Water Quality Management Practices

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Week – 01
Lecture – 01

Hello everyone, welcome to the NPTEL online certification course on Water Quality Management Practices. My name is Gaurav, Gaurav Dharbhomik. I am a faculty in the Department of Agriculture and Food Engineering of Indian Institute of Technology, Kharagpur. In this particular course as you might have already know that we will be discussing majorly about the water qualities, the different quantitative measurement criteria's, how we can actually get to know about the water that is coming to your glass or the water that you are discarding out of your uses, what is the fate of those water that will be majorly discussing on. And that is a very important for all of us to understand this very basic concept about the fate of the water that is coming to your glass when you will be have drinking water or the water that is coming out of your houses or any other excretory purposes when you get in getting it out of your body ok. Other than that the industrial purposes also we normally use the water and that water what is the fate of that water that is already being that that is being used in the industry that is also something of our concern.

Every one of us actually should have some basic idea about this water and a wastewater quality parameters and their treatment parameters and what are the treatment plant design and all that will be majorly our major point of concern in this whole lecture series ok. Very good. So, we will in this particular introduction video or this introduction class I would say in the first lecture, we will be majorly covering the freshwater scarcity and the pollution at this current stage in the global scenario. The water demand and the crisis the stage that we are actually going through all over the world and the need of the wastewater treatment techniques or the systems urban water cycle, the water treatment and the sewage treatment what is the difference between this water treatment and sewage treatment I will be definitely going through all those things.

So, that you will be understanding in details that how water treatment is little bit different what to what is the wastewater treatment or the sewage treatment when it is concerned. The objectives of the sewage treatment and all these things ok. Other than that historical development is also something of our concern that we need to understand that how from the very early civilizations where people used to use different kind of sewage units and all and how they are actually treating those units ok. We will be discussing in details in a in a couple of minute. To start with you we all know that the water it is it is it is a in other words we can say it is a life right.

Because it naturally it is occurring it is naturally it is present in the system and present in the in our atmosphere in our like you know everywhere around us and it is one of the major reason why we can live happily and with our own regular all the cellular you know working the functionalities are actually happening in a very finite manner because of the presence of the water. So, the water it presents in the system in if you if you know about the hydrological cycle I think you all know about it in your school times we understand about this hydrological cycles where we know that the water which is present in the surface water body gets evaporated and also the water which is coming out of the plants by the process of transpiration along with this both the term evaporation and transpiration we call it evapotranspiration losses. So, this evapotranspiration loss or the evapotranspiration water it actually finally, form the it condensate and the form the cloud right. So, that cloud when it actually precipitated it actually form the either it when it precipitated on the high altitude on the ah the in the polar regions it form the ice and ice caps and the snow it may form the snows and whereas, this snow and this ice caps actually when it melts down and actually it forms the water which is going through the runoff procedure or the snow like surface runoff procedures or through the infiltration through the ground it comes to the surface water body again. So, this cycle is like you know it is a continuous continuous thing and that is what is running our beautiful earth ah in a way that we see now right now.

The fresh water scarcity ah if we talk about the fresh water scarcity we all know that what is happening in if we if I talk about the Indian context if you go to the Bangalore Chennai couple of years back also forget about couple of years even in a year back also we were facing a lot of issues in those places which is highly sophisticated and the metropolitan cities. However, the water is one of the fresh water is one of the major concern. It is I would say it is not only because of the natural phenomena, but also the anthropogenic activity like the human induced activities are one of the major reason of this fresh water ah I would say like the ground water depletion and the all the overall the fresh water scarcity that is happening all over the world. As of now there is a report in ah it it showcase that in June 2018 in India India record India actually faced one of the forced ah water crisis in its recorded history and it is projected to be almost twice as of twice of that in by the end of 2030. If you see in Indian context only ah almost 695 billion cubic meter of water is more or less available ah in for you know in in in right now in for daily uses.

However, the projected demand will be somewhere around 1180 billion cubic meter by the end of 2050 which is quite a lot and if you consider the world scenario the global scenario it can be as high as 6600 billion of billion met of cubic meter per year by by the end of 2050. So, countries like you know populated country I know you know that the India become the most populous country in the world right now and countries like this it actually has a very high water demand fresh water demand and that has to be fulfilled by

the government or the regulatory bodies and all they have to be you know very much concerned they have to be having some policies which are at place which can actually govern us and which can actually save us or actually provide us with the safe water waters and all. However in order to do so, we need to understand some techniques some engineering details and some science behind it that is what we are going to go through throughout this whole lecture series ok. So, ah what we need to do we need to find out either some alternate sources of water or the water that we are using we need to somehow treat it and use it back. So, we call it reusable water or the reused water right.

