Water Quality Management Practices

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Week – 04

Lecture – 18

Grit Chamber and its Classification II and Skimming Tank

Hello everyone, welcome you all to this NPTEL online certification course on Water Quality Management Practices. In this fourth module the 18th lecture, today I will continue with the grid chamber discussion and also today we will be discussing about the skimming tank as well. So, majorly what we are doing right now we are now discussing about the different type of physicochemical proper operations and processes involved in the primary treatment units in any waste power treatment plant or effluent treatment plant. So, here in this particular lecture the concept that I will be covering are majorly the square grid tank or the grid chamber, aerated grid chamber and the vortex type grid chamber, the sludge degrading collection and deposition of the grid and the skimming tank. To start with in earlier discussions we discussed about the rectangular grid chamber even we solve a problem also if you remember. So, in this particular lecture video we will be continuing with that discussion only, but we will be discussing on different other type of grid chambers and why we need to discuss about it and why we need to design and develop this other type of grid chambers also will be discussed in general.

So, what are the problems associated with the rectangular grid chambers? It is a sedimentation of the grid particles and the organic matter that requires an external washing before it is disposed. Means what does that mean? Means whatever the in the rectangular grid chamber if you remember there what is happening in the settling zone the grid chamber along with there is a chance of very minimal amount though because no way we cannot be 100 percent assured and there is no organic matter attached to the surface of this grid particles or this organic particles also somehow get you know sedimented on that on the on the bottom of grid chamber. So, in any case what we need to do we need to clean the disposed grid materials to in order to get rid of the sedimented organic material matter first and in order to handle the grid separately. However, in order to because this all this this procedures actually requires a lot of water and one when we need a lot of water definitely it comes with a lot of economic disadvantages.

So, that is another reason why actually we need to design we need to actually go through go for some other kind of designs which actually reduces the requirement of water for washing purposes. So, in general what is happening in the square grid chambers? We have the screen sewage we distributed throughout the cross section of the series with the series of veins as you can see from the right side if you can see in the right side these are the in the in influent line you see in this veins from this veins the water is coming into the chamber and it maintains a continuous plug flow kind of non ideal plug flow kind of condition and at the end it reaches to the this effluent veins and all through this effluent blends it actually goes out of the system in the using the effluent line. You can see this scrapper blades are in installed this scrapper blades what it does actually it actually whatever this grid that is getting sedimented on the bottom it is actually scrapping it off in a certain area and a grid discharge pocket is there through which the this grids will be collected and it will be it will go to the further grid collection line. In the grid collection line we have a grid washing mechanisms nothing, but there is a rack like you know over the rack only there is one additional when a comb like structure which will actually make sure that all the make a little bit turbulence in this in this grid particles and what happens there is a water also going back into the system it actually cleans the grids. So, in a way it actually reduces the chances of you know disposing the I mean like the chances of grid particles to be escaping the systems along with the sedimented organic matter.

So, organic matter will definitely be clean easily using this grid washing mechanism and they from there the sediment again comes back to the system. So, in general it has a surface overflow rate of around 800 to 1400 meter cube per meter square per day and 95 percent is removal of grid particle is possible with this kind of systems and here the diameter can be the grid particle diameter can be as low as 0.15 millimeter compared to the rectangular one where we design it for 0.2 millimeter. In case of horizontal flow velocity it has to be around 0.3 meter per second we can reach up to 0.3 meter per second at peak flow and how in general it works if you see the we first do the grid collection as I was discussing that first we need to have a sump or the grid collection chamber where there is a rotating rack. So, which provided with a scraper and in the grid washing you remember that grid washing what I was saying reciprocating rack mechanism is there a complex structure is there which actually helps to you know provide adequate abrasion to the to for the organic solid to suspend make it suspended condition again. So, by this way we can actually get to the final stage of the treatment which is like the grid disposal. In this grid disposal the reciprocating pump arrangement is made where actually this grids can be actually collected and processed and sent for further disposal purposes and all.

