Fundamentals of Environmental Pollution and Control

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Lecture No. # 14

Ground Water and its Contamination (Continued)

Well, we begin the discussion again, I mean this we are starting with this. We have discussing the ground water flow. Then this is the flow velocity is the thing that you know that we will discuss now.

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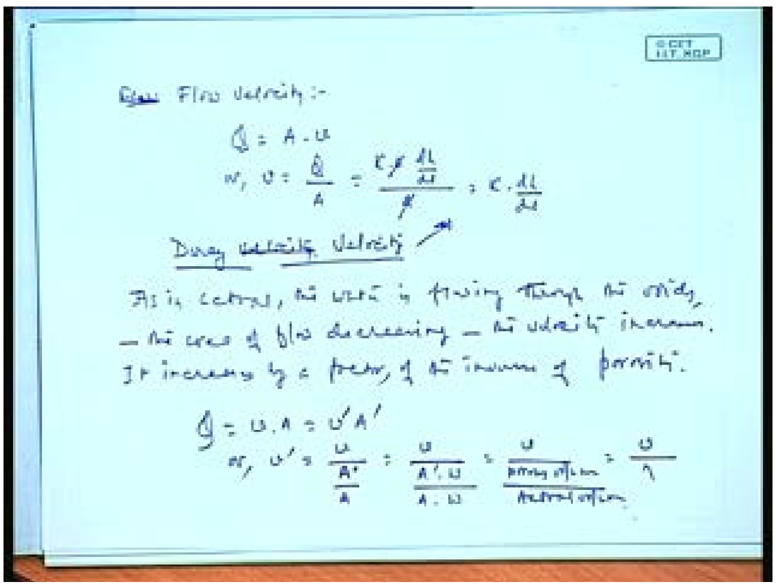

Flow velocity, flow velocity having to see in the flow velocity part you know let me explain few things about here. What is generally if you can see that generally a very popular nation that you know Q is equal to A into v that you know A is the area of the cross section, v is the velocity that you know so or so v is equal to Q divided by A. Here in this Darcy's case you know if Q divided A is as we have done for this, this K dh by dl that we have done for Q if we this, this the Ka cancels out, K dh by dl that is you know this very simply can be written like this, velocity as this. So, this velocity is known as the Darcy velocity, Darcy velocity. This requires a certain explanation here Darcy velocity, velocity. This Darcy velocity if this can be, this is known as the Darcy velocity.

Now, let me explain this Darcy velocity here. Suppose, you know in this case yeah, so here say in case of a Darcy velocity what is generally understood is this. This is, if this is the, this is the cross section of the, cross section of the aquifer under consideration, cross section of the aquifer under consideration, it takes about then you know the cross section there would be some impervious zones, some pervious zones like this say here not coming in there, I mean now it's coming.

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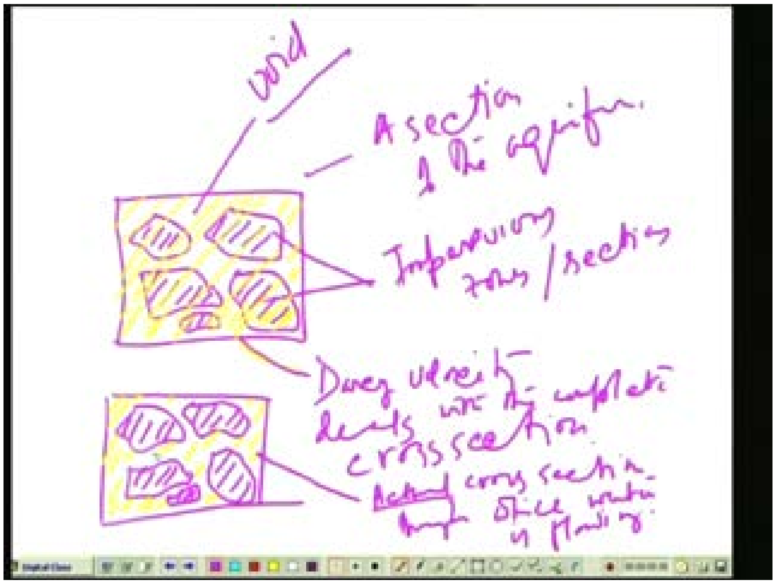

Yeah, so here we can see this is the impervious, impervious section. If you just make a section in the aquifer, this is a, this is a section, a section, a section of the aquifer. This is, these are the impervious, impervious zones, impervious sections or impervious zones we can write or sections. Now, here this is, this is the area you know the white portion is the void, this is the void, this is the void. When you are considering this Darcy's you know particularly this here a considering here like this, what we are trying to say here is this area is the water is flowing through this whole area, water is flowing through the whole area irrespective of, irrespective of the impervious zones, irrespective of the impervious zones. So, the velocity that we are going to, velocity that we are measuring here is so Darcy velocity, you can say this you know this Darcy velocity here, Darcy velocity, Darcy velocity this deals with the complete, complete cross section.

Darcy velocity is basically dealing with, deals with the complete cross section but actually the flow is taking place, if it the, but if we just in try to observe here in the same, in the same cross section again if we just try to redraw this, so here the actual flow, actual flow is essentially taking place here through the void, through the void, through the void. So, you can see this flow remaining same, the velocity actually is higher, flow remaining same since the cross section is decreased, so the velocity will be higher. So, this is where, this is what you generally say as to say this is, this is the actual velocity you know this is the, say the actual, actual, a cross section, section through which, through which water is flowing, water is flowing, all right.

So, Darcy's velocity deals with the complete cross section. Here, you know complete cross section or the, but the actual cross section, actual cross section through which the water is flowing is basically the voids, basically the voids we are not including this, this impervious layers. As a result of this you know this is what if we can observe with, this one is, this one is as we as we see this you know that this is known as a Darcy velocity, the Darcy velocity. So, as in actual, as in actual, as in actual the water is flowing through the voids, through the voids is flowing through the voids, the area of flow decreasing, area flow decreasing the velocity increases and it increases by a factor, by a factor of the inverse of porosity which is nothing but you know we can very well identify this is, this you know as you know this Q would be v into A here. This one is v into A, also this is v dashed into A dashed or this v dashed is equal to v divided by A by A dashed by A, A dashed by A yeah, A dashed by A.

