Wastewater Treatment and Recycling
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Lecture - 03
Pollutannts in Wastewater: Point and Non-point Sources

Hello everyone. So, in this lecture we will continue the discussions on to the sources of Wastewater, we are going to talk some of the pollution aspects in the wastewater, because essentially as we are talking in our very first lecture. That wastewater is essentially considered or normally perceived as a burden, because there are pollutants available in it. So, because it has the harmful constituents, which makes it not fit for direct uses in most scenarios and that is why we considered this as a burden. So, when we talk about the wastewater processing or treatment, we have to have an idea of the from where the wastewater is coming.

Now, we did talk about the different sources of wastewater that sources what we discussed was about the origin from where the wastewater is being originated. Now, the sources can be classified or can be perceived in a different approach also. So, what we are going to cover in this lecture is about the sources of wastewater or the type of sources of wastewater, where it is actually introduced in the nature. So, generation is one aspect water is we generate water in our households or in our factories, industries, but whatever let us say we are we are getting water out of our kitchen sink, we are getting water out of our bathroom.

So, all these type of sources or the places where wastewater is being generated are there, but when we talk about the processing of wastewater or treatment of wastewater we are not going to put treatment in each and every households, we are not going to put treatment in every kitchen sink, we are not going to put treatment in every bathroom. So, the water when we talk about the processing or subsequent treatment of wastewater, we have to get an idea how wastewater comes into the environment.

So, like when water is released from independent houses or let us say a specific factory, what happens after that? And, when it is introduced in nature in what form it is getting introduced so, based on that also the sources can be classified. So, we will be talking some of those aspects here.

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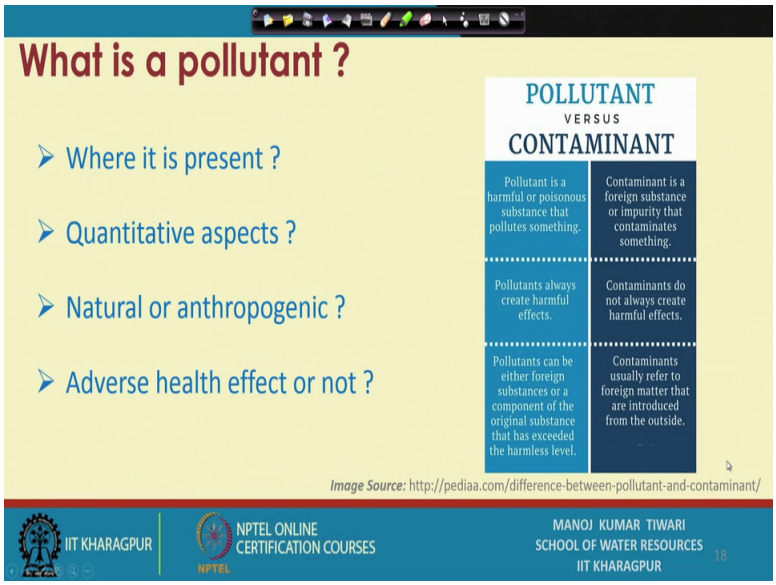

Before that when we say that water is essentially unfit for uses or considered as a burden wastewater, because of the pollution or contamination in it.

So, we should realize what we are talking about. What is a pollutant? Because, when we were just in the early session we were saying that water is rich in the sediments or rich in the pesticides fertilizers the agricultural runoff water, or industrial runoff water may be rich in organic loadings or various other harmful and toxic materials our domestic sewage is again rich in the various elements. So, when we say that the water is polluted because, essentially we afraid of the wastewater because it is polluted.

So, when we say that something which is polluted, what we are actually referring to? What is a pollution? Or, what is a pollutant? Whether, I am sure like a the basic idea of pollution is everybody knows what pollution is, but when we specifically talk about what is pollution how broad perception we can generate about the pollution?

