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Lecture-26
Water Treatment Units: Sedimentation

Hello friends and welcome back. So, we will continue our discussion on water treatment aspects and in the last lecture we did talk about the Sedimentation andAeration which our unit sometime provided in the water treatment facilities. This particular class we will be discussing about the Sedimentation.

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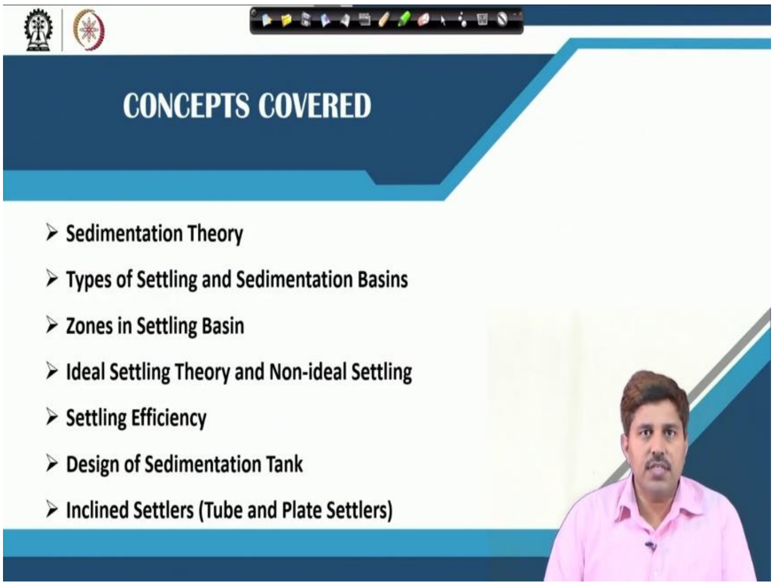

So, what we are going to cover is the Basic Theory of the Sedimentation, then what are the different type of Settling and what are the Sedimentation Basins, different Classes of Sedimentation Basins. We will be talking about zones in a Settling Basin and then Ideal Settling Theory and what are what happens when we do not meet those ideal conditions. So, the Non-Ideal Settling or Flocculent Settling concepts also will be discussing.

We will talk about the Settling Efficiency and then touch upon the design aspects of a typical Sedimentation Basin. And last, we will be discussing about the Inclined Settlers which are tube and plate settlers.

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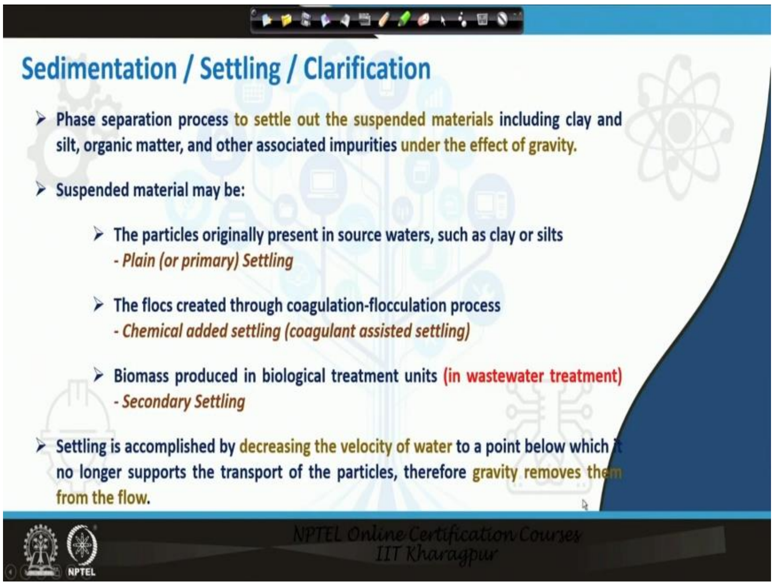

So, to begin with, there are quite a few words used like Sedimentation, Settling or Clarification. So, in water treatment or in even in the waste water treatment aspects, these all meant about basically a unit where we tend to do the phase separation process in order to settle out the suspended materials.

So, the water coming in or the waste water coming in for that matter may have several suspended particles and what we tend to achieve to putting them to a sedimentation unit or settling basin is removal of majority of those settleable materials like clay, silt, organic matter or various other associated impurities and the settlement takes place under the effect of gravity.

So, we may have suspended materials which are particles originally present in the source water like clay and silts. So, for them we go for plain settling or primary settling or primary sedimentation what we call. We may tend to settle at times flocs, so, we may go for coagulation flocculation first and then go for settling process. So, that is basically the coagulant assisted settling or chemical settling or chemical added settling.

And we may at times need to settle the biomass which is more applicable to the waste water treatment and not for the water treatment. So, this is actually for waste water treatment. When we have secondary settling where we try to settle the biomass, but generally for water treatment aspects, we go for in most cases we go for Coagulant Assisted Settling means we do settling after coagulation flocculation process, but at times if water is too turbid we may go for the primary or plain settling as well.

Now, how we achieve settling, we achieve settling by decreasing the velocity of water. So, if we have any unit and water is say nothing settles in the pipe because, water is flowing through substantial velocity. So, velocity is enough to keep the suspended materials in the suspension no settling will happen. When we put that in a tank, the velocity is reduced and then the other there will be some horizontal velocity component but then there is a by virtue of gravity, there is a pull from bottom or pull towards Like downward direction.

So, the resultant direction of the flow becomes somewhere like this and then it can hit the bottom and settle out.So, the settling is achieved by decreasing the velocity of water to a point below which it will not support the transport of particle and by gravity, the particle, will actually be settling at the bottom and will be removed.

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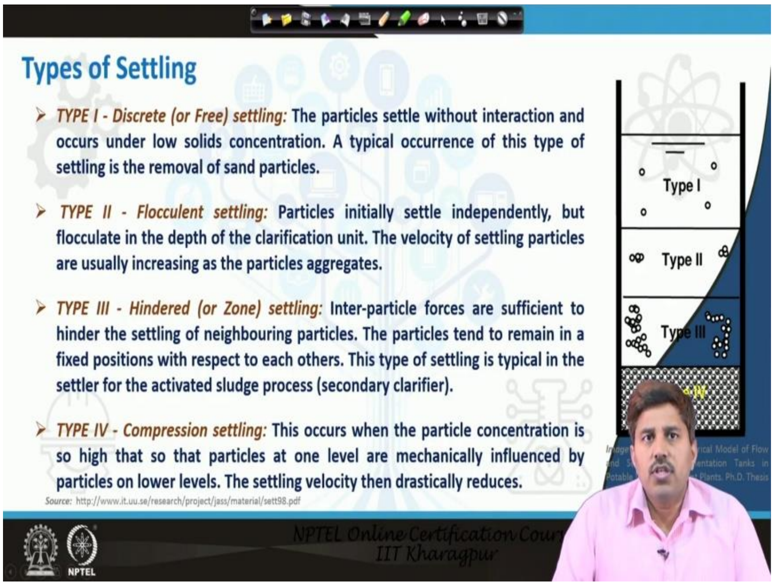

So, there are four different type of settling.The type one settling which is also known as Discrete Settling or Free Settling is when a particle is settling without kind of getting into interaction with any other particle. So, one particle is settling on its own it is not affected by other particle, okay, so, that is the most kind of ideal case it is a particle is settling free from the effect or interaction of the other particles.