So, you can see here this one is nothing but you know what we have found out, what we have said if you are just A into if you just multiply by the volume factor, the width factor or the depth factor here, the depth factor cancelling. So, volume we have said the void in case of voids, so you know if you can, if you are multiplying by the width, area multiplied by the width that gives us the volume, the width cancelling out, so you can just generally find out. So, here itself we can write it like this say W this W, the W is the out change is this into W, this one is nothing but the porous volume divided by the actual volume and this is known as porosity that is porosity is that is what we generally try to know. So, here we can see this, as this one is as not a, not necessary to be emphasize but nonetheless let me tell you that this one is v dashed would be always more than v because of eta is less than 1, eta is less than 1.

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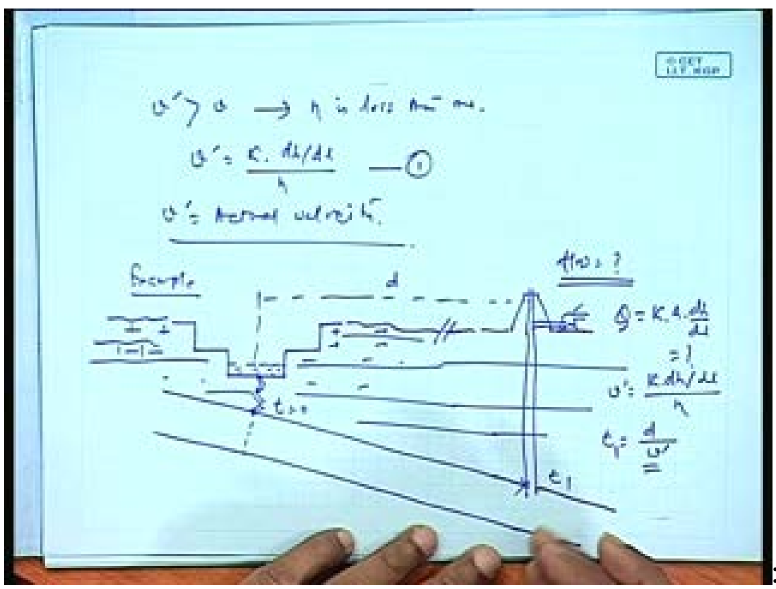

So, you know you can find out so we can very well find out here we can replacing, replacing this values of v by v dashed, we can find out thus you know this one can be say we can find out this K into dh by dl divided by theta. So here, so this is the actual velocity so you can find out this one is an actual velocity is we are just making a notation here is v dashed is equal to actual velocity, actual velocity, right.

Now, let me just give you an example, small example here how actually is can be physically be used. This thing can be physically used and where it would be of great importance, you know particularly great importance you know is many cases is like this. Say is, say there is a mine source like this. If it is say mine, this is say a small block of mine, here the water is you know as you know the water collects in the sump, this is at the sump is very simple diagram, okay. You have a water regime like this, you have a water regime going like this. This is you know the structures so you know you can find you know these are the rock say essentially the rock structure, this is what is a rock structure. So, you can find out say you know different kinds of rock structure taking place like this. So, we just generally that you know a different kind of rock structure and we have one aquifer cutting across this area. What happens here is now due to, due to the surface mining, due to the mining activity and things like that we can except there is a crack been developed and which is naturally takes place you know is very common I mean is nothing to be, nothing to be you know very nothing to be dispute, nothing to dispute here.

So, you know you can see the contaminate is essentially reaching here and you consider that this contaminant is essentially dispersed into the cross section of the ground water regime almost immediately and almost in the same concentration in all the places, we consider this. Now, here having said this, so this is what is you know suppose what is here is say we have one installation here wherever it is say here we can see this a ground water pumping at a distance, at a distance you know you will have a ground water pumping installation. We have a pumping installation which is connecting, which is drawing water from this prefer. It's pretty common you know if you have gone to… area which is likely you know you can very well anticipate this kind of things taking place, this kind of things taking place, so you know here you can see this one is being pumped out like this is a pump here which is actually drawing water from this.

Now, it would be our point of interest right, it would be our point of interest from the time when this contamination taking place till what time it would reach here because after this time it will continuous to be this water would be pollutant. Isn't it? Considering that this is what you know this can be, very well be understood here. So, here we can see this that you know this the, from this one particularly a flow is to be measured, the flow is to be measured, the flow can be measured by means of say as I have said the flow can be measured like you know K into A into dh by dl. The flow can be measured like this. From this flow we can find out we can Q A is say you know we can find out say from this we can find out that in the actual velocity, actual velocity by which this one would be K dh by dl, dh by dl divided by porosity.

So, we can find out the actual velocity at which this water is moving, actual velocity at which water is moving. So, from this, so you know if you are considering a, considering a distance of d, if you are considering a distance say you know either you measure this distance from here or this distance from here, if it is at a long distance, if it is a very long distance say you know if you find out d here we can very well find out the time t_1 to know that d by v withstands to find out the time, to find out the time when the water is likely to be polluted, when the water is likely to be polluted.

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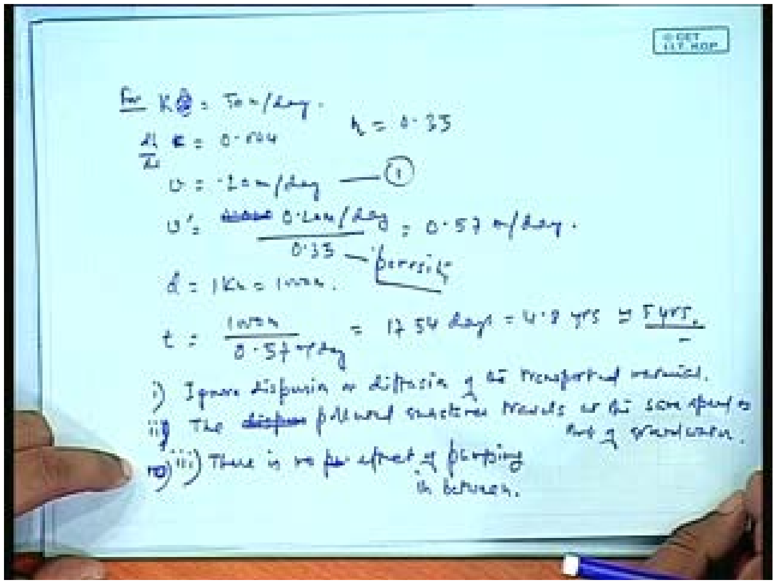

So, essentially if you just take the examples like say if it is say the velocity is for example if Q is equal to say 50 meter per day and this K is considered to be 0.004, so you can find out that you know this is sorry, this dh by dl is so K is… Q sorry, Q is, this is K sorry, I am sorry this is K for say 50 meter per day and if this is dh by dl is this, so we can find out the velocity say an about say as you can say 0.2 meter per day this is number one okay. Now this v so we can find out the porosity, if the porosity is given say 0.02 sorry, we find out this porosity say at about 0.35 or 0.25 whatever, we can find out the velocity as 0.57 meter per day.

