Wastewater Treatment and Recycling
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Lecture – 02
Sources and Types of Wastewater

Hello, everyone and welcome to this second lecture of course Wastewater Treatment and Recycling. So, we will be starting our formal discussions from this lecture and the first thing that we are going to discuss is about the sources and different types of wastewater.

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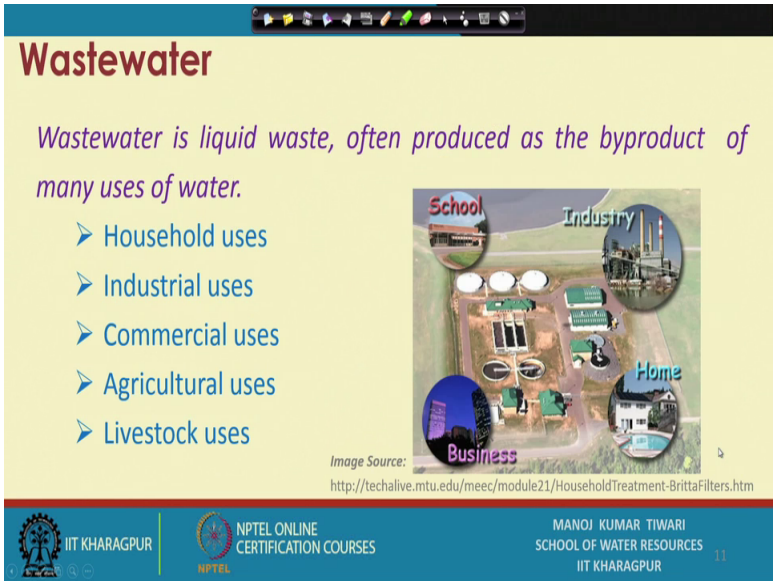

So, to start with the as we were talking in the previous lecture as well, the wastewater is essentially a water which has been used. So, it is a liquid waste which is often produced as the by-product of several uses of water, the uses could be anything, ok. The uses could be household uses, industrial uses, commercial uses, agricultural uses or livestock uses. So, from any of these uses or for that matter any other uses whatsoever water is produced or whatsoever processed water or after use whatsoever by-product in the form of used water is produced is typically referred as wastewater. There are several other terms which are often used for selectively for a specific type of wastewater so like the household water or the domestic wastewater is typically referred as sewage at times.

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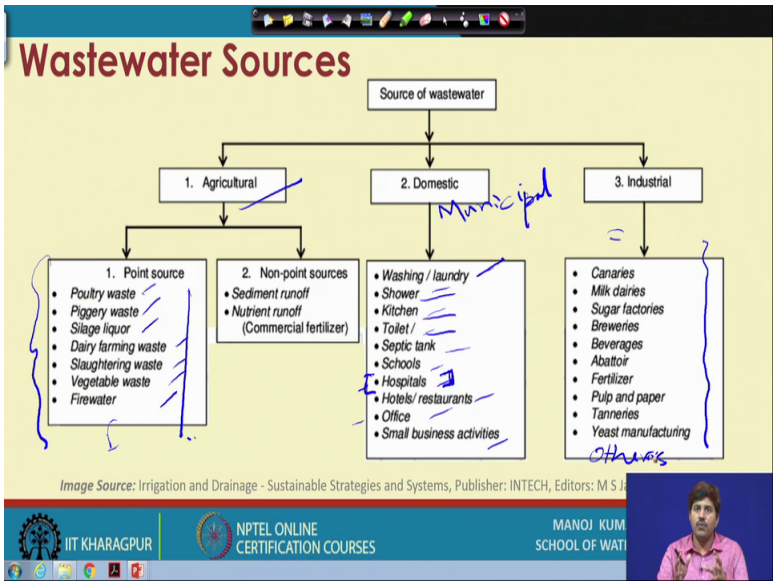

So, that way there are some nomination, some classification or different types of wastewater are there so we will be discussing all this. To begin with, if we look at what are the various sources of wastewater, so there are as we were seeing that from the region or zone where wastewater is produced we could have different type of contaminants entering into the water, different type of pollutants entering into the water which actually changes the characteristic the form of the by-product liquid waste which is being produced. So, that way the characteristic of wastewater to large scale depends on the its origin or the source from where it is generating.