So, normally at the top the particles are kind of free they are individual and they settle by their own but once they are settling in the in between somewhere, where the particle density increases, they get an opportunity to interact with each other. So, then they will move to the type two settling which is Flocculent Settling Zone. So, in Flocculent Settling or type two settling, basically the particle initially settles independently as we said but then they will flocculate in depth in the clarification unit.

So, instead of settling as a single particle they will settle as a floc, as a larger mass and because this is the aggregate has a larger mass, so, the settling velocity will also be higher in the case okay. So, flocculent particle or the settling velocity in the Flocculent Settling is higher typically than the Discrete Settling.

Now, the type three settling which is also known as HinderedSettling or Zone settling is basically when particles settle as a mass, settle as a complete zone, but there are inter particle forces, which kind of keep those particles apart. So, if I have one particle here another particle here another particle here another particle here, so, all will settle together but they are not getting accumulated. It is not like they will club like this, that does not happen.

So, these particles will settle as a mass kind of, but their inter particle forces will basically be keep on acting and these forces then hinder the settling and that is why it is known as hindered settling. They settle as a zones so that is why it is also known as Zones Settling, but in the Zone Settling cases, the inter particle forces will hinder the settling of the neighbouring particles and that is why the settling slows down. So velocity of the settling or settling velocity here is going to be lower as opposed to the Free Settling or Flocculent Settling

And then the last which is type for settling is basically the CompressionSettling so which occurs towards the bottom of the tank okay when there is a sufficient high load at the top okay. So, the because of this high weight the particles are mechanically influenced and they get compressed. So, the settling achieved because of this compression of the particle is known as the Compression Settling and the settling velocity will be drastically low here.

So, if we see the settling velocity, this one will have the kind of highest settling velocity and then this will be kind of second highest. So, this one will be the highest this one will be the second highest Zone Settling will be third and Compression Settling has the least velocity okay. So, this is the different type of settling four different type settling that we typically see,

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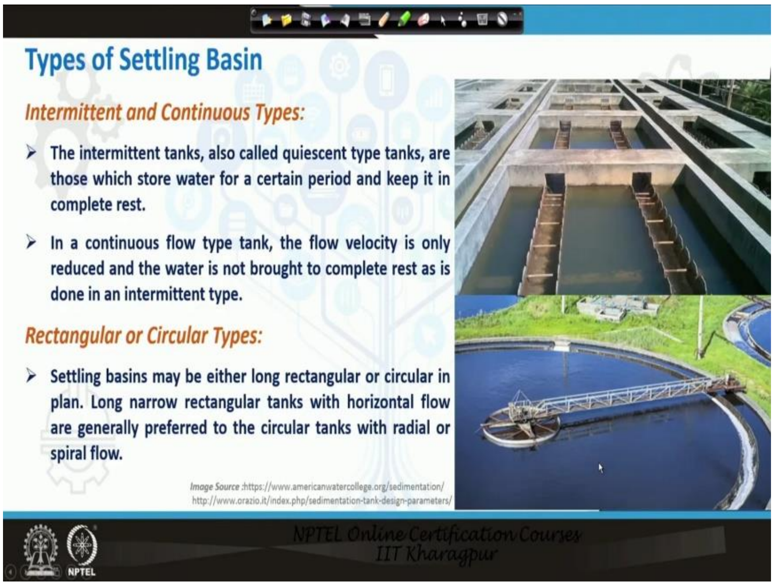

In the sedimentation process. Now, if we see the different type of Sedimentation Basins, so, there are two types Intermittent and Continuous types, the intermittent types are also kind of batch type. So, they are quiescent type tank water is filled it completely remains a static the particles which has to be settled will be settled and then water will be taken out okay after a certain period.

The more common is actually the continuous flow type settling tank where the water will be coming from one side and leaving from the other side but as discussed the velocity will be very low and it actually kind of gives the removal of the suspended materials or suspended particle so it will never be bought to complete rest okay. From Geometry perspective, there are two types of tank which are usually in practice, the Rectangular Settling Tanks and Circular Settling Tanks.

So, Rectangular Settling Tanks are basing which are long rectangular kind or circular basins are which are circular in the plan okay. Long rectangular tanks with kind of horizontal flow are generally preferred to circular tanks with radial or spiral flow but economy wise circular tank may actually prove the better solution at times,

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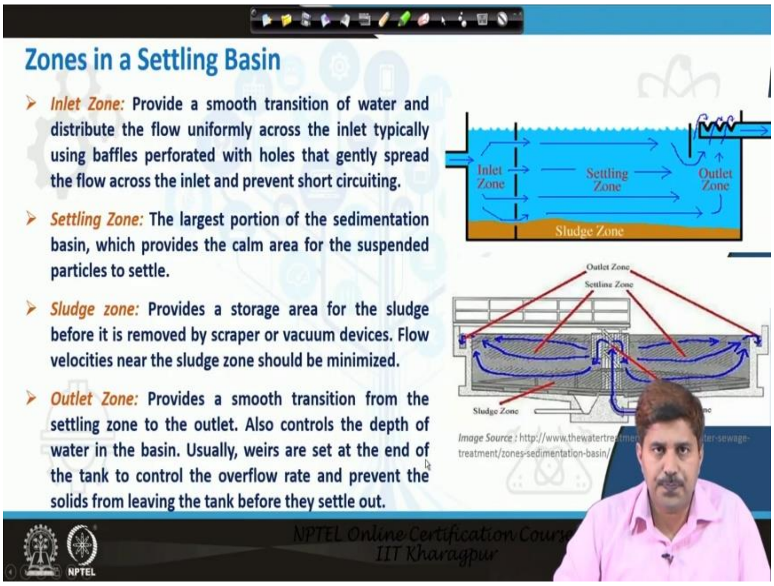

So, circular tanks are also quite popular. Now, in the process of settling any settling based in will typically have four different Zones. So, these zones are the Inlet Zone the first one so, either it is a rectangular settling tank or it is a circular settling time what happens water will be entering at some point in the tank so, let us say if water is entering from this point this so, where water enters the point there will be some initial turbulence over here.