Now, if it has to travel a distance say of say 1 kilometer, say distance d is 1 kilometer this is 1000 meter, a time required is you can see this 1000 meter divided by 0.57 meter per day, so here we can see this would be about say, if 4 2 4 17 54 days which should be about say you know about 4.8 years about say you know 5 years. So, porosity, this is porosity, the velocity of, the value of porosity is given okay, the velocity, the value of porosity is given the value of eta is given. So, you can see this 5 years. Why I am asking where I have done this exercise is only to show that the ground water, the flow is at a very slow speed, you know it requires say for 1 kilometer, to travel 1 kilometer it would take 5 years okay, it would take 5 years naturally under typical condition, it would take about 5 years to travel in particular, particular flow condition but this one is to suggest that though this estimate is very important in the sense say one can very well say after the mine has started or after the plant has started or the toxic waste is being released in the environment, it would take about 5 years to reach a ground water well which can have a serious consequence, which can have a serious consequence.

You know if the serious consequences are many, there are many plenty of examples by which you know the ground water wells are being contaminant, all throughout the world, all throughout the world. So, even if say 2 or 3 years may be this is an important planning decision, this is an important planning parameter. So, you have when you are doing mining or when you are discharging something into a source which might lead to ground water, there are many areas where this can be finally be reached to the ground water, you have, you stand a very great chance that the ground water would be contaminated. Very very, very common, very common you say problem is a very common and very serious.

No, no solid rule and not only that you know even in small calculation like this are quiet in frequent in many of the planning estimates. Yes, sir. People generally do not use them. See, even if, so that is the beauty of this Darcy's law and things like that you see, you know you can have a very quick fast estimate, 5 years, it would take 5 years. So, whatever things you want to do, you have to think about the changes within that time, within that time. So, you know here but well I mean having said that this is one is you know one is a 5 years and things like that. So, here again as we have said it has mostly discussed about the flow but this Darcy's law does not discuss about the dispersion.

Let me briefly put light on you know what will be the dispersion and things like that. So, this is, this has a two, there are three assumptions to make here, you know any case in a sorry 1 2 and 3. 3 assumptions here is that ignore dispersion, I will just take it out it is going to diffusion. Yes, yes it would, it would suddenly is going to affect suddenly, you know dispersion or diffusion of the transported material let me explain this, this is ignore the dispersion, ignore dispersion or diffusion, this Darcy's law generally do not take clear care of this.

Another is the dispersed, the dispersion sorry, the polluted substance travels at the same speed that of ground water, that of ground water. This also, this is perfectly, perfectly mixed when you consider is perfectly mixed then you can consider that this polluted substance travels at the same speed that of, as that of, as that of the ground water and the third is that there is no pumping, effect of pumping, pumping in between, there is no effect of pumping in between. So, in between the two holes under consideration, in between the two points that we are discussing. So, this is this is the Darcy's laws you know the typical assumptions of Darcy's laws in this ingrained with the inefficiency by which Darcy's law cannot estimate several other things but let me just briefly discuss about what is, what is the important difference here is that you know as we can see here this is let me point out this is here you know… See, what is being done here is if you just observe this Darcy's law.

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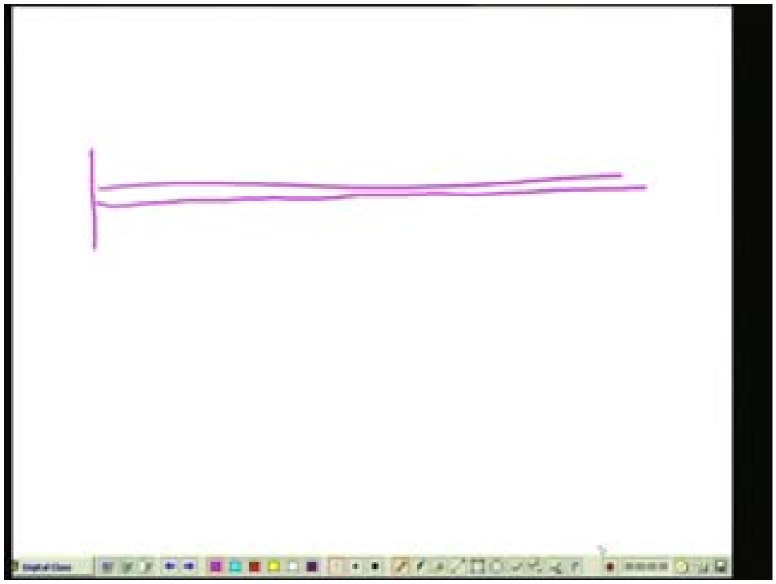

If you make a drawing like this, it goes like as if it is in a plug flow, we call this as a plug flow. What you mean by this is say this is you know okay just one minute, let me do that again.

