Introduction to Mineral Processing
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Lecture - 15
Plant Sampling (Contd.)

Hello welcome back. So, we are discussing about the Plant Sampling. And I was giving examples that what is the right way of doing sampling and what are the common mistakes we make in our plant sampling.

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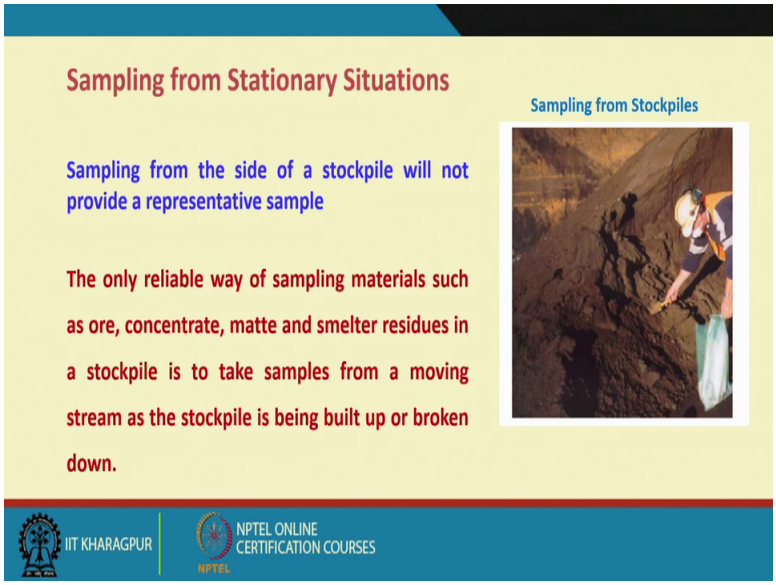

This is a good example: many times you have to do this that is sampling from stationary situations. The material is not moving we said that we have to take samples when the material is moving that is from a moving stream. I hope that you all aware of stockpiles. Like, we are having a huge body of material, we have stacked there, because at that moment at that as of now we do not know how to utilize them, but we are hopeful that in future probably we can extract, or we can convert them into a valuable products.

So, the management has asked you to send him the information about the average as content of any metal bearing mineral into that stockpile. So, you are given the task of sampling. So, there is a huge stockpile, and many times we do we try to take up we try to pick up samples from different sides of these stockpile. But that is incorrect sampling, because this stockpile may have been generated over a period of last 20 years; so initially

whatever the material was there. So, that is now hiding somewhere in the so, middle of this stockpile. So, you are collecting when you are collecting from only from the sides the samples. So, they may have different characteristics than what is inside.

So, when you plan to utilize this stockpile material, you will be utilizing the entire thing. If you are fortunate that when the samples you have collected from this sides of this, you may getting a very good amount of a valuable mineral. And based on that you are taking a decision that we will part the process it and we may go for a extraction plant. But so, suppose this entire stockpile there are 20 million ton. And you said that you have got 5 percent of this material x, based on the sample you have collected only from the side. But maybe inside there is almost 0 percentage of that material. So, when you start doing your processing and your extraction plant you may find that you are getting only at a rate of one percent of that material x, for your entire economics your entire investment is in will not bring profit as we have expected.

So, how do I collect samples from a stationary material? It is a very difficult proposition. So, what it should be tried that when the stockpile is being formed, or when it is being dislodge; that means, you try to move the material stacked into the stockpile, and from that moving stream you try to get a sample. If possible, if your economics, if your budget permits that. Otherwise, you may have to think of some equipment that which cross cut this entire done at different heights and at different depths. So, that you minimize the chances of missing any particle, any important mineral in large quantity what is hiding somewhere else.

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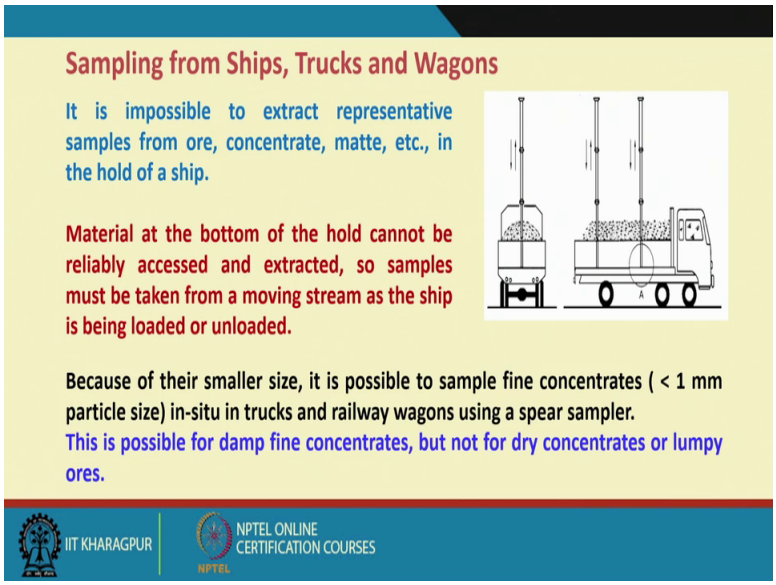