Broadly, the wastewater sources are categorize into agricultural, domestic and industrial sector. There is another sector which few people considered is actually the storm water which is the just rainwater which is coming and falling on the surface and generating runoff. So, urban runoff or storm water that matters so that is also a type of or a source of wastewater which can be considered. Although normally storm water, there are two opinions of considering storm water as a wastewater or not because it is rain water directly. So, it is not been used or it is not that way have been utilized for any purpose, but when it falls on the surface it acquires some pollutants and the characteristic of water is not usable without adequate treatment for many purpose, ok.

So, that is why this also is a form of polluted water, storm water is also a not a pure water is storm water is also form of polluted water and needs treatment before it is processed or

used and that is why there are two opinion some because it has not been used so, it does not fit to the classic definition of wastewater. But since it is polluted so, many people club it as a type of wastewater and consider it together along with sewage at many points.

So, the three major classes which we are talking are actually the agricultural wastewater. The agricultural wastewater is the water which is originating from agricultural sources. Now, it is very common and I am sure all of us are aware with it that the agricultural applications of water are mainly in the form of irrigation. So, when we irrigate the fields or let us say the rainfall occurs on the agricultural fields and the huge or bulk amount of runoff which is generated is agricultural wastewater. So, either rainfall falling on to the agricultural field because that is also rainfall is or the precipitation or the water which is coming through rainfall in the agricultural field is also a kind of application because it is fulfilling the irrigation needs of the crop.

So, that is being used for irrigation, it is not that like in case of urban runoff where if water is falling and it is just going on to the plane or maybe at many times lined or unlined surfaces. So, there the water is not being utilized, here the water is serving a purpose of irrigation. Although, it is questionable that all of the water which is falling is not serving the same purpose, but in general water falling on agricultural field is sort of providing a service in the form of irrigating agricultural field or if it is, if the irrigation is being done by the other means so, by the canal water or pumped groundwater or by those means. So, the excess irrigation water or the excess water which is applied to the agricultural field comes in the form of agricultural runoff and that is the agricultural wastewater and that what we considered as a source of agricultural wastewater.

There could be another like if we expand the horizon of agricultural industry, if we consider agricultural industry just to this scale of cropping we are essentially talking about the runoff form. But if we expand the agricultural industry say considering the vegetable processing, slaughter slaughtering then dairy farming so, poultry all these things so, if we spend the horizon of agricultural sector so, then there could be different type of subtype of waste in the agricultural sector. Although, this may not essentially be considered as a agricultural waste and many sources many references will not consider this as a agricultural waste rather they consider this as a form of industrial waste because slaughter house is a industry, vegetable processing is a industry, poultry farming is a

industry, dairy farming is a industry. So, this can also be considered or many of this in fact, can also be considered as a component of the industrial wastewater.

So, that is one sector agricultural wastewater, then there is another type which is domestic wastewater. Now, domestic wastewater is the wastewater which is being generated out of domestic activities, ok. So, there is washing or laundry there is shower, kitchen, toilet, septic tanks are generally because domestic wastewater when we say is a broad term it is not necessarily limited to just household it is limited to the living area of a civilized population, ok. So, in that sense we have our hospitals, schools, hotel, restaurants, offices, small business activities, so all these takes place in a municipal area where people live, where people resides and all these are the places where some extent to some degree the water is being used and as a result the wastewater is being generated.

So, when we consider the domestic wastewater this is also referred as municipal wastewater. So, municipal wastewater, the municipal wastewater considers all the activity we generally takes place in a municipal territory. So, there would be of course, small business activities there will be shops, there will be restaurants, hotels, tea shops all those things will be there will be a few offices, there will be hospitals, although hospital again is a different type of setup, hospital waste generally is not recommended to be considered as a simple municipal waste because of its specific nature as it contains lot lots of toxicants.

However, all other form if you see the so, you have toilets, kitchen, shower laundry so, all these things are generated in a different activities to a household level and then from some small market place or a business activity areas. So, this is what is typically referred as municipal wastewater and then there we have industrial wastewater which again depend, there are variety of industries and these different industries utilize water in different processes, different approaches and the kind of contaminant they add to the water are of different nature.

So, depending on which industry or what type of industries we are considering we can have different characteristics of the wastewater. So, typically the wastewater generated from these industries these or other industries so, these are all other industries are generally referred as industrial wastewater. So, these are the three major sectors we have

agricultural wastewater, domestic wastewater and industrial wastewater we may considers storm water as one of the form of wastewater.