So, this particular zone is known as Inlet Zone. The role of Inlet Zone is to provide a smooth transaction of water and distribute water uniformly across the tank okay across the inlet of the tank. So, generally a baffle will be provided and through these buffers water will interact the different Zones it is not that all water is entering from here because in that case, if all water is entering here there is a large chance of shorts circuiting and then water entering here may directly flow out there.

So, in order to avoid that, we generally provide baffle and in so that water enters at different levels through the inlet point. So, the role of inlet is to gently spread the flow across the inlet and prevent any type of any kind of short circuiting. In Rectangular Settling Basins we will have zones where the water where inlet zone where the water is entering, in circular also water enters basically in the centre. So, the inlet zone is usually in the centre.

So, like if this is my inlet pipe water will enter here and then it will be basically will provide some sort of mechanism in order to reduce the turbulence over here and this becomes my inlet zone in circular tanks. Next is Settling zone which is the most important part of a settling basin. Ideally when we design when we go for designing a settling basin, we target this zone particularly.

So, settling zone is where water is coming from the inlet and then the settlement process typically takes place. So, this is the Zone where sedimentation will take place in rectangular majority of the tank part is actually settling zone in circular again. So, after inlet all round, the water is basically in the settling zone, so as you can see the settling zone all these portions are in the settling zone.

Then there is a Sludgezone. So, the mass which settles down the sediments with settle downs are typically known as sludge, okay. So, the tank has to provide a storage area for the sludge before the sludge is taken out okay before the sludge is removed by a scrapper or any vacuum device. So, flow velocity near the sludgezone should be minimized so that sludge does not come into the suspension.

So, the bottom portion will actually be sludge zone. So, in case of a rectangular tank, this is your sludgezone and in case of circular tank also the sludgezone will be at the bottoms as you can see, this is the Sludge Zone. The last one is the Outlet Zone which has a responsibility to provide a smooth transition from the settling zone to the influent channel or outlet channel or outlet pipe. This also basically controls the level of water in the tank to what level the water will be there in the tank that is also controlled by this outlet basin.

So, outlet basin is typically in the form of weirs at the end, which kind of controls the flow. So, we can have a weir like this and water can enter through these weirs and we can be taken out. So, this Zone is known as Outlet Zone and in the circular tank, towards the periphery throughout all the periphery will have basically weir are from water will be flowing towards these and these are known as then the Outlet Zone.

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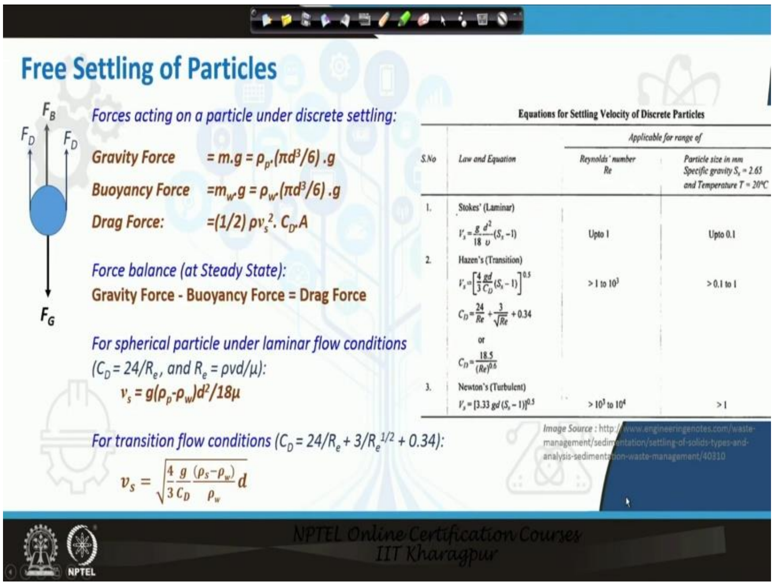

So, these are the four typical Zones. Now, if we see the free settling of a particle, typically, if a particle say this is the particle which is settling in a fluid so it will be subjected under different forces, there will be gravity force which will be pulling the particle down, they will be balancing force which will be basically pulling the particle up which is equal to the mass of the water moved and then there will be drag force which would be acting on the surface okay.

So, if you see these three forces gravity forces equal to Mass into the gravity, mass of the particle, so, particle density into the volume of the particle if we consider this as a spherical particles of Pi d cube by 6 is the volume, okay. And Row is the density of the particle into g.Buoyancy force is again the mass of water moved, so, that it will be equal to the volume of the particle itself and instead of density of particle will take the density of water in order to get the mass of water moved and into g.

The drag force is half Row V square into C d into A. So, if we see in a steady state do a force balance at a steady state. So, the gravity force which is acting at the acting downwards should be equal to the sum of the buoyancy force and drag force Okay, because buoyancy force will always be acting up, gravity force will always be acting down and drag force will be acting depending on the movement of the particles a particle is moving down.

So, the drag force will be up, a particle is moving up means it is going to float then drag force is going to be downwards. But here since we are talking about the settling process, that means particle is moving down and, in that case, drag force is going to be upward in the upward direction. So, if you do a force balance, okay, what we get is the like, by force balance, we can determine the settling velocity from here, okay.

And if particle is a spherical under laminar flow condition, so the C d under laminar flow conditions become 24 by R e andR e as we know is rowV d by mu. So, if we substitute these things, we get this expression which is actually the Stokes law. So, the settling velocity under Laminar of a spherical particle under Laminar flow condition will be given by this Stokes law and we can get settling velocity like this, okay.

As you can see here and it is valid up to Reynold number of 1, for Reynold number between 1 to 1000 we go for the transition equation so, which is Hazen's Law, settling velocity can be given by this expression where C d is 24 by R e +3 by square root of R e + 0.34 Okay. And then under complete turbulent conditions we can use this Newton's equation when the Reynold numbers are even higher.So, that way we can actually get the settling velocity of the particles.

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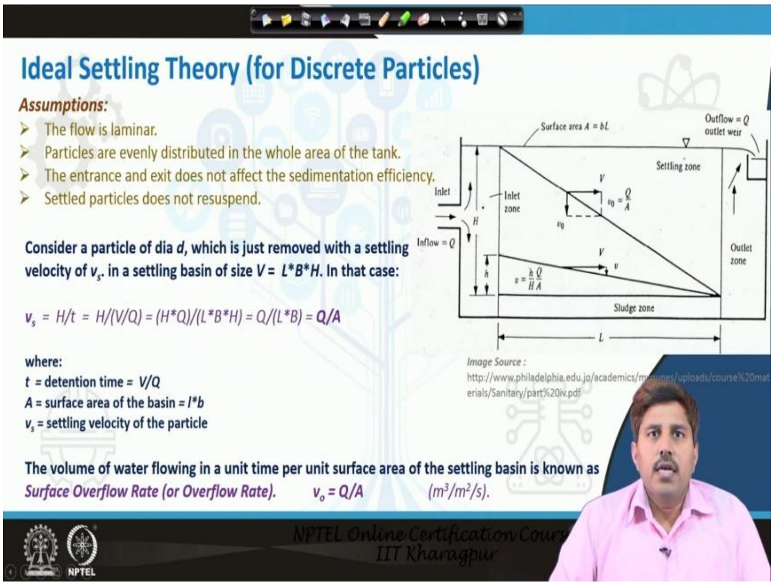

Now, in ideal conditions if we talk about the ideal settling of discrete particle, so, what happens when a particle enters in the tank, okay? It will be Under the like different forces. So, it will have some horizontal velocity and it will have some vertical velocity. If we take certain assumptions under idealconditions like flow is laminar the particle isevenly distributed in the tank, the entrance and exit of the tank are not affecting the removal efficiency or sedimentation efficiency and whatever particle has settled has come to this Sludge Zone is not getting resuspended.