So, what are the major advantages of square grid chamber you can already understand. First of all it reduces the cost of external grid washing by reducing the amount of water requirement for water required for it. It reduces the overall footprint because for washing purpose you need to have a separate unit to establish a separate reservoir kind of structure along with the grid chamber. So, that also reduces that needs are actually gone. So, that is why the overall footprint of the system will also reduce and also it requires a less space for construction then the other conventional grid chambers. So, let us do a numerical. So, in order to you know I understand the concept more in detail.

So, first of all let us in this example one if you see it is also that to design a square shaped grid chamber for a peak sewage flow rate of 85 MLD you remember what is MLD million litre per day So, considering the grid size to be removed as 0.15 millimetre with a specific gravity of 2.65 and consider we have they are also asked us to consider the kinematic viscosity of water to be 1.14 into 10 to the power minus 6 metre square per day per second. So, let us do the let us do the let us solve this problem now. So, we need to first apply the Stokes law for stay find out the settling velocity in the settling zone if you remember. So, how we can find out the settling velocity it is

$$v_s = \frac{g}{18} \times \frac{(S-1) \times d^2}{\vartheta}$$

here s is nothing, but the specific gravity and the d is the diameter of the minimum the grid size and g is the acceleration due to gravity and the nu is the kinematic viscosity of water which is given as 1.14 into 10 to the power minus 6 metre square per second. So, now, let us take out your calculators and try to find out put all this values in this equation and trying to find out the v s. So, the settling velocity will become if you do it in the do the calculation in a calculator it will become 17.74 millimetre per second. Now, check for the Reynolds number we know the Reynolds number equation Reynolds number how expression

$$R_e = \frac{v_s D}{\vartheta}$$

from here we can easily find out this velocity 17.74 or like 0.017 metre per second. D is nothing, but in millimetre in metre you have to put. So, 0.15 into 10 to the power minus 3 divided by nu is the kinematic viscosity that is 1.14 into 10 to the power minus 6 metre square per second. So, if you put all this value the Reynolds number will become 2.32. However, this Reynolds number is more than 1. So, therefore, this Stokes this Stokes law in this particular case will not be it is not valid ok. So, it should be less than 1 then only this particular equation expression will be valid. So, once it is not valid no now we have to do the further iteration what we will do what is the best way of doing it I am telling first you have you find out a settling velocity using the Stokes law then from there you check for the Reynolds number now whatever the Reynolds number you will get from there only you do the cross calculation ok. So, what is the Reynolds number that you have got 2.32. So, from 2.32 only we will do the cross calculations now. So, we will do the first iteration for finding all the C D value the C D value if it is like like you know layer for this this particular equation we if you remember we did it in rich chamber also it should be

$$C_D = \frac{24}{R} + \frac{3}{\sqrt{R}} + 0.34$$

So, we will discuss about it in more details in like this equation and it is how to say the significance I would say more in details, but as of now let us take this equation and try to find out how we can actually solve this equation. So, in this capital R if you replace it with 2.32 the C D value will become 12.644. Now, if you replace that value for calculating the V s again root over of 4 g into s minus 1 d by 3 into C D here if you put this C D value as 12.644 you will get the V s value as 0.01600 meter per second. Now, use this V s value to find out the Reynolds number again. So, if you do this particular V s value to find out the Reynolds number again.