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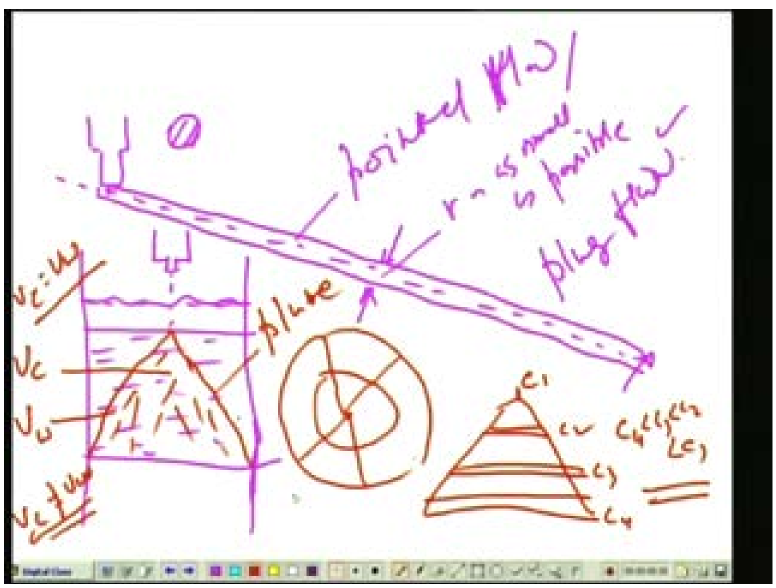

As if you what we say is just like this, it is if it is coming out of a pipe, coming out of a pipe and then it is as if flowing in a particularly in a very pointed manner, pointed manner, it will have a radius, this is, this is as if you know a cross section of a, cross section of a pipe you know this is how it looks like. This will have a radius r which is conceptually r is as small as possible to idealize that as if the dispersion is taking place, the flow is taking place in a line, in a single line. This particular characteristic is known as the plug flow, this is known as the plug flow. This is one of the consideration of the Darcy's equation, this is one of the consideration of Darcy's equation. But what happens in a natural setting is a natural setting is like this. If you are just you know if you are making a controlled experiment, this is how it is taking place instead of a pointed flow, this is a pointed flow, pointed flow or also called plug flow, also called plug flow. So, you can see this, this is as if the flow is taking place and there is no dispersion. So, the concentration of, the concentration of the material being dispersed here would remain the same here as well. The concentration is not getting changed, this is a very simplistic assumption to make.

What happens essentially in cases like this is you know if we can observe the things like this is just observe a plot like this. If we are just trying to say if you are making a column of say sand or anything like this, any material with some permeability, if you are just observing this, if you are just putting this plug flow here, if you are just dispersing this material here say you know this is how the material is being dropped in this. What we generally observe is you know this particular the pollutant, the pollutant you know is if it is in the, this is what is through which the water is flowing. So, you know you can have a level of water here, level of water and we are collecting the water at this point here. So, what we observe here now is suddenly different.

Here, in this case a contaminant instead of following a single line then the concentration remaining unchanged throughout the flow direction, throughout the flow distance the concentration here is likely to change like this. It is going to go out as a plume, this is called a plume. So, the plume would be if you just observe it like this, it would be, it would be like a cap. The concentration of the pollutants would be, concentration of the pollutant here would be completely distributed across the cross section of the, cross section of the ground water regime as far the cross section of the total experiment of flow. This is known as, this particularly is known as plume, plume flow.

So, here if you remember that you know one approximation that we made that here you can very well understand that the contaminant here, the contaminant here, the contaminant transport velocity say you can observe we are say this is the contaminant getting mixed here, this is the contaminant getting mixed here, the contaminant transport velocity say v c contaminant transport velocity and the ground water, water velocity, velocity of the water this may be quiet different may not be same as velocity of water, is not necessarily that they have to be constant because, the constant because of their you know the properties being different, the density being different, their you know other parameters remaining different. So, all this can lead to a change in the velocities.

So, the plume velocity here in the Darcy's case we have considered at any point of time vc is equal to vw. It is not necessarily a case, so in a transformation generally we called this as… So, we understand a plume transport, so you can here you can see that the, this is essentially you can see the concentration is C 1 here say if it is concentration is same here C 2, C 3, C 4 as you can see observe here, so it's always C 4 less than C 3 less than C 2 less than C 1 whereas in the other case in the Gaussian, in the plume, in the Darcy's law equation we consider that the concentration remains the same across the direction of flow.

So, this is what you know this is the dispersion, this is what is known as the dispersion and the characteristics of the dispersion would be generally a function you know it's a particularly a function which is say this transportation you know transport say if you just consider here that you know erase all, clear all drawings. Here, we can see this you know if we just make a case like this the concentration, concentration at say at a point xc, at a point xc even you know in dx cy, this is a function, this should be a function of the initial concentration say at initial xc 0, initial concentration, at initial concentration then aquifer other parameters like this and aquifer parameters this, if say the hydraulic connectivity k, porosity at different points, porosity at different points, the distance travel, the total distance of travel, so this a, this is a xc itself, xc itself.

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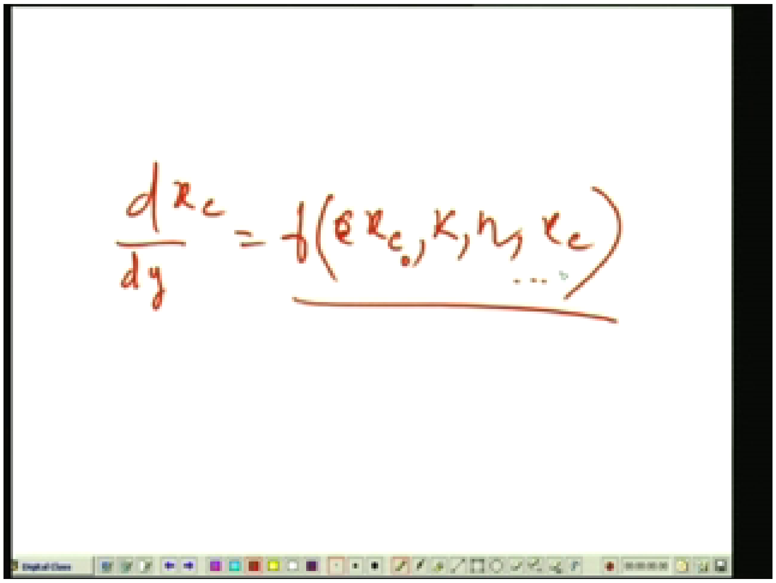

So, here it becomes a, it becomes a differential equation which is much more complex you know in considering into a particularly a plume characteristics, we would see this you know in more detailed you know we will not discuss about this plume dispersion of this water for this continent transport here but you will have a further discussion on this in our air pollution modeling. We will see that you know in greater detail about one kind of plume distribution that we generally see observe dispersion, plume dispersion that generally observe. So, here you can see this, this is how this is how the concentration across the different aquifers should basically change. If you just observe this, if you, if you just make a case here one we can see this is okay.

