Water Supply Engineering
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Lecture - 23
Water Quality Parameters

Welcome back Friends. We will continue our discussion from the earlier class of the week. In the earlier class, we started discussing about the water quality aspects and we did talk about various sources of the pollutant in the water and why it is important to remove pollutants from water before it is sent to the end consumers. What kind of effect these can lead in terms of chronic or acute effects on the consumers and how the consumer may get exposed to these pollutants.

Now, in this class, we will be focussing on the assessment of water quality and how we can basically say certain water is of good quality or bad quality using the water quality parameters.

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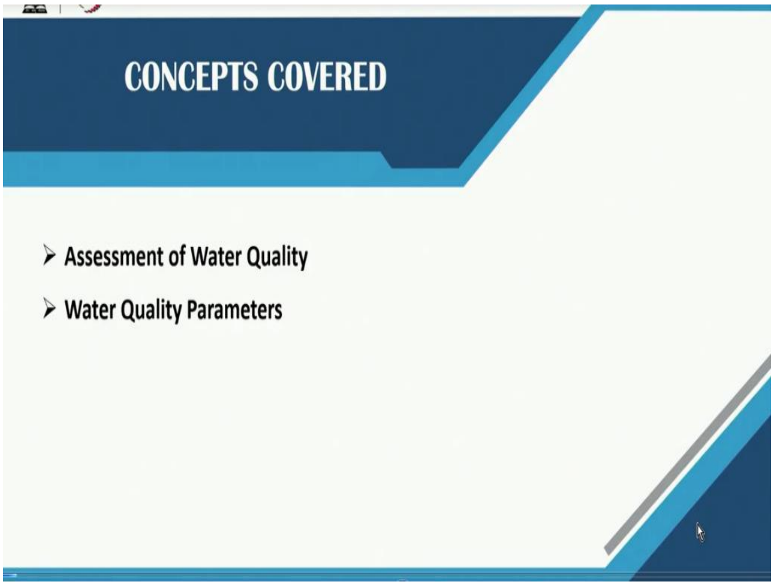

So, practically we will be discussing about different water quality parameters in this week.

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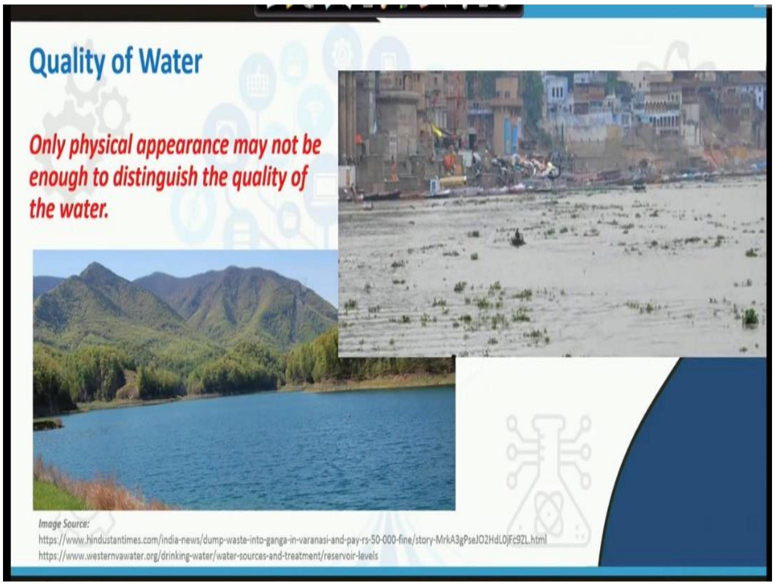

Now, these are the same images which were displayed in the earlier class as well. So, we see that there are two sources of water here. In the earlier class we say that the, two sources of water here kind of give an idea that the quality of water is different in these 2 sources. That is ok the quality of water may be different, but which one has better quality and which one has poor quality? Apparently, like just by seeing one will say that certain water looks dirty or more turbid but is that enough, to suggest that it is of bad quality water than this?

Who knows that this may have certain contaminants which are far more toxic than this water because this apparently what we are able to see, is the sediments, the turbidity and the filterable material which may be rather like easily removed whereas this may have contaminants; say may have some pesticides or antibiotics or some other kind of contaminants which will not impart any colour, taste or odour but may be far more dangerous than the contaminants present in these water.