So, you will see that you will get 0.01600 you remember right V s the V s is here 0.016 meter per second multiplied by the diameter is you know capital D 0.15 into 10 to the power minus 3 divided by a kinematic viscosity you will get the Reynolds number as 2.1. So, still the value is not ok. So, you have to repeat the calculation again it is very easy repetitions are easy you do not worry about it you just need to do couple of iterations in within 5 to 6 iteration you will obviously, get to the conclusion ok. So, for designing purpose it is actually not much I would say ok. So, you use this 2.105 value in the C D. So, 24 by 2.105 if you replace it and plus 3 by root over of 2.105 plus 0.34 equal to 13.8 what you need to do you use this value again to calculate the V s. So, now, the V s comes 0.01536 meter per second what you need to do now for this V s value you need to calculate the Reynolds number again. So, if you keep on continuing it after iteration around iteration 6 you will see you will find out the Reynolds number as 1.96. The moment you will find this Reynolds number you use that Reynolds number you will find out about for a velocity value of 1.0148 the Reynolds number if you put it in the C D value the C D will give you a value of 14.726. This 14.726 you use it for calculating the further V s value you will see it is 0.01482 it is almost the same. So, in 5th iteration and 6th iteration the V s value is matching with each other so that means, your problem is solved. Now this value is the final value the settling velocity that you are you have come up with ok. So, now, the V s now the value of V s is conversed with the iteration 5 and iteration 6 that means, the final value of V s is 0.0148 meter per second. Now you can calculate use it for calculating the surface overflow rate by having a performance efficiency of say like 75 percent and n value of 1 by 8 corresponding to a very good performance. So, this from there you can use this equation to find out the Q by A. So, from there to you can easily find out the 8.00977 meter cube per meter square per second or 844.13 meter cube per meter square per day.

So, let us continue with that. So, we from there you can easily find out the surface area because we know the Q value 85 million liter per day if you remember. So, 85 million liter means 85000 meter cube is not it because 1 million liter means 10 to the power 6 liter 10 to the power 6 liter means 10 to the power 3 meter cube because 1000 liter is 1 meter cube. So, from there we can get the value of Q as 85000 meter cube per second. So, 85000 meter cube per second divided by surface overflow rate that we just found out 844.13. So, surface area that you require in your square grid chamber is 100.69 square centimeter square meter. So, if the surface area is 100.69 square meter. So, what will be the side of the each grid chamber? It will be root over of 100.69 that is 10.03 meter. So, assuming the grid size grid chamber of size of 10.05 meter with the retention time of 60 second. So, what will be the actual flow here? I mean like I mean like flow we already calculated 85000 divided by 3600 into 24 that is 0.9838 meter cube per second.

So, volume that is required that 0.9838 multiplied by 60 that much of second is the retention time. So, that is coming out as 59 meter cube. So, 59 meter cube is the total volume and what is the total area 100.69 meter square. So, from there you can easily find out the depth.

So, depth coming as 59 divided by 100.69 equal to 0.584. So, horizontal flow velocity also from there you can easily calculate. So, we know the flow Q 0.9838 divided by the what is the depth into width here. So, depth is 0.584 width is 10.05. So, what is the this cutoff area? This cutoff area is depth multiplied by width. So, this much of area. So, horizontal flow velocity is Q divided by this area you will get the velocity.

So, Q is 0.9838 divided by the velocity 0.584 into 10 to the power 10 into 10.05 it will become 0.168 meter per second. So, how will you get the critical velocity here? The critical velocity can be easily calculated as root over of 8 into 0.06 divided by 0.03 multiplied by 9.81 multiplied S minus 1 that is S is 2.65 and multiplied by the 0.00015. So, you will get the final velocity final critical velocity as 1.197 meter per second. So, therefore, your horizontal velocity at peak flow is around 0.168 meter per second which is less than the critical flow velocity. Hence the grid particle will not be resuspended. So, your problem your design is perfect ok. So, what are the final consideration? Final consideration we have to provide a freeboard of 0.3 meter and grid accumulation depth of 0.25 meter. So, what will be the total depth? 0.584 is the actual depth the the settling zone depth and plus you have you have to provide another plus 0.3 plus 0.25 it will become 1.134 meter and the total depth you can to make it an you know make it easier for you.

So, you can have you can take 1.15 meter and you always have to provide two grid chamber of these dimensions to have one backup option backup ready. Hence the final dimension will be 1 10.05 by 10.05 by 1.15 that will be the final dimension of your square grid chamber you understand.

So, this is how we calculate we design the square grid chamber when we try to find out the volume of volume when we the once we are given the actual inflow rate from there we can easily find out the dimensions of a square grid chamber like this. I hope you understand it please go through this video again and also this equations you try to solve it by yourself in a pen and paper otherwise it is very difficult for you because until you actually solve it by yourself two three times. Then there comes the aerated grid chamber in case of aerated grid chamber it is nothing, but you have you add some diffuser aeration diffuser based aeration systems there by which actually is this makes it the waste water in little bit in swinging in motion which actually helps to have more amount of the most of the organic matter in suspended form and it only let the grid particles to settle in the bottom.

