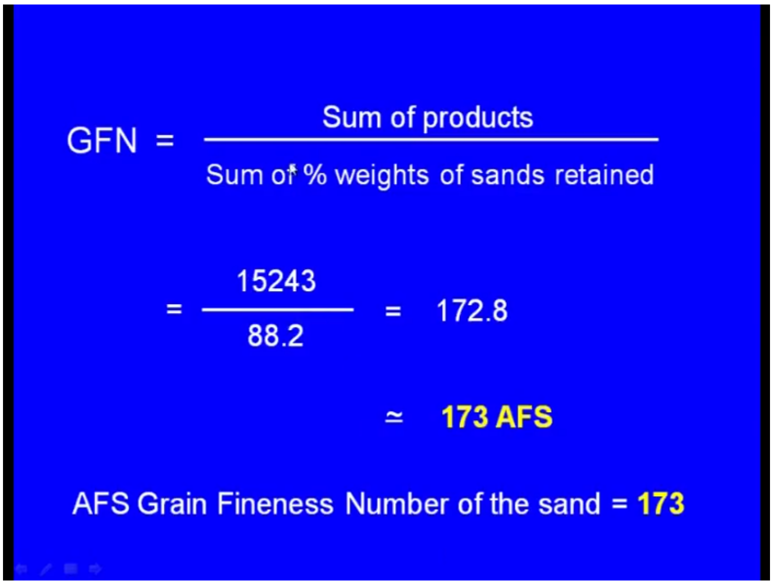

Now, we are getting grain fineness number is equal to 172.8 or it is approximately equal to 173 AFS. So, the AFS grain fineness number 4 these sand is 173, so this is the way to find out what say grain fineness number of the moulding sand. So, remember this what say what say number seems to be little high, generally in most of the sand foundries the grain fineness number right of the sand casting industries it will be between say 50 to 70. So, that is the normal what says grain fineness number of those sands and here the grain fineness number is 173 means this is very fine sand.

On the other hand if the number happens to be very low below 50 or below 40 then it is very coarse sand, whereas this one is a very fine sand. So, that is all that is the interpretation of the grain fineness number. Next one let us see the permeability test; we have seen that what is permeability? Permeability is the ability of the moulding sand to enable hot gases to pass through the neighbouring sand grains and finally to the atmosphere, because when we pour the molten metal the moisture in the moulding sand readily reacts with the molten metal and forms steam and hot gases these stream and hot gases, will be escaping through the gaps between the neighbouring sand particles and finally they leave the mould. So, a good moulding sand should have this property of the permeability.

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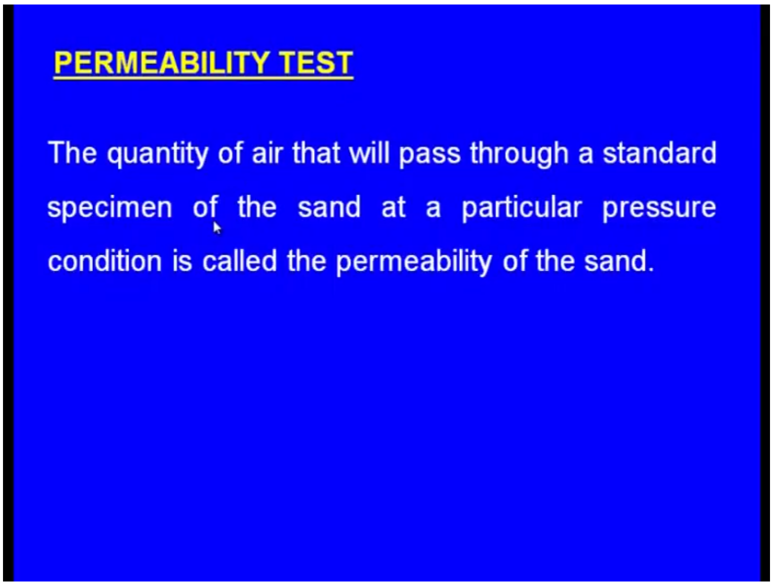

If the permeability is not adequate what happens, the gases thus produced will be accommodated inside the mould and finally they lead to the gas and blow defects blow holes defects. Now how to know whether our sand has the required permeability or not; we have to determine. So, how we will determine this permeability, the quantity of the air that will pass through a standard specimen of the sand at a particular pressure condition is called the permeability of the sand, means we will make a sand specimen may be generally it is 2 inches diameter and 2 inches height and generally about say 2000cc of air will be made to pass a at a particular pressure, but whether 200 cc will pass right or not we have to see. So, that is how we used to measure the permeability so, for that purpose we use the sand rammer right.