So, the point here is, only the physical appearance may not be sufficient to distinguish the quality of water. Just by appearance, if a source is looking very clean, that does not mean that the quality of water is a good source. It may be good but it may have certain contaminants which is undesirable; undesirable in the sense that it may be toxic, it may be like harmful to the consumers but it is apparently not giving any colour, taste or odour or its not changing any physical attribute of water.

So, the contaminant, which does not change any physical attribute of the water, is hard to detect by just physical appearance because it is not changing anything in water which can be physically detected. So if the nature of the contaminant is such it is not possible to detect that contaminant just by observing the water. In any case, even if you say this is practically looking the water which is having a lot of contaminants or turbidity or floating materials.

But how we say that what is the quality of the source, how we signify that; just by seeing we can say water looks dirty but dirty means what? Dirty is just a kind of qualitative assessment- it is dirtier as approached to this one. But what is the characteristic of this water so because we cannot distinguish just by the physical appearance; we have to go for the assessment of water quality through certain parameters.

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And these parameters are called water quality parameters which typically show the physical, chemical and biological properties of the water. So the characterization of water is typically done in terms of these water quality parameters which eventually will show that value of these parameters in the water and which will help quantitively estimate the characteristic of water and not just qualitatively not just good, better, bad or doesn't look good kind of observations but to be precisely.

If we say this water is contaminated we can be quantitatively tell what is the level of contamination in this water. Say for example, if wea re seeing this water is coloured, what is the relative value of the colour? If this water is turbid what is the value of turbidity? If the water has solids or suspended solids what is the amount of suspended solids present in the water? Similarly, there are different sets of parameters: physical, chemical and biological properties are assessed through these parameters, there is no specified list of water quality parameters.

We may have n number of parameters there are several parameters; the parameters essentially test the quality of water or the level of pollutants present in the water. Now there are more than 80,000 chemicals registered and all of them somehow or other way may enter the water. At least majority of them may be present in water at some place or some stages, so they might be detected so that the detection of one chemical may become actually a parameter.

There is no specified list of water quality parameters but there are certain common water quality parameters which are more popular or which are more frequently used so these different parameters include like temperature, colour or odour, turbidity, conductivity, electrical conductivity, solids or different kinds of solids then various chemical parameters like pH, acidity, hardness, nutrients, metals, pesticides, radioactive emissions, dissolved oxygen, PUDCOD and various other trace elements.

Some biological parameters like most probable number, total and fecal colliform so these are some of the parameters which are estimated for getting an idea of what is the level of contamination present in the water.

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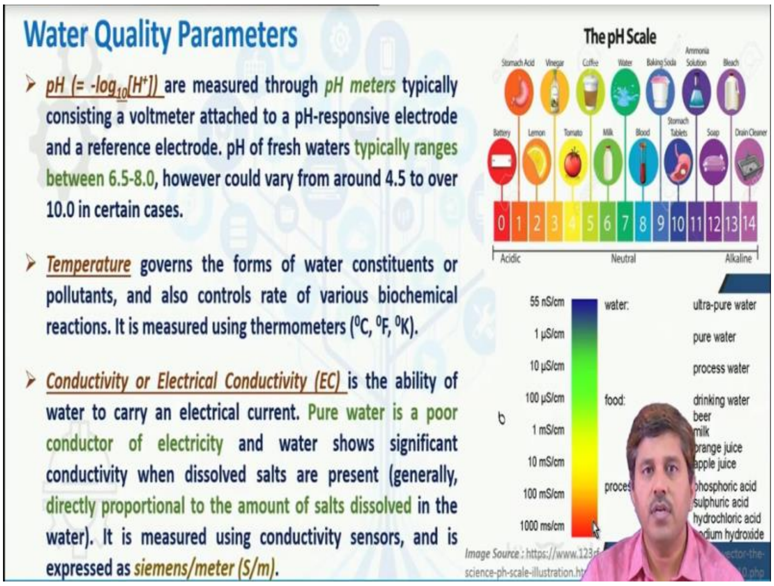

The parameters that we listed, we will be discussing some of the parameters which are more important like pH is generally well known to everyone, it is -log $_{10}$ H^+(hydrogen ion concentration) is measured typically through pH meter which consists of voltammeter which is attached to pH electro response electrode and the reference electrode. pH of fresh water is typically in the range of 7, pH of water is in the range of 7 and if we move below 7 we get the acidic characteristic and if you go higher than the 7 we actually face the basic characteristic.

