INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

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NPTEL ONLINE CERTIFICATION COURSE

Unit Operations of Particulate Matter

Lec-05
Centrifugal Sedimentation and Equipment (Part-02)

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Welcome to the 5th lecture of week 1 which is on industrial sedimentation equipment so here we will discuss different equipment which are specifically used in the gravity sedimentation in industry.

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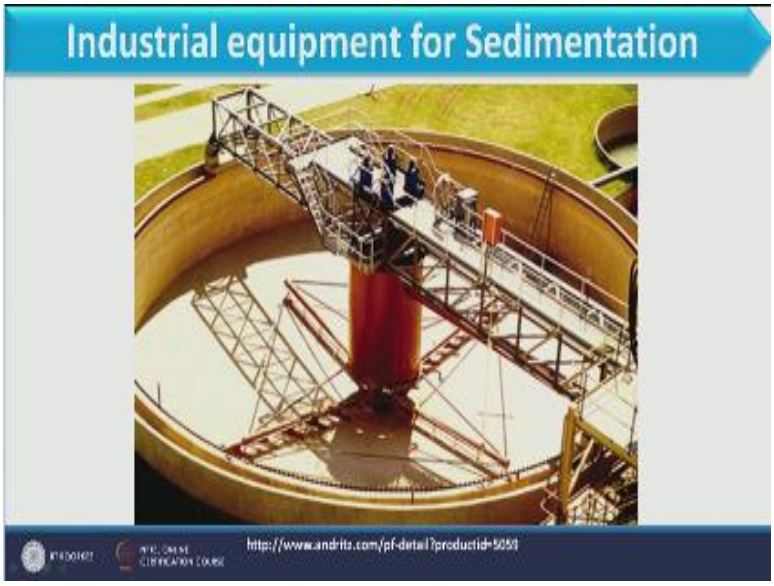

So here I have shown one figure one photographic view if you see this image here we have the tank and at the middle of it we have this fed in let section so if we consider this particular image this tank is nothing but the sedimentary or industrial sedimentation tank it has different section

first is the tank itself then the outer rink where liquid is available where over flow is collected and at the bottom we have the rake assembly which basically collected at the center is that so that exit from the center becomes easier.

So this is the image which I have shown to make you understand how it sedimentary is sedimentary looks like now discuss it in detail.

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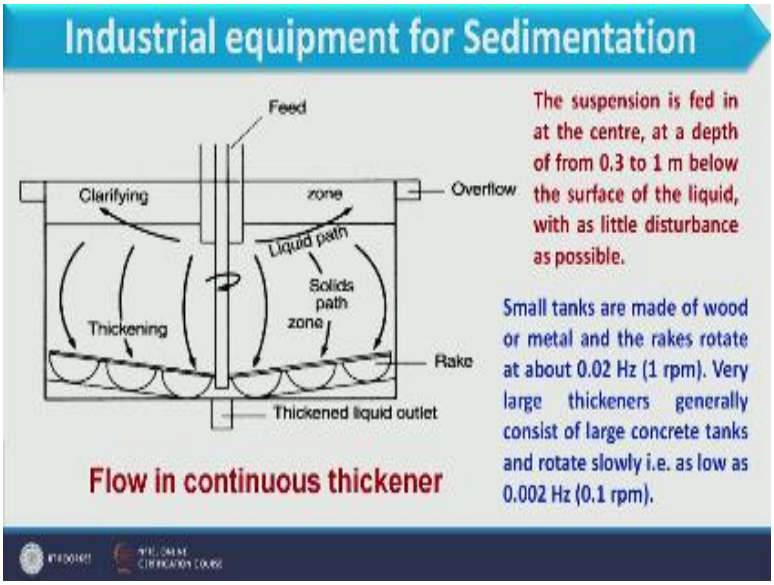

This is the somatic of continuous thickener where we have the tank in which rakes are available at the bottom these rakes as just we have discussed it is their purpose is to collect the slug which is available at the bottom to collect the slug at the center so that discharge becomes easier, now what happens in this thickener fed enters from the center fed enters from the top of the center and this particular assembly revolves now when fed enters into this what happens here we have this structure which is basically we can call as the baffle so here we have fed which enters into this up to here due to baffle it will not disturb the clarifying zone.