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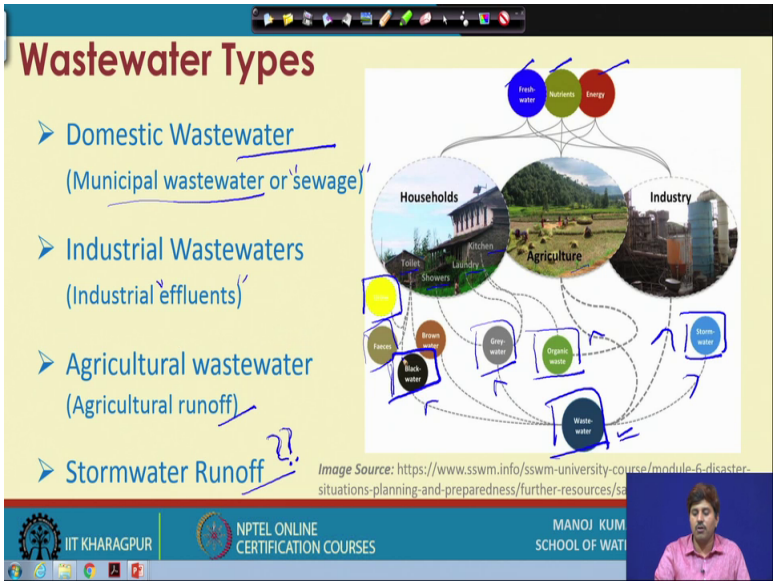

Now, so, based on all these if we specifically see the types of wastewater we have the domestic wastewater as one type which is also referred as municipal wastewater or sewage. So, when normally people use the sewage term the reference is for the municipal wastewater or domestic wastewater. So, that is one type of wastewater, the sewage or municipal wastewater.

Then, the industrial wastewaters or another common term given industrial effluents, ok so these effluents or industrial effluents are the another type of wastewater which are coming from the industries there are agricultural wastewater which is coming in the form of agricultural runoff and storm runoff also can be considered as a wastewater type. However, again it is not necessarily to be considered as a wastewater many people do not consider it as a form of wastewater, but generally while processing because if we see the municipal sewage treatment plants or the combined as we have at places combined STP.

So, combined STP essentially considers municipal sewage and storm water mix them and then treat them accordingly. So, in such system the storm water is also mixed with the municipal wastewater and it is collectively then referred as sewage or wastewater those type of systems do exist at some places, so that is why few sources consider this as a type of wastewater.

Now, if you see our social structure or our development structure so, we get the freshwater, nutrients, various resources and energy from the nature, ok. So, we take fresh nutrients or fresh materials from the nature, fresh water from the nature, then we utilized it for different purposes. In the households we utilize it for toilet, showers, laundry, kitchens; in agricultural we utilize it for irrigation; in industry we utilize it for irrigation processes and as a result we generate different type of waste.

So, there is a colour coding which is therefore, different type of waste depending on the level of pollution and that way. You see the water coming from the agricultural sector and kitchen sector is primarily containing organic waste, ok. So, can be considered as a green waste or the water comprising of the green waste and that is why it is colour coded as green many a times. The water which is coming from the kitchen laundry and showers are actually typically referred as grey water there are various other colour codings available but, generally this is considered as grey water.

The water coming from the toilets is normally considered as black water. Now, this black water many people sort of go for further segmentation. So, like the urines coming are considered as yellow water because of urea and all those things, whereas faeces are relatively the darker sides and in combination we normally considered this as a black water which is far more polluted in terms of organic load as suppose to the other this thing. So, we will discuss in detail about the characteristic of the different types of wastewater later, but as in general so, this thing and storm water which is actually the your rainwater, so that way it has not polluted directly, whatsoever pollution it is acquiring it is acquiring because it has fallen on to the surface.

So, that way we get the storm water also and when all these are combined what we get is wastewater, overall wastewater. So, these are the different components or different type of wastewater we have storm water, we have industrial wastewater, we have agricultural wastewater out of which organic is a component only. There could be other impurities coming in agricultural waste water primarily the physical impurities in the form of sediments and all those things. From domestic sector we have grey water and black water has two major constituents or two major components of the waste water and then there are again sub component of black water or sub component of the total household water or domestic wastewater can also be obtained. So, that way these different type of wastewater can be classified.

