Introduction to Mineral Processing
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Lecture - 52
Gravity Concentration (Contd.)

So, welcome. So, we have discussing about the jigging cycle now let me continue that discussion.

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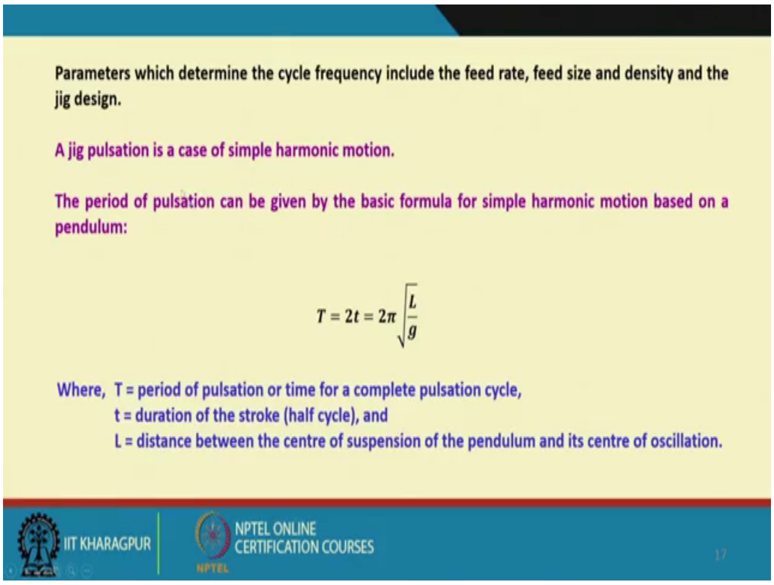

Now, you see that parameters, which continue which determine the cycle frequency include the feed rate that is at what rate you are feeding. Why you should control the determine the jigging frequency? Because what is the load on the bed that, what is the weight of the total particle bed. So, that would determine that how frequency what should be the frequency of my, your pulsation cycle or the pulsation instruction cycle or the jigging cycle would say.

Then feed size what is the size range and the density and the jig design. So, that is how much of material it can accommodate that is the jig design and remaining three that is of size density and feed rate will determine that, what is the your weight of the material that volume it can accommodate at. So, the frequency has to be adjusted because it the inter bed has to be lifted up and down.

So, it requires that at how frequently you have to do, that will depend on the size feed rate and the density the rate is basically also controlling the, your residence time of the particles. So, how much time you require that depends on what is the size range and what is the density range you are trying to play with.

A jig pulsation is a case of simple harmonic motion we have seen that the jigging cycle is like this. So, that is nothing, but a simple harmonic motion. So, the period of pulsation can be given by the basic formula if you remember for simple harmonic motion, based on a pendulum.

So, if you remember that basic formula for a simple harmonic motion for a pendulum. So, at a just your harmonic motion is like this. So, this is like a pendulum movement. So, here capital T had that capital T is equal to period of pulsation or time for a complete pulsation cycle that is for entire pulsation cycle how much time you have given is equal to 2 t that is a duration of the stroke, that is the half cycle; that is or if the duration of the stroke that is the half cycle, that is it is not the complete cycle it is just the half cycle.

So, and L is equal o the distance between the center of suspension of the pendulum center of suspension of so, pendulum and its center of oscillation. So, that is written as equal to t is equal 2 t is equal to 2 pi square root of L by g; and I will try to show you that how we can apply this your basic formula which we learned in our your school days or simple harmonic motion.

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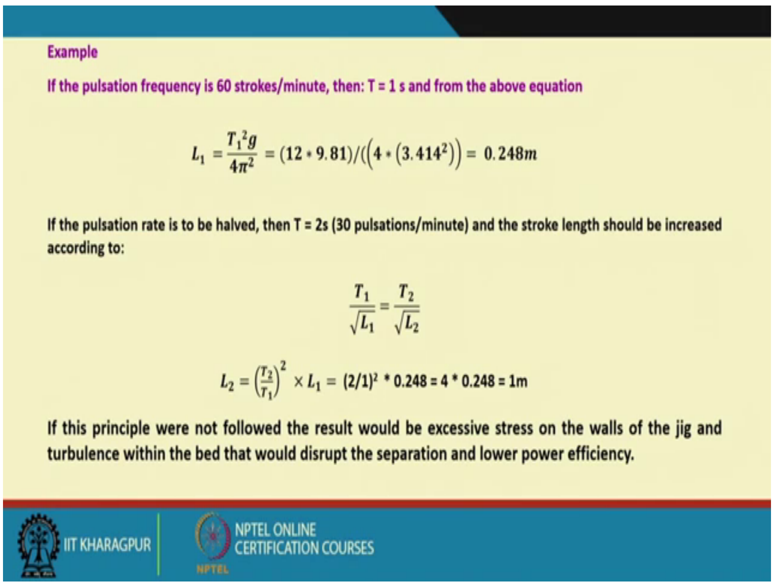