So, in general it can have average flow point 0.2 to 0.5 meter cube per minute meter per minute and the size of the smallest grid particle can be as low as 0.2 millimeter and this screened effluent a sewage when it comes in contact with the pumped air and the spiral flow pattern is generated. In this spiral this pattern at this flow actually induces the agitation and mixing and because of that the organic solid attached to the grid particle will be brought in suspension as I was mentioning. And also this appropriate velocity of this role can actually assist in achieving this overall removal of higher overall removal of grid particles which can be tweaked by adjusting the air flow quality quantity I would say ok. So, in general waste water passes through the grid chamber in a spiral flow tends to make two or three phases or role you can see this roles two or three roles it makes normally in a in a across the tanks bottom at the maximum flow and the number of roles tend to increase with the decrease in the flow.

So, how you can find out the velocity of this role this if you see here the total length is capital L. So, say like del L is the you know the only del L is the I mean like you calculate the total height of this you know that I mean like that the pitch I would say in this case the between two roles. So, the del L divided by pi into d equal to rho g by rho 8 and since number of role can also be calculated capital L divided by this del L the length of one spiral role. So, what is the advantages of aerated grid chamber pre aeration reduces the septic condition head loss can be minimized and also it gives a constant removal efficiency of grid over a wide range of flow. So, what are the design recommendation? First you need to have a depth of this grid chamber of around 2 to 5 meter the length of the aerated grid chamber should be around 7.

5 to 20 meter width to depth ratio 1.1 to 1 is to 1 is best to maximum 5 is to 1 width of the grid chamber 2.5 to 7 meter detention time during peak flow 2 to 5 meter minute, but typical value is 3 minute not more than 180 second. Air supply 0.3 meter cube per minute per meter of the length of the grid chamber you remember this one and the air diffuser should be around 0.

45 to 0.6 meter from the bottom of the I mean like the from the floor of the grid chamber and a grid hopper should be provided with a 0.9 meter depth with a sharp sloping side under the air diffuser. So, let us do one numerical again for aerated grid chamber also it is quite easy compared to the square grid chamber that I we just finished. So, in case of aerated grid chamber if you see for a for treating a average flow of 0.8 meter cube per second with a peak factor of 2.5. So, you remember average flow and peak factor if it is given then we have to if we need to find out the peak flow or the maximum flow we just need to multiply it. So, 0.8 multiplied by 2.5. So, what is the peak sewage flow here? It is 2 meter cube per second if the peak sewage flow is 2 meter cube per second we can easily determine the volume of grid chamber how because we know the value of we know the Q, Q is 2 meter cube per second and say suppose a detention time we take 180 second or 3 minute.

So, it will become 2 into 180 it is 360 meter cube. So, we can have a 2 constant 2 aerated grid chamber with each handling the 180 meter cube of volume and which assuming a depth width to depth ratio 1.5 is to 1 and depth of 3 meter. So, our width become 4.5 meter. So, the length will be 180 meter cube is the volume divided by width into depth.

So, it will the length will become 13.33 meter. So, we can provide 20 percent extra length for inlet and outlet if you remember. So, providing 120 percent extra here the dimension becomes. So, the length will become around 16 meter. So, all total the dimension of the tank will be 16 meter by 4.5 meter by 3 meter. Now, estimating the air supply you remember how much air we need to supply 0.3 meter cube per meter square per meter per minute. So, per meter of length you mean.

So, 0.3 meter cube per meter of length per minute. So, 0.3 meter cube what is the length here 16 meter. So, 0.3 meter cube per minute per meter. So, multiplied by 16 it will become meter cube per second meter cube per minute.

So, 0.3 into 16 that is 4.8 now it will become 4.8 meter cube per minute you understand. So, that is how we can actually calculate the amount of air that it requires ok. So, we can also check for the surface overflow rate which is coming as 2 is the you can you remember the total flow rate divided by 2 into 13.33 is that we in this calculation surface overflow rate we need to only consider the settling zone ok.

