Fundamentals of Environmental Pollution and Control
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Lecture No. # 16
Waste Water Treatment (Continued)

So, we would be dealing with this primary waste, waste water treatment techniques that we would start now.

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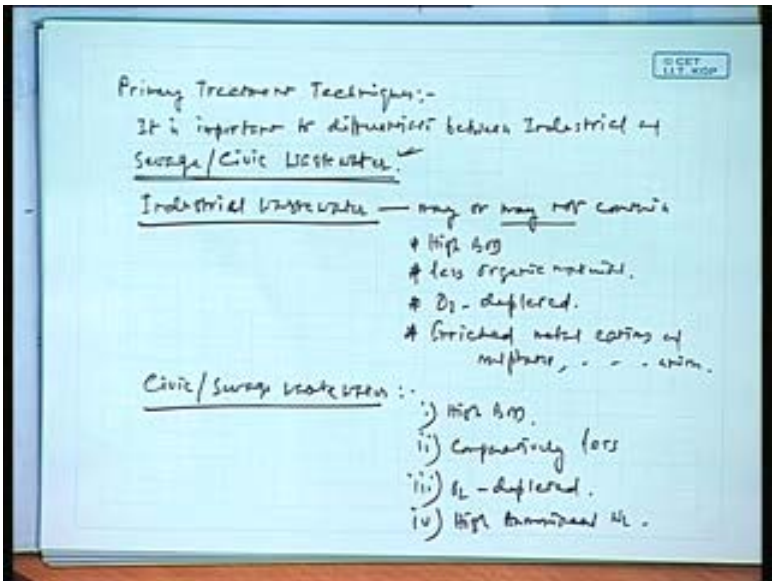

But before that let me tell you, you know we would not generally discuss much about the screening and filtration part because you know this is the very basic part I have said but this is, there has the method of screening, screening method of combination that I will not discuss mostly but we will start with the primary treatment techniques. At this junction you know it's very important for all of us to understand that difference between the, what is the expectation about the water.

Suppose this water is coming out from a source, any source say coming out from an industry, coming out from a sewage pump, coming out from a typical say a process like you know something like food processing waste. What are the expectations of the water? I mean having seen the water or coming out of a particular industry or a process, we should try to understand what we should expect in that water. Say, in a food processing waste water would have high BOD. Essentially, it would have high BOD but it will have less say inorganic TDS, less inorganic TDS may have some salt, may have in the lessed or inorganic TDS. So, here but on the other hand say a mine waste, mining related waste water or say waste water where there are only the substances, the mixing substances are of inorganic nature, we would only observe inorganic salts present in that.

So, in the most of this mining waste water acid mine drainage or whatever we discuss about will deal with that also, acid mine drainage and all this. We generally observe the water to be of a certain characteristics. The characteristics is initially whenever it is, whenever, wherever it is getting produced, there would be the environment would be oxygen deficient this is number one. The second point that we would observe in such cases is there would be no very little BOD because mining as such the process does not create any place for BOD to be produced. So, why would find is this would be high TSS, high TDS but this high TDS is basically due to inorganic content, inorganic contents of different kinds of metal cations, anions okay.

So, having said this, so now if you can make it is important to differentiate between industrial and sewage or civic waste water though largely, large you know most of the waste, waste water engineering today is mostly that this part of waste water engineering is highly developed, is quite well developed civic and town waste water treatment methods but industrial waste water treatment is still in the process of development. There is lot of things still required lot of research inputs are still important. So, what we find is in the industrial waste water may or may not contain as I have said industrial waste water may not, may or may not contain high BOD, right. It may not contain high BOD is not some industry like you know sugarcane waste, sugarcane industry or sugar industry, there may be high BOD but not in all say you know like a process, a chemical process like you know mineral processing.

The waste cannot have high BOD mineral processing, the waste will not have high BOD say similarly a method where you know say sulphuric acid is produced, a chemical plant or a particular any other chemical being produced. Here, there you will not find high BOD, the BOD would not be important parameter there. Though you measure BOD but you know is not may be, may not contain, mostly may not contain high BOD say this this mostly the, there would be less say less organic material but they would be mostly you know oxygen efficiency, oxygen depleted, they would be mostly oxygen depleted and the finally the most important part would be, they would be having enriched metal cations and sulphate, carbonate, bicarbonate anions, okay.