So, in the pulsation frequency is 60 strokes per minute. So, then t is equal to one second because it is 60 divided by 60. So, your what about the t? T is the period of pulsation. So, your t is equal to capital T is equal to one second and from the above equation.

We can write that is as we are writing it, that t is equal 2 pi L by g. So, L is equal to t square g by 4 pi square. So, that is what I am writing that L 1 is equal to T 1 square g by 4 pi square. So, we know the value of your T that is your T 1 is basically what we say that. So, T 1 is equal to 12 into 9.81 into divided by 4 into 3.414 square.

So, that will give you 0.248 meter say as in a meter. So, if I see that that, that is L 1 is equal to T 1 square g by 4 pi square. So, what is the value of g? 9.81 I have given and T is equal to 1one second. So, I think it should be 1, it is it is one square it is not 12. So, that is should be 1 square. So, sorry it is a typo again. So, this T is equal to 1 second. So, it should be 1 to the power square that is nothing, but 1. So, this becomes 9.81 and divided by 4 into 3.414 square.

So, that is equal to 0.248 meter. So, this must be collected. If the pulsation rate is to be half that is they suppose T is equal to 2 second so; that means, we have got 30 pulsations per minute. So, it is half at the stroke length should be increased. So, the question is if the pulsation is rate is half, then what should be the adjusted your stroke length. So, that we can correlated if we say that T 1 by root about that your square root of L 1 is equal to T 2 by square root of L 2.

So, L 2 is equal to T 2 by L 1 square T 2 T 2 by T 1 is square into L 1 because if I just take this thing towards that. So, it will become now T 2 it is two because we have halved it and T 1 was 1. So, 2 by 1 square into 0.248 that will give you one meter. So that means, you see that if I want to reduce the stroke, if I want to half the reduce the pulsation frequency to half, then I have to increase the your stroke length your almost a from 0.248 meter to 1 meter.

So, that is the stroke length we have to increase. So, this is one square that is a correction. If this principle were not followed then what will happen? Then the result would be excessive stress on the walls of the jig and turbulence within the bed that would disrupt the separation and lower power efficiency; that means, you are separation efficiency will go down. So, this is how we have to adjust that is your what should be the stroke length, what should be the frequency of my jigging cycle.

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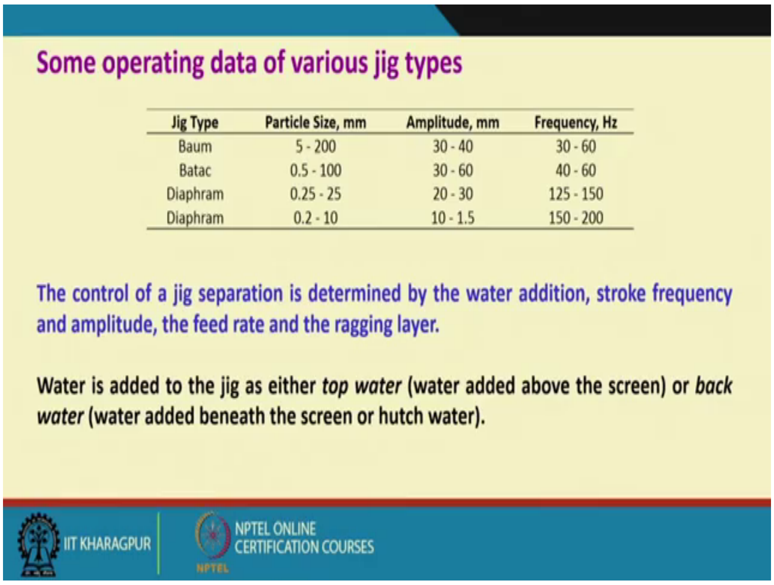

Somehow the operating data of various jig types, again I would like to show you that was for a coal jig and this is for some of the operating data from some of the jigs by different manufacturers at a or the different types, it is called the Baum jig.