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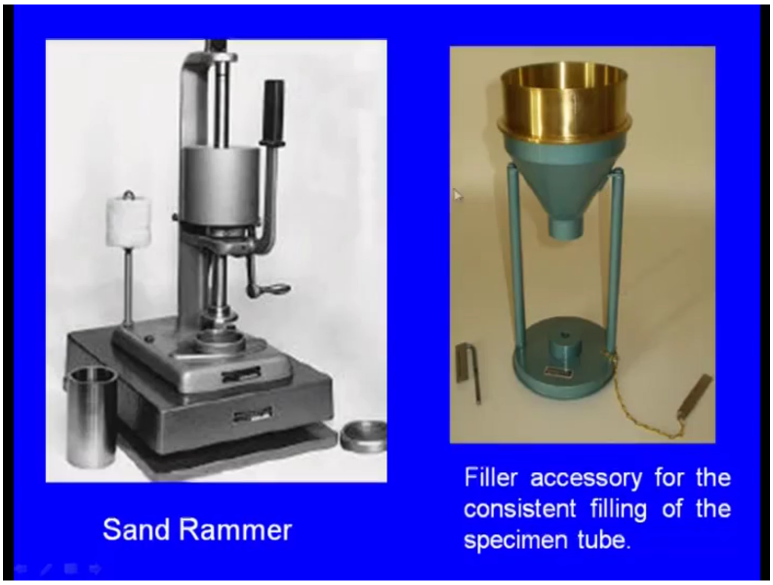

So, this is the specimen tube it is a cylindrical tube and inside this is what say specimen tube we placed the sand, for placing the sand effectively we place the tube here take this tube and put it here. So, this is the filler accessory and through this of funnel we what say drop what say green sand and the grain sand green sand will be dropping inside this specimen tube and now we place this specimen tube here, so this the sand rammer.

So, this sand rammer has a hammer you can see and this is the hammer and this is the what say hand spindle, we can rotate this spindle like this and every time when you rotate this hammer will go and suddenly will fall, again if we rotate it will go and it suddenly it falls. So, when we place this what say sand specimen here and with the sand inside that and yes now you rotate the what say that spindle the hammer goes up and falls down and the sand will be compacted. Generally people give 3 to 5 rams, now the sand will be compacted inside the specimen tube right, now we now to take this specimen tube with the compacted sand inside to the permeability meter.

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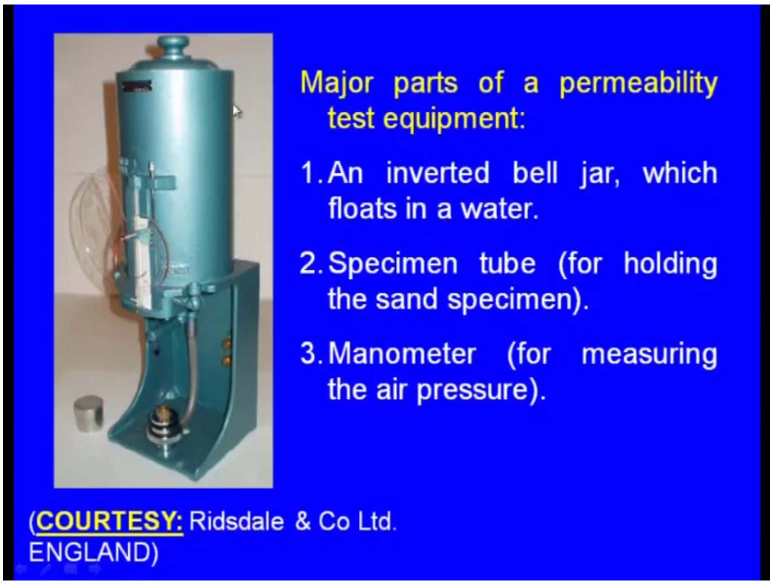