Water up to pH 6.5 to 8 range might also be considered okay. It may vary in some cases like from 4.5 even to over 10 in certain cases, pH of water may vary depending on the source of water. If some pH of water is basically flowing through the limestone region it requires **(8:14 speech not clear)** more and the pH becomes high. Similarly, if water is flowing through acid, mines, drainage they may have a low pH even lower to 4.5 also possibility.

So that way, pH kind of decides what is the acidity or alkanility in the water, so its not just the pH decides that but it gives an basic idea whether the characteristic of water is acidic or alkaline. Then the temperature which basically governs the form of the constituents or pollutants present in the water, there are many constituents which are like if the temperature of water rises below certain limit it gets evaporated or there are certain bio- chemical reactions which are controlled by the temperature.

So the rate of biochemical reactions may also be controlled by basically the prevailing temperature of the water. The temperature of water is typically measured using thermometers it can be reported as degree Celsius, degree Fahrenheit or degree Kelvin. Then the conductivity or electrical conductivity is a parameter which basically talks about the ability of water to carry in electric current. Now, pure water is a very poor conductor of electricity, pure water cannot conduct electricity so the water if it is showing significant conductivity that means it is having some dissolved salts because water has to have ions to carry the charge.

So the salts when dissolved in water they get ionised and these ions are able to carry the charge. If there are substantial conductivity or significant conductivity in the water, that means there are presence of the dissolved salts which are able to carry the electricity. Generally, over most ranges particularly the lower, the conductivity is directly proportional to the number of salts dissolved in water.

The conductivity is typically measured using conductivity sensor within 1cm it says that basically how the current is passed through the so what is resistance or conductance it is offering and it is typically reported as Siemens/meter (S/m) or Siemens/cm (S/cm) it may be in a micro Siemens as well or milli Siemens as well in time. So if you see the conductivity of ultra pure water is very low of the order of 55 nano Siemens/cm.

Then pure water will have conductivity less than 1µS/cm, the process water typically has 10µS/cm, drinking water may have conductivity of the order of 100µS/cm because we do not drink distilled water, we do not drink pure or ultra pure water. We want to drink water which has certain minerals in it so, the drinking water may have and in fact should have certain conductivity it shouldn't be completely of **(not audible 11:24)** conductivity .

And then there are basically the milk have a conductivity in the range of 1mS and juices in higher range then the acids and these things the conductivity is even more higher. So that way we can actually have an idea of the characteristic of the water by measuring conductivity and conductivity as we said that is generally proportional to the level of dissolved salts present in the water so conductivity is taken as indirect measurement for various other parameters which includes the total dissolved solids.

Because it is proportional to dissolved salts so that we can have indirect assessment of total dissolved solids using conductivity or salinity. Salinity can also be measured using conductivity which is a form of the dissolved salts so this salinity or TDS can also be measured through the electrical conductivity

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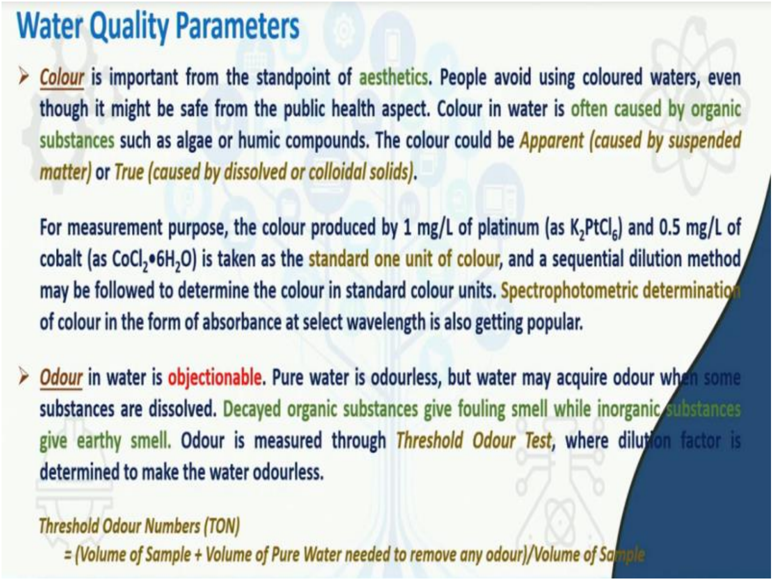