So, this is industrial waste water but say civic waste water on the other hand civic or sewage waste water, waste water, civic waste water on the other hand will be necessarily high BOD say less organic matter I mean comparatively less, comparatively less organic material, it would also be oxygen depleted. There will be, it will be deficient in oxygen you may or may not accept some of this metal cations and sulphates etc. Another very important thing here is high in nitrogen, high ammoniacal nitrogen, nitrogen, high ammoniacal nitrogen. So, this is the difference, so you can see depending on this process depending on these purposes the total treatment method would be different, treatment methods would be different but nonetheless you know there are several methods you know which are true for say civic and waste water treatment. We'll deal with them because just to explain you what are the basic principles of the treatment, what we would rarely like to attach with this.

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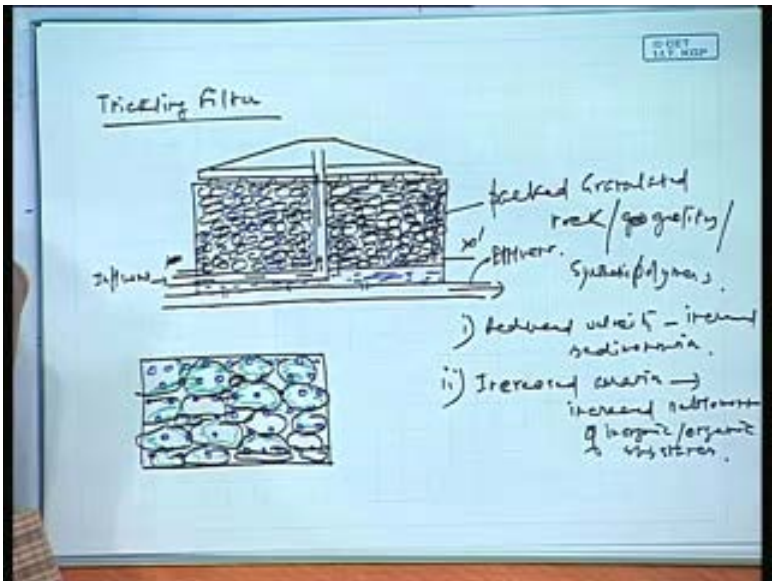

The one very important thing is a trickling filter, trickling filter. This is where we are dealing with the primary treatment techniques. This trickling filter, the trickling filter is like this. What is, what is generally done in a trickling filter is like this. This is particularly, what is this influent is entering into the column like this? Here, you can see this nothing like you know what you observing is in a bathroom spray or things like that, the water goes and sprays, okay. Yeah, this is like a fountain or spray like that. You can see here this would be the sprays you know here would be the perforation should be there through which this water would be passed into this, a particularly this one is either is a packed, packed granulated rock, packed granulated rock or it can sometimes we are using nowadays you know say geolites also, geolite beds, geolites or even polymers also is polymers, synthetic polymers, synthetic polymers are being used.

What is this, they do is you see here the water finally is the most important part here is to understand is that you know this water finally forming like this, you know travelling across this different pebble surfaces, the rock surfaces and then finally coming out from the bottom, finally coming out from the bottom. So, you know here this water trickling from there and thinks like that you know as soon as this the two, two purposes are served, two purposes the water begins to trickle through this, through this granulated rock or geolites or synthetic polymers packed with that and two things that two things are achieved one is you know the reduced velocity, reduced velocity.

So, increased, increased sedimentation, increased aeration, increased aeration, it also means you know increased, increased settlement of a both increased settlement of an organic and inorganic substances inorganic, inorganic and organic substances. So, you can see this you know this is particularly, so after having coming from there you know through this chamber, through this channel, this water that would be collected here, this water that would be collected here would be generally taken out, be taken out through, through the ports here. So, this is what would be you can see this water coming going out through an effluent like this, through an effluent like this okay.

So, here this water is going out as an effluent from the chamber, from the chamber, from the chamber. So, you can see if you just try to observe from a, from a plant you just this across say you know about if you just make a section along this line, along this x x x x dashed, if you make a section what you observe is that there would be, there would be small perforation on this surfaces, small perforations, the small perforations on this, on them, a small perforations that we see generally in all surfaces of this nature. So, through which the water would be allowed to pass and small perforation should be there and on top of that, on top of that you will find this, this the pebbles settle like this.