The particle size from 500 5 to 200 millimeter it can your it was because the data for which I am showing it that Baum jig, it was separating from 5 1 5 to 200 millimeter of particle size, amplitude was 30 to 40 millimeter frequency was 30 to 60 like that we have got another type of jig. So, it can vary.

So, it depends on what type of jig what is the particles size range, at what rate you are feeding and what is the density of the different particles. The control of a jig separation is determined by the water addition, that is how much of water that is what would do when the you are having a overflow where. So, the ideally the lighter particles should pass through a particular where, but if I am having some kind of your horizontal current of water.

So, you are having a horizontal current of water. So, you want to promote that horizontal current. So, you have to add some water and that that also helps in the separation, that is how fast you are trying to remove your float materials.

So, that is what is known as water addition. Stroke frequency and amplitude we have already discussed, feed rate we have already discussed and the ragging layer, that is how effective is the ragging layer. Water is added to the jig at as either top water, that is what I have explained that water added above the screen or back water, water added beneath the screen or the hutch water that is how much of water you have in the hutch, because if we do not have if you do not have sufficient quantity of water, then if there is some your say less quantity of water, then the your when you are trying to compress that your entire your particle bed may not be fluidize properly.

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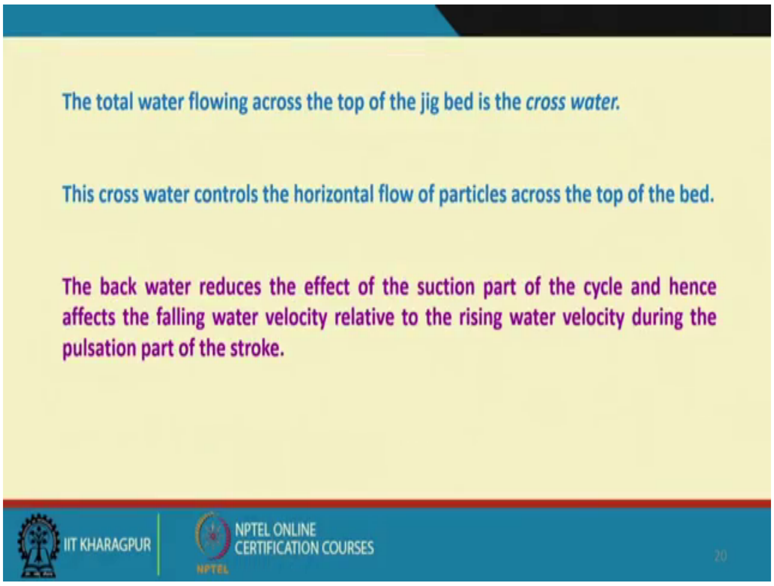

The total water flowing across the top of the jig bed is the cross water. That is when you are basically adding therefore, a because this normally the water moves in this direction. So, it have a vertical direction, but when you are arriving in this direction the water.

So, that is your cross water and that is only for collection of your float materials. This cross water controls the horizontal flow of particles across the top of the bed; the back water reduces the effect of the suction part of the cycle. Because what will happen if you are if I have more water then what is required. So, when you are doing the suction stroke.

So, it will be the two compartments there water level will be balanced immediately because otherwise. So, to have a better suction, you need some lowering of that your level. So, to adjust that, you need to have an optimum quantity optimum volume of water into your hutch and hence it effects the falling water velocity relative to the rising water velocity during the pulsation part of the stroke. These are all finite details of the jigging operation. The feed rate must be matched with the discharge rate of the heavy fraction so, that a steady state operation can be maintained.