or generally the conductivity meter having conductivity probes in other mode they will be able to give the direct value of TDS or salinity. Then the colour and odour are other couple of parameters which are important more from the standpoint of aesthetics, both are objectionable in water particularly for drinking purpose so no one wants to have a colour or odour from the drinking water.

People avoid using colour water even if it is safe from the public health aspect.
Colour is generally caused by the organic substance such as algae or humic compounds.
The colour typically could be of two types: One is called True colour – which is caused by dissolved or colloidal solids present in the water. If a you take a pinch of dye and put in water, it gets coloured.

Now you keep that water for a day, couple of days, 7 days a week or even a higher time you will not see that the colour of water is changing. It is still coloured water because it is due to the compounds which are already dissolved in the water or in some cases even in the colloidal stages; because colloidals are also typically not removed just by statically holding the water.

However, there are other types of colours which are called apparent colour primarily because of suspended solids or suspended matters so its not the colour of water but colour of suspended matters and as the suspended matters settle down, the colour of water will get removed. This kind of colour is called apparent colour, it is not a true colour of water. It is just apparently visible because the suspended matters which is there which is coloured.

So once the suspended matter settles or filtered out, we see the water coming actually colourless. So these two types of colour are there for measurement purpose is measured on the colour unit and the standard colour unit is made by dissolving 1mg/litre of platinum and 0.5 mg/litre of cobalt, if we dissolve this, if make a solution say having 1mg of platinum and 0.5 mg of cobalt and dissolved these two in 1L of water, the colour of that water is considered as 1 unit of colour.

And then through sequential dilution if we have water, coloured water and we want to measure the colour in that so lets say this is our sample we will dilute the sample say 100 times, so we have a 100x dilution and then match its colour with the standard unit we see still darker, again dilute it 10 times then we match we see still darker and again dilute it 5 times we see that now it is getting close but still far of, again diluting 2 times and then we see that now it is more or less matching with this.

Therefore, the unit of colour in the standard unit is because we had a 100x dilution then 10x, 5x, and 2 x dilutions, we have to multiply all these so 5x2x10x100 = 10000 so the colour is actually 10,000 standard units of colour. So, that way we can determine the colour. That’s a old traditional method. Now a days, the Spectrophotometric determination of colour is also getting more popular in fact.

Where the colour is determined through Spectrophotometer, and it is represented at specific wavelength i.e. select wavelength and we can have absorbance value as λ400nm, so at λ400nm what is the value of colour , what is the value of absorbance at λ400nm or we can have say absorbance at λ400nm and this represents the colour at 400nm .The odour in water is also objectionable. Pure water is again odourless, but it may acquire odour through substances which are dissolved.

Generally decayed organic substances give fouling smell whereas inorganic substances give earthy smell. And Odour also be measured through Threshold Odour Test where the dilution factor is determined to make the water odourless. So, again it’s a kind of a similar approach we have lets say sample which is, V_A volume of a sample and then we add, this is having certain odour so we want to add keep on adding pure odourless water in this and until and unless it becomes odourless.

Let us say we require VW volume of pure water in order to make this odourless.
SO the total Volume becomes: VA + VW (volume of water needed to remove the odour)

$$\frac{V_A + V_W}{V_A}$$

gives us the Threshold Odour Number (TON) this is used to determine the odour of samples.