So, settling zone multiplied by the 4.5 is the width. So, 2 into 13.33 into 4.5. So, from there you can easily find out the surface overflow rate of 0.017 meter per second. So, this almost all the or the 1.7 centimeter per second. So, in general surface overflow rate is less than the settling velocity of the smallest grid particle of which is which earlier we discussed it is 2.4 centimeter per second. So, that means, the design is same if it is less than 2.4 centimeter per second that means, the design is ok very good. So, now, we will discuss about another type of grid chamber which we call the vortex type grid chamber.

In the vortex from the name itself you can understand that you know we let the wastewater enter tangentially. If you see this picture we let the wastewater enter tangentially ok. So, will wastewater is entering tangentially what is happening the grid particles will settle down ok. And the all the other particles will it will take time for them. So, the grid particles will be settling very fast when if you see this particular design is with the turbine and this particular design is without the turbine.

This turbine is provided to make additional push into the wastewater during in towards the tangential vector. So, that it will make this flow just perfect enough to you know settle more amount of grid in a in the just on the central line of its of its of the structure. So, it is normally this flow normally follows this toroidal flow pattern if you can see. And this toroidal flow pattern because of this tangential force tangential way that we that the wastewater enters. And effluent gets perpendicular to the flow direction preventing the grid particles in the effluent due to the toroidal flow.

And vortex flow is achieved by wastewater entering tangentially and also sometimes we add the this turbine to actually make it like in a continuous this flow continuous. And because of the inertia of force it plays the major role which actually helps us to remove the grid particle allowing the grid free waste water to move out after the treatment is done ok. The in general the detention time of 20 to 30 second is enough with the height of 2.7 to 4.5 meter and the diameter of 0.9 to 7.2 meter is the standard practice. Now, another important thing is the sludge de-grid. So, when separate grid chambers are not provided in a treatment plant. So, we need to provide the sludge de-gritting process along with the primary sedimentation tank ok. So, normally what happened in this case the grid particles are allowed to settle along with the organic suspended particles. Then what we do we do the some cost analysis if we think that it is better not to provide the grid chamber we can have it in the primary sedimentation tank itself because there anyway we are providing enough time.

So, there only we have the grid along with the organic matter. So, along with these organic suspended particles plus the grid now what we need to do we need to have a cyclone de-gritter. In the cyclone de-gritter we use it separately another small system. So, we take the sludge out of the primary segmentation tank which is along with the grid particles as well. So, we will use a cyclone de-gritter to actually get rid of the this grid particles easily from the sludge and actually the organics portion can be again put it back to the either the anaerobic digestion process or maybe for further purposes you understand. So, this is the way actually we normally get rid of the grid particle sometimes if we do not have enough space for providing the separate grid chamber.

The quality of the grid it when it when we collect it depends on different factors majorly the type of sewerage system, the geography of the drainage area, the sewer conditions and the variety of industries present in the area and the type of the soil is not it you understand right. I do not have to describe all this because from your basic understanding only you can feel it like because if it is a type of sewerage system. Suppose you have a structure in a in a such a way you have a sewerage system means what the infrastructure the infrastructure is made such a way where it actually involves some amount of rain waters or storm water discharge to enter to the system. If there is a storm water runoff I mean like it enters to the system what will happen it actually carries a lot of sand particles from around the vicinity. So, because of that this sand particles will actually increases the amount of grid particles this is nothing, but the grid particles right.

So, this grid particle portion in the wastewater will slowly it will definitely be much in higher range because of this kind of structure. And geography obviously, as I was mentioning the geography is very important if it is like a deserted area all of a sudden there is a huge rain I mean like for all of a sudden what will happen this drainage system is not normally they are not designed to you know handle so much of grid particles. So, in that case in general if that kind of situation arrives. So, just for the factor of safety we need to design our grid chamber based on those excess amount of grid that may that it may experience in future. So, based on that only that also you have to take into consideration you know taken into consideration your while designing.

