Introduction to Mineral Processing
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Lecture – 14
Plant Sampling

Hello everyone. So, we are discussing about sampling. So, in the first 2 lectures of sampling I have discussed about the some theoretical part and then what is the meaning of sampling and then how much of sample will circulate based on g wise equation and I have briefly explained you that what are the limitation of g wise equation.

Now, this lecture or we starting the plant sampling that is in the plant how will you be able to collect the sample; that means, suppose I am mineral processing engineer and I have to collect the representative samples from the running plant maybe every shift of 8 hours from different locations to monitor the performances of high different unit operations and the overall plant performance.

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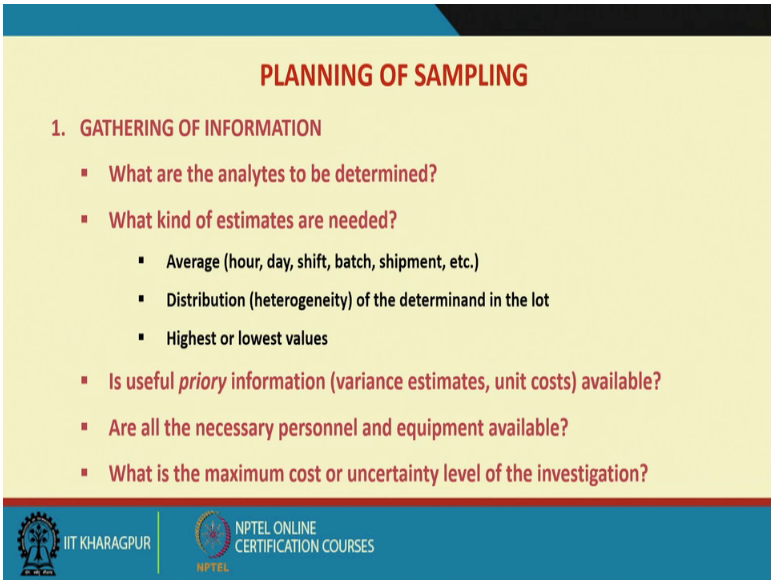

So, before we decide that we will go for sampling we must plan ahead or the meaning of planning now we have to first gather some information must be very clear about the what are the analytes to be determined; that means, whether I am collecting the sample for particle size analysis or for s analysis or for flow rate analysis or for some other purposes.

So, accordingly your goal must be well defined for your sampling, then what kind of estimates are needed; that means, first the average; that means, out of what frequency at what frequency interval he want to take the sample and if you want the sample from each stream on hourly basis or daily basis or monthly basis or yearly basis. So, that is very important or you are to do this analysis you want to take the sample for shipment that what quality of product I am dispatching for my client, because my prices that is how much of money I will charge from my client that will depend entirely on the quality and the quantity of my material. So, that quality part you are looking at.

Then here we have to know your sample characteristics, there is the how heterogeneous is your material. So, distribution of the heterogeneity of the determinant on the lot as I suppose I am doing analysis for copper. So, what are the sources of copper is it a heterogeneous is this a heterogeneous source like it may be from the sulfide mineral bearing material also sulfide mineral bearing ore, it may be oxidized ore, it may be some other carbonate or it may be mixture of all this. So, I must know that then it is better to have some kind of priori information.

Now, what is the highest and lowest values I would expect that when I am sampling it your concentrate that is what I think that I have already concentrated and then that concentrate the range you can have some kind of guess that whether it is within having a copper up in between 28 to 32 percent. Similarly if it is tailing sample it cannot be 28 percent it has to be much less.

So, whether it is around point O 2 to point O 4 percent that is very important. Then we should know that is useful priori information that is variance estimates unit cause available has it been done before and (Refer Time: 05:41) provide it some kind of your variance analysis. Then are all the necessary personnel and equipment available suppose we need when we reach to the sampling point we find that oh my goodness I am writing sort of manpower, I need someone to hold the my bucket, I need someone to look at the time, I need someone to write up tags.