So, this is the permeability meter or the permeability test apparatus, now how to measure what say permeability using this permeability apparatus. Now previously we have filled what say moulding sand in this specimen tube we have to bring this placement tube and we have to place it here, we can see here there is a what say whoop ring here. We have to place it and here we can see there is a jar and there will be water in it and with this what say what say handle or a this lid can be raised up, then what happens air will be going inside. Now when you release it slowly the air will be coming out and it will be passing through this tube and finally it will pass through the sand specimen. So, this is what say permeability apparatus right. What are the components it has an inverted bell jar which floats in a water so this is the inverted bell jar, now it right specimen tube for holding these sands specimen right. So, here we place the specimen tube and finally there is a manometer for measuring the air pressure and here we can see there is a manometer

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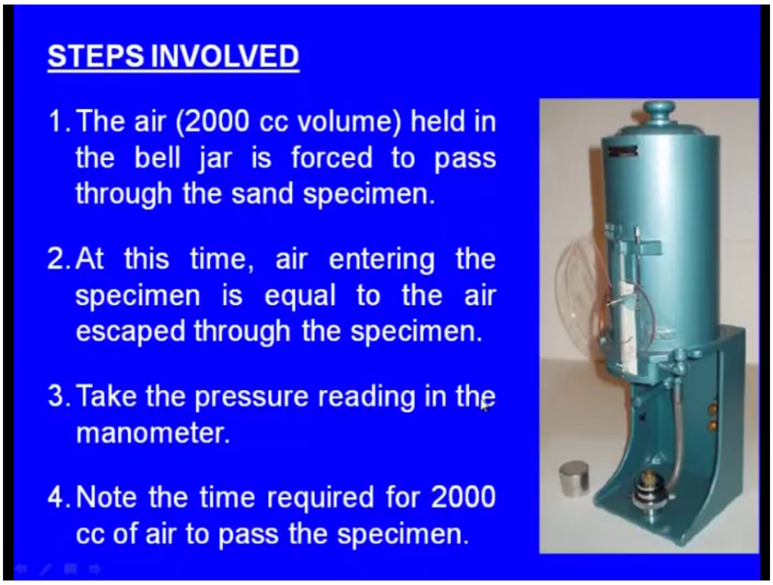

What are the steps involved 200cc volume of air held in the bell jar and it is forced to pass through the sand specimen, at this time air entering the specimen is equal to the air escaped through the specimen, take the pressure reading of the manometer right. Note the time required for the 200 cc of air to escape through the specimen, now permeability can be measured like this.

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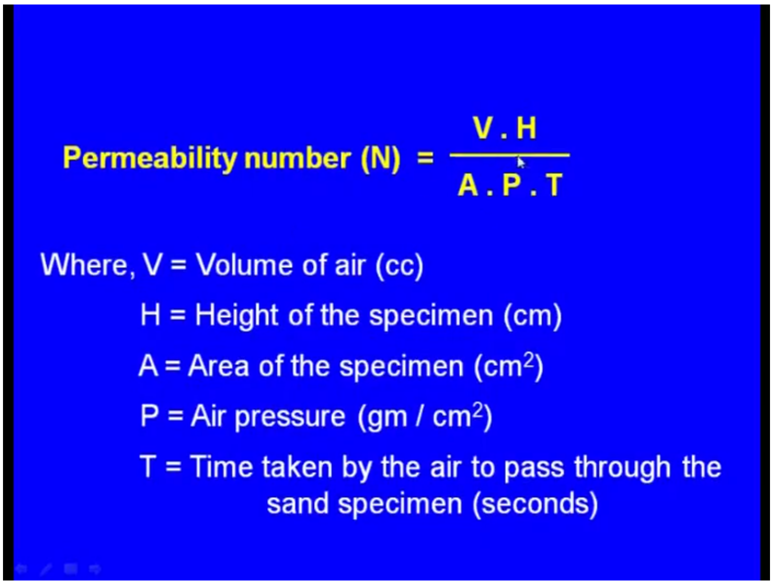

Permeability number is equal to V H divided by A P T, where V is the volume of the air, H is the height of the specimen in centimetres, A is the area of the cross sectional area of the specimen that is the space centimetres. Next one P is the air pressure grams per square centimetre, next one T is the time taken by the air to pass through the sand specimen and this is expressed in seconds, now let us take a problem.