Sampling from sieves trucks and wagons, here also by advises, the when the material is being poured into the truck or maybe in the sieve, or when it is getting say delivered to a place; that means, where it is being emptied. That time the materials what is inside there will be in a moving stream, try to get that a representative sample. But many a times we are forced to take a representative sample from that.

So, for that although it is impossible to extract representative samples from ore concentrated matte etcetera in the hold of a ship, it is almost impossible that it has already filled up and then you are asked to take a representative sample, and you try to asses that how much is that material available, because it is very difficult to get hold of the bottom of that. But many a times if the particles are very small sizes, and they have got a bit of dampness, they in probably you can use a spear sampler to take any representative sample. Why not it dries it? You are dries it, they are not compact. So, you may miss some of these that will they may say actually because of the frictions in between your spear sample head and your material, the materials may be sliding out from your so available area of your spear. That is what is being advised.

So, my suggestion would be that you try to take the sample impossible, when the ship or the truck is filled up with your fine material, or when it is getting emptied to 1 place and there you should take a representative sample; moisture sampling. Suppose moisture is a very critical parameter for my plant. And you have taken a representative sample, but

you are sending the representative sample for to the lab through a open conveyor belt; that means, it is open to the atmosphere. That is what is being done here.

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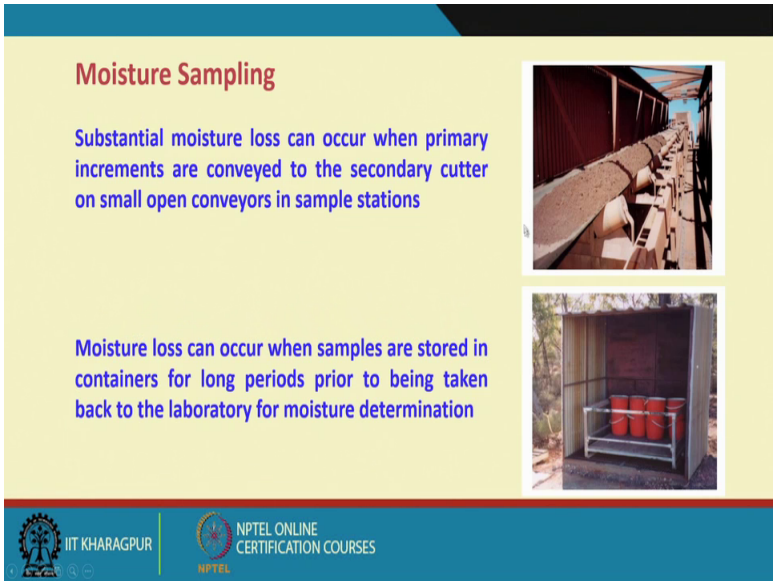

So, it will definitely pick up some moisture from the atmosphere. So, your moisture data what you will be reporting that may be erroneous. Many a times as I said repeatedly that there will be a considerable delay in many times in many situations between your collecting your samples and your analysis. So, in that case your moisture sample if it is not preserved properly, that will also give you erroneous result. So, you have to take all these precautions also.

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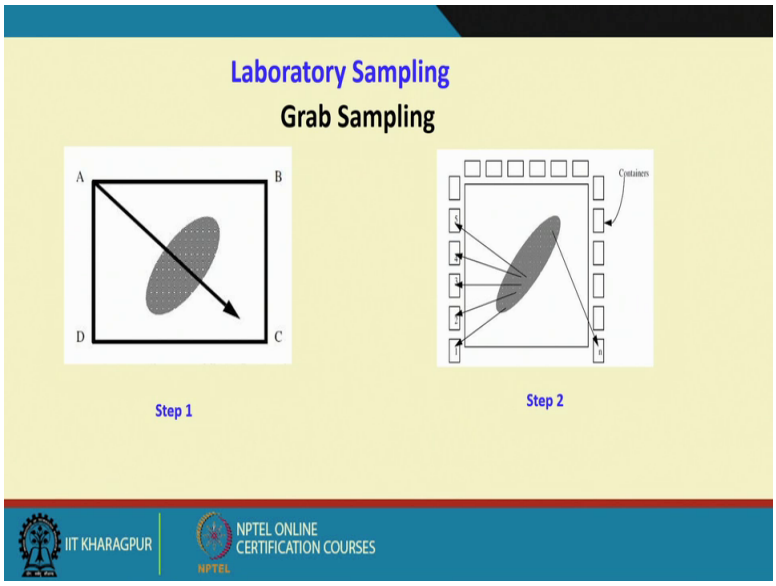