So, whether I need 2 percents 10 percents or 20 percents to the do that and then what kind of equipment I required recommend. So, when you are going for sampling you should be going there with all kind of preparedness then what is the maximum cost or uncertainty level of the investigation as we have seen in the previous class. That when you want to bring down the uncertainty level that is the precision level to be much more precise; that means, the error you want to minimize your sample rate goes up so; that means, automatically your cost of sampling also goes up. So, how much of money I have allocated what is the budget. So, we should have all this thing ready beforehand.

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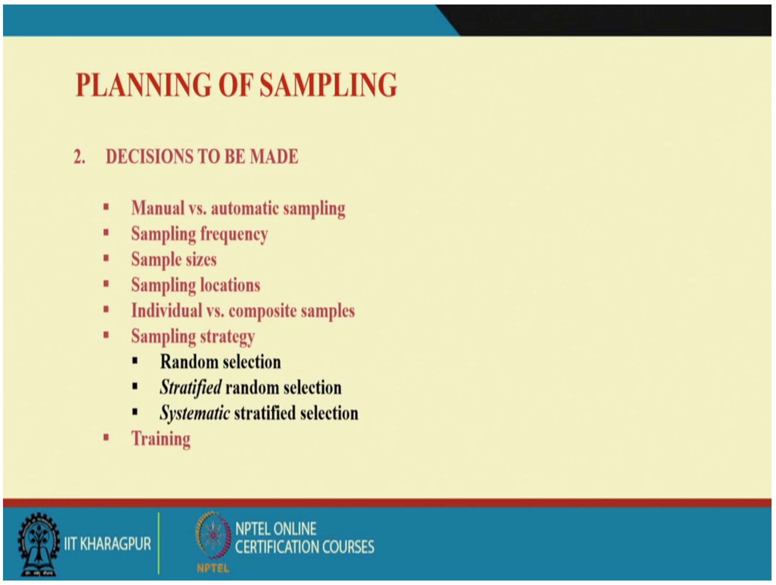

Then decisions to be made that whether we should go for manual sampling or automatic sampling, like if you are doing the sampling for reserve estimates they do not need automation, but if it is a processing plant and every safety want the similar kind of your samples probably you may think of automation that we should have some automatic instruments or automatic equipment. Through which I will be able to get the representative sample very quickly and this is also what do you have already discussed their sampling frequency that is how frequently we need this data we need this sample.

Now, suppose I am collecting samples or hourly basis and suppose my plant works for 20 hours a day. So, every day I will be having 20 samples and it is my chemical analysis facility or my laboratory facility for doing size analysis are equipped enough do you have sufficient manpower there to generate the final data or size analysis or maybe sa analysis. So, there must be a synchronization between the 2 sample sizes based on GYS equation we know that if we are collecting hourly samples as suppose each hour we are collecting 10 kilograms of samples. So, part a says suppose a 20 hours running hours. So, we having 200 kilograms of sample do you have adequate space, in my laboratory where the size analysis or maybe the sa analysis will be done to preserve them in a uninterrupted fashion; that means, we have to prevent them from getting contaminated and from other losses what we have already discussed.

Then sampling locations in your sitting in your office you might have decided that we will collect samples from here and there, but does your logistics support that you might find that that there you cannot have access to that your safety officer may not allow you to do that maybe your equipment layout does not allow to do that. So, we have to decide on that also that is sampling locations this is very important individual versus composite samples like the examples are giving that every day you have collected 20 samples.

Now whether you want to know the sa analysis of individual 20 samples or you want the sa analysis on daily basis based on the representative samples you have collected on hourly basis; that means, you may mix up all the 20 samples you have collected obtained kg. So, you have got 2 hundred kilograms and then you want to take only one sample out of that of 1 gram for final analysis. So, for that 2 hundred kilograms again you have to do this sampling at your laboratory are you ready with that do you have adequate facility to do that is that your target that I want sa analysis on daily basis.

Then of course, we have not discussed about that, but I am re done it. So, if anybody is interested you can look at the some of the textbooks on sampling I would refer the GOS book the sampling strategy there whether we want random sampling stratified random selection of systematic stratified selection. So, only the interested leaders they can look at that, then training the people who will be doing the sampling are they properly trained to do that do they know that how important this sampling means and where this sampling has to be done with the minimum bias. So, all this personnel should be well trained.

