Wastewater Treatment and Recycling
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Lecture – 07
Quantity Estimation of Sewage

Hi everyone. In previous session we were discussing about the Quantity Estimation of Sewage. We will continue our discussion from there on. So, we were basically talking about, how the dry weather flow, what is the dry weather flow, and what are the different things that come under the dry weather flow, when in a case of let us say combined sewer or separate sewer networks.

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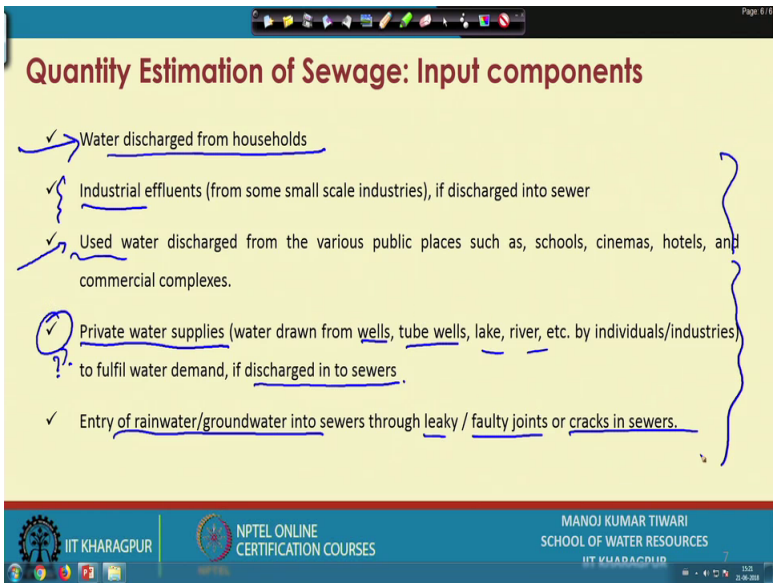

So, starting from there itself, we will talk about the input components of the sewage. So, when we need to estimate the quantity of sewage, we must realize; what are the various input components that come into the sewage.

So, if we see there are water discharge from the households, that is one of the most important and major component of the sewage. Particularly the municipal wastewater what we are talking, but we are referring as sewage. And, since the municipalities are responsible for managing this, so that is their prime attention area as well. Then there are industrial effluents if discharge into the sewer. Again the normal practice is that industries are supposed to manage their wastewater by themselves.

So, industries nowadays we like our government is more insisting onto the 0 discharge policy, we will talk about this 0 liquid discharge or ZLD concept in much more detail in the later stages. However, just briefly so, government wants that industries should treat their water and reuse or recycling recycle, it within their own premises.

So, no wastewater or no industrial effluents should be generated or should be sent outside the industries. However, there are many small scale industries, which are not able to afford the treatment facilities. Generally either legally or illegally discharge their effluents channelize their effluents into the sewer line itself.

So, if such industries are there many places municipalities allows it also for smaller industries based on certain charges. So, they will charge the industries and allow them to send the water into a sewer line that way. And, they then accordingly plan facilities, which can treat a combined municipal as well as industrial sewerage system.

So, some is some small scale industries that way release their effluent into t sewer line. So, if those kinds of industries are there and if those kind of industrial effluents are coming into the sewer so, they need to be accounted. So, that is another important component of the sewage.

Then we have used water from the various public health places; such as school, cinemas, hotels, commercial areas, recreational areas. So, all such public facilities many times even hospitals, platform, railway, bus stations. So, they also there also some water is consumed and accordingly the waste is generated and these wastes are also often are normally channelized to the sewerage system.

So, this is one of the another input to the sewage lines to the sewerage networks, where this water which is being discharged from all these public places comes into the sewer. So, this is another component. Now, all these the 3 components industrial effluent could be legal or could be illegal, but generally the water discharge from households or water which is discharged from public places are to be connected to the city sewer system. And, it is the responsibility of the state or of the municipality to ensure the proper sanitation or proper sewerage system for these constituents.

Now, in addition there are various private water supplies. Now, this also could be illegal because there is no estimation of such waters. So, if there are private water supplies

many individual or even industries draw water from wells, tube wells, lakes, rivers. So, if such waters are being drawn being used and after use obviously, they will also be of typically discharge to the sewer lines. Now, let us say I have one bungalow and then I put a submersible or I put a boring there in the bungalow, and I am withdrawing water as per my needs. So, the municipal supply or the tap apply, which is coming to my house it may be accounted maybe unaccounted, but there is a there is a perception that this is say 150 litres per capita per day and 30 litres per capita per day. So, there is a idea of how much water is being supplied.