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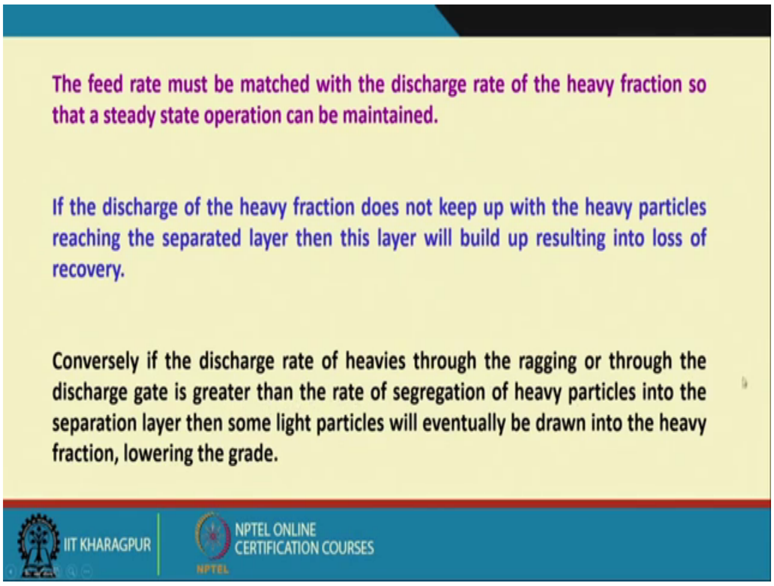

This is true for any continuous operation. If the discharge of the heavy fraction does not keep up with the heavy particles reaching the separated layer, then this layer will build up resulting into loss of recovery that is at what rate you are trying to remove the heavier fraction that is your wanted material.

If you are not removing it then there will be accumulation of this particles and you may start losing some of the heavier material into the float fraction, that is relatively large lighter fractions. Conversely if the discharge rate of heavies through the ragging or through the discharge gate is greater than the rate of segregation of heavy particles into the separation layer, then some light particles will eventually be drawn into the heavy fraction lowering the grade that.

If you are removing it is too fast, then even the lighter particles may come down because of its own gravitational acceleration or the gravitation of force speed. So, your heavier fraction may be contaminated with the lighter fraction.

So, there must be a synchronized your collection rate of your heavies and lights and with the your feeding rate, to enable the system to reach a steady state condition.

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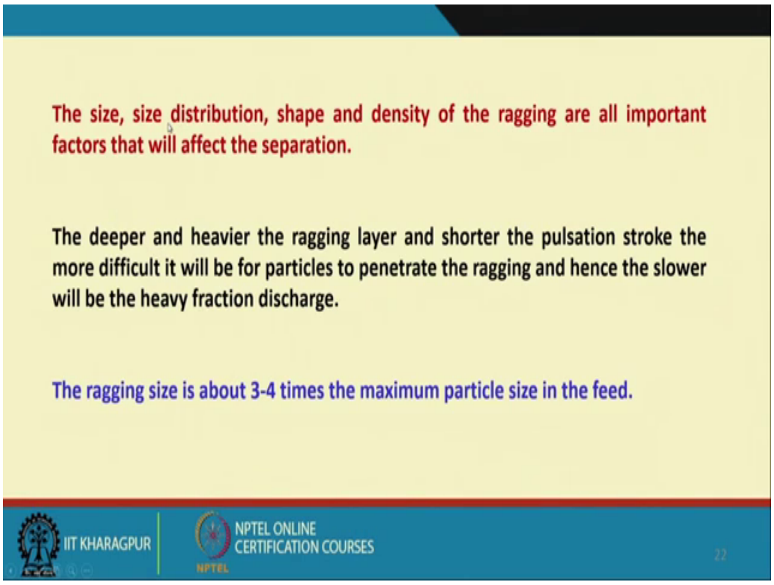

The size, size distribution, shape and density of the ragging are all important factors that will affect the separation. Even for the jigs where we are use ragging material. So, as the size of those particles size distribution because if you have wide size distribution. So, even the ragging material themselves, which are relatively finer they will occupy the wide spaces in between them.

So, what will happen? The when the heavier particle they try to penetrate that bed or try to tickle down the bed, they will not be having that excess and even those particles will be reporting through the overflow. The deeper and heavier the ragging layer and shorter the pulsation stroke, the more difficult it will be for particles to penetrate the ragging and hence the slower will be the heavy fraction discharge but you will get a better quality product in the concentrate.

The ragging size should be about 3 to 4 times the maximum particle size in the feed these are all very hutch finite details.