And fed enters at this level at this point to the thickener now what happens when fed enters into this obviously when continuously fresh fed enters into this it disturbs the process, so to avoid this

turbulence fed enters a certain distance lower than the total high of the tank, so that it will not disturb this clarifying liquid and clarifying liquid will be collected at this ring which is available at the periphery of this and this we call as the over flow and the settled solid the settled slug we can call that slug is collected at the bottom which can be directed towards to the discharge and through this rake s.

And this section if you see at the bottom this is nothing but the exit of sedimentary so this the somatic of sedimentation tank due to slight variation in fed inlet and exit other sediment can be defined but the basic structure of sedimentary is like this only so here the suspension is fed at the center as just I have explained at the depth of from 0.3 to 1m below the surface of the liquid with as little disturbance as possible.

So it disturbs it does not disturb the or it avoid disturbance obviously disturbance will be there but the disturbance can be avoided significantly while entering the fed after some distance from the top so for this such arrangement is made so small tanks are made of wood or metal and the rakes rotates at about 0.02 Hz that is 1 rpm very large thickeners if we use they generally consists of large concert tanks and rotate slowly that is as low as 0.002 Hz that is 0.1 rpm so you can see this revolves very slowly.

So that the settling process should not be disturbed otherwise the whole slug which is collected at the bottom it is mixed with the upper clarifying liquid so it moves very slowly and collects these rakes collects all the sludge at the center or towards the exit nozzle.

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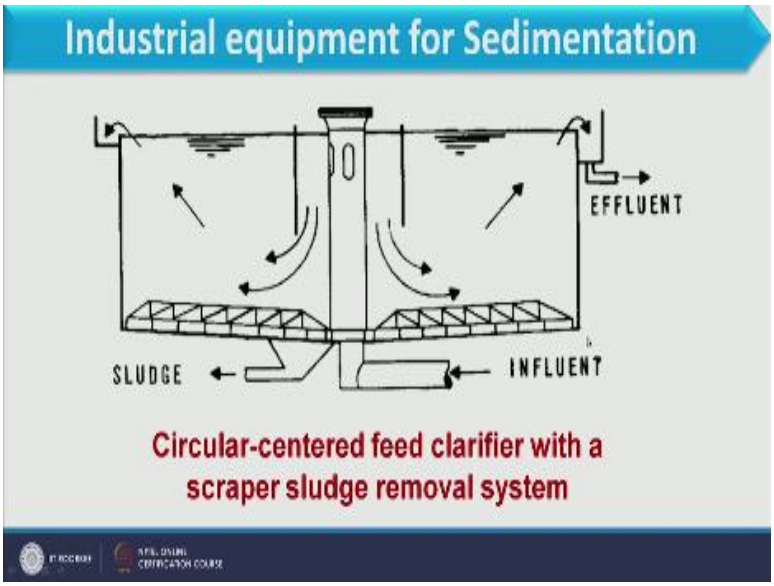

Here in this diagram that is another type of sedimentar that is called as circular centered feed clarifier with scrapper sludge removal system so here we have the scrapper sludge removal system it means it is a speaking about these rags and at the bottom of these rags some brush kind of a structure is there which scrap the sludge which is available at the bottom of it so here you see feed enters from the bottom not from the top feed enters from the bottom and it comes to the tank through these nozzles.

Here you see these nozzles are available where this influent on this or feed enters to the tank now once this feed enters to the tank here we have this again we call it basically the baffle which removes or which reduces the disturbance in the clarifying liquid so what happens when feed enters into this it enters at slight lower distance then the top and the and here sedimentation starts the clarifying fine liquid the clear liquid passes the particle and moves up and collected from this at the Perry ferry so a fluent will be collected from this however sludge will be collected from the bottom.

So here we have the circular center wing were the scraper removal system that is another type of sedimentar now here we have another sedimentar that a circular ring feed rim take of clarifier.

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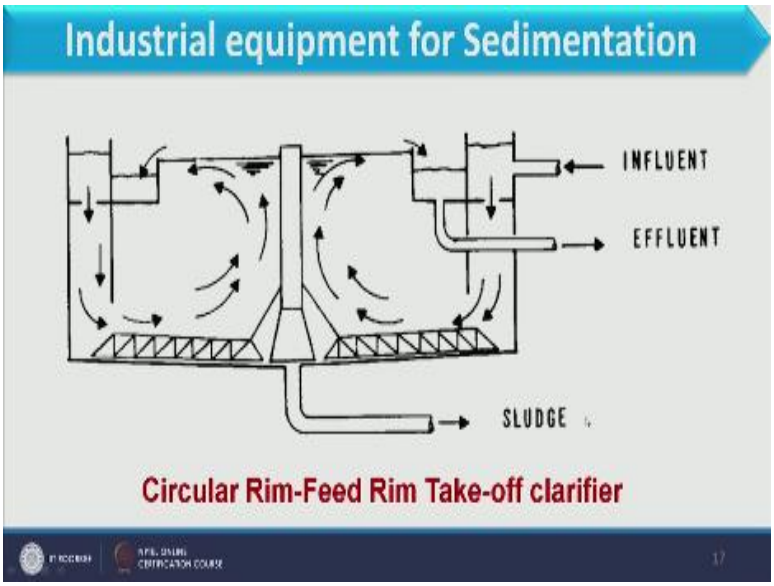