So, here if you see this you know in a section like this, so water trickling through these surfaces, through these surfaces at a much reduced velocity, at a much reduced velocity would essentially go down like this. And as a result of which there would be in the surfaces, in the surfaces we will find in the surfaces due to the natural process, due to natural processes the, the sediments, the sediments should be collected. So, these sediments need to be regularly cleaned for the effective use of these substances. So, here you two important things are two, two important things are to be noted here. That is the increase in the area of contact, slowing of velocity, increased direction all leading to increase sedimentation of different substances, inorganic and organic or both, of both nature both inorganic and organic. Isn't it?

So, this is what, this is how this surface is if you just see this, this is across if you, if you don't see the full part of it, if you just make a section instead of this x x x x dashed here of this section it would look like this. I have not you know if x x x x dash I have not drawn this, so I am just trying to limit to this particular part, here it would be looking like this. So, here this is a trickling filter, so this is a very interesting and very typical type of water treatment methods. Much of this I tell you one thing still today much of this can be achieved a great amount of water filtration can be achieved if this kind of small typical, very simple systems are very effectively used.

I can tell you with all I mean all my understanding about the subject is the earthen filter that we used to see you know, you know in our childhood you know even say I mean my childhood specially say you know in cases like that they are as effective as many of the water mechanical or electronic filters that we have observed today, they are equally effective. Only most important thing is that has to be maintained you don't expect that the, that this would be set up for in countries like ours the problem is we set up a plant and then forget about it. We then only do not make much effort to maintain it, if we maintain it this can itself serve a lot of great purposes. They can be as effective as secondary treatment methods. So, here this is about a trickling filter is another very important part is you know is that is generally is called is a rotating biological contactor, rotating biological contactor, rotating biological contactor.

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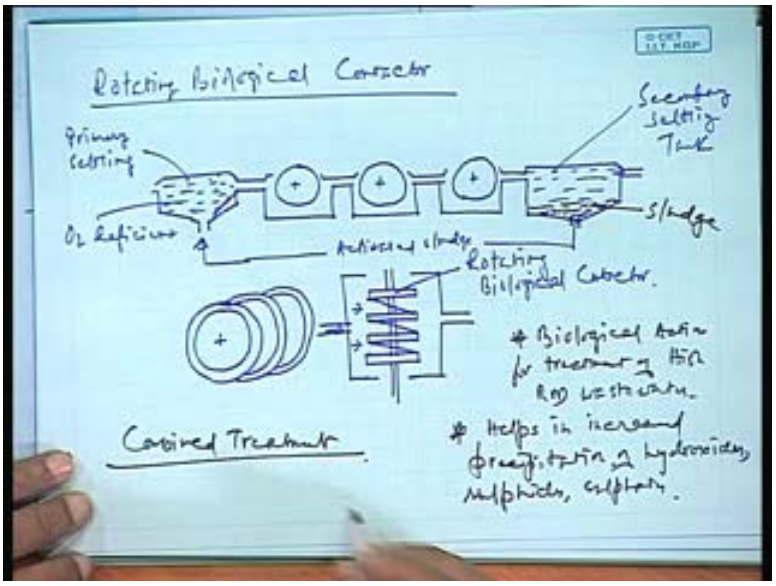

Let me make a drawing first. This is how it looks like, you will find this you know in the text book also you know you will find this drawing here but try to do the drawing I mean I'll make some changes in the drawing okay. It should be, it should be like this and then this okay don't take this, all right. So, here this one is now it is going like is this, sorry here this should be an opening there, this should be an opening there also that's all okay. So, you see this, this is what is you know this is what is where this is primary settling is taking place, a primary settling, primary settling taking place you can see this primary settling tank you can generally take it out, right. This is what is a rotating biological contactor you know is a rotating biological contactor.

Let me explain how it is. It is basically if you just observe it would be, it would be like this. These are basically rotating disks, rotating disks of, these rotating disks you know if you just observe this thing like this, so you can see this, this is, this is how they would look from one view or else you can say it like this you know they would be like, all right. You see this, this is the, this is how the tank is on which there would be water on which there would be water coming out, going out like this, coming in and going out like this. So, here the water would enter, this is how the water would enter and this is, this would be, they would be connected you know this is, these are called rotating because they rotate either powered or with the flow of the water rotating biological contactor, rotating biological contactor.