Now, if the sewer considers that only that much amount of water is being generated as a wastewater or as a sewage from my house, it may actually be a grossly inaccurate estimate. There is a possibility that the person has a private boring and withdrawing lot of ground water through that boring using that and then again discharging to the sewer line.

So, this one of the very practical problems, and I am sure the viewers or most of you have seen that, that many individual many households have their own private water arrangements in the form of either well, tube well, hand pumps, submersible borings, and some small scale, or small colonies or an sort of the slum areas withdraw lot of water from the lakes, and rivers for utilizing at home or sort of that water needs there the water demands.

So, if such waters are there that is also going to be typically discharged to the sewer line and that makes one of the components of the sewage. Although, it is very difficult to estimate this, the amount of water which is typically generated from households based on the supplies can be estimated. People have an idea how much water is being supplied that way, can be meter also so that kind of estimates can be obtained. Then in the water from the recreational areas or the public places is also fairly easy to estimate the estimate of such waters can also be obtained.

The industries if it is legally permitted so the municipalities are the waterworks sewerage works has an idea of how much effluent industrial effluent is coming into the sewer line. So, that also to some scale can be quantified particularly, if it is legalized. However, this is very difficult, owing to the private water supplies who is using how much it is using it is their own so, resource. So, it becomes very difficult to precisely estimate how much

will be consumed in their. Then as we were discussing previous week, previous session also, there is possibility of entry of rainwater or ground water into sewer, if there is a leak or faulty joints or there is a cracks in the sewer line.

So, that is kind of error or unaccounted water, which is entering into the sewer line. So, these are the major constituents or major components, which come into the sewer line. This is apart from the storm water runoff if it is a combined system. If it is a combined system, then there is a obviously, storm water runoff will also come and by the flow by the value that is the highest quantity.

However, if we exclude that or let us say if you are talk about the separate sewer line system. So, separate sewer line systems are likely to have these constituents or these components coming in as a input into the sewer lines.

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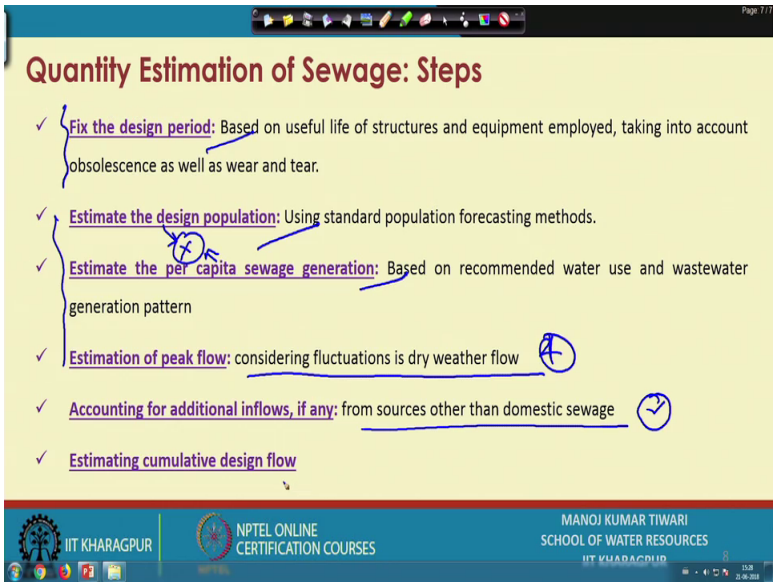

Now, if we talk about the quantity estimation of the sewage there are various steps that needs to be taken; how you are going to estimate the quantity? So, for the purpose first and foremost we need to fix the design period. Well, for estimation of the quantity if we want to estimate the quantity at any given particular point of time we do not need design period, but the idea of putting this design period over here is that, generally when we estimate the quantity of sewage or objective is to design a infrastructures sewerage network or sewer system.

So, with that idea if we intend to design a sewer system, if we intend to design a sewer network so then we obviously, will be designing it for a design period for a future age. So, for that purpose we need to fix the design period. So, for the design of sewerage system that becomes the first step that we fix the design period of the sewer network. Design period is means for how many years or system is going to work. So, or the expected life of the infrastructure, expected life of the system that we are going to install is actually it is design period.

Now, this design period is typically based on the useful life of this structures that we are going to create, the equipment that we are going to install and it take into the account the sort of natural wear and tear of the equipment's of the structures that is being created. So, design period can be based on that can be based on the political agendas also. So, all those criteria's are there to fix the design period.