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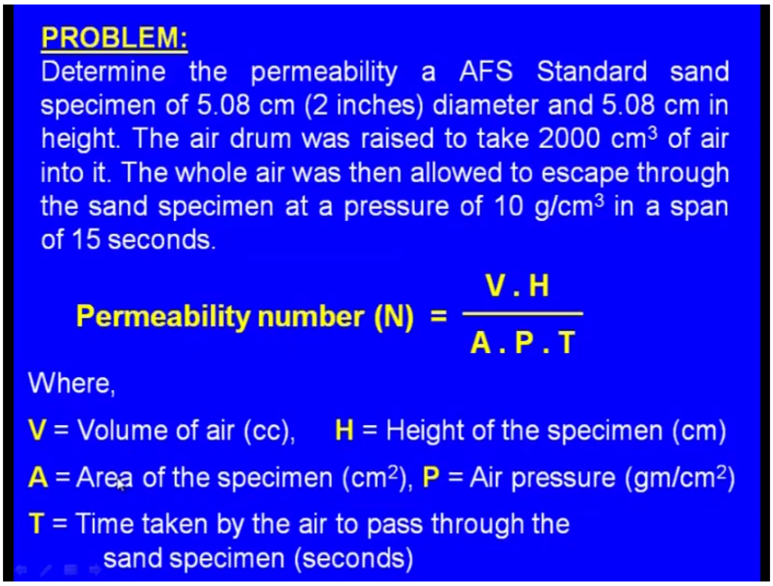

Determine the permeability of a AFS standard what say specimen of 5.08 centimetres means 2 inches diameter and 5.08 centimetres means 2 inches height, the air drum was raised to take 2000 cubic centimetres of air into it, the whole air was then allowed to escape through the sand specimen at a pressure of 10 grams per or centimetre square meter this is square in a span of 15 seconds. Now how to calculate the permeability? First of all this is the formula for the permeability, permeability number V H by A P T where Vis the volume of the air in cc, H is the height of the specimen in centimetres, A is the cross sectional area of the specimen square centimetres and P is the air pressure, next one T is the time taken by the specimen to pass through, time taken by the air to pass through the specimen and it is experienced in seconds.

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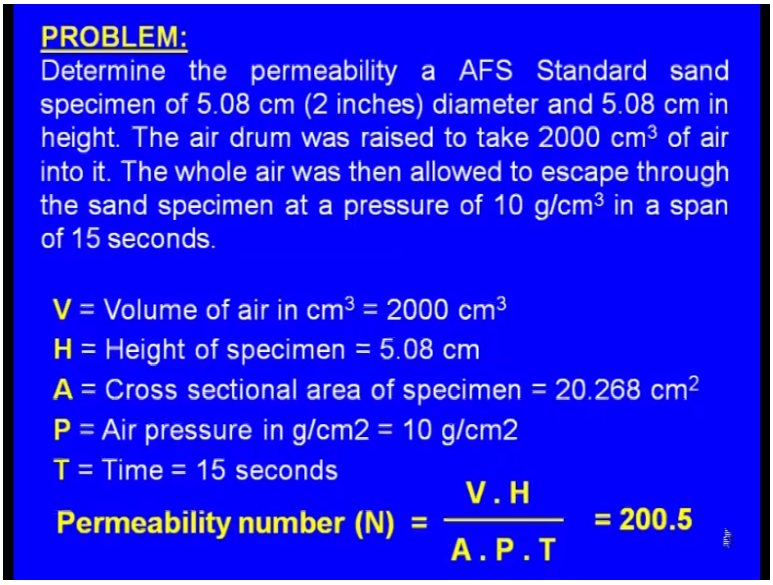

That way V is equal to 2000 cubic centimetres, next one H is the height of the specimen that is 5.08 centimetres, A is the cross sectional area of the specimen that is 20.268 square centimetres, P is the air pressure that is 10 grams per square centimetre, next one T is the time that is the 15 seconds, now we have the formula so this is the formula for the permeability V H by A P T, let us substitute these values in this formula when we substitute and simplified the permeability becomes 205. So, this is the permeability of the sand. So, we have seen how to measure the permeability of the moulding sand. Next one let us see the compatibility test. So, we have covered moisture content test clay content test, grain fineness test permeability test and now let us see the compatibility test. What is this compatibility?