Now, in laboratory suppose you are given 20 kilograms of sample, and you have to do chemical analysis on that. Or say I say analysis of them, but for your essay analysis you need only 1 gram. So, again you have to do sampling from that 20 kg 20 kilograms to 1 gram. What are the different techniques for laboratory sampling? One is called grab sampling; that means, you take the material up to say 20 kg material, you flatten them, then you take samples from different locations.

And then you mix them up, and then you do you repeat the test you repeat the so, this technique again and again; that means, you mix them up flattened it and then you just with a spoon you take samples from different locations. Mix them up and then continue it unless and until you get a 1 gram of sample it is called grab sampling.

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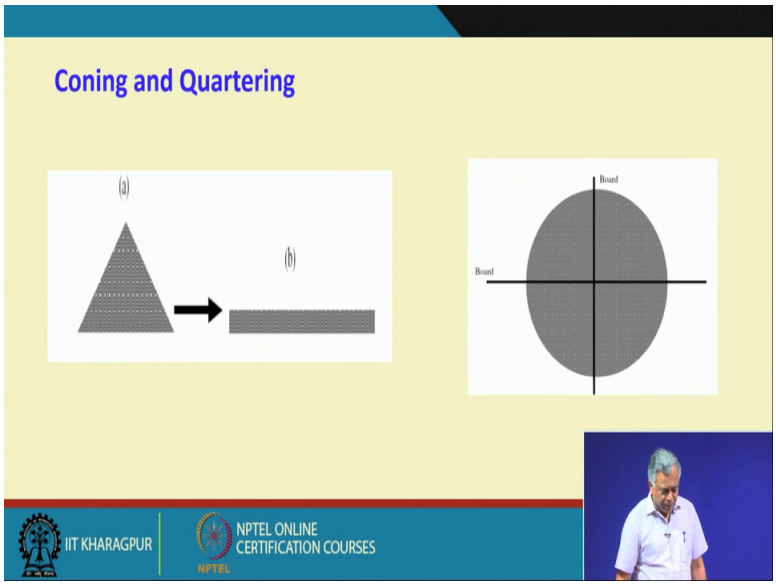

There is another process it is called coning and quartering. You make a cone and that cone angle and all these is what when I talked about the angle of repose you probably remember. So, a cone will be formed why you want to form a cone. Now because you are giving equal opportunity for all the particulates to reorient rearrange themselves based on their physical properties. Like your shape size and densities.

And then you flattened them with a plate pressure, you flattened them like this into a floor which is a smooth floor, and then after flattening it you just cut it into 4 equal parts. You can have partitions to divide it into 4 equal parts, then you mix the opposite sides; that means, we mix this sample with this one and discard these two. And that is how gradually you repeat this test, and to reduce your sample weight and when you arrive at a level of few grams. Then that is your sample on which they are say analysis should be done.

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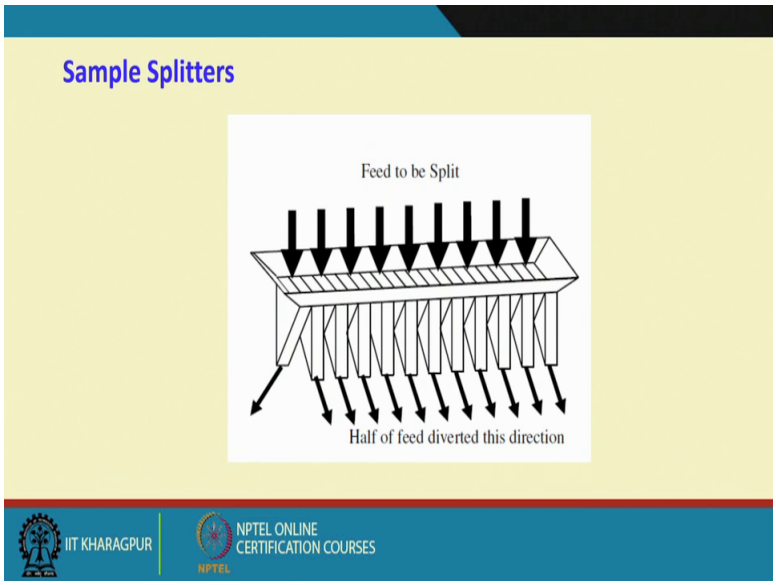

There is another technique it is called riffle sampling or say samples splitters. So, the sample splitters are basically arranged like this in a opposite side of that, and here you are got an opening and then they are basically half of feed diverted this direction half of feed is diverted to that direction. Here you need a little bit of skill that is you take your entire sample into it your tray or a scoop, and then gently you let them fall into these little openings, and they will be diverted 50 by 50 to this splitter.