So, we all know about all these things. So, but we still want to know more in details about the quality that it requires to you know qualify in order for you to you know have it as a drinking water or any other portable or other say like you know agriculture purposes or the ah household purposes and all ok. So, what is the need of this wastewater treatment system to start with as I already discussed that the over exploitation of the by because of the anthropogenic activities are one of the major reason anthropogenic one of you know can you tell me what is the major anthropogenic activity that is actually responsible for the over exploitation of the groundwater? It is the agriculture. Agriculture only if you consider only in Indian context if most of the part of India they they they they take like enormous amount of groundwater for its agriculture purposes and all even like even still now. So, which is a major concern earlier days we talk about the groundwater depletion in centimeter scale, nowadays we talk about in feet scale.

So, just you can imagine that how ah drastic changes are happening and what is we need to actually act fast in order to safeguard us right. So, this over exploitation of groundwater it is actually ah depleting like anything and because of that we actually end up having like you know depending on the saline water supplies in some countries like in ah say like in any way if you go ahead with the Israel the example of Israel what they do they completely depending on saline water supply the sea water supply they what they doing they are doing the desalination they are having the desalination plant they are desalinize the water by incineration or by reverse osmosis process and then they take that water for their civilian purpose for the purpose of their ah that the countrymen and all ok. So, all these things are actually happening because because of that we need to have the wastewater treatment plant. So, just imagine if Israel case only if I give you one that example only if they the water that they are desalinating it from the sea water that is very costly for them isn't it because they need to use huge amount of energy for it. If they what they can do that water that they are using it after then if they can treat that water and reuse that water.

So, in that case their actual water requirement can be drastically reduced like you know I mean like actual water requirement that needs to be desalinated isn't it. So, this is where that wastewater treatment systems ah the importance are coming up ok. Then next to the

urban water supplies in most of the ah urban areas the it is it is majorly it is far from the surface water bodies. Even if it is say like surface water bodies if say like in general we normally try to have the civilized ah like civilization normally grows up right next to the river that is true, but in most of the cases that river water needs to be treated like anything in order for it to fade to the the the the country man or say like the people present in the city areas and all isn't it. So, all these things comes with the necessity of water treatment or the wastewater treatment ah concepts and all ok.

We will discuss about it in later in details this this fine difference between this water treatment and the wastewater treatment systems and the necessity of this of the both. Reusing water is becomes a paramount as I already discussed and unmanaged wastewater discharge which is very important. Because if you see the most of the municipality also in the industries even couple of years back also when the regulatory bodies are not ah like you know that much of concern and people were not even the scientist were asking people to be cautious from couple of decades. However people are recently only the all the regulatory bodies are actually becoming more concern and actually they are putting a very strong policies at placed with the help of the government of local government whether it be state or central. So, to implement those policies so that those industry and those municipality people they actually treat the wastewater before leave ah discharging it to the ah regular I mean like the surface water bodies isn't it.

So, it needs to be this reusing water and the unmanaged water the water discharge is one of the major concern that is happening nowadays. But still things are improving and we are very hopeful that after understanding after going through this lecture series you got to know some information you got to know some knowledge and you can build some knowledge in this particular regard that why it is so important and you can actually ah talk to your colleagues talk to your seniors talk to your junior or you know ah your like your neighbors and let them get them like you know educated about the necessity of this proper management of the wastewater that is being discharge from your household from your industry from your start up whatever you have it isn't it. So, this is very important and you all of us should be knowledgeable and well educated about this water we call it water education water educated people isn't it. And this proper treatment is also very important ah it actually ah proper treatment why it is important some country are quite stringent ok. Suppose in Indian context or say suppose in ah if I give you one example of say like one country in Africa say take like Zambia and one ah country in Europe say like Switzerland.