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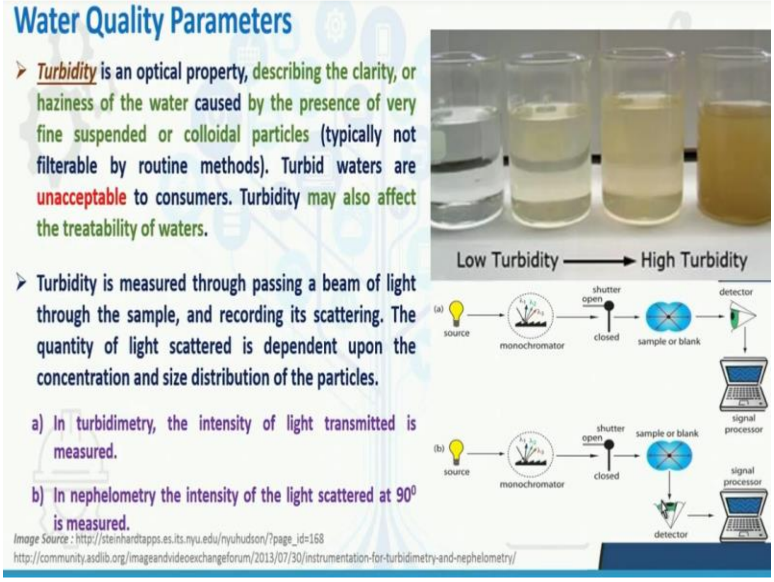

Now, the other parameter is Turbidity. Turbidity is again an optical property, it describes the clarity or haziness of the water. Simply, like if we pass a light through a water if it is clear water, light will easily pass through but if its having lot of suspended or colloidal materials, light does not pass through when we strike those particles get scattered. The more scattering means more turbidity and less scattering means less turbidity.

We can see that basically the water which looks clear will have low turbidity and water which looks quite dark or dirty will have the high turbidity. So when we move towards from low and high turbidity we will get to know how the level of clarity is reducing and the level of haziness is increasing in the water. Turbid waters are also unacceptable to consumers and turbidity may also affect **(speech not clear 19:10)** of water which will be discussing later because when there are suspended materials present and for certain cases let’s say, If you want to put a UV light disinfectant and those kind of thing, the turbidity may stop the path of light, the light may not heat the intended target or bacteria and those kind of thing so that way may create a problem in the treatment process as well. Turbidity is measured by basically passing a light beam; a light beam is passed through monochromator and then it actually goes to the sample so then once it goes through the sample part of light can actually transmit.

If we detect the light which is transmitted, then also we can determine the value of turbidity and this principle is called Turbidimetry where we basically detect the light which is transmitted through the water but whereas this is no more used in fact. The popular one which is used these days is the one which detects the scattered light and not the transmitted light, so same principle is followed and the detector is the right angle of the sample

so that the light scattered at the 90^0 or right angle is measured and detected and then we get the value of turbidity. This principle is called Nephelometry. Nephelometry is the one which is used for measuring turbidity these days and as a result the unit of turbidity is NTU which is Nephelometry Turbidity Unit. So this is about turbidity.

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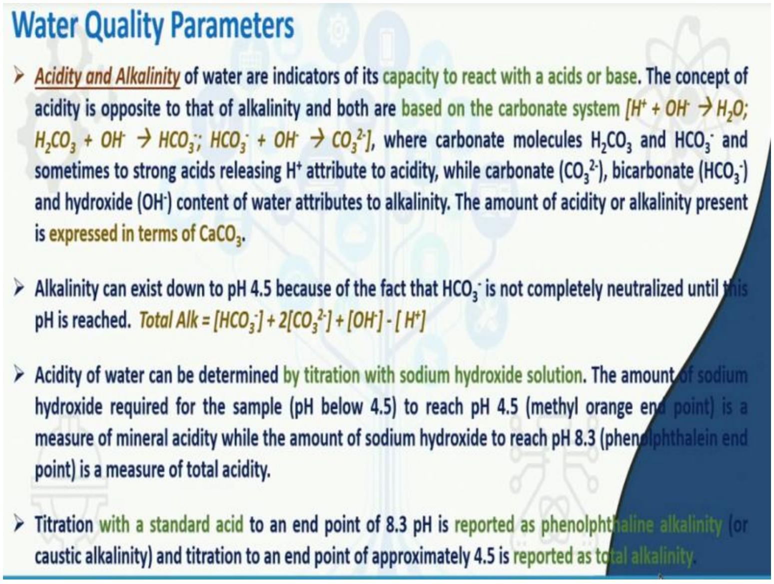