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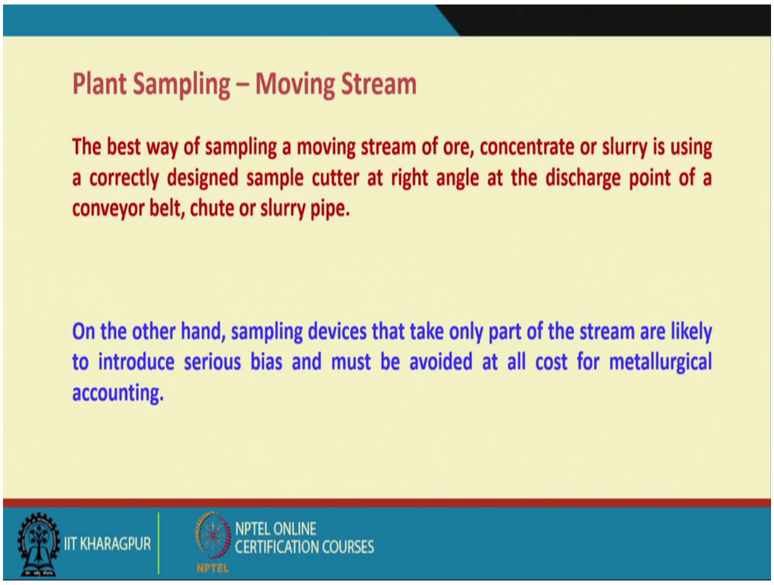

The plant sampling generally is advised and we should do it in a moving stream the biases or the areas will be minimum if we plan to sample from a moving stream. Even for solid materials when they are flowing when they are flowing means that suppose the material is transported through conveyor belt. So, when they are moving we should try to sample them; that means are they feeding or maybe at the discharge or even in the conveyor belt they are moving. So, even from there also we can plan to take a sample.

So, the best way of sampling a moving stream up over concentrate or slurry is using a correctly desired sample cutter at a right angle at the discharge point of a conveyor belt chewed or slurry pipe, what we try to say that that if there is a conveyor belt. So, you are collecting it from here and then you want to transport it there. So, you are having a conveyor belt. So, conveyor belt is now discharging the material there.

So, what it is what I try to say that that when the material is being discharged to another container or to another unit. So, the materials are basically free falling. So, there I should have a sampling device which will cross cut the flow; that means, the material is flowing like this and I should have a cross cutter at a right angle that should take at a frequency of the material which is being poor and that is the example order I had shown you with the red and black particles into my previous lecture. That was the perfect example of what I have written here that is the your cutter should be at right angle and the material how it is flowing calling onto the next container, on the other hand sampling devices that take only part of the stream are likely to introduce serious bias and must be avoided at all cost for metallurgical accounting this part I would like to show you with some of the examples that what I try to mean here.

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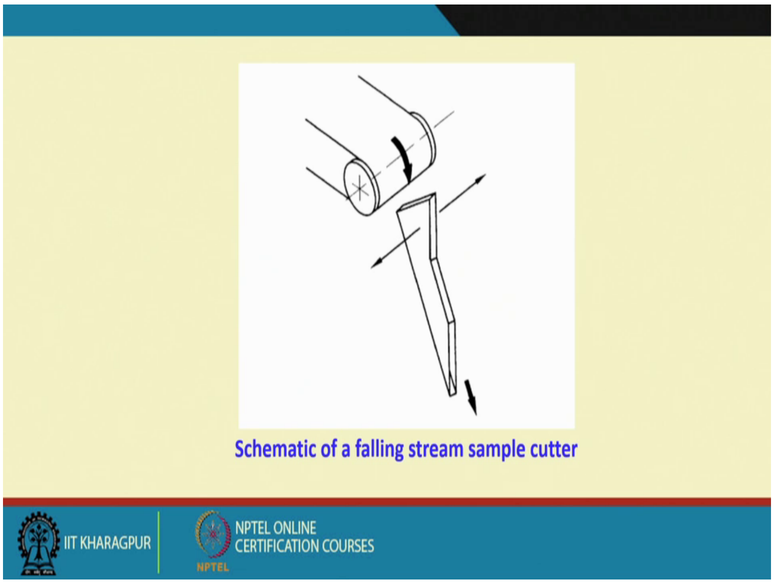

See this is what is schematic of a falling stream cutter; that means, the material is coming or say falling to another container here which is somewhere here and this is a sampling equipment.