So, all these three countries suppose they all have their own regulatory bodies which are concerned about their pollutions water pollution say air pollution noise pollution whatever it is. So, first case Switzerland second case is say like India third case say like Zambia. In all these three cases do you think the regulatory bodies are strict about their

water quality ah I mean like as stricter than the others. In case of Switzerland the water quality the if you check the final water quality that is actually the has to be maintained by the ah the the municipal treatment unit or before throwing it to the water body or say like industrial bodies before throwing it to the surface water bodies are quite strong quite stringent then India and then comes Zambia. I mean like I am giving you just to give an example it may be not right in actual basis I am saying this it based on the country based on the sophisticated level sophistication level it is differ it is differ it is differing like anything.

However, it has it should not be it should be same it should be equal in any case any countries ah is concerned. However, things are starting in for the some countries. So, in that case they had to they have to be little bit less stringent in order for you know to still go ahead with the industries and all. Because if we all of a sudden you know go ahead with the very strong action with the huge penalty and all there is a chance most of the government ah institutes most of the government ah led industries in any of the countries may also falsify and at the end actually you have to close those things and it will drastically impact on your ah country as well. So, in general people go step by step is not it.

So, this is however, as a ah scientist as an water engineer I would suggest all of all of us has to maintain a certain category based on the ah the the the the based on the actual scientific with the with the help of the actual scientific research we need to maintain the water quality up to a certain level whether it be domestic water, waste water or it can be industrial waste water ok. So, urban water cycle we all know how this ah how this water and the waste water treatment scenario is coming up. You see the surface water body in the left side left more ah in the left more side if you can see the surface water body. Some of the water getting evaporated or evaporated if you remember some of them are going to the water treatment plant. First it is going to the water treatment plant from the surface water body.

In the water treatment plant the water is is being treated and then it is supplied to the cities and the industries. In the cities we are using it for our drinking purposes or any household purposes and all ok. After then we come out with some grey water. What is grey water? Grey water is nothing, but the water that we use in a daily household basis and other than the black water other than the black water means in the washroom. The washroom I mean like the in the latter in the water that we use that is the black water other than that all the household purposes whether it be kitchen, shower and all that is the grey water.

That grey water along with the black water which is going to the septic tank and the grey water goes to the ah the municipality waste water treatment line or the sewage line

we call it. So, it will go through the sewage line with the proper structuring that infrastructure is called sewerage and through this sewage or the waste water it is actually going to the waste water treatment plant as you can see with the blue line it is mentioned. Same with the industry whatever the water they use it some of them actually converted into polluted water because of some uses and all some chemical addition or ah physical impurities and all. This water this waste water it is been it should be treated. So, that is in general we call it effluent treatment plant ETP ok.

In case of cities we normally consider we will name it as a sewage treatment plant STP in case of industry we call it ETP ok effluent treatment plant ok. So, this STPs and ETPs in in general we consider say like ah waste water treatment plant. From this waste water treatment plant the treated water discharge again we it goes back to the surface water bodies and some of them it leaches through the soil and it reach it reserves it actually enriches the groundwater reserves isn't it. So, now, some of this water this waste water treatment plant water can be used for agriculture purposes as well. So, agriculture purposes water can be taken from the surface water body or from the treatment plant waste water treatment plant.

Some of this agriculture water will during the runoff or during the rainy season and what happen it goes through the surface runoff phenomena it goes at and in goes in contact with the surface water body again ok. Some of them loss ah we we consider is evapotranspiration loss we all know it right and a some portion of it actually leach and it will actually also ah enriches the groundwater reserves ok. So, in general if you see out of all this blue arrow lines those are the those are the those are showing the conventional systems conventional ah you know systems are the directions at which the water is moving from one place to another. However, our target should be the green ones. The green ones are the one that we actually should focus on that the waste water treatment plant whatever the water when it is been treated that water has to be supplied to the city back again has to be has to be put back to the industry I mean like some for their for some uses say like the cooling tower uses.

In the cooling tower uses in the industry it doesn't mean the fresh water you can simply supply the water which even it may have some amount of impurities isn't it. So, like likewise so, you can supply to the industry you can supply to the city you can supply to the agricultural purposes as well. So, based on the quality of the water that is after being treated that water quality also you need to understand we will discuss about it based on what we can say it is the water is polluted or not or semi polluted or little bit polluted or I mean like you know you will understand this vibe like which when it is considered as unpolluted when it is considered as polluted when we actually go through the water quality parameter analysis and all. You will actually understand based on the regulatory bodies norms and regulations that is provided for your individual country whatever country you are coming from ok. So, this is how the functionality the urban water cycle

is actually presents and our target is to focus on the green ones like we have to recharge the groundwater we have to reuse the cities in the industries and as well as in the agricultural purposes.