So here what happens the feed enters in the ring and collected in the rim therefore this is called as a rim feed rim take-off now what happens here you see the feed enters from one side in the rim not in whole tank but in the rim as previously what we have seen feed enters from the center pipe and then it distributed to the whole tank in this particular sedimentar feed enters at the Perry ferry and then if you see the baffle in this case baffle is very deep like this is the total height of the baffle and liquid which is entered into this it.

Enters the system so that if it can disturb the bottom but it should not disturb the top because it works as a clarifier so mean purpose is to get the clear liquid so here we have a very long baffle feed enters in rim and then it enters to the tank through this section and similarly from this feed is enter to the tank and then after sedimentation clarifying liquid will collected at the top which will be collected at in a ring so through ring it enters and through ring it exit but the first ring from the Perry ferry.

Is the in littering and second ring from the Perry ferry is the exit ring so and sludge is collected from the bottom if we need it clear liquid as the product we have to choose such type of clarifier.

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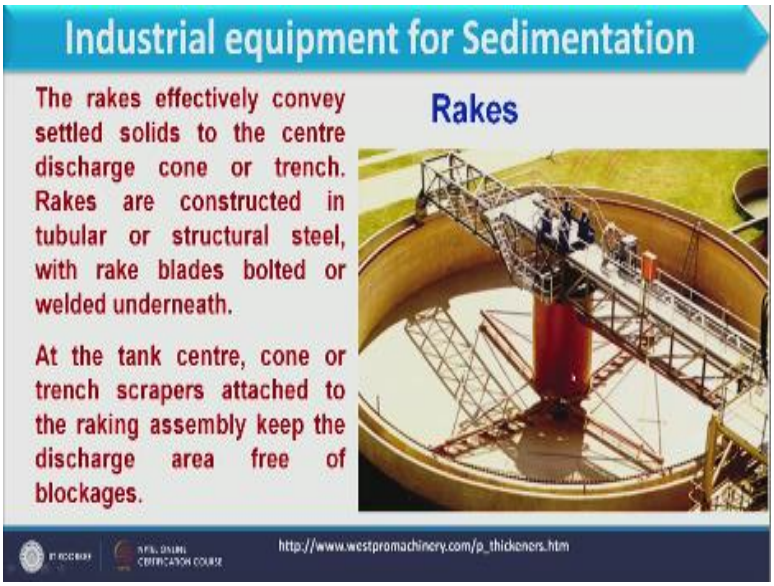

Now we will discuss different sections or different accessories which are associated with the sedimentar the first one is the rakes as we have already discuss the purpose of this here we will discuss a details about this the rakes effectively convey settled solids to the center discharge cone or trench, that is when complete assembly rotate so what happens the rake which is available over here. That will be that rotates and collect the whole sludge to the center and here probably the exit stream exit nozzle will be there.

So rakes are constructed in tubular or a structural steel with rake blades bolted or welded underneath so here we have this rake structure which is basically prepare with the steel now what happens all because the purpose of rake is to direct the sludge to the center but what happens that it can also block the exit nozzle so what happens when this complete assembly rotates so the purpose of rake is to collect he whole sludge to the center but sometime what happens it can also block the exit nozzle.

So in that case at the tank center cone or trench scrappers attach to the raking assembly keep the discharge area free of blockages so here if you see this diagram the brushers are also available at the rank is assembly over here which cleans the path of this discharge and it removes the

blockages so purpose of rake is collect and then we have the scrappers at the cone also where it will remove the discharge which is collected over there and clear if and it clear the path for sludge to move.