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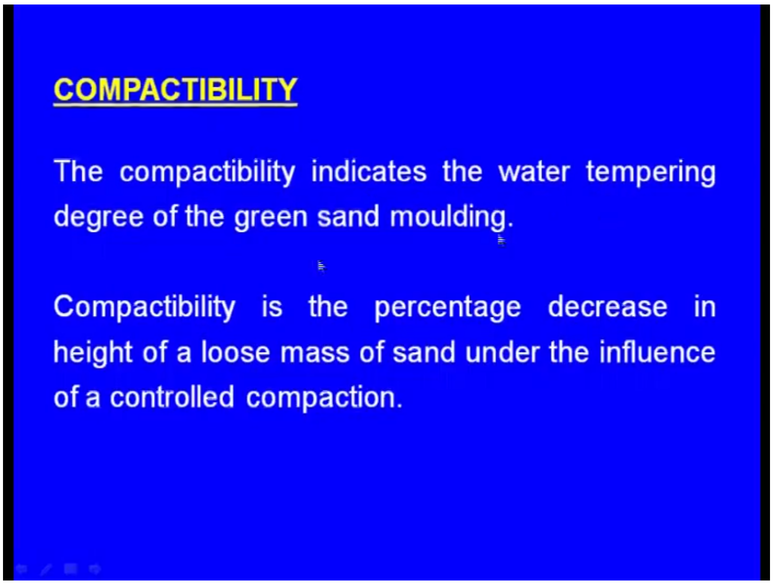

The compatibility indicates the water tempering degree of the green sand moulding, then how to measure it compatibility is the percentage decrease in height of a loose mass of sand under the influence of a controlled compaction, we take the what say loose sand and we make a controlled compaction, then what is the reduction in height percentage reduction in height that is the compatibility. So, this is the compatibility scale accessories right mounted on the sand rammer, sometime back we have seen the sand rammer right. So, to measure the compatibility this is the compatibility accessory which is fitted on the sand rammer.

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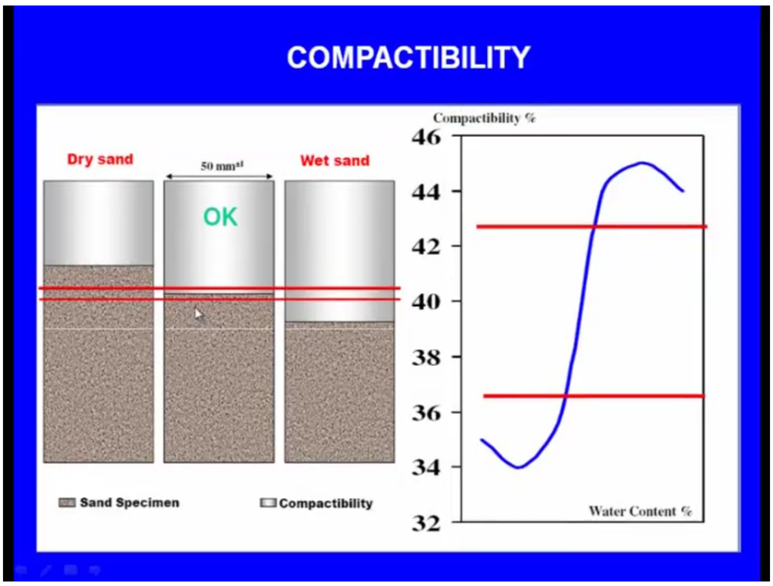

Now we can see here since these are the we can see here 3 specimens are there specimen tubes and this is the moulding sand this is also the moulding sand and this is also the moulding sand and all the 3 specimens are given same compaction, may be they are given 3 what say rams, but see the reduction is this much in this case, in the second case the reduction is this much, in the third case the reductionism this much means the third sample has the highest compatibility and this is how the compatibility varies with the clay content.