So, if we consider these assumptions, then what we can see that for any particle of dia d which is kind of just getting removed here, okay. The settling velocity of that particle is going to be equal to because say if a particle is entering here you consider that if you are talking about particle of just one size, if the one particle is entering here and another particle is entering here. So, they will be under similar says if this is the trajectoryof the particle, this will be the trajectory of this particle okay.

So, this particle will certainly get removed if we want to remove all particles of this size, we have to consider that whichever is entering at the top in the tank should also get removed, okay. Whichever is entering in the lower positions will automatically get removed if the particle diameter is of the similar size but the one that is entering at the top should be removed that should be our target.

So, if tank height means the effective height of the settling basin okay, of this settling zone, okay tank height does not mean the entire tank height we keep some free board we keep some provision for sludge zone also, but here because we are talking about the settling process that means we are specifically focusing on the settling zone.

So, if the height of the settling zone is say H okay, then and the particle removes t time in the tank because we know that some discharge is going on queue and then there is it is leaving the system. So, it is spending some time depending on the volume of this settling zone. So, then we can get the we can get Ts basically volume by discharge, okay. So, thethis is the time that the particles are spending in the basically you are settling zone okay.

And they have they should be removed in this time and how they will remove they will remove only if they strike this sludge zone somewhere and does not fall into the outlet zone. Because assumption, if any particle is going into the Outlet Zone we consider that particle not to be settled and will actually move with influent.

So, technically in order are toparticularly getting settled we want the particle to come into this sludge zone and how it will come into this sludgezone only if it can cover this H distance in the T time. If the particlespending T time in the tank. So, in this T time in this particularly T time it has to cover this H distance.

So, what has to be the settling velocity of the particle, settling velocity of the particle has to be H by T.This is the minimum settling velocity of the particle that is needed for particle of this particular dia to get removed, okay. Now, as we just discussed that your T is V by Q So, we get H by V by Q or HQ by V,right. So, volume is length into width into height of this particular basin, this particular zone and then height gets cancelled and weget Qinto L into B which is basically the plan area of the tank.

So, the settling velocity has effectively equal to the discharge divided by the plan area and this is known as surface overflow rate, okay. So, surface overflow rate means per unit surface area how much discharge is being provided okay and that our settling velocity has to be equal to the surface overflow rate or higher than surface overflow rate in order to particle of that diameter should have hundred percent removal.

So, the surface overflow rate is typically the volume of water flowing in a unit time per unit surface area of the settling basin okay, this is also known as overflow rate. And the unit is actually meter cube which isdischarged meter cube per secondand per unit areas, so meter cube per meter square per second or meter cube per second per meter square per second per meter square whichever way we want to express.

This is unit which eventually turns out to the meter per second okay or meter per hour whatever unit we take means the length per unit time. So, it will come to that level but while expressing we do not express is as meter per second rather, we more commonly express as meter cube per meter square per second or meter cube per second per meter square.

Because here we are talking it should be basically clearly show that we are not talking about the velocity, it is more offer like discharge loaded per unit surface area, okay and that is why we go forthis kind of units.

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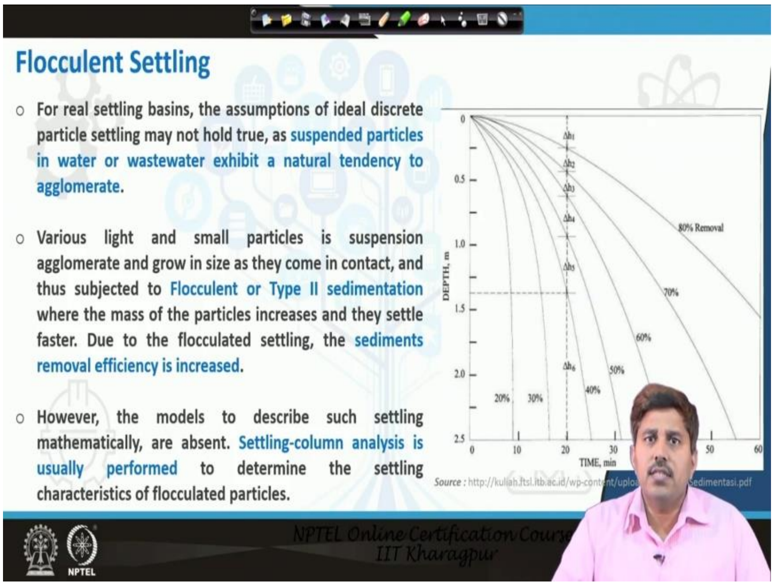

So, that is about the ideal settling. Now, what happens in the real settling basins this assumption of idle discrete settling does not hold true because, when the particle are settling from the top as we discussed earlier also that in between the particles will get agglomerate and they will be basic because it is a natural tendency when the particle density increases they will come into the contact.

And they will form agglomerate and then their velocity increases settling velocity increases they will go into the type two or flocculent type of sedimentation and they are going to be settled faster. So, the removal efficiency is rather increased in real settling basins okay, but there is no specific model to describe that and generally basically the settling column analysis is used to kind of see what kind of settling profile we can achieve.