So, what happening is as I have said this oxygen, oxygen, this is, this water is O 2 deficient, O 2 deficient. So, the reaction rate drops down, reaction rate drops down to a substantial amount. So, the reaction rate actually comes down, so it to increase the reaction rate, to increase the reaction rate it is an important thing, it is essential, it is essential that we increase the concentration of oxygen in the water. And this can only be possible you know where we are just allowing some of the water in turn you know in the processes of we will come into contact with the air and as a result of which increase direction taking place. This is, this is a, this is a typical biological, rotating biological contractor, there will be three streams or four streams like this then would finally go into a secondary settling tank. So, you can see this, in this in the secondary settling

tank this is what is the secondary settling tank, settling tank. What is another interesting thing that takes place here is another is basically this is called activated sludge, activated sludge. This activated sludge generally send back here. Some of this sludge is that would be, some of the sludges that would be produced here, some of the sludges that would be produced here.

See, this sludge that would be produced here selectively, selectively, it would be brought back and would be supplied into this water. The reason is very simple. The reason is you know this water the microbial activity in this water would be much less because this is the fresh waste water stream or whereas on the other hand here this is completely enriched with microbes, large number of microbes are present already there. So, this microbes would be generally put into this stream back, back to this stream again and as a result of which you know the oxidation, the reaction process would increase is something like you have seen that preparation of curd at home. What do they do is you know the curd in our part of the curd would be left, kept aside and would be mixed with the milk, so the process of the curding takes place, okay.

The same thing takes places here, the same situation is here also. What is, what we are skipping? we are essentially keeping something with lot of microbes. The microbes that would be actually transfer the milk into a curd. This is a typical microbial action, very simple microbial action you see this, the total characteristics of this, the milk would get changed and this is completely microbially control, complete microbial action taking place. to control this microbial actions sometimes what we require is to do it fast, to do it in a control manner, to do it in a control manner. Some of these microbes, the preferred microbes or you know a something, some of those microbes which should be found in the waste of the sludge of, sludge of the secondary settling tank would be reverted back to the primary settling tank again, okay.

So, as a result of which this the process of, in this process this thing the decomposition of the organic waste and also different chemical precipitation method also can be applied. A large part of that would also be involved in the chemical precipitation methods. Chemical precipitation would also takes place. Two is, one is the two purposes of this is that you know into, this is biological, biological action for treatment of high BOD waste water. It also helps, helps in, helps in increased precipitation, helps in increased precipitation, helps in increased precipitation. This is another very important part biological action, biological action for treatment of high BOD waste water is a purpose of using this rotating biological contactor helps in increased precipitation, also helps in increased precipitation of say hydroxides, hydroxides then you can say sulphides, sulphates okay. Ideally a, ideally a, ideally a process suitable for, ideally a process suitable for civic waste water but this one can also be used for the purpose of increased sedimentation of say a number of inorganic chemicals, number of inorganic substances okay.

So, it serves two ways, it serves two ways, this is called a rotating biological contactor. This rotating biological contactors are also in great use you know is a various purposes they are generally used, a particularly they are also another important part is you know the combined treatment you know where combined treatment you know in some cases this, this rotating biological contactor or trickling filter may be combined with a principal treatment technique. So, that to augment the process, to augment the process we would require that to speed up the process, it is required. Some kind of pre-treatment is required of the waste pre-treatment. So, these are basically very good pre-treatment methods where we are trying to before the final

settlement takes place, we are trying to pre-treat the waste material, pre-treat the waste material in water, so that they become more to sedimentation at the later stage. We will see you know particularly in organic treatment this kind of situations or this kind of techniques are very very important I mean a pre-treatment cases for pre-treatment can be used.

Another very typical I mean if we are not doing any kind of a waste water treatment, the essential very essential part is you know in many cases in your households or wherever if you are just trying to use if you are in, you are thinking of using a generally polluted water for some purposes say irrigation or say for say something like you know at least feeding the livestock cows and buffalos and things like that. One very important method of treatment technique process is oxidation pond treatment, oxidation pond.