So, material is falling here and the cross cutter that is your sampling equipment should move in this way that is at right angle and that is the correct way of taking a sample, but say suppose this cutter is moving from only from here to there, you are assuming that whatever material is falling here that is this identical whatever material is falling here, but you may introduce some bias because you may miss some particles which are not available here. So, your analysis may be wrong and will be wrong not maybe. So, the first rule is that I must cut across the full stream do not take sample from the part of the stream.

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Incorrect sampling some examples I have given, but let us have a look at this, suppose a slurry is flowing slurry what is slurry is it solid liquid fixed mixture when the particles are in very fine size ranges.

Now, that is coming down through a pipeline and many places you will find that in the plant to make your life easier what we will do that the punch a hole just beside the pipe and they try to bypass some of the material through this, but that is an incorrect sampling because through pipeline now imagine your slurry is flowing like this and you have just put a hole here and you are trying to bypass some of the slurry now you are not cutting the full stream.

So, whatever material you are getting into the right side of the wall of your pipe that may not be true representative of the entire material what it is coming down because there this side you may have different material. So, you are you are biased towards this right hand side of material and that is incorrect. So, what is the correct word that when the pipeline through pipeline when the material is coming there slurry is flowing, you have to have some means of taking the slurry from the slurry sample from the cutting across the whole stream.

This is another example like says suppose I give this example like you are asked to get a representative sample from a nearby river and you want to do the calculation that your analysis, that what kind of particles are suspended into that river water our river is suppose thirty meter wide a 10 meter deep. So, it is very difficult you will say that it is very difficult to get sample from that middle of the river. So, what you do you take a sample only from the side of the other bank of the river that is a water sample and you are doing all sorts of analysis for your suspended solids their size analysis, but you will you may have a different particles which is suspended at a higher depth and at the middle of the river than what you are getting towards the bank of the river.

So and based on your sample analysis data you are giving a judgment that this river contains. So, much of material of this nature and that nature that is incorrect and many times what you do you are tainted that I will put as small it is called a surfing type of sampling sample collecting device, I put it there and you collect the samples some of the river is this much of wide and you are put somewhere small your sampling device to collect the sample from here. So, you are missing these samples the slurry what is flowing through that.

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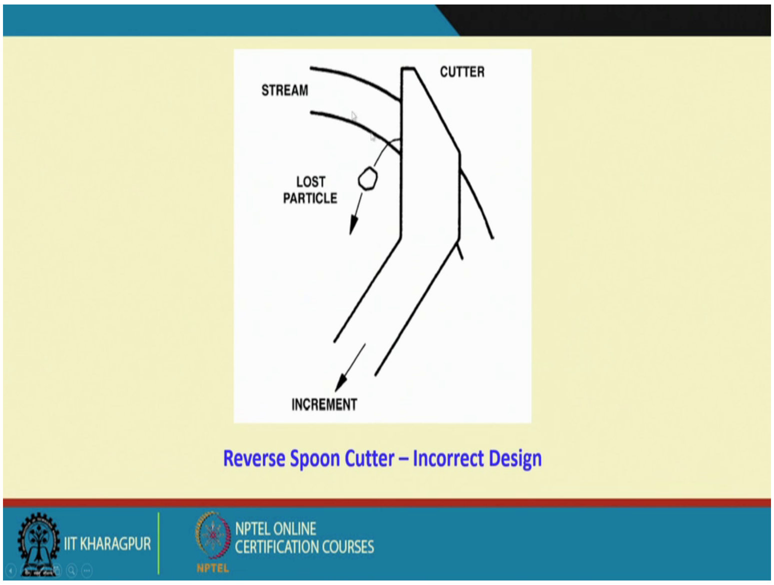

So, that is you are introducing biases from that. So, these are incorrect samples. This is also another example of incorrect sampling many times you have done everything right, that your material your stream is coming and you are having a your sample cutter in a right angle, but it is the wrong speed and wrong dimension of your sample cutter you have. So, maybe the particles are getting into your container and basically going out of your sample container, because of wrong dimensions or maybe wrong speed of your of your sample cutting devices. So, you are missing some of the particles which are supposed to be collected this is called a reverse spoon cutter. So, this is an incorrect design because of the incorrect design.