For say, if we want to estimate the quantity of the sewage today we do not need a design period ok. Then for the estimation of the sewage we need the population. If, it is for today we can have an idea, if it is accounted population we can get the data from Sensex, but if we are going to plan or if you are going to install a system which is going to work let us say for 30 years 25 years. So, if you install a system in say 20 20 and the expected life period is for 25 years so that means, we need to know the population up till 45 ok. So, for that we need to use the standard population forecasting methods and get an idea of what is going to be the population at that point of time, because that becomes our design population based on the design period.

Thereafter, once would look for estimation of the per capita sewage generation ok. Now, this is based on the recommended water used and wastewater generation patterns ok. Our manual suggest certain values or certain approaches that can be adopted for the estimation of what is going to be the per capita, water consumption or per capita water demand and per capita sewage generation that way.

Then for the purpose of design, if we go for a design of network we need to estimate the peak flow as well. So, as we were discussing that there is fluctuations in the dry weather flow. So, we need to consider those fluctuation and we need to estimate what is going to be the peak flow, because, our system should be able to cater the sewage transport in the peak flow season. So, when the highest amount of sewage is being released or system

should be able to transport that sewage, our system should be able to carry that sewage. Otherwise, there will be overflow and there will be significant failures to the system.

Then, after these important steps there has to be accounting for additional flows and inflows ok. So, from sources other than the domestic sewage, if there is any inflow is coming, as we discussed in the previous slide that, there are many other like the private water supplies, then there are industrial flows could be possible some idea of the commercial residential flow. So, whatsoever additional flow or error or those kind of things should be considered ok. At times we need to basically if there are losses or if some of water is not being used, so there might be some substraction also ok.

So, that needs to be considered and then we can have a cumulative estimate of the total design flow of the sewage, because once we know that this is our design period, then this is our design population, this is the per capita sewage generation. So, we can get the sort of estimate of sewage by multiplying these two; multiplying design population with the per capita sewage. So, that will give us an idea of the sewage being produced, we can apply the peaking factors, we will talk about those factors later on. But we can apply those peaking factors and get idea of what is going to be the peak value of the flow. And, then we need to consider any additional inflows or any additional losses which is not reaching, it is not only for inclusive, it is even for losses as well.

So, we need to either add or substrate based on what kind of flows are there. And then, we can estimate the cumulative design flow by considering all these independent or all these components of the sewage.

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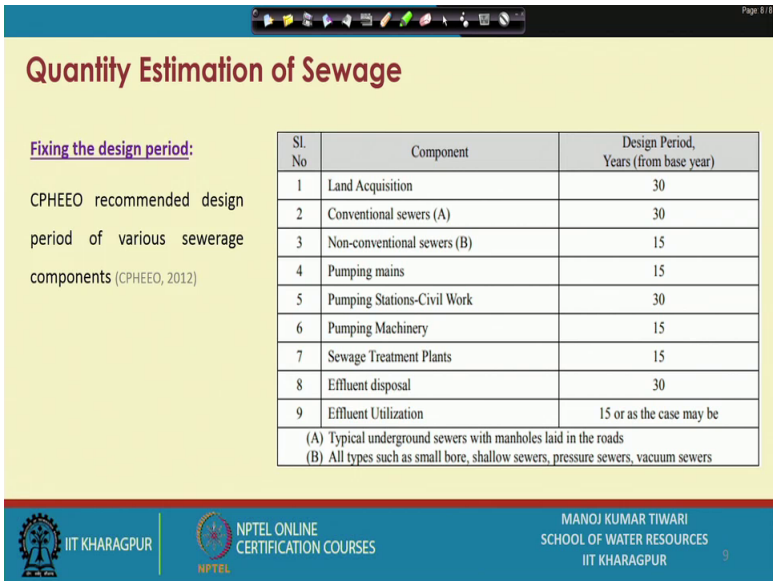

Now, how we fix the design period? Well as the design period for fixing the design period the CPHEEO manual recommends the period for various sewerage component. So, it is not necessarily that our entire sewage network will have the same design period ok.

Because, there are variety of components are installed, there are structural work which can have a different lifetime, there are pumping work, which can have a different lifetime, there is sort of pipelines, machinery, sewage treatment plants. So, they may have sort of the different life periods and accordingly the manual has given this idea of the design period in the years from the base year.

So, like land acquisition typically could last for 30 or higher years ok. Then conventional sewers typically have 30 years design period non-conventional sewer have 15 years, your pumping means 15 years, pumping station or civil work will have obviously, will have civil structures will have higher lifetime. So, they can be designed for 30 years.

The machinery is the treatment plants the mechanical equipment's the pumps can be considered for 15 year period. And, then subsequently could be augmented to meet the total design period if it is a higher ok. The disposal systems, again is largely based on the civil works. So, that can also be of for the 30 year design period. And, the effluent utilization maybe for 15 years or as the case may be. So, that can be even for lower period as well.