So, in general let us discuss about some very important grid facts or numbers as I name it. So, the quantity of the grid that can be collected from the municipal wastewater it is in the range of 0.004 to 0.2 meter cube of grid per million liter per of wastewater being treated. And the typical value of grid handling facilities around 0.015 meter cube per million liter of wastewater treated. Moisture content of the grid is it can be as high as low as 13 to as high as 65 percentage with a volatile content of 1 to 56 percentage. This volatile content actually signifies the amount of suspended organic matter that it comes along with.

Specific gravity in general 1.3 to 2.7 with a bulk density of 1600 kg per meter cube. Next very important technology that we need to understand we are done with the grid chamber now. We understand the grid chamber what are the different types of grid chamber how it performs and different numerical also we solved to get a better idea about like how it is to be designed and all ok. So, now, we will design a discuss about the skimming tank. If you remember at the very beginning we will discuss a very basic like you know facts about the skimming tank. What we do in a skimming tank we try to get rid of the fat oil and grease the or FOGs in short we call it in wastewater treatment line or water treatment line.

So, how we can get rid of this FOGs using a skimming tank. So, I will discuss about its functionalities, but before that why to remove this fat oil and grease let us discuss. So, as you as you understand that in a fat oil and grease is nothing, but it stays on the top of the on the surface of the water bodies right when you when it somehow enters to the systems this aquatic system. So, what it does it stays on the surface of the water body. So, it literally cut off the air water interaction because what I mean it acts like a interface. So, what I am because of that the diffusion process completely stops from the air to water or the other way around.

So, because of that what is happening the dissolved oxygen level in the water can also get depleted over time ok. And not only that it will also reduces the sunlight penetration, it will reduces the biological activity by reducing the dissolved oxygen and also it will it will be very much difficult for the surface dwellers to actually because their body will be actually their this oil can also get choked and like get attached to their body. And which will also problem get them in a very peculiar problems like you know skin irritations and different other kind of issues the health issues also. It can also clog the pipes and the pumps because of and it leads to the corrosion of and obviously, at the end it damage the whole system.

So, because of all these things we need to have a different type of fat oil and grid removal systems. To start with what are the different types of skimming tanks those are available or the designs or the researchers those are available and based on that any one of you can actually in future actually implement those technologies or you can think about some alternate options which can actually be implemented to remove the fat oil and grease. So, in this particular design if you see this is called the gravity separation. In this gravity separation you see the water in like you know enters from this from this side you have this oil retention baffles this baffles are there from this then it goes to the systems in this particular systems if you see there are scrappers are there this you can see in the bottom there is scrappers this white this circular thing if you can see it is nothing, but you know this I mean like if you see the side view it looks like this. So, it is nothing, but it has a sorry this is the top view if you see in the top view if you see it looks like this it is like a like a cylindrical structure on the top of it with a lot of hole or protrusion in between. So, this holes and this protrusions are what they are doing they are nothing, but the this oils are actually getting collected on that on inside of it and then it has a certain angle.

So, because of that this you know this oil and oils are slowly we can collect it from one side and can goes to the collected to the sum and the rest of the water which the which after the remove after the removal of oil actually it goes to this through this external wire through this external wire it comes to this outlet chamber and from an outlet chamber you can easily collect it ok. So, that is called the gravity separation systems then we have the dissolved air flotation what is happening in the dissolved air flotation we can we can add some flocculent on the flocculent on the some kind of chemicals we can add it and in the feed water then it can be introduced and introduced into the main system in system there you can introduce some air also ok. So, air saturated water will be there. So, because of this air which is saturated the compressed air which is supplied along with the water. So, this air saturated water it is this it helps the you know this oil particles as this fat oil and grease particle to come on to the top and actually make a froth like structure.

So, that froth is and can be easily collected though we call it scum this scum can be easily collected from the top. Then you have this adsorption systems adsorption system is mainly like when we as we have use different kind of adsorbent different types of adsorbents are there which what is the difference between the adsorption and absorption. Absorption we all know right the adsorptions when we talk about it means it is like a surface properties it is like you know some chemicals we are introducing. So, that the chemicals will actually help some foreign particle to get attached to its surface ok. So, this adsorbed particles can be easily deterred I mean like can be easily we can actually get rid of this adsorbed materials as well on the from the surface of this adsorbents.