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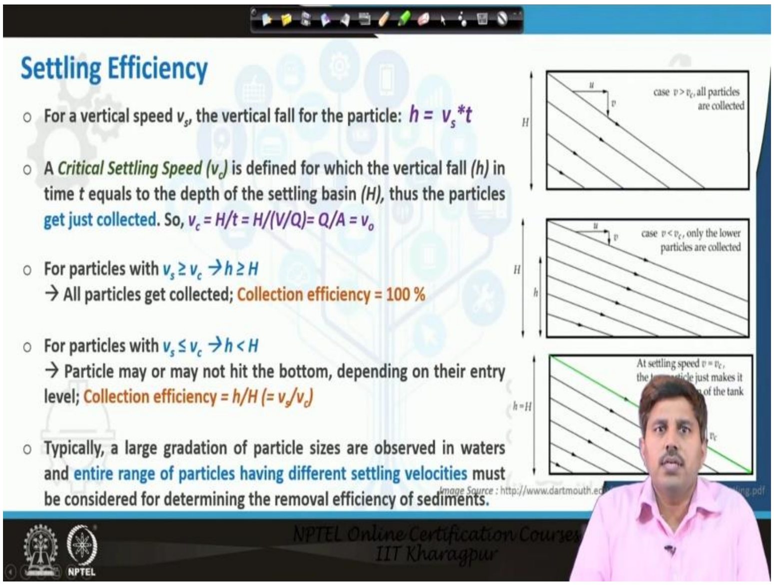

So, that we can use these kinds of lab analysis in order to get the idea of the removal efficiency or settling efficiency. Theoretically for a particle with settling speed Vs the vertical fall is going to be V S times t. Okay if the velocity settling velocity is V s and t is the time. So, any particle who is which is spending t time in the tank will have a vertical fall off H. Now, if this H if this vertical fall H say for a particle entering at any particular point okay if this vertical fall H is less than the total tank depththenit may or may not get removed.

However, if this H is higher than the total depth of the tank that means, the particle is going to have a vertical fall in that time which is more than the tank depth. So, that is certainly going to hit the bottom. So, that may be actually define a term which is called critical settling speed or critical settling velocity which is defined as the when the vertical fall H is just equal to the tank depth or settling base in depth edge.

Okay. So, when h is basically this h is equal to capital H. So, that time what we get velocity is known as V c which is again comes to Q by A and which is equal to the surface overflow rate as discussed earlier. So, basically critical settling velocity of a particle is equal to the overflow rate of the time. So, if you want to remove a particular dia particle completely we have to kind of see that it is settling velocity is actually equal to the overflow rate.

Now, for all particles, which is having settling velocity greater than critical settling velocity, so, as just we are saying they are vertical fall will actually be greater than equal to H and all these particles will get removed. So, we will have a collection efficiency of hundred percent whereas, for particles which has settling velocity lesser than the critical settling velocity. So, for them h is going to be equal to less than H.

The like vertical fall is going to be less than the tank height. So, vertical fall being less than the tank height means it is not going to be removed hundred percent, how much it will be removed will depend on at what level the particle is entering. So, if let us say h is less than the H a particle is entering at this or higher points they will get removed but if it is entering this or lesser point they will not get removed okay sorry if it is entering below this they will get removed if it is entering higher than this.

So, particle entering here will have vertical fall only this much. So, it is going to strike here and leave to the outlet Zone. So, typically what happens in a real system a largegradation of particle sizes is observed in water and entirerange of particles having kind of different settling velocity should be considered when we try to study. The removal or efficiency of the particle.

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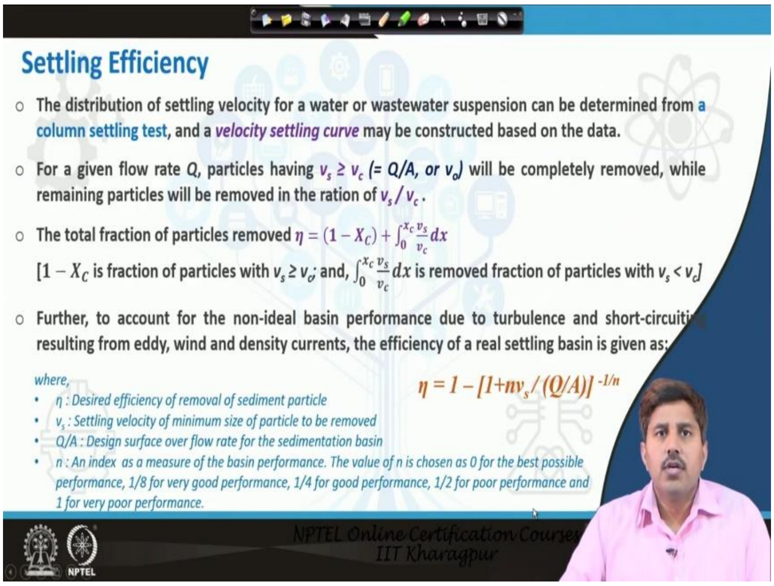

Again, a column settling tank column settling test may be done. So, for a given flow rate we see which are like how much mass or how much fraction of the particle how many number of the particle is having settling velocity greater than the critical settling velocity. So, they will remove completely and whichever is having lesser will actually be remove din the ratio of thesettling velocities or tank heights, okay.

So, the total fraction of the particle the move will be this which is be which is basically gives an idea of the total removal efficiency where this part 1– X c is the fraction of the particle which is having settling velocity greater than the critical settling velocity means hundred percent removal. And this is the fraction of the particle means, removed fraction of the particles which is having the settling velocity lesser than the critical settling velocity.

So, accounting all these like non-ideal cases and other non-ideal cases, which could be like the turbulence and shortcircuiting from at events or density current while designing the settling basin, we compute the efficiency as this 1- [1+ nv s / (Q/A)] to the power minus 1 by n, where basically this is the efficiency which we desire or which we consider.

So, generally this equation is like if say we want to have a tank minimum 70% efficiency, so, our n becomes point 0.7 okay and then Vs is the settling velocity of the minimum size of the particle we want to remove So, we can compute vs for the particle that we are actually willing to.Q by A is the discharge versus tank area and n is a basically Performance Index, which depends on the what kind of what type of performance we want.

Okay. So, n is chosen0 for the best possible,1/8 for very good, 1/4 for good performance, 1/2 for poor performance and 1 for very poor performance.

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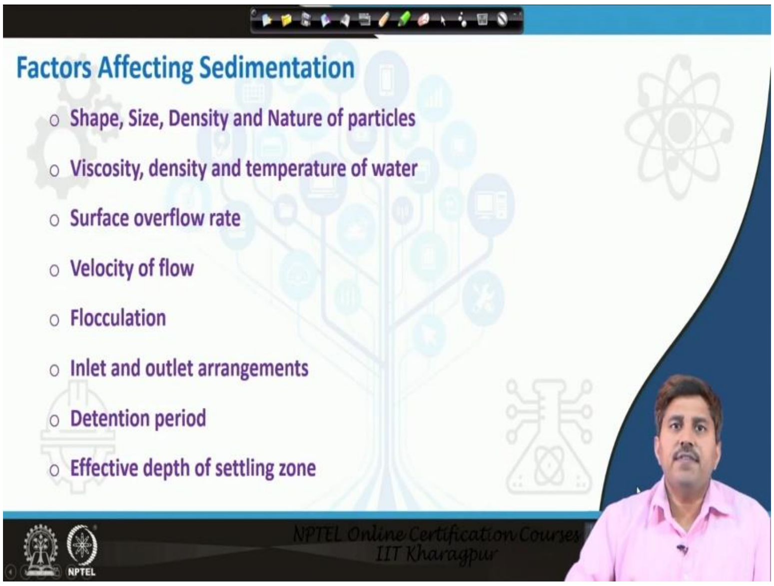