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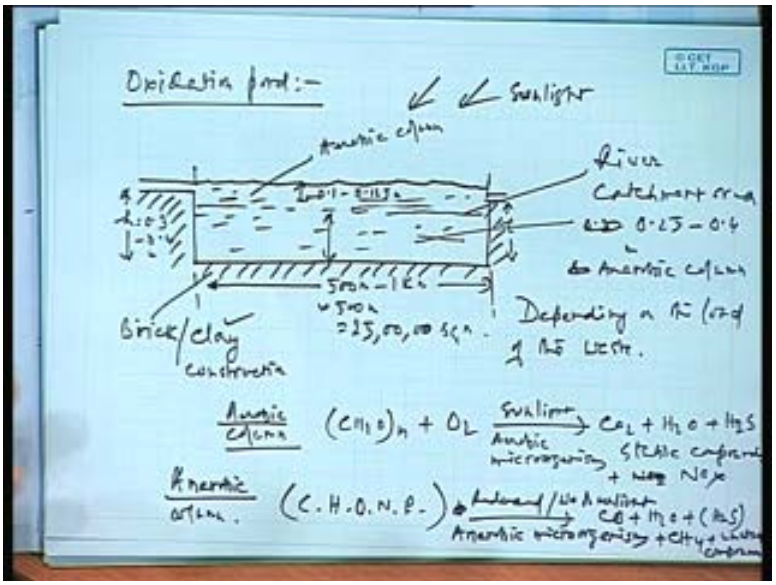

The particularly of great importance to countries like ours where we should have an oxidation pond. What is an oxidation pond? This oxidation pond is you know largely say the influent. Influent would be, would be generally sent into its most ideally, is most ideally is the earthen tanks, the earthen tanks which are generally shallow is very shallowing, this earthen tanks. You can see this them as very shallow, shallow earthen tanks you know sometimes this the effluent height of the effluent and this height this is mostly the same. So, here this is, this depth is 0.3 to say about 0.4 meter or say above 30 centimeter to 40 centimeter. Here, as this one can be as width as possible you know this is not necessary that this one can be as long as possible.

Sometimes, you know it is better between 500 meters, 500 meters or say 500 meters to it can be up to 1 kilometre. So, this is typical wetland you know if you have seen the wetlands, wetlands, typical wetlands where there is a very small width of the water, the depth of the water is very small, this particular surface you can see this, this particular surface say here the water is being dumped here. This is, this is either brick or clay, clay is favoured, clay construction. So, basically an earthen construction you can see this, this one would be 500 into 500 say 25, say 500 into 500 so 500 into 500 say meter square. So, you know you can see this meter, so is about say 25 into 0

0 0 so square meter of width. Square meter of area very wide, very wide work, very shallow also. What happens we generally do is we say this effluent water. if you just allow the effluent water, this can be, this particularly this is you know this is, this particular area is a catchment area, this can be a, say a river catchment, river catchment area which should be suitable for an oxygenation treatment like this.

What is, what we are trying to do is here there will be, it would be you know a good supply of sunlight a good supply of sunlight. We would observe that you know initially is basically it will we observes say about 1 to 0.1 to 0.1 to 0.125 meter. We observe mostly a good oxidation say aerobic column, aerobic column and particularly below this, particularly below this up to a certain depth, after a certain depth say between say point, 0.2to say 0.250 point say 0.25 to 0.4 this step, at this step we find an anaerobic column depending on the load of the waste, the load of the waste, depending on the load of the waste we find that the, about this you know in this about this column there would be an aerobic column, there would be an anaerobic column. What would happen is in the aerobic column, in the aerobic column what we find is as I have said mostly you know in a say sunlight and then aerobic microorganisms. Aerobic microorganisms you will find Co 2, you will find H 2 O then you will find say Co 2, H 2 O mostly stable compounds, stable compounds, several stable compounds we'll also find some H 2 S here. We'll also find some nitrogen say in the form of say you know two or say in the form of NOX, okay.

On the other hand in this anaerobic column if you see column is C H O say N, N or any other substances ph for p phosphorous all these substances connected, connected with a reduced oxygen, with reduced oxygen, sufficient oxygen here reduced oxygen here. You would find that on the reduced oxygen, reduced sunlight, reduced or no sunlight reduced or no sunlight anaerobic microorganisms, anaerobic microorganisms, anaerobic microorganism, we will find carbon monoxide will find, carbon monoxide will find water, will find some H 2 S also here.