So, you collect all the samples collected from this side and remove these samples. And then you repeat the test with the samples collected from this side to minimum to reduce the total mass of your sample.

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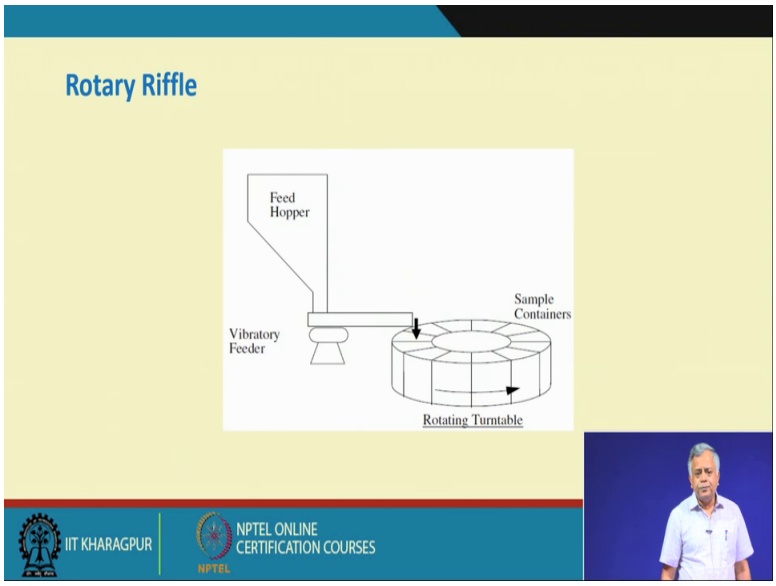

This is another one that is called a rotary riffle. What you do? Now forty or 10 20 kg material here, there is a feed hopper. And then you have got a vibratory feeder here. You have to monitor the speed and everything that it should fall gently; that means, you are using the principle of cutting across at a 90-degree angle of the falling stream.

So, the material because of vibration the material will flow. In this direction and when it is falling. You have got a turntable rotating turntable, and you have got sample containers the number of containers will depend on what is the angle of that. So, you can cover with that you can have 8 containers you can have 12 you can have 16 of different volumes. So, that dimensions of these containers will depend on how much is the sample you want in what the reduction ratio that is from 20 kg you want to take first 10 kg the 10 kg you want to make it 1 kg and 1 kilogram, we want to make 200 kilo 200 grams like that; this would have different sizes of this and this turntable they rotate at a fixed rpm.

So, what will happen? So, because you are cutting the stream at a right angle and you are collecting the samples be careful about the openings and all this. So, these are readily available in the market there are many manufacturers. And so, the entire lot is equally distributed to all the containers. Now you take either one container out for your main sample or me maybe you can take 2 or 3 containers randomly. And they mix them up and repeat the test with another say actually smaller size of rotary riffle. And then you can keep on reducing the amount of your sample.

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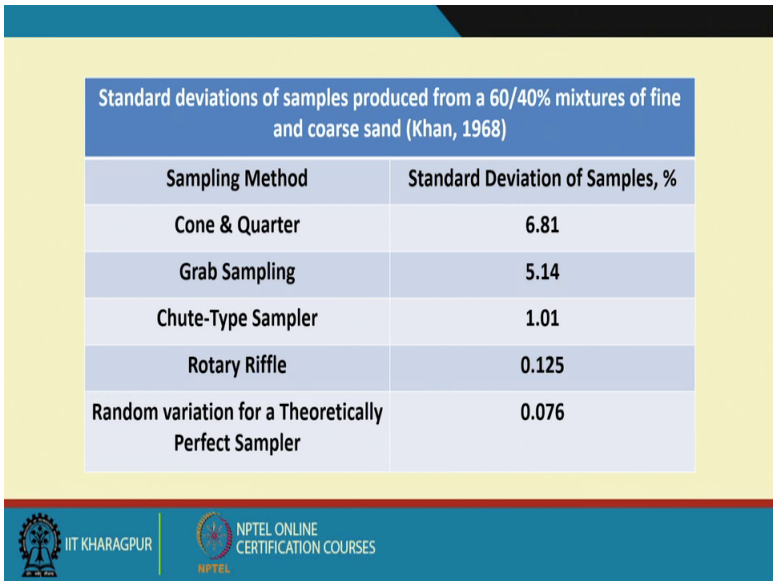