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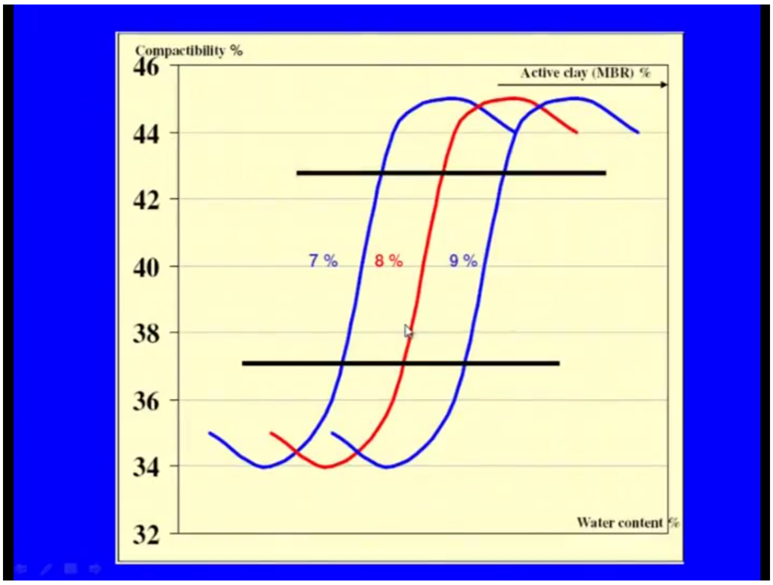

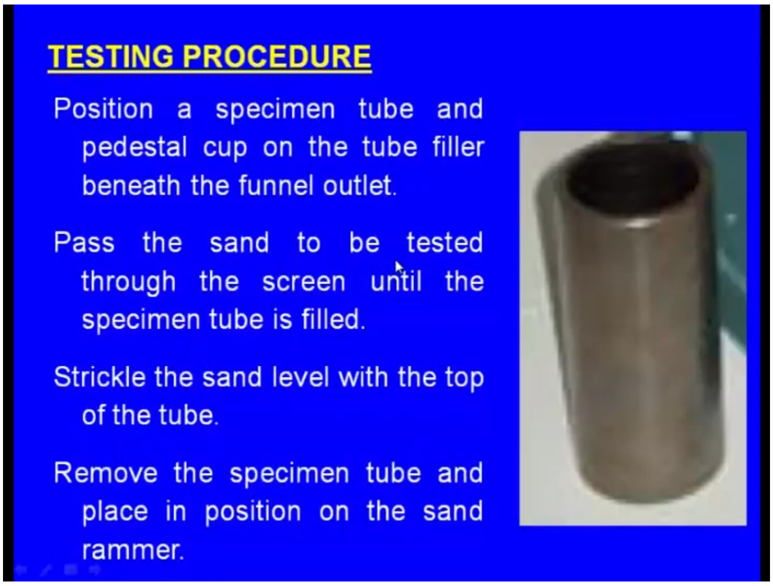

Now testing procedure, how to measure the compatibility, position a specimen tube and pedestal cup on the tube filler beneath the funnel outlet, next one pass the sand to be tested through the screen until the specimen tube is filled. So, fill this specimen with the moulding sand loosely do not compact to yourself right, next one stickle the what say sand level with the top of the tube, if there is any excess sand that one we have to stickle.

Next one remove the specimen tube and place in position on the sand rammer now we have to take this specimen tube after placing sand inside and we have to put it under the sand rammer. Now this is the sand rammer and this is the specimen tube and the specimen tube and we have to place it here and right. So this is what say we can with that we can rotate and we here we can see this is the hammer and it goes suddenly it falls goes suddenly it falls.

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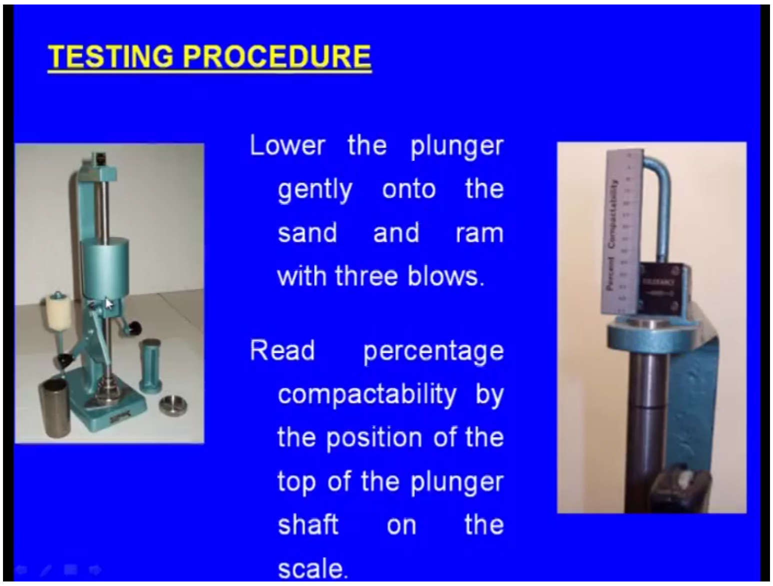