The next important parameter are Acidity and Alkalinity. Now acidity and alkalinity of water indicates the capacity to react with acids or bases. Acidity will be basically capacity to react with the base and the capacity of alkaline reacts with acids. The concept is basically concept of acidity is opposite of alkalinity. However, both are based on carbonate systems. In water we have basically we may have molecules form we may have a chain forming H_2O

and we may have H_2CO_3 + OH -> HCO_3 , HCO^{-}_3 + OH -> CO_3^{2-} . So, we may have different forms of carbonate present in the water. Now where the carbonate molecules which is H_2CO_3 and HCO^{-}_3 also sometimes H^+ ion attributes to the acidity while Carbonate (CO_3^{-2}), Bicarbonate (HCO^{-}_3) or Hydroxide (OH^-) contains this attribute alkalinity. That means if water is having H_2CO_3 , HCO^{-}_3 and H^+ in the predominant form you will see

that its more acidic whereas if the bicarbonate and carbonate or hydroxides are in the dominant form then we will see that it has more alkaline water. The alkalinity can exists down to pH 4.5, generally people say that the water above 7 is alkaline but that is not totally true because if we determining the alkalinity can be low as much as 4.5 because HCO^{-}_3 cannot be completely neutralized before this pH.

So, Total alkalinity will be HCO_3 + $2CO_3^{-2}$ + OH – H^+. This is what it gives the total alkalinity. The acidity in the water is determined by titration through Sodium Hydroxide solution whereas the acidity can be determined by titrating a standard acid and we can use 4.5 and 8.3 as an indicator or end points in both the cases. So the amount of the base of Sodium Hydroxide required to neutralise the sample means if the pH of sample below 4.5 we titrate it to reach to 4.5 which is basically methyl orange end point.

It is measured as a mineral acidity while the amount of Sodium Hydroxide to reach the pH 8.3 is known as the total acidity. Similarly, if the pH of water is higher than 8.3, so we bring down to 8.3 which is reported as phenolphthalein alkalinity and or caustic alkalinity and then we titrate it to 4.5 in order to get the total alkalinity. So for pH lets say if we are having water of pH 7.5 that means it is not having any caustic alkalinity it can only have total alkalinity, When we titrate it to bring it down to 4.5.

But if we are having water of pH 9, so then we bring this 9 to 8.3 , pH 9 to pH 8.3 this portion reflects to caustic alkalinity and then we bring again back to the pH 4.5 so the total combining caustic alkalinity this combine will give the total alkalinity. Similarly, for samples pH above 4.5, there is no mineral acidity but if the pH is less than 4.5, the amount needed to neutralize or to reach till 4.5 will give us the mineral acidity and when we titrate it back to 8.3 we get total acidity.

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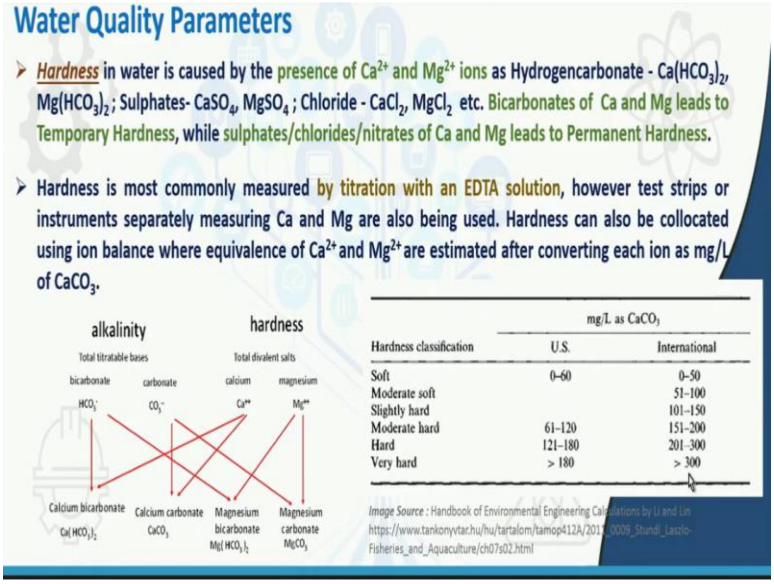

Then there are hardness, hardness is basically caused by the presence of calcium and magnesium ions. If the ions present as bicarbonates we call that temporary hardness. If they are present the Sulphate, Chloride Nitrates we call that permanent hardness. Hardness is commonly measured by titration with EDTA solution but there are test strips and other things available and depending on the value of hardness there are standards which can be adopted for calling that water as soft.