Whether the pollution depends on where it is present, whether it depends on it is quantitative aspects, how much it is present? Whether it depends on whether it is a natural or anthropogenic, whether it is defined based on the health impacts or not well there are 2 terms which are typically coined the pollutant and contaminant. This people often use as a synonym; however, there is a very minute basic difference exist between this, further for all practical purpose we can interchange them pollutant, we must realize

that we are talking about something which is unwanted ok. That is why we want to remove the contamination we want to remove the pollution.

So, we are talking about something which is unwanted now, whether this unwanted thing is naturally occurring has been added anthropogenically, whether this unwanted thing is having any adverse health impact or not. So, all these thing is what sort of differentiates between pollutant and contaminant as per few references ok. However, many places it is considered same. So, when we say the unwanted we must realize that what exactly unwanted is in which sense we are talking about the pollution is unwanted. So, we eat let us say let us talk about the dissolved oxygen level ok.

So, dissolved oxygen level in water that we consume is not a criteria is not a factor, but the dissolved oxygen level in a river water, in a surface water, has to be there because if it is not there. So, then the aquatic animals, which survive based on the oxygen dissolved in the water if oxygen is not there in the water, they may not be able to survive.

So, the same thing may not have any impact or may not be an essential aspect for one type of users, but is required for other type of users. Similarly, we all of us consume lot of ingredients in the water that we consume in the water that we use for different purposes ok. You are let us say cooking some pulses and you add salt to it.

So, whether salt is a contaminant or salt is a pollutant; obviously, not because you are intensely adding it and you want that to be there in your [FL] that you are preparing. So, that you can eat that and like it, you feel the taste of it. However, what if the quantity of salt which is being added is increased let us say tenfolds. So, now, because the so, location of the salt is still same it is still in that the bowl of the [FL], but since the quantity has increased. Now, it is actually going to create some sort of possibly unwanted effect or unwanted impact.

So, now, you can consider this as a pollutant, because it may have a harmful impact or at least a contaminant because it is not desirable at that quantity. So, something which is not desirable beyond a quantity and is present there is considered as a contaminant or a pollutant for that matter. Now, the pollutant will depend on whether the label is having any adverse health impact or not, where as contamination even if it is present beyond your desirable expectation or beyond your desirable limit it is a contaminant for that sake of that.

Similarly, let us say we considered the agricultural runoff ok. So, we apply the pesticides we apply the fertilizers to the soil right. So, when we are applying them they are being applied for a useful purpose and they are not a contaminant or a pollutant for the purpose we are applying to it.

But, when that thing in when let us say we irrigate that field and the runoff which generates, brings the level of some molecules or some content of the pesticides and fertilizers or some even sediments along with it. So, the water is not supposed to carry those things. These pesticides these products or for say in household applications we use soap. So, we take bath out of that soap. So, is that soap a contaminant no, because we are anyway using it.

So, as a material it is not a contaminant as a material it is not a pollutant, but it is not a contaminant or it is not a pollutant until it is in it is original form until it is in a soap form or with until it is in a the dispenser, but when we dispense it when we wash our hands or when it flows with the water.

So, the water which flows is not supposed to carry or is like water is not the appropriate medium for containing that soap that way. So, that is why when it enters into the water medium it becomes a contaminant or it becomes a pollutant. So, here the substance whether it is soap or it is pesticides or herbicides in the runoff example.

So, the substance is the same when it is there in it is original state or for some practical purpose or it is being applied somewhere, it is not a contaminant, but when it is coming into the water, it is becoming it is being considered it is being perceived as a contaminant or a pollutant, that is because it is not supposed to be present in the water or water is not supposed to contain all those things the usable water. So, that way it is about the undesirable location of the contaminants of the materials.

So, if any material is present at an undesirable location it becomes a contaminant, it is not only relate in the reference to the water it can be in the reference to other things as well ok. We are using mobile, we do not consider it as a waste, but when it is not in use any more or when it has (Refer Time: 11:26) we throw it becomes a electronic waste ok.