So, what is the basic distinguishing criteria of water treatment and the sewage treatment as I was telling you sewage is what the wastewater which is coming out of your cities say ok. So, in terms of purpose and scope water treatment it addresses the suitability of raw water for publicly water supply or the drinkable water or it can be uses for your showering purposes or cleaning purposes and all. What are the target contaminants in case of water treatment only the suspended solids, colloidal particles and the pathogens. Soluble impurities it normally it normally enables to remove the soluble impurities present in the water bodies and all. What is the soluble impurities here? Majorly the impurities which is actually in dissolved conditions isn't it.

In case of water quality objectives it our major target is to ensure that the water quality reaches to the standard of potable water quality. So, that you can actually drink it or you can actually use it for your household purposes. However, in case of sewage treatment if you see it majorly focuses on treating the wastewater coming from various sources city or the industries. Then it targets the reduction of the organic and the inorganic impurities pathogens and all the others. We will discuss about in next lecture that what are the different type of parameters at like you know or the contaminants that is present in the water bodies.

Then there comes the soluble impurities that is the major difference. In case of sewage treatment they can they have a biological treatment units. Other than that also they have some treatment units which has the capacity to reduce the soluble impurities present in the wastewater. However, in the water treatment water treatment plants majorly it does not have those things majorly, but you can actually implement it based on your the demand of the city, demand of your the based on your water quality that the quality of the water that is coming that you are actually taking the water from say suppose the surface water body, suppose the river or the lake from which you are actually taking the water. If the it does have the soluble water soluble contaminant in a higher amount.

So, definitely you need to go ahead with the that treatment process as well ok. So, in general I am talking about in general the soluble impurities present in the wastewater can be treated by using the sewage treatment plants ok. Water quality object is major target is to prevent the environmental contamination or the pollution why? Suppose the water which is coming out of your household if you are not treating it what will happen to that? That water will actually flow through the drain through the sewerage line or the we as a as I told as I told you sewer line or the sewerage system and at the end it will come in contact with the surface water body whether it be river, lake, say like sea, ocean anywhere. So, what what it will do? It actually contaminate that water ok. We will

discuss about the contaminant in coming lecture, but in general I hope you understand the difference between these two.

So, overall our objective is what? When we go for the sewage treatment. In this lecture series we will majorly be focusing on the sewage treatment systems. In the sewage treatment systems when we focus on that if you have any questions or any queries you can definitely ask me in a forum. We will discuss about it in how actually water treatment system also those same technologies can be used or some with some certain alterations and all ok. Our major target in case of sewage treatment is what? To ensure the safe collection, transportation and the effective sewage treatment to the required standard.

To prevent the treated sewage from posing health risk or causing the environmental harms. We have to also maintain the sanitary and environmental condition in the city to protect the public health and also to efficiently manage the liquid waste to prevent the mosquito breeding, fly habitats or the bacterial growth which will have to meet with the specific requirement for the sewage treatment. If you if you ask me for the historical development of different treatment plant ancient civilizations like in Mesopotamia and the Indus valley civilizations and also they have early sanitation systems. They have their own sewage systems it is well proved you know people have found archaeologist they have found different evidences on it. So, in in Minoan civilization in the ancient Greek they actually pioneered in this advanced sewer systems and all.

However, in the early sewer systems even in the say like 1000 years back also they majorly focused on the primary treatment. That means, the mainly say like the gravity settling. They have the certain reservoir like structure or like pond like structure, lagoon like structure they simply dumping the waste water from their city and let it settle a little bit after then after a while they take out the from the from the top of it they get which we call it supernatant. That supernatant water will they release it to the surface water bodies. In this early 20th century secondary treatment methods are started becoming blooming like anything.

In the secondary treatment systems majorly involving the biological treatment unit we will discuss about it what is primary treatment unit, what is secondary treatment unit, what is tertiary. In three stages we normally do the treatment. Primary treatment units majorly focusing on the in solid military focus on the inorganic constituents, majorly focusing on the grids, oils etcetera the major higher sized foreign particles. In case of secondary treatment units we majorly focus on the organic matter organic fraction of the waste water other than that some amount of inorganic pollutants can also be removed.