Now, the different factors that affect the sedimentation process include shape, size, density nature a particle then viscosity, density and temperature of water, surface overflow rate velocity of flow, if the flocculation is happening in there, then what are the inlet and outlet arrangement, the detention period the effective shape,

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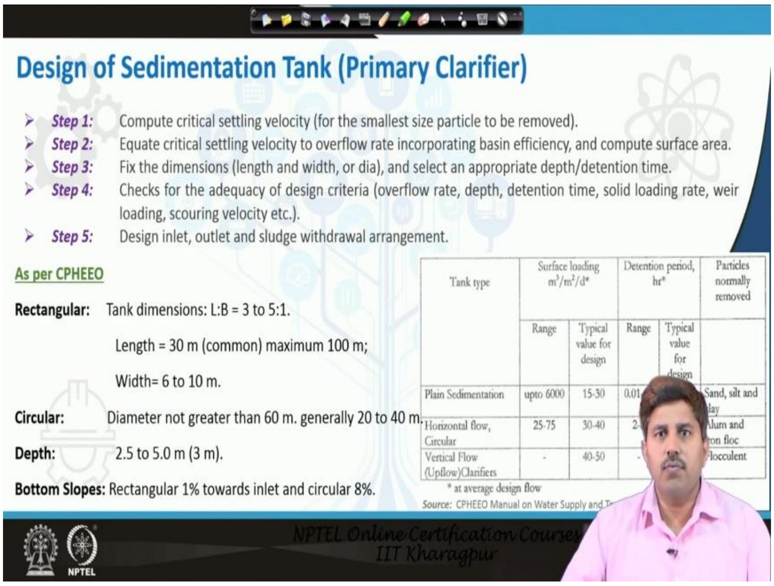

And size of the Zone all these actually will affect the sedimentation efficiency. And for designing purpose, what we do is the first step that we do is we calculate the critical settling velocity for the smallest size of particle that we wish to remove. So, let us say if you want to design a tank for removal of all the particles of point 0.002 or 0.02mm particle sizes, so, if this is our particle size which we want to remove.

So, will estimate the settling like critical settling velocity following Stokes law or if it is in laminar flow condition and if it is in a transit flow condition. So, accordingly Hazen’s or Newton's equation will use in order to find the settling velocity. Once they find the settling velocity, we equate that critical settling velocity to the overflow rate incorporating the basin efficiency.

So, as we were discussing, so, we know the let us say we want 75% basinefficiency or 70% base in efficiency. So, we know that assume a suitable n value and then keep all these things and determine the plan area or tank area from there. So, once we know the tank area, we can fix the dimension length and width or dia if you want to go for circular and select an appropriate depth or detention time.

So, we fix the tank length, width for rectangular case or Diafor circular case and then choose a depth or detention time.And then we check the adequacy of the design criterialike what are the what is the overflow rate for that condition or what depth or detention time we have chosen what is the loading rate, what is the weir loading, what is the scoring velocity etc. So, all these we check and then we put the appropriate inlet outlet and sludgewithdrawal arrangement.

As per CPHEEO manual, some dimensions like the for rectangular length to width ratio has to be with basically 3 to 5 is to 1 and common length is around 30 meter, maximum can go 100 meter widthis 6 to 10 meters. So, this issome like numbers suggested by CPHEEO for circular tank. Generally, 20 to 40 meter diameter is used, should not be exceed 60 meter.

Depth again 2.5 to 5 meters. 3 or 3.5 meter is the common depth, which is typically used and slope for rectangular it should be 1% towards inlet and for circular it should be 8% towards thecentre.Recommended surface loading roll rate and detention periods are also provided in the CPHEEO your manual.

So, for PlainSedimentation it has to be like range these up to this and typical design values taken 15 to 30. For horizontal flow circular again 30 to 40 for vertical flow clarifiers it is 40 to 50 the detention period range typical value 3 to 4,2 to 5 or 1 to 5 years So, that way basically some design recommendations are given,

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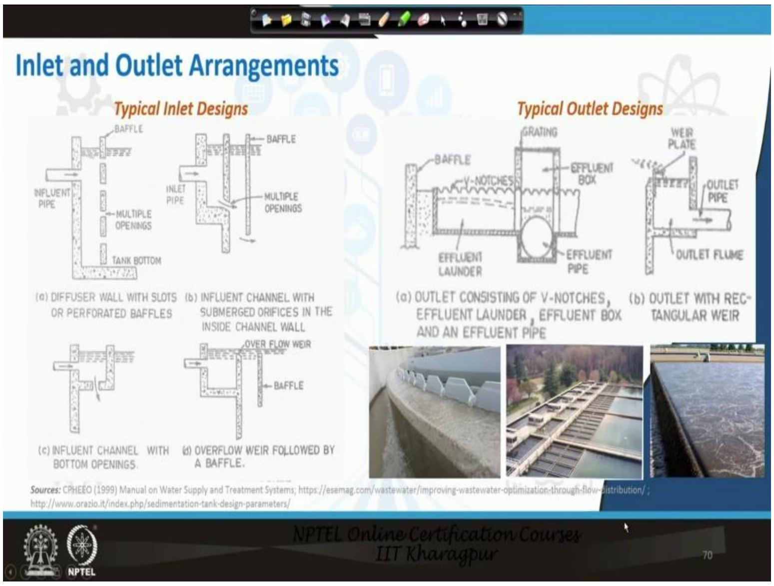

And they can be used. These are typical inlet and outlet arrangement okay. So, for any like sedimentation basin, we can say that if influent pipe is coming as we can have baffle for entry at the different levels at the inlet or in order to reduce the turbulent we can have one baffles of water interest from here and then another baffled for So, giving the multiple opening. We may have influenced channel with bottom opening so gentle in water is coming here and it is actually being released from the bottom instead of top So, that will also reduce the turbulence here.

We can have basically a weir kind of things are water entering here and this subsidizes the turbulence and then water overflow through the weir and then it is basically passed through a buffer. So, these kinds of inlet arrangement and for outlet we can have a V- notch as effluent launder. So, what are basically coming through with these V notches like this what we see here this V notch as it is in so from the tank.

It is entering through these V notches launder and then coming into the outlet channel. Or again we may have just a simple weir and then from weir basically process here and then collect in the effluent pipe. So, this kind of system may also be used. So, these are some of the recommended inlet and outlet arrangement.