So, the same thing, which is or let us say we are writing in a paper book the page is not a waste, but if we tear that page and throw it in a dustbin that becomes a form of waste. So,

the point is that something which is in it is appropriate location is not a waste, when it changes location, when it reaches to a place where it is not supposed to where it is undesirable that same thing can be consider or can be perceived as a waste.

So, that way any material can be become a waste. The other example earlier that we took about the salt in a bowl of [FL] is the location is same it is it earlier also it was in a bowl in the same bowl, now also it is in the same bowl, but the quantity has increased. So the, it has exceeded quantitative limit or a quantitative level, it has exceeded beyond that level and then we considered this as a form of pollution.

So, there we are talking about undesirable quantity. So, if we that we want to define let us say contaminant. So, we are we are essentially talking about substances or materials, which are present either at undesirable location or in undesirable quantity. So, that is what essentially is the pollution. Now, whether it is a contaminant or it is a pollutant, whether it is having adverse health impact or not will depend again on the nature of it. Something, which is going to have adverse health effect will be called as a pollutant also of course, it is a contaminant as well.

But, the contaminant may or may not have adverse health impact pollution generally is perceived to have some sort of harmful effects ok. Similarly, it whether we are talking about natural or anthropogenic. So, pollution can be natural or can be anthropogenic both form ok. A natural substance increasing the level is also a form of pollution, contaminants are usually referred to the foreign materials or the anthropogenic activities which brings unwanted undesirable substances in the water ok.

So, those kind of things can be considered as a contaminant. However, we will not restrict to the division between contaminant and pollution for all practical purpose, even if it is harmful or not, if it may not be harmful today, but if it is undesirable in water it should be removed.

So, for us pollution and although contaminant in a way can be a subset of pollution in the larger prospective, but we will consider contaminant and we will use rather like pollution, which considers both contaminant whether it is harmful or not and whether it is coming from natural sources or anthropogenic sources.

So, that way the pollutant can be defined and this is what is the prime reason for the, not direct usability of the waste water. So, in that sense we see that the waste water that we get is polluted out is having these type of contamination and our target will be throughout this course, how to manage this or how in what way it can be processed and these contaminants can be removed.

Now, for the, that purpose we need to understand that we have to get an idea of how we can capture the wastewater first. Because, if you want to process that wastewater if you want to removal remove the contaminants from the waste water one have to capture that wastewater first. So, one had to get an idea how they are getting introduced in the nature. Now, the contaminants or the contaminated water or waste water gets introduced in nature in 2 forms ok.

There is something which is called point sources and then there is nonpoint sources, it is not limited to just water only it is for other type of pollution as well, it is it applicable for air pollution and other forms as well. However, we will restrict our discussion to the water pollution.

So, there are point source pollution and there are nonpoint source pollution. Now, if we see what is point source pollution and what is nonpoint source pollution?

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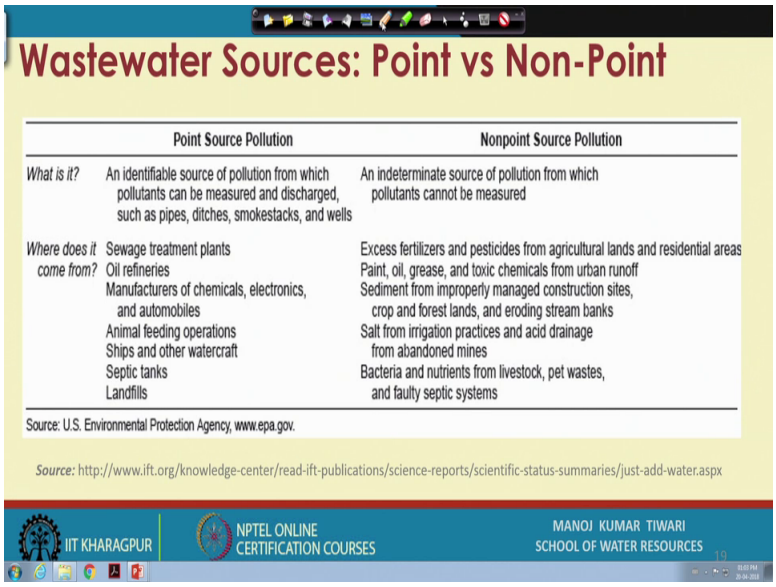