In the tertiary we go ahead with the fine tuning. In the fine tuning we normally do the nutrient removal, complete nutrient removal, pathogen removal. We go ahead with the

different kind of emerging contaminant removal that is been done in the tertiary treatment unit third one ok. So, the second one as I was discussing the secondary treatment units normally developed started developing in the early 20th century and their major target is to remove the soluble and the colloidal organic matter which is by the by means of organic fraction by means of biological treatment units. What is a biological treatment units? It is nothing, but suppose you are introducing your waste water there will be certain type of microorganisms already present in your tank. That microorganisms are hungry what they will do they will consume the pollutant present in your waste water and by this way they will consume the pollutant and they will grow in their biomass they will kind of they will conserve it as a in the form of energy as well as in the biomass converted into the biomass that biomass can be easily collected by sedimentation tank.

So, by this way what is happening at the end? This pollutant level goes down. So, suppose you have say 100 unit of pollutant I will not discuss about the what is the unit and all because you may get confused there are terms called COD, BODs and all TKN and all, but however we will start with say 100 unit ok, 100 unit of pollutant. So, after the biological treatment unit they consume say like another 90 of them. So, the effluent which is coming out of that tank biological treatment unit what will happen? It will only be having 10 unit of this pollutant so that means, your reactor your plant is 90 percent efficient. You are 90 percent efficient in treating that pollutant present in your waste water ok.

So, this is how the biological treatment systems starts coming up in the early 90th century. Then in the recently there are we understood that even the primary and the secondary treatment is not enough, majorly because of the presence of the pathogens and the majorly because of the presence of the nutrients. In order to remove those nutrients and to further remove those nutrients and to further remove those pathogens we need to go ahead with the second stage of last stage of treatment unit which we call the tertiary treatment units ok. In case of tertiary treatment units we majorly focusing on discharging ammonia, nitrate, phosphates, pathogens some emerging contaminants etcetera etcetera ok.

So, that is how it works in the treatment plants. In conclusion we discussed about the water which is the renewable resource definitely is it keeps on coming it has a cycle it maintains a cycle, it is completely up to us how we disrupt the system and it is completely up to us how we protect the system isn't it. So, our focus is to emphasizing and the need of the responsible use of water. Considering the water though there is like huge amount of water present in our earth in our ah mother earth. However, very few percentage of that available water is drinkable few percentage or the fresh water or what we call it. Nowadays this concept drinkable is changing because even with the sea water also we have the system which actually converts it into the potable water or the drinkable

water.

So, this drinking water is not anymore we call it we only call it fresh water that fresh water sources is also can be considered as contaminated and fresh like really fresh water which actually can be used for drinking purposes. Believe me this contaminated portion of the fresh water is accelerating like anything. We all should be you know knowledgeable enough we all should share this information and the knowledge to the neighbor to the people around surrounding to us that how important it is to preserve the water, how important it is to reuse the water, how important it is to treat the water that is coming out of your house, coming out of your apartment, coming out of your building or industries or the cities. So, this treatment is very much necessary. So, this is what we will be discussing for this whole series lecture series that how this treatment can be done, how we can treat that water which is coming out of the systems and all ok.

We also discuss about the global water demand which is increasing and also the challenges that is causing in the densely populated countries like India. We discussed about the alternative water sources are crucial due to fresh water scarcity and the pollution concerns and over exploitation of groundwater can impact the water quality and supply. It is not can out say like it is already doing it and we have to be very cautious about it and we have to act on it very fast. Urban water supply really needs a rigorous treatment of treatment to meet the portable water quality standards. Reusing water is very much important and we also discussed about how unmanaged water discharge, wastewater discharge can pollute the natural waterways and which necessiate and which is necessitating the proper treatment of this wastewater for further use.

And also we discussed about the how we can if we can promote a proper urban water management, it involves by treating the wastewater and maintaining the quality standard and we can easily feed that water back to the system again back to the units again whether it be city or the industries ok. I hope ah this is this is just a very introductory lecture way where we will be discussing about the overall way we just did the discussion about the overall scenario and we will be discussing more in details in the coming weeks and coming ah months. So, these are the references that I have taken you can take a snapshot of it or you can definitely go through this lecture series and those books which are very important for us to go ahead. So, thank you so much I hope you got to know some important information about the this water quality management practice subjects and it is I think a very good kick start and we will definitely learn together more in the coming weeks. Thank you so much. See you.