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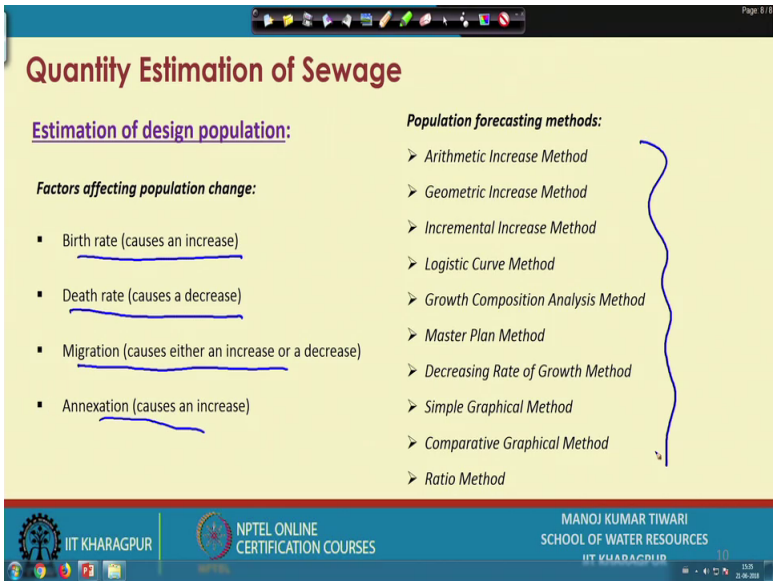

Now, so, after the knowing design period, one needs to know the design population. So, the design populations there are variety of methods to forecast the design population, the population obviously, depends on the birth rate which causes as increase in the population. So, the rate at which the population is increasing typically; then there is a death rate which cause a decrease to the population. So, when people die there is certain death rate that let us say 1 or 2 people are dying out of 1000 people in a fixed amount of time that way. So, we can get an idea of death rate, we can get an idea of birth rate, then there is a possibility of migration which can cause either increase or a decrease.

So, if people are migrating in to the territory or the area that we have considered it is population is likely to increase. And, if people are migrating out of the territory of the area it is population is going to decrease. So, there is a possibility of either increase or decrease due to migration, but generally when we plan an new city or plan an new town and we are let us say planning a sewerage system or this kind of network over there. So obviously, more and more people come into the city. So, that migration also often will give increase to the population. But again by concept if people are migrating out of the city or out of the zone, so there is a possibility of decrease in the population.

And then there is a annexation. So, this is again, because many times what we see that when there is the capacity of city is almost about to exhaust so, newer areas are added ok. This is a very common, we saw then there was Bombay city, then it has got expended

lot many areas are annex to it we have Navi Mumbai, similarly new town in the Kolkata, in NCR we have annexed this Gurgaon, Noida, Ghaziabad and even is likely to increase to the Meerut. So, all major cities; take any big city example and you will see that lot new areas are being annexed ok. Because city is expending so, when city expends it acquire more and more areas. So, when it acquire more areas it acquire more population also. So, overall there is this causes as an increase in the population ok. So, that is another point annexation.

So, these are the major factors that affect the population changes. Of course, there are many other factors in which could lead to any of these ok. There are job opportunities health conditions, living conditions, the facilities, but these small small factors leads to any of these, if there are not proper health conditions you will see that higher death rates, we will see that people migrating out of that reason. If you see that a well facilitated city you will see lot many people coming in migrating into their ok. So, all those various another sub factors or smaller factors lead to any of these bigger factors.

Then for the purpose of forecasting population there are variety of methods ok. There is a arithmetic increase method, geometric increase method, incremental increase method. So, these are some of the more popular methods. And, then there are variety of other methods including logistic growth or growth composition analysis method, then decreasing rate of growth methods, simple or comparative graphical method, ratio method, master plan method.

So, there are various methods various approaches which can be used for forecasting population. And, population forecasting is one of the very important step for design of water supply or sewerage network. Not only for sewer, but for water supply network as well, because for this kind of facilities, we need these are designed for a significant futuristic period as we were discussing earlier as well.

So, since we are designing it for future period and we are designing it for the residents for the population for the inhabitants of that reason. So, we must get an idea of what is going to be the population in that period. And, for the purpose we have to forecast the population, because there is no way we can correctly know future population for a city or a for a town.

So, if we cannot get the correct data directly we need to forecast that, we need to estimate that value or the of the future population and for that these are the several methods which are typically used.

So, we will be discussing these methods one by one in the next session.

Thank you.