Mostly, H 2 S you will find you know some kind of methane also be in produced methane and you will find say unstable compounds, other unstable and compounds, odorous compounds. So, you know here in this anaerobic column you can find this. Apart from this you know there would be many, many things to deal with this inorganic components also, a large part of inorganic substances like you know say iron say here in case you can also observe another important reaction is taking place in this column itself.

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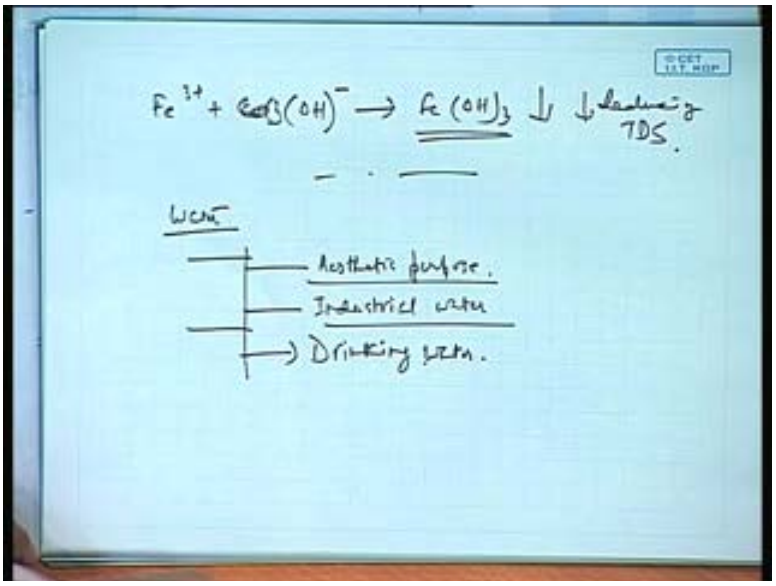

We will find that Fe 3 plus with say, with say increased, increased, say increased finding Fe OH 3 which would be settling. We would also observe that ferric hydroxide deposition taking place, ferric hydroxide deposition taking place. So, this is also known as an oxygen, this is as suddenly reducing, reducing TDS, so reducing TDS. So, we can see this is the part you know oxygen ponds see this is, this oxygen pond generally helps us to obtain. So, these are the purposes, these are the typical, these are very simple type of, very simple type of the primary treatment methods that we generally use. This primary treatment methods you see that we have not used any material, we have generally used you have just generally encouraging the natural reactions to take place and as a result of which you know without much cost, without much cost we are able to reduce the concentration of pollutants in the water.

Reducing the concentration of pollutants in the water is a major significant step because by that time you know if you are reducing the concentration of several substances in water, the reactivity of the remaining substances increase. So, that is how you know it generally serves a purpose in carrying out with a method, this kind of methods to treat water. And initially mostly when you are trying to do you know you say initial processes, this particularly this kind of methods generally have. We will continue the discussion here, will continue the discussion whenever in the next class we will still discuss on the different other methods all right, okay. Any question? Depending on the standards that you meet, suppose you know there are three kinds of you know you say in water generally what we are say that the varieties are like this say water, water treated with, treated water, the different purposes for use. Say, the first level is say for aesthetic use, aesthetic purpose say you know when we are, when we are trying to do say in the perk or we are using in a pond. So, you want the water to be clear, so that you know people generally get drawn to this but that water is not essentially drinkable water, you don't want to expect that to be drinkable water. This can be particularly, this is aesthetic purposes that is also for that also we may need treatment okay not only for drinking.

The next comes is industrial water say hardness, reducing hardness is an important part of industrial water. In industrial water we should have hardness very little because you know hardness increases the carbonation process inside, there will be many kind of difficulties that arise out of this processes. So, you know the, after aesthetic purpose the industrial water that we used for industrial purposes. Next comes is the drinking water, so may be in many cases, may be in many cases a primary treatment method may not be sufficient for to make the water a good for drinking. But you know the secondary treatment may be required, a tertiary treatment may be required for just to make it sufficiently potable water that we will see later on you know where we can use. The water that we have said in most cases these are used for aesthetic purposes and industrial water, they are not still good for drinking water. In drinking water we require certain other requirements also, we will deal with this, we'll discuss with them drinking water so all right. So, this is how you know will see there later on, okay.