So, as per the U S EPA, U S Environmental Protection Agency a point source is actually an identifiable source, what we can identify? Ok. So, an identifiable source of pollution from which pollutant can be measured and discharge such as pipe ditches and in air pollution sense it is smokestacks all those things, where as a nonpoint source is indeterminate source. So, it is a indeterminate source of pollution, which cannot practically be measured ok. Now, we are having industry which is discharging it is effluent through a pipe. Of course, we can put the flow meter to that pipe and know, what is the total discharge coming out of that pipe?

So, we can quantify that waste, we can capture that waste, we can process that waste. So, that becomes a point source of pollution. Where as in another case let us say rainfall is occurring on agricultural field. So, you I am sure all of you might have all of you have seen this at somewhere, that when this precipitation occurs you will see n number of channels or small flow lines are coming here and there. So, they are all the way spread. And, if it is not if it is not collectively coming at one place, it becomes very difficult to know how much is flowing where. You have agricultural field say across a river and when the you irrigate that agricultural field or when there is a precipitation or there is a rainfall occurs.

So, what happens that? What is ever runoff is being generated all will actually lead to the river, but it will lead to the river with multiple different small small small channels. It is not possible to measure and monitor all these small channels number is too large and the flow in each of these approaches is very little. So, this is a dispersed or distributed source. So, nonpoint source is also called as a dispersed or distributed source, because it is a indeterminate source and we will not be able to collect it capture it together until unless we do some those sort of intervention and convert this to a point source. So, that is a big challenge big task and we will possibly not be able to measure how much flow is taking place? Normally, point source pollution comes from yours sewage treatment plants various industrial applications or a landfills.

So, the points where we know that the waste will be generated and can be collected itself, while the nonpoint sources comes from the fertilizer and pesticides in agricultural runoff or residential area runoff, urban runoff and few small distributed source or let us say atmospheric deposition, when rainfall takes place. So, what is ever is the impurities in the atmosphere we know the phenomena of acid rain and all that. So, when the rainfall

takes place those pollutants gets dissolved into the water and they fall at different locations. So, it is it becomes overall distributed and it is not located at a specific point. So, that is, what is the nonpoint source.

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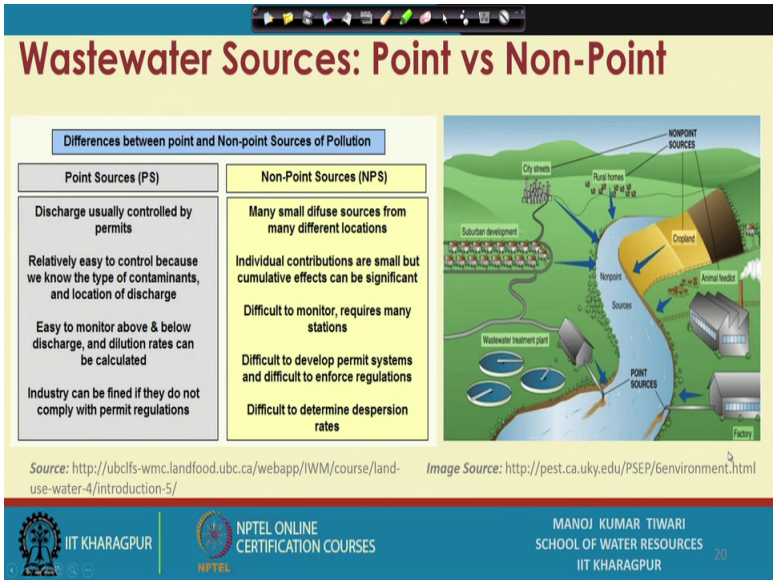

If, we see the difference between nonpoint source and point source, so, we can see that discharge usually controlled by permits, because if we are having a industry let us say the point source. So, of course, there will be a discharge limit that you cannot discharge more than this it is a measurable quantity, it is a measurable characteristics and then there is a possibility because it is collectively coming at one point. So, there is a possibility to captured that to process that to treat that.