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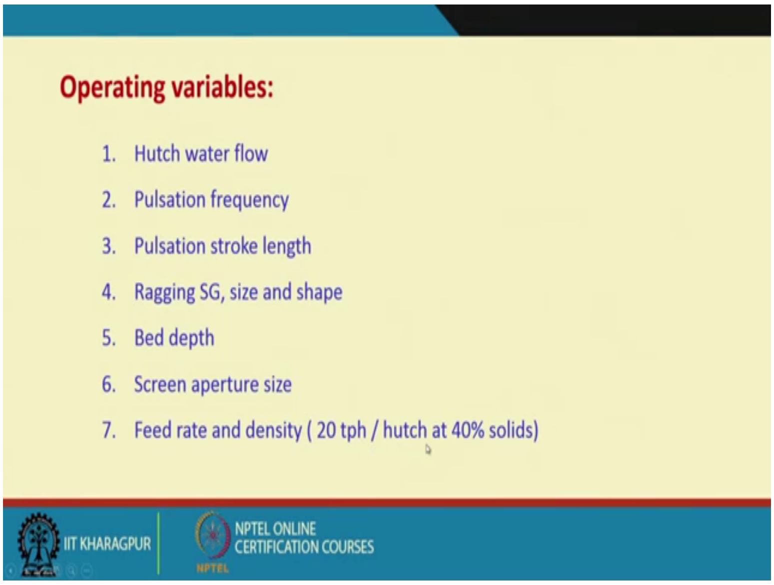

So, what are the operating variables in a jig? That is hutch water flow, that is at what rate the hutch water is flowing pulsation frequency, which controls the hutch water flow pulsation stroke length that is again controlling the hutch water flow rate, ragging specific gravity, size and shape we have already discussed.

Bed depth that is how much of material you have in that that is what is the depth of your bed, I said that if it is 1 meter, if it is 0.5 meter what will happen? So, you have a lesser margin of error. So, screen aperture size feed rate and density these are all discussed at gated depth.

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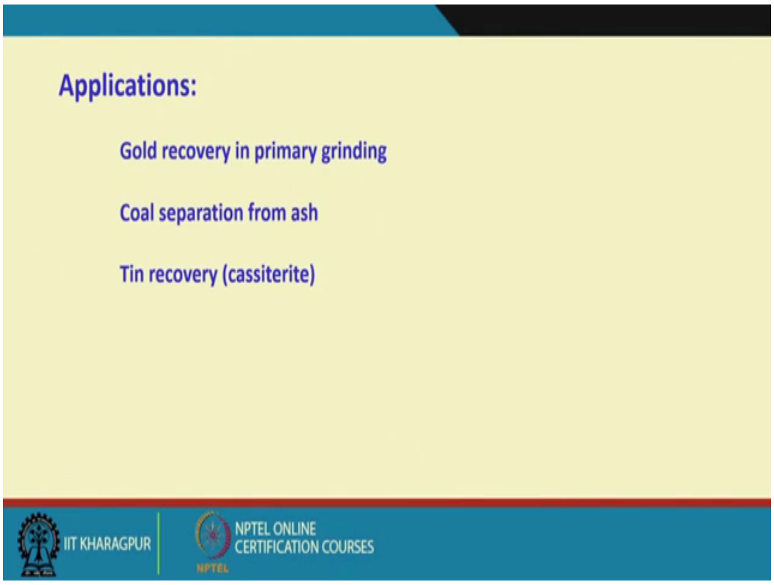

Now, applications we have already means in let me restate that the in mineral processing field, the gold recovery in primarily grinding stage where the jigging is being applied, coal separation that is where the most of the uses are for the jigs, the tin recovery that is the cassiterite. You see that this cases gold and tin in cases of mineral, they are my wanted material is having much more heavier higher density than my your gang materials.

Now, but in case of coal the specific gravity difference between my wanted and unwanted materials all though they are less, but still why they are popular because who were trying to separate the coal at a much coarser sizes, but for tin and gold you have to because of the liberations, the related issues you have to grind the particles into very fine sizes.

So, you are essentially dealing with relatively much finer sizes, while treating them into a mineral jig in comparison to a coal jig. There is also another difference between a coal jig and mineral jig.