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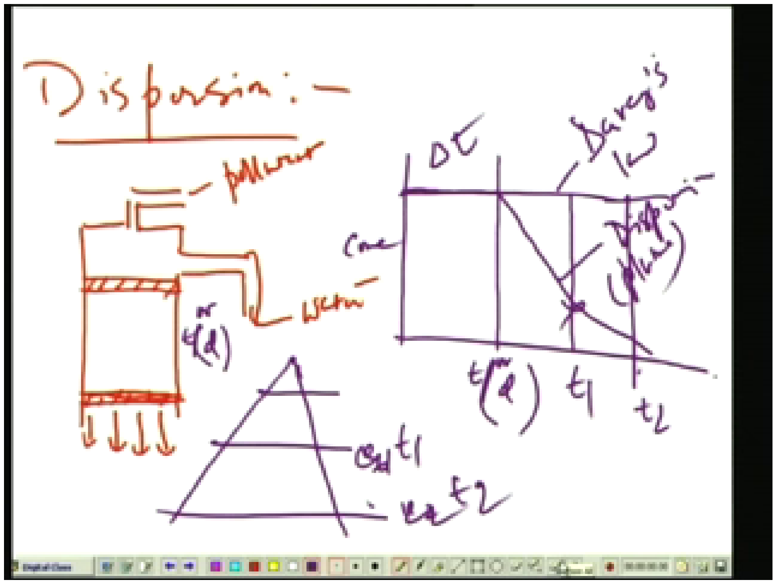

So, we are basically discussing dispersion. In dispersion what we are basically we are trying to emphasize here on this. In this dispersion here that we are generally trying to emphasize is this. So, having said this you know if you just making a controlled experiment of this nature is as I have made the drawing is a controlled experiment of this nature. We generally can observe you know one important, it's attribute here is this. This is a concentration, concentration, this concentration as we can see across you know this is a time or distance here. This one is in terms of time or distance or write this one is or this one is or. As we can explain in times, time or distribution distance, we can generally see if it is a Darcy's law coefficient you know the way we disused, this is how the value would be in the concentration remaining constant but if it is you know it's a plume flow that we have discussed you know the dispersion actually the weight takes place. We can observe that this concentration remaining constant and then finally going to go down like this, going to go down like this with dispersion you know this is how the value would be. So, this is Darcy's law. This talks about Darcy's law. This is dispersion, plume dispersion, this is about the plume dispersion that you know how it would work out like this. Is that clear?

What is doing, being done here is at a particular time after a certain time, this time may be very short, very short you know this is del t you know this time is very short after that we will consider that you know about the dispersion that I have said that actually their concentration would be this at the same concentration would be distributed. So, here you can see that is the value is actually going down here. So, you are, if you just observe this at different points here, this one is, this one is x 1 x 2, this one say sorry t 1 t 2, t 1 t 2, this one is t 1, this one is t 2 like this. The concentration continuously decreasing as the cross section is increasing, the concentration is likely to decrease. So, having said all this, so having said all these, having said all these you know this is how it would be behaving.

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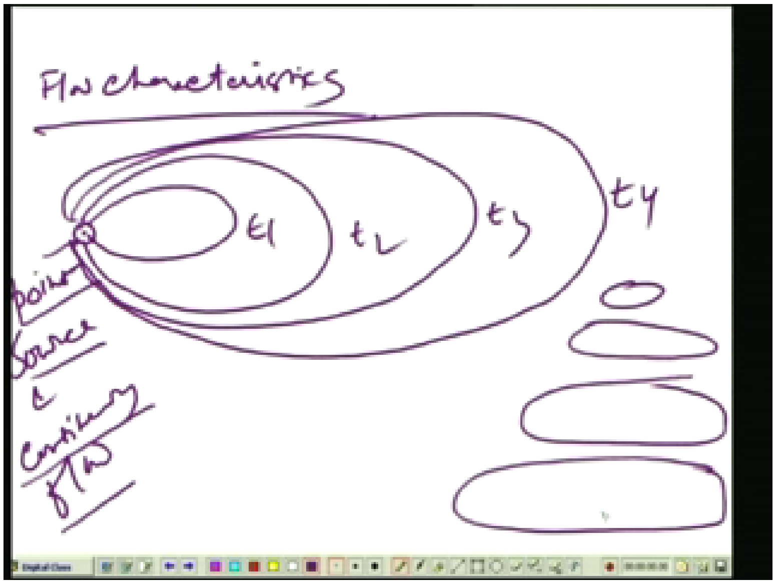

So, as we can see I mean we would not go in to much further distance here but let us see this a flow characteristics, flow characteristics but if it is a point source, if it is a point source and continuous flow, this is point source and continuous flow, point source and continuous flow, we generally observe that you know this is how the plume would essentially behave. This is t 1, t 2, t 3, t 4, point source delivering where this is a plug flow at one point, point four plug flow at one point and then in the medium it is getting dispersed, it is getting dispersed. This is how the plume would look like, this is what is the plume would look like. So, the quiet similar to what I have said earlier that you know it would be like this, it will be further like this. This one can be if it is overlap to or one another, it would like this. Isn't it? This is a point source and continuous flow, if it is point source and continuous flow it would look like this. If it is point source with discontinuous flow, the point source with discontinuous flow it would more look like this.

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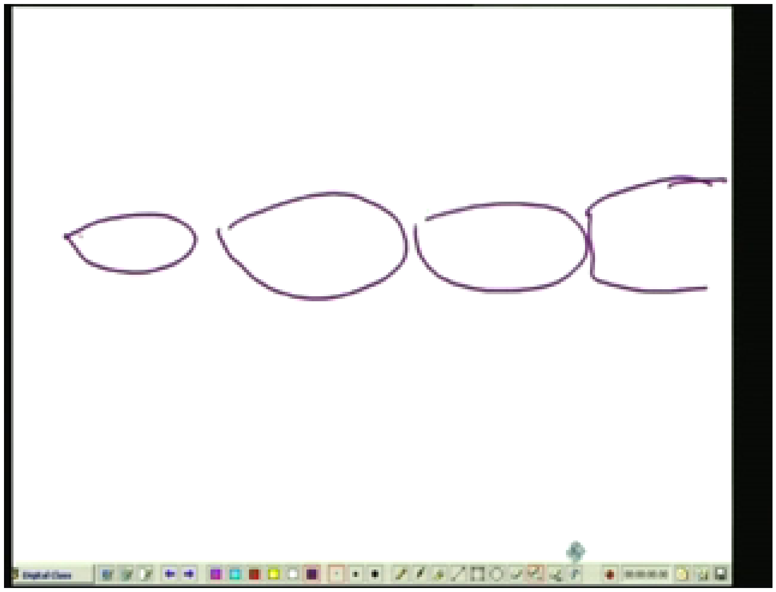

This is a plug flow, this is where it is like this, this is okay. Okay, let me draw it again, sometimes it doesn't go.