So, all those things are there it is relatively easy to control that way easy to monitor ok. While, nonpoint sources because of the many diffused sources from many different locations so, individual contribution could be very small of all the sources, but collective or cumulative effect can be significant, like if we see the load of pollution coming into our rivers. So, if there are lot of agricultural activities are being done let us say so, all those eventually washout.

So, each point each specific point contribution could be very small, but if we see this collective contribution towards this, it is it may actually be problem more than the industrial or the point source discharge, but because of it is nature it is very difficult to

monitor it is very difficult to control it all those issues are there. So, we can have a sort of that way different characteristic and different sources in such cases.

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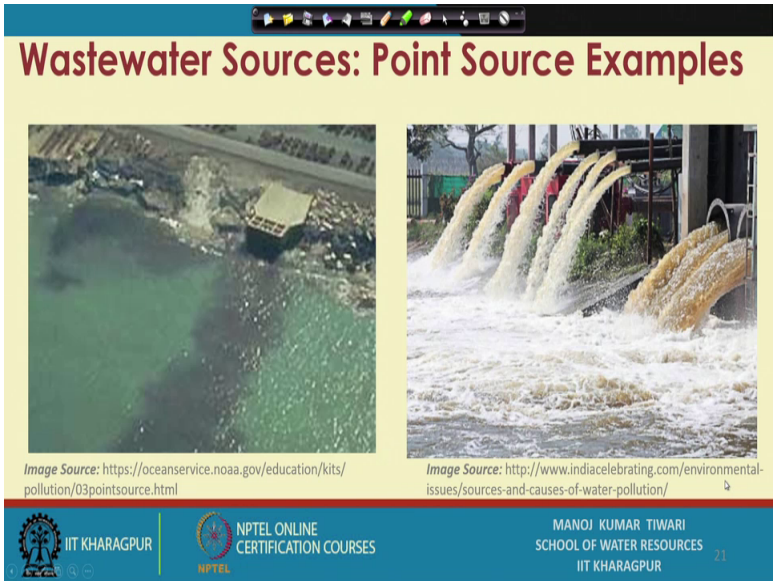

So, the couple of examples of point sources as you can see here. So, this is a very interesting image if you see. So, we can see there is a industry or factory or what is ever is over here. Which is leading to some discharge and generally the point source is discharged; it is because heavy pollution load is coming at a specific point.

So, the effect appears far more immediate that can be seen in the form of here. So, you can see that this discharge has made this patch of river dark and probably flowing over somewhere here also or that way. So, the quality of water even the visually can be seen poor in the near the point of discharge, because a large mass or a large flow is being discharged at one specific point ok. So, the lot of pollution is being introduced at one particular point and that leads to the change in the river water quality or the stream water quality or for that matter whatever source it is it maybe a lake it may be anything.

So, it can change the water quality in the vicinity to significant degrees. Generally the flows are collective and pretty large flows and when this kind of large flows appear or are discharge at one point. So, the impact or the effect on water quality is very significant in such cases.

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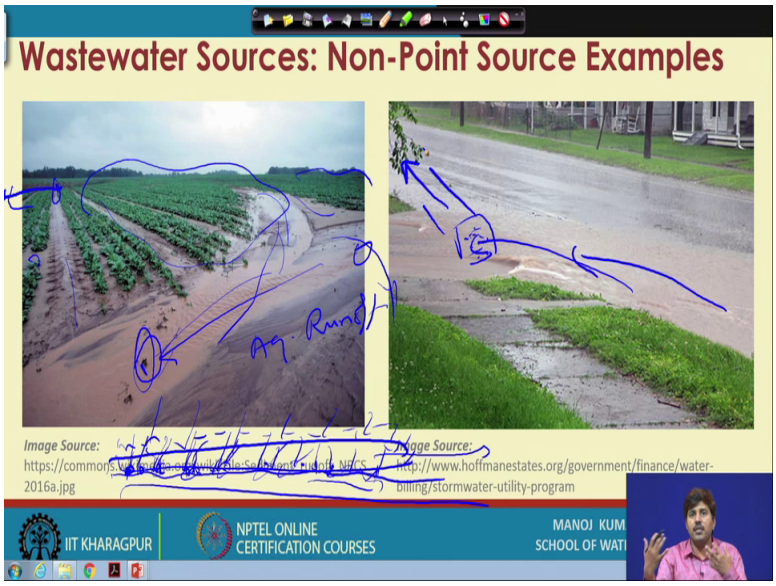