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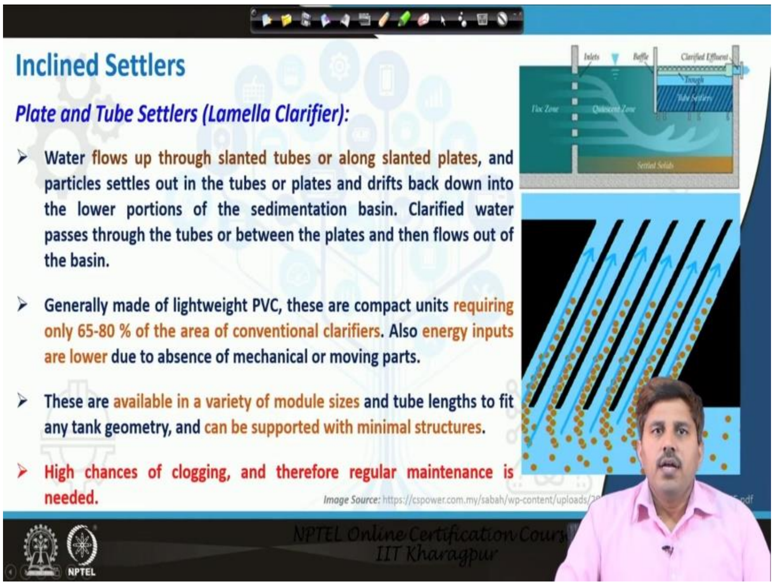

Now, one last thing that we wish to discuss is the Inclined Settlers. So, which is basically the Lamella clarifiers there are plate or tube settlers are the two configurations which are used. So, in this kind of setup what happens that we will have inclined plates or tubes and water will flow through the passage provided okay. So, it will basically flow through the slanted tubes or kind of along slanted plates and as water is flowing.

So, various particles will settle unclarified water will be basically passed through the plates and will be basically collected at the top. So, generally these are lightweight made of PVC plates could be made of steel also which gives them a longer life okay. And these are basically compact units which require roughly 65 to 80% of the area of the conventional jelly fair.

So, LA is smaller area is needed as opposed to the conventional sedimentation basins also the energy input are lower because we do not have any mechanical is scrapping or moving part for sludge cleaning it is rather more easier there and these are available in a variety of module size on different to blends which can fit to any size any sort of tank geometry are available, okay and our needs minimal structure for supporting because of them being lightweight relatively.

The problem side they have a high chance of clogging and therefore regular maintenance is needed for these kinds of systems.

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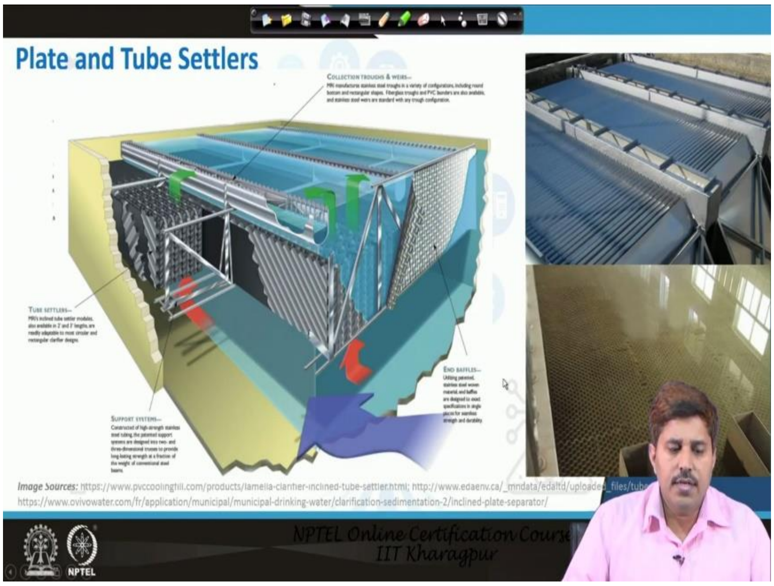

Now, what happens actually, in this plate or tube settlers. As, you can see here, so, the water will be basically flowing from the bottom and then it passes through this series of tubes. Now, the advantage here isin fact it will be likefor purpose water getting passed out of the tank it needs to be, it needs to travel a longer distance. So, water will be entering from the bottom of the tube and will have to basically pass through the entire tube in order to get there.

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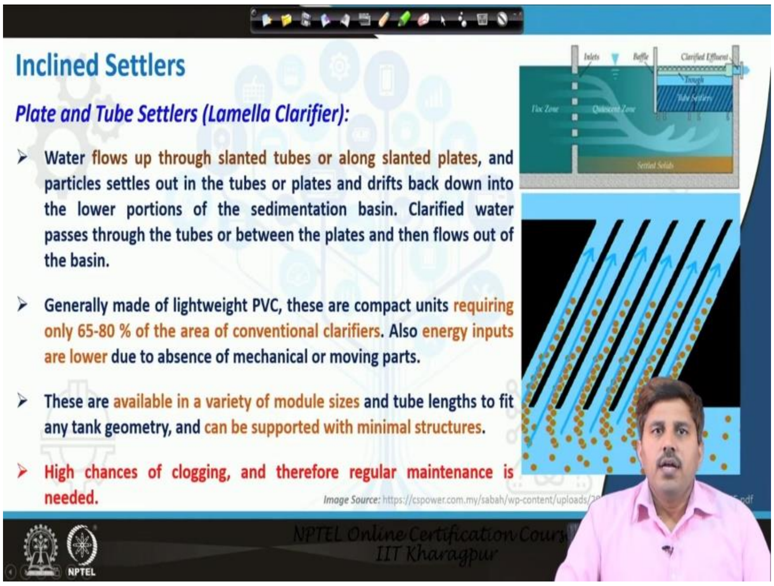

However, for solids, Or for the suspended materials there for them to settle they need just as they need to just come a shorter distance.So, if you see the water aslike if say this is the length of the tube so, water has to come from here and it has to basically pass through this entire length, but solid particles. So, as solid is rising it basically strikes or it falls it will find a surface right here. So, it does not need that distance to basically go settle or it does not need this much once it comes on the tube and then from here it can basically slide down.