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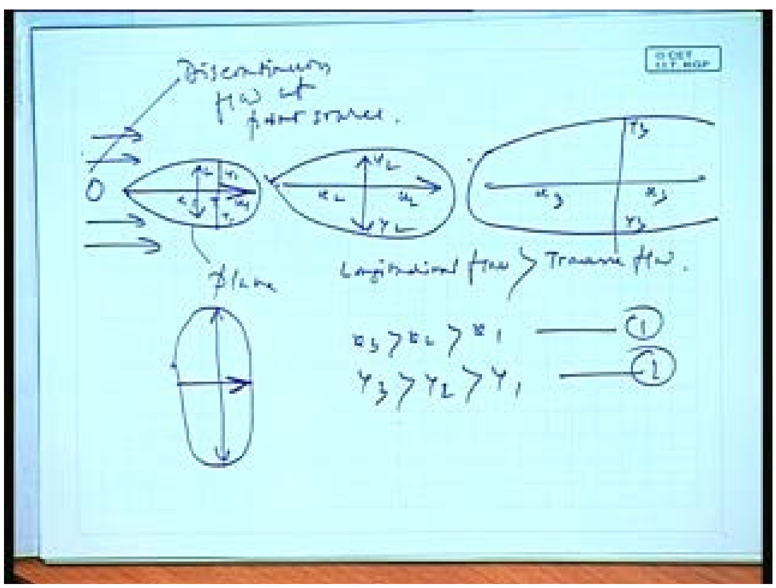

Anyway let me put this here right. Here as you can see if it is like this, this should be initially like this. This is starting from here, this is at the point flow, this is the flow direction, this is the flow direction, this is the flow direction, it should begin to expand like this and then it would be more like this. This is a discontinuous, instantaneous, discontinuous flow, discontinuous flow at point source, discontinuous flow at point source. This should be, this is how we can see, this is the time gap you know by which that there will be no flow. So, this is how the discontinuous flow would take place you know this is would be the plume, this is would be the plume look like. Sir, that begins in every plume we can consider Darcy flow also perpendicular to the flow direction. Perpendicular to the flow direction, yes this is, this is, this is a plume which says that this is flowing like this, this is flowing like this. Yeah, this is what is you know dispersion. Darcy's law only discusses about the flow along the, along the head, along the head, along the decrease in head.

So, it is essentially discussing about the mostly the transverse flow but transverse flow sometimes this longitudinal flow and transverse flow, this longitudinal flow, longitudinal flow sometimes is more than transverse flow, transverse flow. So, what is observed here is instead of, instead of the plume might look like this, the transverse movement has been much more than the say longitudinal movement has become much more than the transverse flow. This quiet possible you know in most cases it is quite possible that this kind of situation can take place. So, in such cases that it is you can see that in that case it is not very, is not quite possible to explain the flow, total flow by means of Darcy's law. We have to find out another parametric coefficient, parametric functions to deal with this kind of situation.

So, instead of movement in the x direction, we will have to consider the movement in around y direction. So, this kind of thing, this is only is possible with a differential equations that will not deal with but you know I'll just tell that you know there is scope of use of those kind of methods to deal with situations like this. So, anyway nonetheless this is what is generally it is, it would look like, it is how it would look, it will consider this case it will be like this. So, but one thing interesting here is to you must observe here as that this particular this one if you just say this one is, this one is x, x the direction x, the y 1 or y y 1 here or both sides this y 2 y 2, here y 3 y 3, this one is say a considering that this one is a x 2 x 2, this is x 1 x 1, here x x 2 x 3 x 3, always remember x 3 is more than x 2 more than x 1. This is a characteristic of the plume and also y 3 is more than y 2 and more than y 1. This will always takes place that is why it is taking a shape of a balloon or a plume like this, a constituent, a balloon continuously getting inflated, this would how the plume would look like in case of a discontinuous flow, okay.

So, with this you know our coverage on this ground water flow is complete you know we have said you know have seen how this contamination takes place and what are the possible things for the, for, since there are so many things to cover, so we'll not be able to discuss about the dispersion in great detail. But this is the basic principal of depression, you can see how this you know mathematical equations can be used to find out the different, different functional values of dispersion but we have to stop at this because there are so many other things to cover. After this we are going to go for waste water treatment. The next class would be on waste water treatment. So, mid sem is till this class okay, till this class is mid sem and that is our post mid sem will begin the waste water management, right. Okay, thank you very much.

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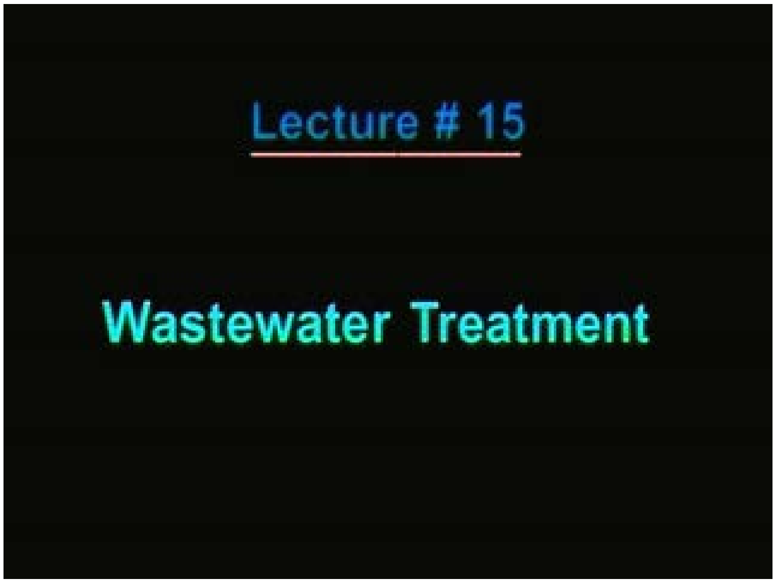

Good morning. I mean with what we have learned so far that is about the water pollutants and you know the typical BOD modeling then you know is about this ground water modeling and ground water pollution. One very important thing by now we have seen that you know there is a, there are many ways water can get polluted either in the surface or in the ground water and now it's our turn to learn about the treatment of waste water. Waste water treatment becomes either a very important area of, very important area of environmental engineering.