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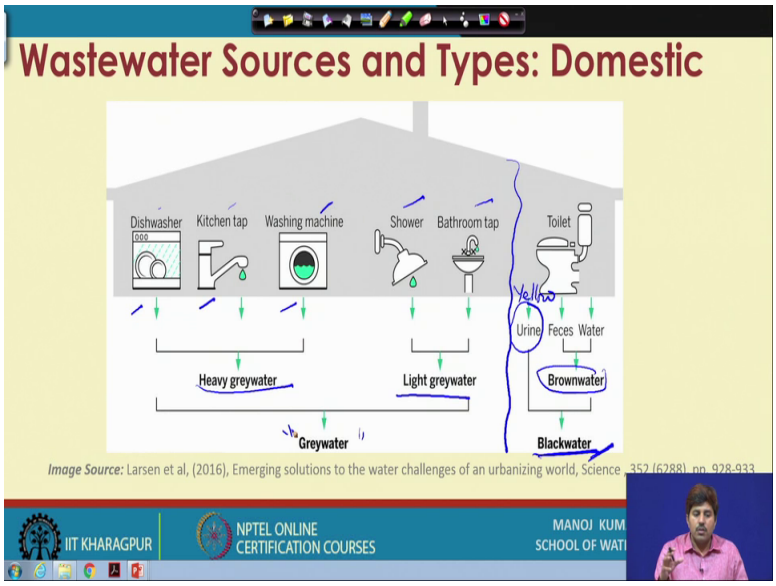

Now, if we see the wastewater sources and types from the domestic sector so what we were just discussing that we often have colour coding for such systems. Normally the water which is coming from the dishwasher, kitchen tap and washing machines are known as heavy grey water. Why it is heavy grey water? See the first thing is that your water apart from the toilets the domestic wastewater apart from the toilets are considered as a grey water from whichever source it is coming, ok.

While the water which is coming from the toilets are considered as a black water and as we were discussing the urine part may be considered as yellow water while faeces part or the flushed water part can be considered as a brown water and in collection of the yellow and brown water what we normally refer or what we consider as the black water. So, that is essential because it is the far more polluted and cannot be used for any purpose directly, ok. So, that is why we refer this as a black water. Black is a colour coding is a indication which tells the level of pollution and sort of because of the severe level of pollution in the form of pathogens, in the form of organic loads this is marked as a, this part or the toilet part of the water coming from the households or other sectors also are marked as a black water.

Now, coming to the other uses of the domestic wastewater what we see, we see that water is used in the bathroom taps, in the showers, in the washing machines, kitchen taps, dishwasher, again the water coming in the shower so, the shower water normally

what we do we may apply some soap while taking the shower, but that is very limited and then a lot of water flushes through the shower. So, the load of the pollution or added pollution in the form of soap or all that there is a just little soap nothing else as in there. So, that kind of water is actually your grey water or light grey water rather we can say that.

While the water coming from the bathroom taps is actually your also light grey water because when we wash hands and this things so, lot of water is flushed and not many added constituents or pollutants are added in that. So, the level of contamination is pretty light in the shower and bathroom taps and that is why it is called light grey water. The other part which is washing machine, kitchen tap and dishwasher they also does not have lot of harmful things. So, there would be some organic contamination let say in the kitchen tap that way coming, but your washing machines and dish washer primarily has some phosphate or soap or detergent kind of pollution which is far less as suppose to the black water, but higher as compared to your water coming from the shower or bathroom tap.

So, that is why this may be referred as heavy grey water. If we are going to that level of fractionation so, then this may be perceived on this may be considered as a heavy grey water; while the what we see in combination when we combine these heavy grey water and light grey water what we get is the total grey water. So, this classification of light grey water, heavy grey water, yellow water, brown water, black water, grey total grey water is based on the level of contamination or level of pollutions, ok.

So, you are light grey water is having the least level of pollution which is coming out of households, your heavy grey water is having relatively higher chemical load primarily and some organic load because we are using kitchen tap water as well not too much of microbial or pathogenic contaminations in your grey water. So, the pathogens if we measure or the microbial contamination if we measure in the grey water it is far less and that is why this is collectively considered as a grey water. While the black water has lot of pathogens in it a lot of microbial contamination coming in the faeces and that way the load of pollution in terms of organics or in terms of chemical or microbial impurities are higher in the black water.