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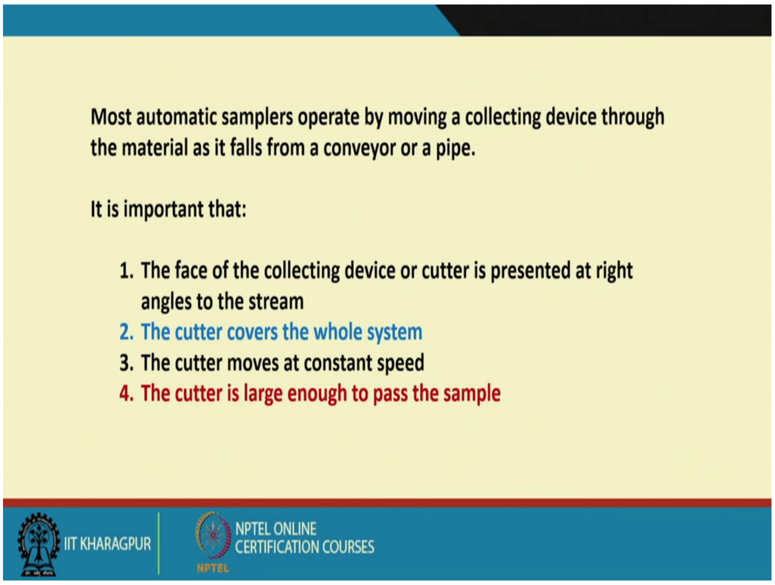

So, most automatic samplers operate by moving a collecting device through the material as it falls from a conveyor or a pipe line, if you remember in my last lecture that I have shown a small animation how a sample car that is moving across like this another automatic sampler and then whatever material is being collected you are basically collecting it on a fixed interval of time.

But before you install that automatic sampler it is important to note that the face of the collecting device or cutter is presented at right angles to the stream. If it is not right angle to the flow stream they knew maybe introducing some bias into that because if it is going like this. So, you are not giving equal opportunity for every particle to be collected and the same velocity at what they are falling the cutter should cover, the whole stream again and again I am saying that it should be like this it should cut the entire stream not like this.

The cutter should move at constant speed otherwise what will happen is suppose I want to know the flow rate of that. So, that flow rate I have calculated that how much is the time that cuter is collecting is having for collection of samples per unit you are same movement. The cutter should be large enough to pass the sample suppose my cutter open in can accommodate only the largest particle size of 3 millimeter, but actually in your stream you have got particles more than 5 millimeter. So, what will happen either they may choke my cutter opening or maybe there these particles will bounce back they will not be collected, in the cutter we will not be able to take into consideration of those 5 millimeter particle while doing the analysis it may be size analysis it may be some other chemical analysis may be any other analysis.

Now, this is generally a thumb rule and this relationship has even been documented in some textbooks also it is a common practice that what should be the dimension of my cross cutter that.