So, anyway so, you we can use different type of adsorbent which will which has a affinity to you know how to say adsorbed the oil particles on its surface and then you can just simply take those adsorbent out and we can treat it to get the concentrated adsorbed this oil separated you can easily separate it ok. Then we have this electro coagulation systems where we different kind of metal metal hydroxides are there which actually helps the oil to you know they attach with each other and then they coagulate on the bottom when in when, but for that we need to introduce external voltage external it is like electrochemical systems where we are introducing some external voltage providing some external potential difference into the anode and the cathode systems. So, that it will actually help the oil to precipitate or some amount of oil will actually float on the surface ok. Then we have the biological removal method different kind of different type of biological or biological systems I mean living beings are there which are having a affinity to consume the oils as well.

So, they can also be introduced by which actually we can reduce the fat oil and grease from the system as well. We normally most famous is the gravity separation process that I was discussing in the last slide. However, grease traps skimming tanks other type of aerated skimming tanks are also nowadays predominant. You see this picture this is this is how the grease trap look like in a in a small scale systems small scale sewage treatment units. In general it is situated at the source before the discharge in the sewerage systems and these are the small concrete tank with a scum baffle. And it is designed for a detention time of 3 to 5 minute and then a flow through velocity of 2 to 6 meter per hour is maintained and this can retain up to 80 percent of the influent fat oil and grease.

However, the poor maintenance and the negligence can actually lead to this FOG enter into the sewerage system. In general the typical FOG limit in this effluent should be around 10 to 20 milligram per liter not more than that. So, in general the this advance this aerated skimming tanks which are available which takes a little bit extra time around 3 minute. The FOG which raise and get collected in the surface in the normal sediment in the skimming tank in case of aerated one air is pumped in the form of bubble to promote the flotation and separate the FOG from the wastewater. In case of skimming tank the surface area of the tank depends upon the minimum rising velocity of the FOGs. In case of aerated skimming tanks what we are doing this scum which on the this froth froth layer on the top on the surface of the water which we call scum can be easily collected from the surface of the wastewater by you know by locating in a which can be we can institute introduce some scum removing system on the top on the on the both side of it and it can be easily collected by using this scum removal mechanisms.

The inlet has to have a designs in a way that it will maintain the uniform horizontal flow velocity in case of skimming tank, but in case of aerated air flow volume of around 180 liter per meter cube is required at peak flow. In case of skimming tank it should provided which should be it is ok for the small treatment plants in industries, but in case of aerated skimming tank the efficiency can be increased by passing chlorine gas along with the compressed air as chlorine gas can destroy the colloidal protective effect of the protein. So, chlorine gas if you introduce it along with the gas that you are supplying along with the air that you are supplying it can actually increase the efficiency of skimming tank. So, in general aerated skimming tank is more favorable nowadays in different industries and all they normally use it. So, in conclusion we did a very good job on understanding the fundamentals about the square grit chamber and the aerated grit chamber.

We also did the new solve some numerical and which I would request all of you again to go through it once more not once more I would say two three times and you write it down in a small in a notebook and try to repeat it a couple of times in order to understand it more ok. And we also understand about the we also get to know about the FOGs. So, these are the references I mean like skimming tank also we discussed these are the references that I would request you to go through it and please if you have any issues these two books I always suggest one is metcafenad and another is this gangarical et al. to enter this two book you can go through it and this will give you a very good understanding about this concepts in more in detail ok. So, I hope you get to know some very interesting facts about the grit chamber and the skimming tank do not get like you know confused with especially with this if the numerical are little bit tough to you because it is it all matters with the practice I am telling you.

So, if you do it do practice it couple of times it will be completely adsorbed to your brain ok. So, do not worry about it I hope you have a very nice understanding and the knowledge about this two technology we will come back again in the next lecture to continue our discussion about the parametric renewables. Thank you so much.