So, this is the water which the different components of water which comes out of the domestic sector or domestic wastewater.

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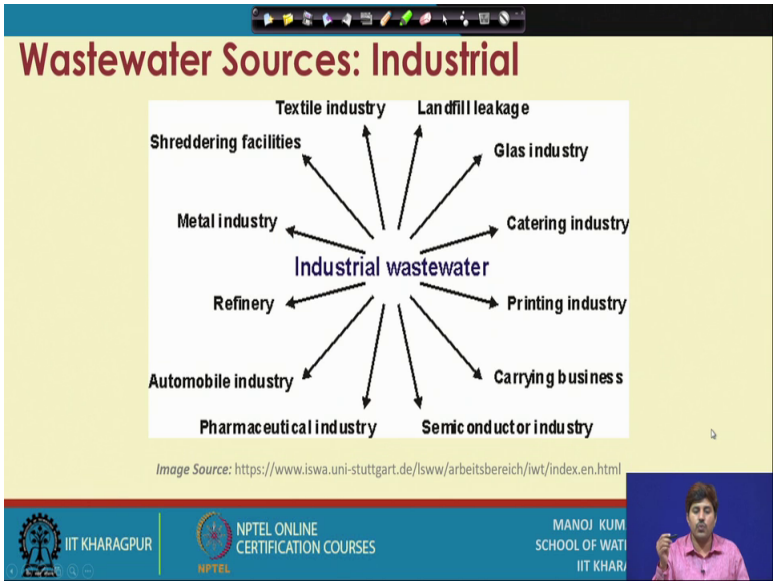

Then we have industrial wastewater. Industrial wastewater of course, will depend on the type of industry as we were discussing earlier also. So, we can have several type of industries there could be textile industries then gas industry, catering industry, printing industry, tanneries, pharmaceuticals, pesticides so, fertilizer industry, automobile industry no process or no growth or development process or even manufacturing process can be completed without having water at some point. Either for cleaning washing industrial is specific processes so, at some skill or some point the water is used and the used water that comes out in the form of wastewater or industrial effluent will have the characteristics according to the process for which it has been used.

So, these different industry may have different, may produce the waste water with different characteristics and it will the quantity of wastewater will also depend on the industry to industry, some industry are heavy water intensive industries, ok, while some industries the uses of water is relatively less. So, depending on which industry we are dealing with we will know what kind of or how much amount of waste can be generated and what could be the likely characteristics or likely level of pollution in that industrial waste.

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Then we have the agricultural sources of wastewater this is nothing, but the waste water which comes from the agricultural sector. Now, this primarily comes in the form of runoff as we discussed and if we expand the origin of the agricultural activity, it could be coming from some other sources processing, after processing sources as well.

So, agricultural wastewater primarily will be contaminated with what do you what one expects in agricultural waste water is the sediments because it is flowing of the agricultural fields particularly if we are talking about the runoff. So, since it is flowing of the agricultural fields it will bring lot of sediments, lot of soil materials soil particles along with it as you can see in the picture also over here. So, all these the dirty colour or the high degree of turbidity which can be seen is a essentially because of the heavy sediment loads.

So, the agricultural water that we will be rich in the sediments and the agrochemicals. So, agrochemicals, what type of agrochemicals are generally apply? We apply pesticides, we apply fertilizers to the agricultural field and when the our top soil or the water which is amalgamated which is mixing with the top soil is washing is flowing so, it does get some of those applied pesticides or fertilizers along with it. So, agricultural runoff is likely to be rich in fertilizers which is nitrogen, phosphorus potassium so, all these nutrients are supposed to be in higher level in agricultural runoff as suppose to the other form of wastewater which is being generated and the pesticides, ok.

So, variety of pesticides, herbicides, fungicides which are used on our soils can also be in for elevated concentrations in the agricultural source of the wastewater. So, these are the different sources and different types of wastewater what we normally encounter as a environmentalist or as a environmental engineer and when we talk about the treatment or recycling aspects we have to deal with such waters which are arising out of the different sources.

So, we will conclude this session here only and in next session we will consider some other aspects of the kind or the type of origin that water takes place when it comes into the nature so, in the form of a point and nonpoint sources. So, that will be discussing in the next lecture.

Thank you.