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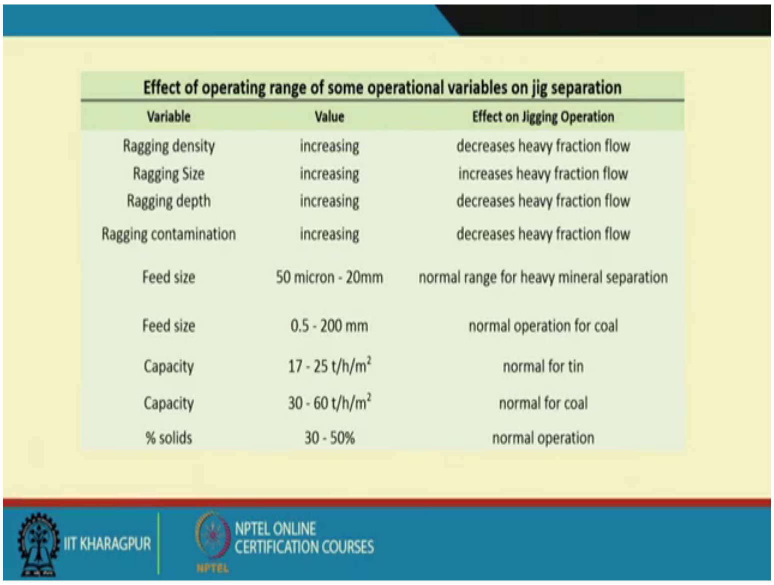

Effect of operating range of some operational variables on jig separation

Variable	Value	Effect on Jigging Operation
Ragging density	increasing	decreases heavy fraction flow
Ragging Size	increasing	increases heavy fraction flow
Ragging depth	increasing	decreases heavy fraction flow
Ragging contamination	increasing	decreases heavy fraction flow
Feed size	50 micron - 20mm	normal range for heavy mineral separation
Feed size	0.5 - 200 mm	normal operation for coal
Capacity	17 - 25 t/h/m^2	normal for tin
Capacity	30 - 60 t/h/m^2	normal for coal
% solids	30 - 50%	normal operation

Now, this has a summary of your effect of operating range of some operating variables. So, jig separation.

So, these are the things you can easily understand, if you have understood how the separation occurs. So, this is just for you to understand the jig in phenomena, I have given. So, I leave it to you, I am not going to explain it again and again because these are all already explained.

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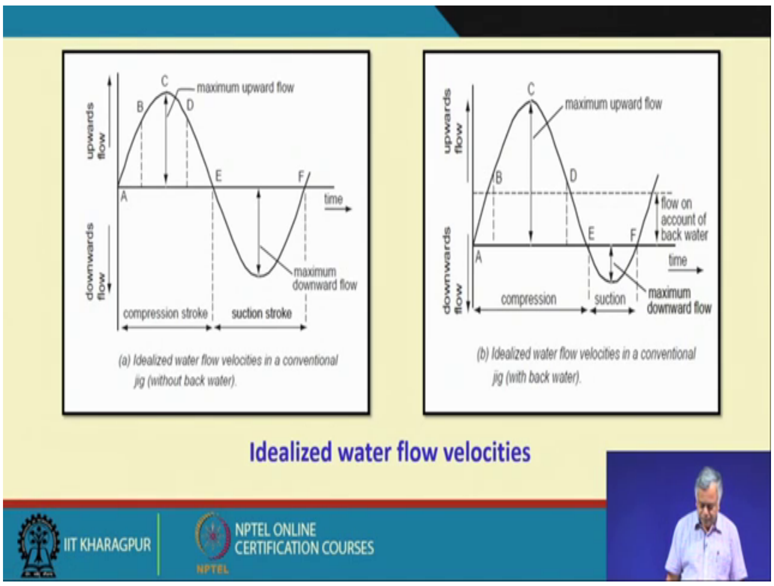

So, this is the compression stroke, that is your when you are compressing the in a in a Baum jig in a conventional jig, that is your when you are compressing it. So, the fluid is having a upward velocity and that is the maximum velocity zone. So, you are having a sinusoidal motion like this. So, this is the pulsation and this is the suction stroke.

So, that is the maximum downward velocity of water you will reach here. This is the ideal water flow velocities in a conventional jig with back water, because when you are adding back water you are trying to minimize the suction stroke you want to increase the your say duration of the pulsation stroke; that means, you are giving more time the particles to reorient them self based on their density differences.

Thank you.