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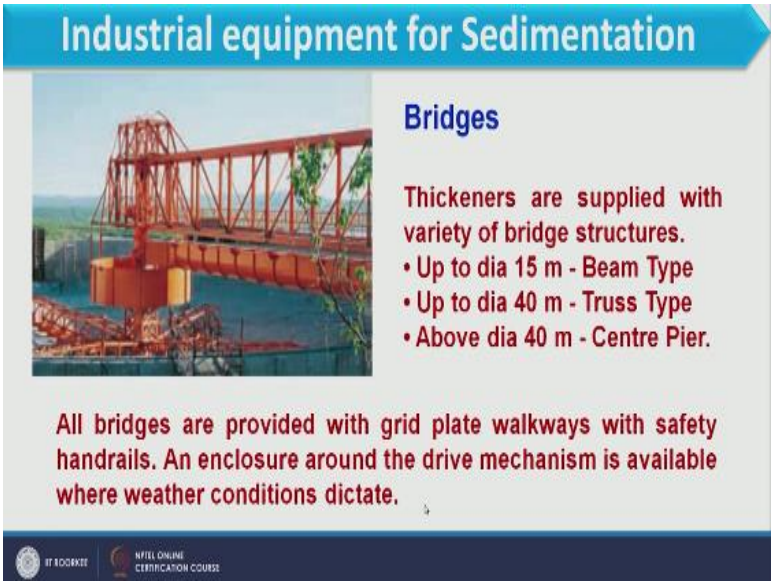

Now another assembly is the bridges if you see this particular diagram or if you see the previous diagram, previous diagram also we have at the top some bridge kind of assembly and that we can call as the bridges, now what is the purpose of this bridge is obviously one purpose is for maintenance when anything we have to maintain we should go into the clarifier so bridge is for that purpose.

Secondly all motors will be placed at the top over here if you see this particular diagram the motor which revolves this that is available over this which is basically which should be covered we should be kept safe in worst weather conditions so for that bridges are there, so thickness are supplied with variety of bridge structures up to diameter 15m beam type bridge we use up to diameter 40m trust type bridge will be used and above that center piers bridges are used.

So all bridges are provided with grid plate walkway with safety handrails if you consider this diagram here we have nothing but these are the safety handrails and an enclosure around the drive mechanism is available where weather condition dictates, so here we have this enclosure which will be covered during the, during worst weather condition so that is operation should not be disturbed.

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So thickness are a major component in a plant layout and their selection maybe critical for several reasons. Now if you see this particular diagram particular view it has it is the Arial view where three sedimentor are placed side by side if you see this diagram, so they occupy really large space as you can see from this diagram so obviously space is the primary requirement for thickness.

So they are normally positioned far away from the center of the plant and owing to the large flows they are fed by gravity to save pumping. Now what happens as you have understood till now the capacity of these tanks are very high so while continuous inlet of feed or addition of feed you can understand this amount of feed should be very large so to enter that much amount

into the clarifier we need significant pumping cost, so that should be reduce so how we can reduce this by placing this so that feed can be enter into this clarifier by gravity action itself.

For example, if we have sedimentation tank over here the plant should be a little bit at higher elevation then this so that feed can be moved through this to feed can be moved to this sedimentor by action of gravity it will reduce the pumping cost significantly. Therefore their position for a given hydraulic gradient may be determine the elevation of the entire plant so when we go for this thickener first of all to install any plant we should see the installation of thickener where the thickener should be place and accordingly we will choose the position of the plant.

Now rake driven thickeners for continuous operation can impose a substantial burden on capital investment though rake assembly is very important at as it collects the sludge but at the same time the capital investment in this case is significantly high as we have to install the steel rake along with this we have to arrange the motor extra for its rotation so you can consider the capital investment involved in this which is very high.

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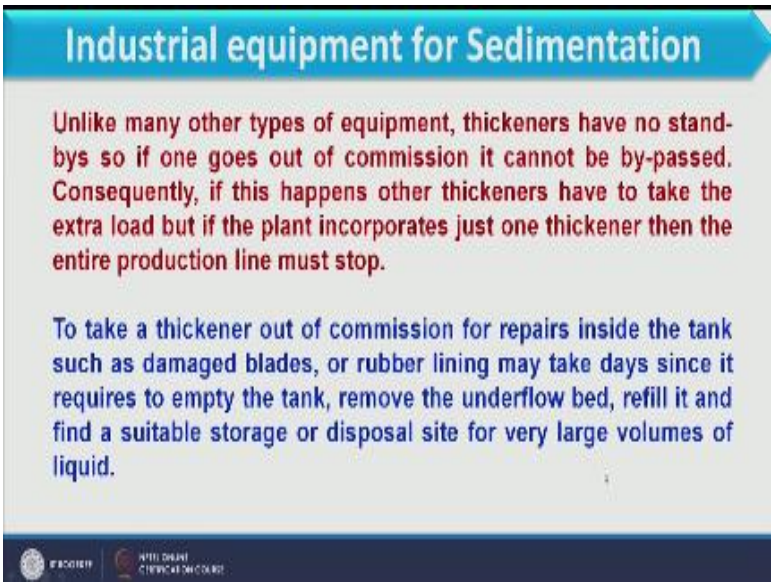