Now, when we place the specimen tube with sand and we can give rams generally lower the plunger and gently on to the sand and ram 3 blows, 3 rams have to be given. Then what happens this is the accessory to measure the what say this compatibility, now this accessory will be fitted here now when we give the 3 rams certainly there will be reduction in the height of the sand .

If it has got a good compatibility there will be more reduction and if it has a poor compatibility there will be less reduction, accordingly read the percentage compatibility by the position of the top of the plunger shaft on the scale. So, here we can see how much reduction is there accordingly from that we can see the percentage reduction also. So, that is how we can find out the compatibility of the moulding sand. Finally let us see the strength tests under the strength tests, we have the green compression strength and we have the green shear strength we have dry compression strength and finally we have the hardness.

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So, let us see how to measure the green compression strength for measuring the green compression strength also we have to prepare the sand specimen, in the same way yes this is the sand what say tube specimen tube and in this we have to place the moulding sand.

Now, we have to what say give the blows or we have to make the give the rams generally 3 rams or 5 rams now right. So, this is used for what say filling easily means what say the specimen tube is kept here and through this way we put the moulding sand, we place the moulding sand. So, the moulding sand is easily placed in to the tube.

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Now, there is a universal sand strength machine is there, you can see this is the universal sand strength what say machine. Now we have to prepare the sand specimen yes this is the tube and in the in to that we have to place the moulding sand and using the rammer and we have to make the rams and the sand will be compacted and here we can see the what say specimen separator.

So, using that we can separate the sand specimen from the tube and this sand specimen we have to kept keep here. So, these are the here we can see there is a pendulum is there right, this pendulum here we can see is a small wheel is there and when we rotate this wheel what happens the pendulums slowly goes up and here there is a graduation is there and here there is a scale and for what say green compression strength there will be one scale, will be there green shear strength there will be another scale, will be there similarly for dry compression strength and dry shear strength there will be another 2 more scales will be there totally there will be 4 scales will be there here.

Now, we are measuring the green compressions strength, for measuring the green compression strength right we have to put this specimen at the bottom and these what say specimen holders will be plane holders right, between these plane holders we place this specimen and when we rotate this pendulum as it goes up the weight of the pendulum falls on the sand specimen, at one stage this specimen breaks and a magnet will be what say carried along with the pendulum somewhere here a magnet will be there.

So, as the pendulum is going up it goes they magnet goes along with that, the moment the sand specimen breaks there the what say magnet will be what say arrested and of course, the pendulum comes back because the specimen is broken. Now where the what say magnet is arrested the that is the what say green compression strength, next one using the same what say sand universal sand strength machine we can also measure the green shear strength right.

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So, this is the here we use the specimen pads used for the shear strength. So, here the specimen pads are different from the specimen pads that are used for measuring the green compression strength. In the case of the measuring the green compression strength the specimen pads are plane, here they have a projection here he this is 1 pad and there is a projection here and this is the other pad and here also there is a projection and in between we place the sand specimen and yes we place it on the what say universal, what say sand strength machine.

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What happens as the machine what say pendulum is going up, what happens previously compression force was falling on the specimen.

Now, because of the what say pads the nature of the pads, now a shear force will be acting on the specimen again same thing you keep rotating this right pendulum, pendulum will be going up, at one stage they there will be shear will be maximum and the specimen will be broken and the magnet will be carried along with the pendulum at one place it will be arrested, where it is arrested and now we have to refer to the scale which is meant for measuring the green compression strength right. There note down that reading that is the green compression strength. Now same way we can also find out the dry compression right. So, for measuring the dry compression strength yes at the bottom for this is the position for placing the or for finding out the green shear strength and green compression strength.