As opposes to this if we look for the nonpoint sources. So, in nonpoint sources we can see that the water which flows can flow actually from the different points. So, this is what you see here is an example of the agricultural runoff let us say. So, this is your agricultural runoff.

Now, here it is apparent that some water is coming from here, some water is coming from here, it is a large channel, but there would not be any like it is it will not be the only channel ok. The water which is falling on that side may be having another channel there might be another channel, which is coming here. So, there is possibility of like variety of channels.

And, if you want to monitor the let us say pollution level in this place So, where you are going to monitor here or here or here or here and these different sources could have the different levels also. This runoff may be coming from a larger fraction. So, the kind of pollution level or could be different this the point of some runoff coming from the other section the point of pollution level could be different in that one. So, there is a possibility of the different zones or different streams, have the different flow rates the quantity could also be different it is not it is highly unlikely that that if there are n number of different streams.

So, all that n number of different streams are going to have the same discharge ok. So, they are not; obviously, they are not. So, that way the quantity of from the different

streams is going to be the different, the characteristics of the different is stream is going to be the different and the introduction point from different stream is going to be the different.

So, if we let us say have a river over here, let us say this is our river boundary and we are having some agricultural activities across this zone when rainfall precipitation occurring. So, what we see that there is possibility some something is entering from here, something is entering from here, something is entering from here. So, we will; obviously, have the different channels which are entering into the river that way and their pollution, their load, their characteristic, their qualities all is different. And, since it is different and it is being introduced at various points until unless we make some arrangement and capture all these get a large mass.

Because, it otherwise treatment is not feasible at all, processing of this is not feasible at all, we will when we cannot captured these there as flow is very small the probably the level of pollution is also relatively small, because industry the point sources are generally the generally the traditional wastewater either coming from municipalities in the form of sewage wastewater or industrial wastewater. So, they are the processed water which are having for higher concentration as suppose to this which is just may have some naturally dissolved means the water which has come on to the field or in the urban sector for that matter.

So, will have be will be having some impurities some contaminants in it. So, the level of contaminants could be for smaller, the individual flowing these different channels could be for smaller; however, the collective flow could be significant. And, that is why it is very difficult to manage this, because of these small small places. How many places we can capture this we can monitor, this we can do the desired intervention that becomes practically too much cost intensive process and for that matter unfeasible economically.

So, in such cases the nonpoint pollution sources becomes very difficult, until unless we make appropriate arrangement to track that or to sort of trap it and put it into a channel, like the urban storm water drains.

So, the urban runoff or urban storm water is also a example of nonpoint sources, but what is done at many places the we have let us say the some opening over here. So, water enters in this one and then it flows through a channel. So, the different nonpoint

sources are collected at different locations, but then eventually they are put to a storm water channel and at the outlet we can get a good, we can get sort of collective storm water of the entire city and then that becomes a point source.

So, we can convert different nonpoint sources we mixing or putting together different nonpoint sources in a specific point source as well. So, that is also possibility and if we want to intervene, if you want to sort of improvise the characteristic of the nonpoint sources we have to do this, we have to have collect them, combine them, and put to a point source because then only it will be possible to conduct some sort of intervention.

So, we end this session here only and in the subsequent session of this week we will talk about the other aspects related to the wastewater issues and what are the various other aspects that we need to know when we are introducing the wastewater in general.

Thank you.