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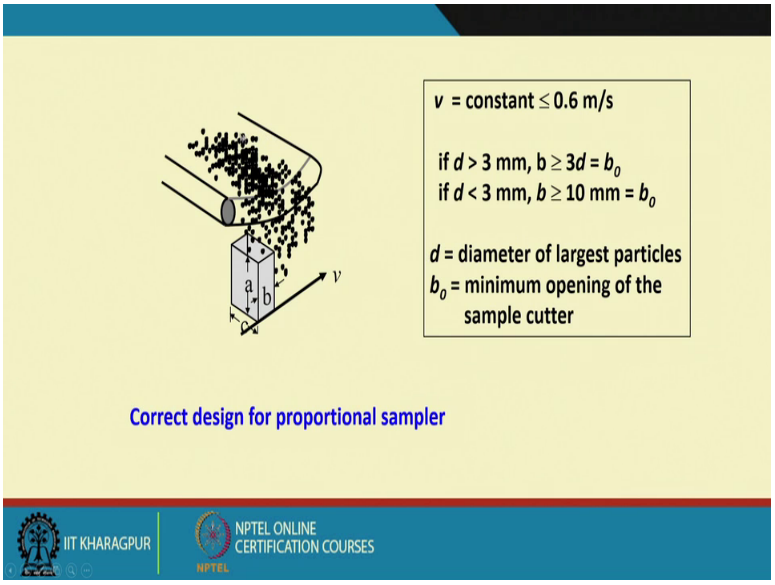

I said that there is a falling stream from a conveyor belt and I want a automatic sampler. So, what should be the dimension of my this cutter to avoid all those incorrect sampling related issues. So, here the velocity should be constant as I said and how much it should be it should be less than 2 equal to 0.6 meter per second, because what will happen if it travels too fast. So, the materials may start bouncing back. So, I should have a constant speed and that should be around less than 0.6 meter per second it should be gentle movement. What should be the dimension of this know if say suppose this is the width of that it is represented by b and this is the say b 0 is the aperture here. So, if d is greater than 3 millimeter there is that d is the diameter of largest particles that is why I said that you should have prior information about the material what you are going to sample.

So, if the largest particle what I am going to sample into the stream I ensure that it is all it is greater than 3 millimeter, then my b that is the width of this should be greater than 3 d; that means, if it is 3 millimeter, then my width of my sample cutter should be more than 9 millimeter if d is less than 3 millimeter b should be greater than is equal to 10 millimeter; that means, here if I have 5 millimeter sample. So, it should be 15 millimeter or more, but if it is less than 3 millimeter it should be more than 10 millimeter at least. So, this is the correct design of my proportional we call it proportional sampler.

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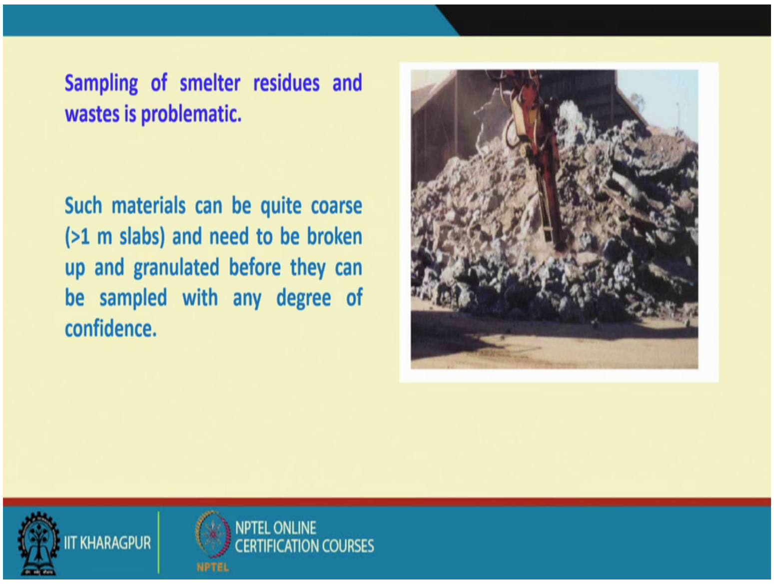

This is an example of sampling smelter residues and wastes because they are in their hard materials like smelted residues means and suppose if you go to a steel plant you will find that there are slags.

So, initially they were in molten state when they came out from your furnaces, but after cooling they have become a solid particles. So, you want to know that how much of may be chromium we are losing in to that. So, I want to do the analysis. So, what I have to do now first I have to break them into very fine particles, that is what it is written and then we should take it as a representative sample and then we should go for assay analysis. So, the breakage how will you break it whether you have got the right kind of equipment or not that you should be ready with do not make any compromise with that otherwise your estimates would be wrong.

So, we will continue this lecture in the say next session also till then.

Thank you very much.