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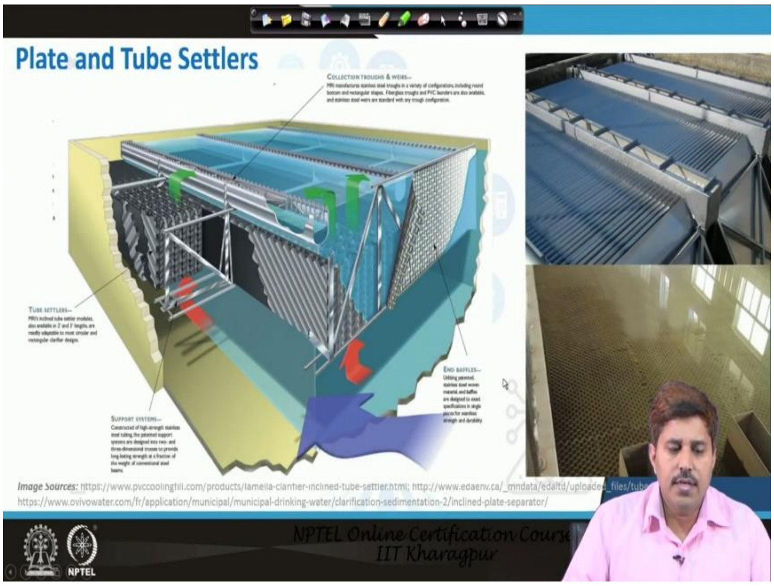

So, that way the removal of the suspended materials becomes fairly easy in these two board played settlers,

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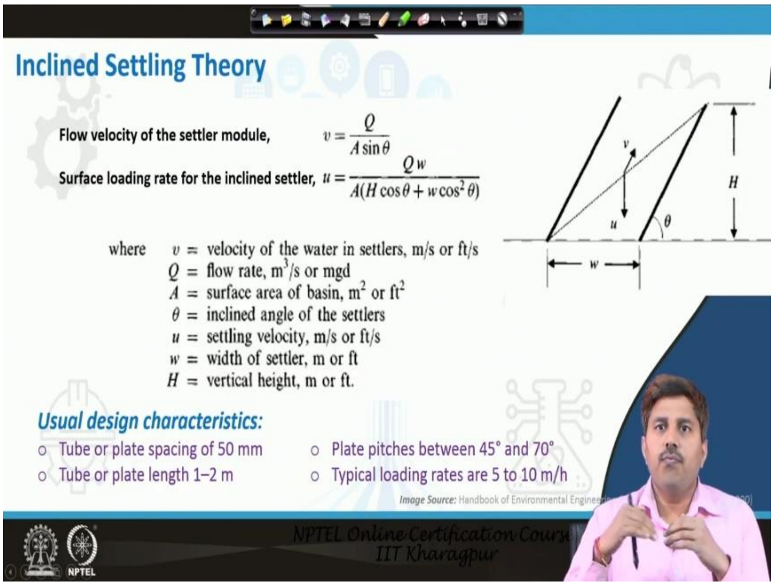

Both of them have similar working principle though. So, what happens for the flow velocity of the settler module like say if this is the two plates and or two tubes and the width between these two is the W, say height is H okay and this angle of inclination is theta, this theta is typically kept around 60 degree, the 45 to 60 is commonatextreme cases we can use a little higher angle also but not it is not advisable to go too high.

So, we have theta. Now what happens for a particle if we see the flow velocity of the settler module, the water which is flowing, so far that if discharge is Q and the A is basically the surface area of the basin, then it becomes Q by sin theta and the surface loading rate for these inclined settlers, which is basically U become Q into W by a h cos theta + w cos square theta. So, this is this way we can get the surface loading rate for the incline settlers.

Usually the tubes or plates have a spacing of 15 millimetre, the like this w value is usually of that order, the tubes or plate will have length of 1 to 2 meter, the plate which is between 45 to 70, 70 is higher side generally it is between 45 to 60 degree, okay, and typical loading rates are 5 to 10 meters square 5 to 10 metersper hour or5 to 10 meter cube per meters square per hour.

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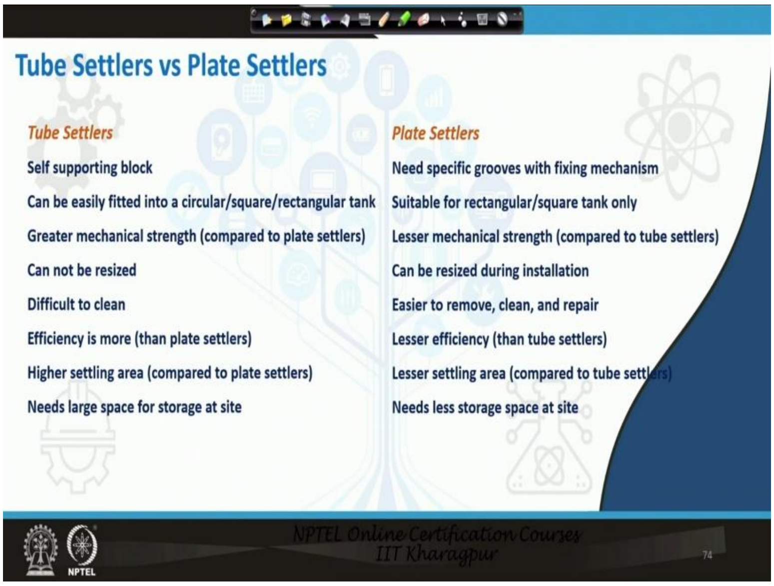

So, if we see these two, they are basically like although both work on a similar principle but is still they may have certain advantages over another. Like tube settler is usually self-supporting blocks but played settlers needs a specific group for fixing mechanism because if you want to fix the place, we should have those specific groups okay.

Tube settlers can be easily fitted into circular, square, rectangular whatever system played settlers are not suitable for circular sections okay because these are plate so generally rectangular or square are used for if you want to put a platesettler. Further the tube settlers have greater mechanical strength because of the packing from both the sides whereas there will compare to tube settlers will have lesser mechanical strength.

However, there is like more flexibility in designing if you go for SS or these kinds of materials the plates of SS or these kind of materials are they have very high mechanical strength.The advantage with plates is there can be resized. So, while fixing we can basically close down the spacing or increase the spacing all those features, we can use whereas, that is not applicable in case of tube settlers we have fixed module so, they are difficult to be resized.

For the tube settlers are difficult to clean whereas plate settlers are easy to remove clean and repair. The advantage with the tube settler is that they have higher settling area because they are closed from all four boundaries. So, any like the settling area becomes higher anywhere it can strike the boundary and then can settle Where as in plate it is closed in only two directions primarily. So, the settling area is relatively like compared to tube settler it is lesser of course with conventional settler it is still much higher settling area okay.

But compared to tube settler it is lesser and because it gives lesser settling area it gives lesser efficiency also compared to tube settler. So, efficiency of the tube settler is slightly more than the plate settlers. The plate settlers need less storage space at site if you want to store at site, we can stack the plates one over the other, but tube because they are prefabricated that way so, they will require much larger storage space at the site. So, these are some of the like comparative assessment of Plate and tube settlers.

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So, with this we conclude the discussion on the Sedimentation and in this week, we started the water treatment aspects and we discussed the basic Screening and Aeration in the previous class and Sedimentation in this class. In next class which is will be the last for the week will take some practice problems and then rest of the major units like Coagulation, Flocculation, filtration, etc will be discussing in the next week. So, thank you for joining.