Another important factor about the sedimentor is unlike many other type of equipment thickeners have no stand bys, so if one goes out of commission it cannot be bypassed so that is very important factor because sedimentor usually covers very large area of the plant so it is not possible to install a standby of this sedimentor. So what happens when any problem occurs in the sedimentor either another sedimentor has to take the load of this or if another sedimentor is not available what we have to do is the production line we have to stop and then first of all we have to rectify the problem in the sedimentor and then the production line should be started.

Therefore its stand by its necessary but it is very difficult to install they stand by of this and because of this the production line should be stopped, to take a thickener out of commission for repair, now what happens when thickeners when it is not working properly or when something went something goes wrong with this it should go for the commissioning now once it goes for the commissioning for repair inside the tank such as damage blades or rubber lining may take days since it requires to empty the tank remove the under flow bed refill it and find a suitable storage or disposal site for very large volumes of liquid.

So that is the very huge problem with the sedimentor for example if it is not working properly to repair purpose we have to empty the whole tank and the whole volume we have to collect we have to kept something somewhere else, so we have to store somewhere else. So one problem is that due to its size its standby is not installed if something goes wrong with this we have to stop the production line.

And similarly it takes so many days because here we have to empty it then collect the whole volume store the whole volume somewhere else then we have to then its repair work will be carried out and then we have to start work again. So these are some problems with the sedimentation.

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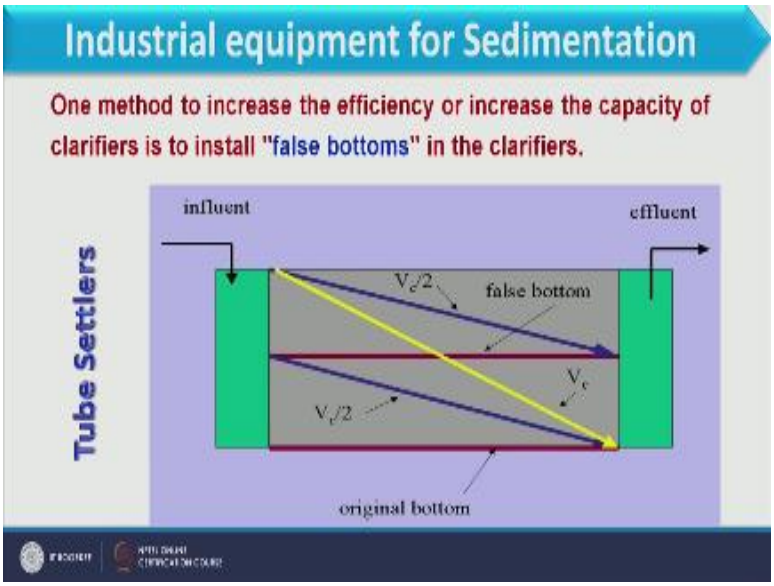

Now here we have another part of this equipment that we call as the false bottom some of in some of the clarifiers false bottom are installed which is currently used so why it is used is to increase the efficiency or to increase the capacity of the clarifier we the installation of false bottom in the clarifiers is recommended. So what is false bottom if you see this figure this is the total height of the tank and this is the actual bottom now what happens when we need the clarifier liquid, when we need the clear liquid it means the bottom or sludge will not be the primary product for us.

The clear liquid is the primary product for us so we will repair the false bottom, so you can argue that when we reduce the total height the residence time of the particle will reduce and it will not settle properly while we using this false bottom. But here what happens I will speak how this problem will be rectify, so in usual case this the original bottom and up to certain height we will fill with tube settlers so that top of this tube settlers will work as a false bottom. So up to that height of the false bottom can be decided that it should covered the half volume of the tank from bottom tank. Now what happens this is the example of tube settler if you see these tube styles.