When we want to measure dry compression strength and dry shear strength we have to place the specimen here at the top and the same thing the pendulum will be there and we have to rotate the pendulum will be raised up, as it is raised up the load will be falling on the sand specimen, but one thing is here more load will be falling on the sand specimen. Same thing if we want to find out the dry compression strength yes keep rotating that at one stage the specimen fails and now we have to refer to that scale which is meant for measuring the dry compression strength, from that scale and from where the magnet has stopped that is the reading of the dry compression strength. Similarly if we want to measure the dry shear strength now we have to change the pads, for measuring the dry compression strength and what say green compression strength, the pads will be plane for measuring the dry shear strength and for measuring the green shear strength. The pads will have what say projections on both the sides.

So, because of the projections your shear will be induced, now here we have to use the second set of the pads though which are meant for measuring the shear strength, yes the dry specimen will be here and keep rotating the pendulum at once stage they will fail; now we have to refer to the scale which is meant for measuring the dry shear strength where the magnet has stopped that indicates the dry shear strength of the specimen.

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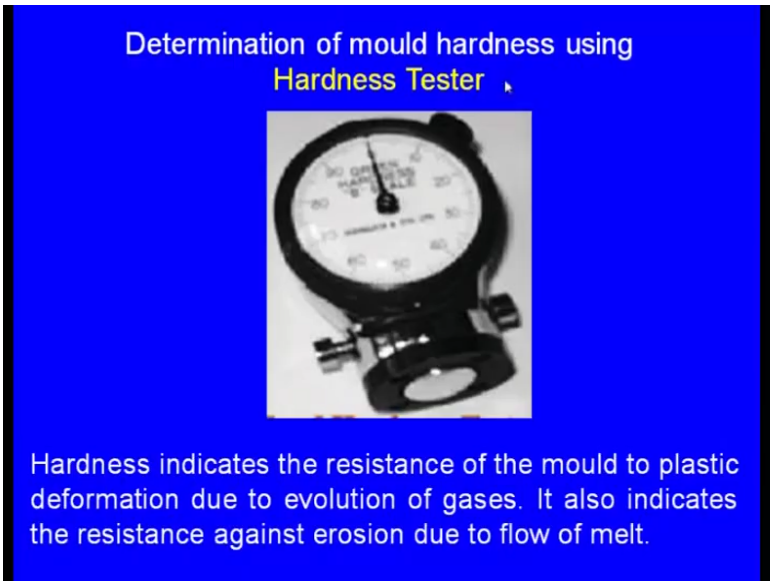

Finally this is the determination of the mould hardness. So, right for measuring the hardness, so this is the what say small device this is known as the hardness tester, now right it is what say there is a scale is graduated inside the dial, now here we can see there is a small what say projection is there.

So, this actually is pushed when we want to find out the hardness. Hardness, indicates the resistance of the mould to plastic deformation due to evolution of the gases; it also indicates the resistance against erosion due to flow of melt. So, that is the hardness now what we do? We prepare the sand specimen and above the sand specimen we take this hardness tester and press it and here is the knob and the knob will be little pushed up because of done that what say the dial gauge here it will be rotating, how much it is rotating accordingly we can know the hardness of the moulding sand. Not only what say specimen, even on the final mould we can find out the hardness in a similar way, just to take this hardness tester and press it on the mould and we can know the reading.

Friends in this lecture we have seen the different methods to find out the properties of the moulding sand right, not the properties how to conduct the what say different tests and we have learnt how to measure the moisture content test right and we under the moisture content is the traditional method we have learnt and the rapid moisture teller method also we have learnt. Next we have seen to what is the method to find out the clay content the active clay and the total clay both the methods we have seen, for finding out the active clay there is a method called the Methylene blue test, that we have learnt. Next one we have seen how to measure the grain fineness number right.

So, the grain fineness number indicates the size of the sand particles, if the grain fineness number is very low the sand particles are very coarser, on the other hand if the grain fineness is very high the sand particles are very fine particles. So, how to they measure this grain fineness number we have learned. Next one, permeability; permeability means ability of the moulding sand to allow hot gases to pass through the sand system. So, this is very important so we have seen how to measure the permeability. Next one what is this compatibility right percentage reduction, when what say it is rammed or a compaction is made. So, we have seen how to measure the compatibility under the strength tests, we have seen how to measure the green compression strength and how to measure the green shear strength and how to measure the dry compression strength and finally the hardness.

So, with this we are closing what say moulding sand testing we will meet in the next lecture.

Thank you.