So, this is a paper by khan in 1968. He did this test, very controlled experiments. For evaluating the errors or the standard deviations in the sampling errors of different techniques what we used in laboratory, with a 60, 40 mixture of fine and coarse sand. So, with the coning and coordinate technique the standard deviation of samples, even after taking all the precautions by following all this say your; so measures to minimize the errors, the standard deviation was 6.81 percent.

Grab sampling it is 5.14 chute type sampler it is 1.01 percent. Rotary riffle it was 0.125 and random variation for the theoretically perfect sampler was 0.076. But please do remember that if you have a different type of particle these numbers may change. But what it indicates that which one is more reliable. It is quite evident, that this chute type sampler and rotary riffle probably the rotary riffle sampler is much more reliable if you want more accuracy. The reason is simple because here the chances of human error are very less. Because the feeding and you are sampling all is done automatically by your equipment. So, it is done mechanically.

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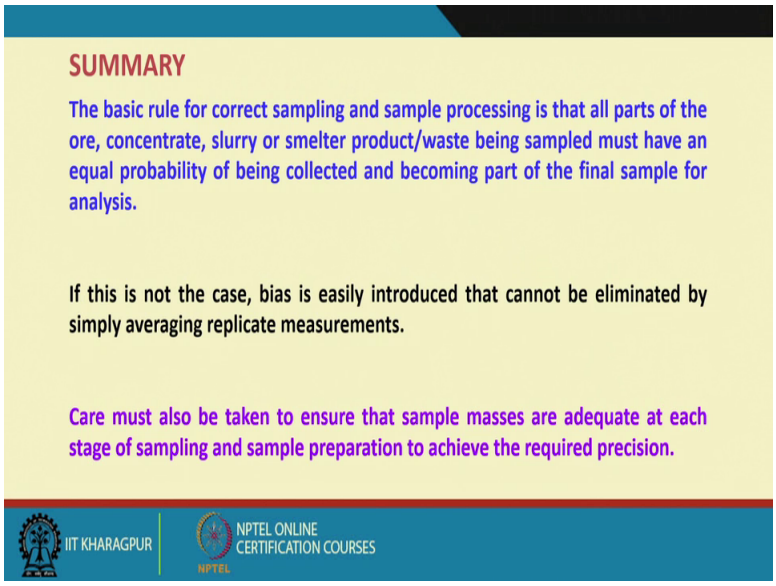

So, if we summarize it the sampling although the subject is quite vast, but we have to cut short up many topics even in sampling. But what I wanted to tell you that in this introductory course, even if you have taken care of this much what we have discussed. I think you will be doing your sampling next time in a much better way.

So, if we summarize the basic rule for correct sampling and sample processing is that all parts of the ore concentrate slurry or smelter product or waste being sampled. Must have an equal probability of being collected and becoming part of the final sample for analysis. The analogy I can draw that for any democratic country. When we elect the head of the nation, you will find that how beautifully it is designed that actually every person who is eligible to cast vote he or she is having a right to decide that will be my leader. And the leader is a representative that head of the nation is the representative of the entire country.

So, that is the basically the sampling means, that you are taking only. So, out of so, suppose in a country like India, we have got 120 crores of peoples, and we have got only one president of India. So, if the selection process is not robust, then may be will be inducing some bias into that selection; that he would that president elected he may be biased towards particular section of over entire population. But that should not be the idealistic situation. Similarly, in this case when you are taking 1-gram sample, if that sample is not appropriate, then your entire analysis based on that data will be wrong. And

for that we have to do we have to make sure that all parts of the ore concentrate and slurry they are given the equal opportunity to be selected.

If this is not the case, bias is easily introduced that cannot be eliminated by simply averaging replicate measurements; that means, that if we now give more importance in only on the analysis; that is, what is being done in most of the cases, but if your actual sample is incorrect, if you already induced bias into that your entire decision will be in the wrong direction. Here must also be taken to ensure, that sample masses are adequate. At each stage of sampling and sample preparation to achieve the required precision.

How accurately how accurate data you want, how precise data you want? Based on that you should decide by applying Gy's equation that at each stage how much of sample weight I must collect. And then when you bring it to the laboratory, again you have to follow the accurate or the most effective sampling technique to minimize the weight of the sample before we send it to my chemistry for analysis.

Thank you very much.