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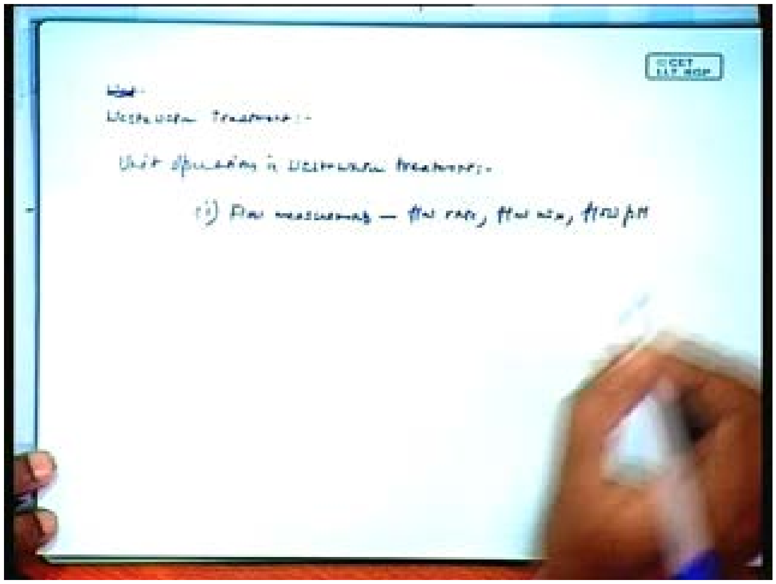

We will see in this classes about 6, 7 classes that I would take on this, you know you will try to understand, you will understand you know how this waste water treatment is designed, what are those priorities, what are the typical methods that we generally follow in waste water treatment. Having to say that you know let us bring out you know the stages you know the parameters of interest for waste water treatment. See this is unit operations, unit operations, unit operations in waste water treatment, right.

The unit operations to start is any kind of whenever there we are discussing with water, anything regarding water you also would understand that there would be a flow, there would be always flow and the measurement of flow is a very important part you know this is remaining is the measurements, flow measurements, flow measurements, flow measurements where we would try to, most of the things that we would know try to find out is flow rate, flow rate, flow mix. What are the material that we have in the flow mixture, what would be the material that is more, yes important for this flow mixture, flow mix. Then we should have, we should have this you know about the flow other things about the flow pH is that you know is a mixing, mixing.

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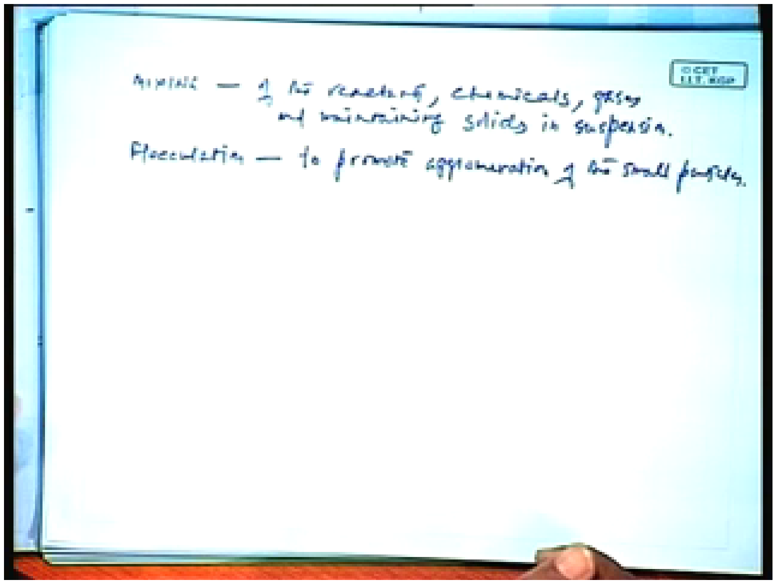

So, mixing this mostly, so the mixing of the reactants, mixing of the reactants you know this is of, it is also of great importance in the sense that you know in many cases in a design there is a risk, always there is a risk in the flow that you would not be getting the designed rate of output, designed rate of outputs. Say you know the reaction mixing is something like say if you are sending, these are the typical things that take place say know if you are, you are using lime in the water so in such cases when you are using lime in the water or if you are adding alum in water what happens is if you are, if the water has a relatively high velocity, so the alum and the water would not come and mix.

The alum would not find enough opportunity to meet with the reactants of, so alum say the lime would not find enough opportunity to meet with the reactants that it is designed to react with. Is that clear? I mean so this kind of situation takes place, the mixing of the reactants is a very important part, so that the larger part of the body, body of water say you now if you have mixing tank, if you have mixing tank in the situation like this you will find that you know a top column is not being mixed, the bottom column is only getting mixed so that would, how to make a homogeneous mix in the total column, this is what is the mixing parameters. These are the situations where we would like to know about, more about the mixing.