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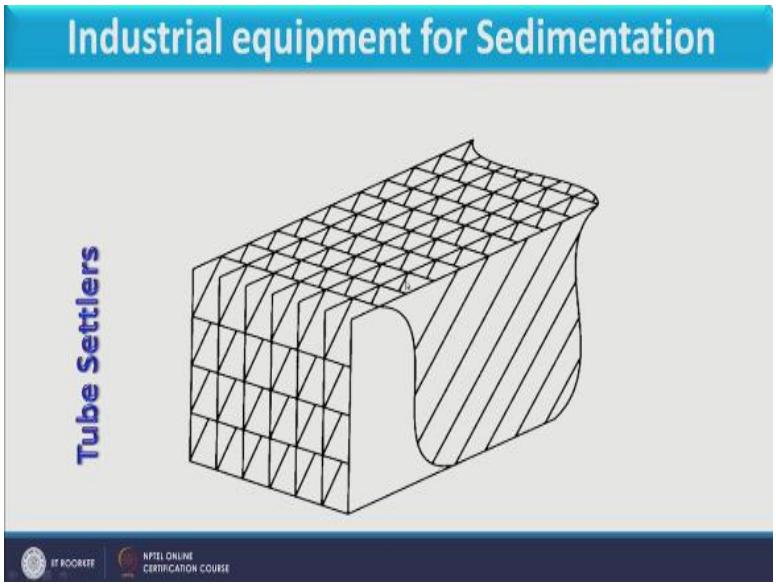

Are having so m e structure this it at as a these are not the solids these are perfumed tubes so in this perforated tube in this block slide which is at the solid particle is enter in to this and they cannot come out even if with the come out even if the when turbans occur in t he tank bounce it is in to this clarify liquid the at the upper level of the this it will not disturb clarify liquid it has more clarify clear so here you can see the height of the tank it is this much and we have put this tube settler.

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The derail of the t use is settler is a it is very l might and whatever that enters in these holes and then it c an be again regenerated by knowing the slide so after some time these tubes settle will taken out and these are not ready heavy it can be taken out easily but once sledge enters in to the it will not disturb the clearance that is the main p purpose so these are the use in clarifying liquid so here in use we can see the tube settler which is available in many.

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Tank were in this we can g et more clearance in rapid and normal clarifier so here we have different we have already discussed f or m equipment in the sublimation so what is the proper admin in the sediment and what are the different accessories involved in this and what is the net to improve efficiency we can use as a clarifier so there are few equipment thicken which we are for the industrial sedimential other equipment we can find in the references so here I am going to summarize the lecture.

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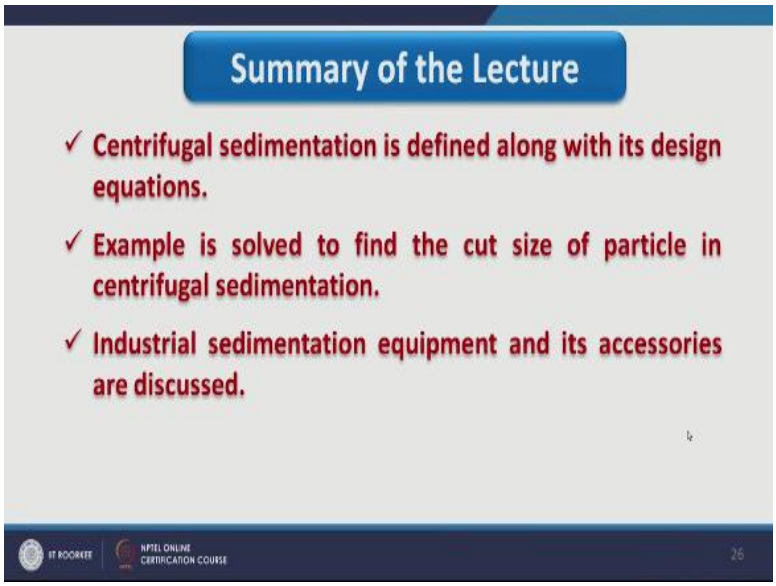

This is the summary of the lecture for as well lecture five here we have discussed some centrifugal sedimentation along with it is design equation example is to solvent to cut the subvention ice particle in centre centrifugal sedimentation and finally the industrial sedimential equipment it is accessories are discussed and here are some reference come of the web sides are given.

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We have used some of the web pages I have already used that I have showed in the subsequent in respective slide it so that refer for more details and you can go through these book further detail an d that is all from now thank you.

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