So, here if the mixing of the reactants you know mixing of the chemicals, chemical reactants, chemicals, gases, gases, etc you know which are maintaining and maintaining, maintaining and maintaining the solids in suspension, solids in suspension, maintaining solids in suspension. This is what is the mixing part flocculation. Flocculation is one great important, this is a flocculation to promote, promote agglomeration of the small particles, agglomeration of the small particles. Have you ever seen I mean see you now if they you would understand this agglomeration, the process of agglomeration is the use of alum in water. Have you ever seen what is the, how this alum reacts in water? Next time if you go you know go home or anywhere try…

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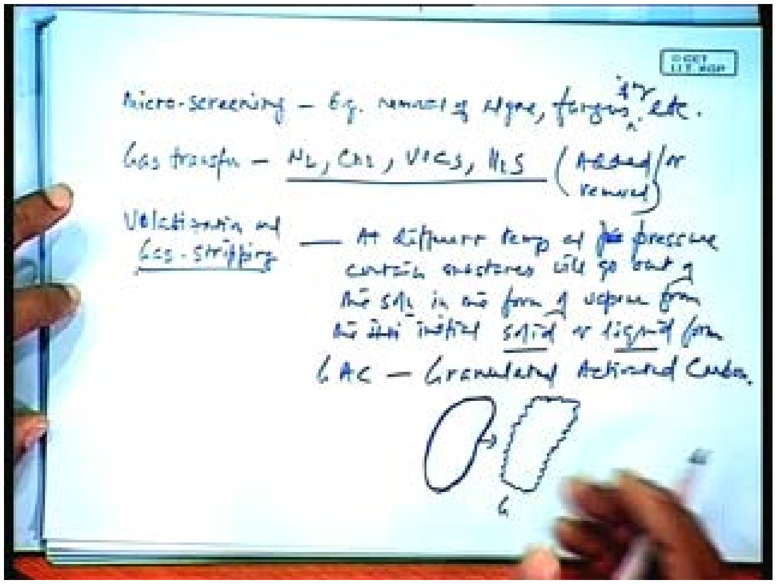

So, these are thus gas striping is also takes in place you know here is a gas striping is a case where particularly a number of you know say there are substances like you know say granulated activated carbon, GAC we call them the granulated, granulated activated carbon. This granulated activated carbon, this is called granulated activated carbon, granulated activated carbon. What is this aspect of this granulated activated carbon? The basically the difference if you just see coal and you know it's basically coal and coke that we see, the coking, the process of coking by which the coke is produced. What is the difference? The essential basic difference is the number of surface areas are more, the surface area is more not number, total surface area is more.

Suppose, if there is a substance like this, if say there is a substance like this, this as a regular surface, regular surface very you know very plain, very smooth surface like this but at the other hand if this surface can be made to be like this where there are, you are increasing the surface area, you are increasing the surface area and as a result of that you know in a particularly when you are increasing here and here you see this is the granulated part, this is a granulated and activated. We call it this activated because this surfaces, this surfaces are very good to keep the gas absorbed in those openings or in those holes or opening that they create. So, is across the body that is the difference between coal and charcoal. What you see in a coal and a charcoal is basically the coal would be having lesser surface area. For the same mass, the coal would have a lesser surface area than charcoal or for the coke also.

As a result of what, what happens is as this surface area increases, within this surface area number of gases can be absorbed like one of this you know is a one of the area which is the most of this water that you can see you know in your water filtration plant that you see or in your hostels or anywhere there is one chamber which is basically full of granulated activated carbon is most basically charcoal, treated charcoal, treated and you know sized charcoal. It's not a large sized charcoal. As the size increases, the surface area further increases.

So, you know the sized charcoal, this charcoal is through which the water is generally passed. What happens is the bad odor, the odor that we generally have in a bad smell in the water that can be removed. As the potential energy increases, the velocity decreases. So, the velocity decreases means you know settling increases. Essentially, we have to settle those things particles, we have to settle when they are in a flowing in a particular above the critical velocity, they would remain in the suspension. So, as soon as you reduce the velocity what would happen? They would begin to settle down.

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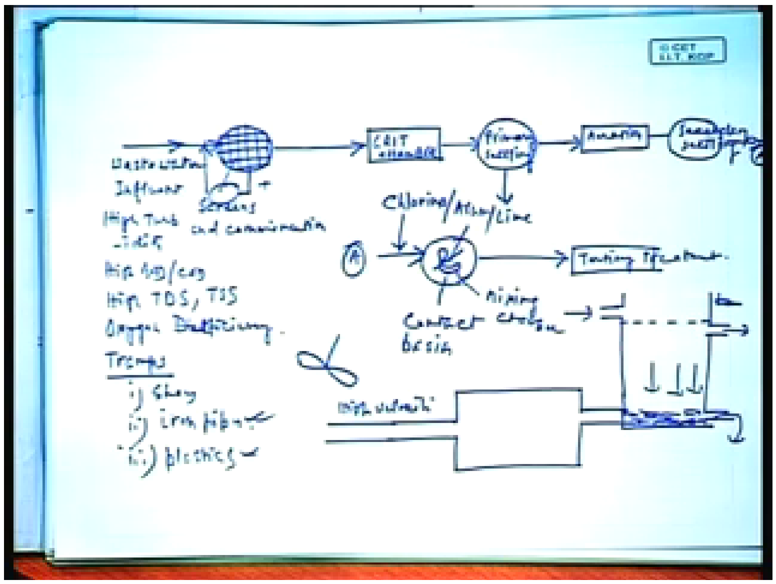

So, this is what is the grit chamber. So, in the grit chamber whatever has passed through the screens would be first allowed to settle, would be allowed to settle and this settled in a grit chamber. So in a grit chamber, if you just observe a grit chamber, a typical grit chamber, if it is an open grit chamber it would be like this where you can find out say this one is you know here you would find out in an open grit chamber like this where a large part of this would be… in a grit chamber, what would be happening is so this is how the water is being for this is the level to be maintained, as you can see this water coming down so here the level is maintained. So, here the particles which would be settling here, the particles that would be settling here would be taken out okay.

So, the settled, you try to understand this. This is what is, this is what is coming from the screen, from the screen with lot of TSS, TDS it also has. TDS you cannot do much at this level. What we are trying to handle this at this time is TSS, the more total suspended solid, all kind of suspended material. This suspended material as this velocity reduces, so we can find a large amount of, large body of particles, large body of material would begin to settle at the bottom. Isn't it, would settle at the bottom. As they settle at the bottom, as they settle at the bottom the water would be more clarified on the top, water would be much more clear on the top and this water would then be taken out okay.

See, till this time, till this time we have not, we have not seen, we have not seen any kind of, any kind of say, any kind of reactants being added to the water. We have not used added anything so far, we are just trying to physically remove things from the water. So, this is also there would be a followed by a grit chamber, there may be another primary settling time where even smaller particles would be allowed to settle okay, even smaller particles would be allowed to settle. Then we would add, then would be, this is what is the aeration. Then the next stage is aeration. What we do in aeration? The aeration has a great importance. Let me explain little bit about aeration here.