So like International standard is 0 to 50 hardness less than 50mg/L as $CaCo_3$ is called soft water. Up to 100 it is moderately soft. Up to 150 it is slightly hard. 150 to 200 is moderate hard and greater than 200 is hard and greater than 300 is very hard. U.S standards up to 60 they consider soft 61 to 120 they considered as moderate hard. 120 to 180 considered hard and above 180 considered water as very hard. That's about the hardness.

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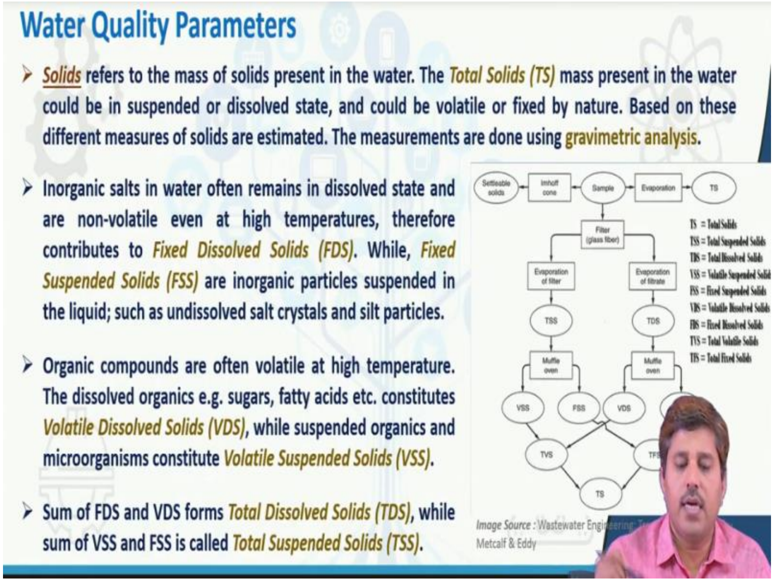

Then there are solids present in the water. Solids actually could be of many types. The total solids present in the water is the mass of all the forms of solids present in the water. Now the total solids can be either in suspended or dissolved state or could be in the volatile and fixed in nature. Generally the measurement is through gravimetric method means we filter the samples so if you are having a water sample we filter it with glass fibre filter paper and

Then the amount retained on the filter is the total suspended solids and amount which has passed through filter is the total dissolved solids then we put these in the oven muffle furnace which is heated at 550^0 Celsius. After filtration we keep it in the oven at 104 or close to 100^0 Celsius 100 200^0 celsius and this we keep for about 24 hours and then after heating we cool it to room temperature.

And then measured in order to get the total suspended solids and dissolved solids whereas we keep the sample is kept again in the furnace and heat it for 20 mins in the furnace so that all the solids which can vaporize generally the organic materials will escape and whatever is left is the fixed part. So the amount which has escaped is basically the volatile part if we see the weight difference between here and here the difference part is the volatile part because it has escaped the system but the residue left over is the fixed part similarly for the dissolved solids also, we get the volatile dissolved solids and fixed dissolved solids.

Now we can sum up the dissolved suspended parts and we can get the total fixed solids and total volatile solids so we can get the total solids. Generally, the inorganic salts often remain in the dissolved state and are non-volatile at temperature, so they form the fixed dissolved solids and fixed suspended solids if there are particles like such as salt, sand, clay and those kind of a thing they will be fixed suspended solids, if there are particles found such silt, sand, clay as fixed suspended solids.

Whereas organic compounds are volatile at high temperature so the organics which are dissolved in water like sugar, fatty acids constitutes the volatile dissolved solids while organics which are suspended like microorganisms or suspended organic matter they will form the volatile suspended solids. Summation of fixed dissolved solids and volatile dissolved solids will give us the total dissolved solids and volatile suspended solids and fixed suspended solids give us the total suspended solids. That way we can determine the types of solids present in water.

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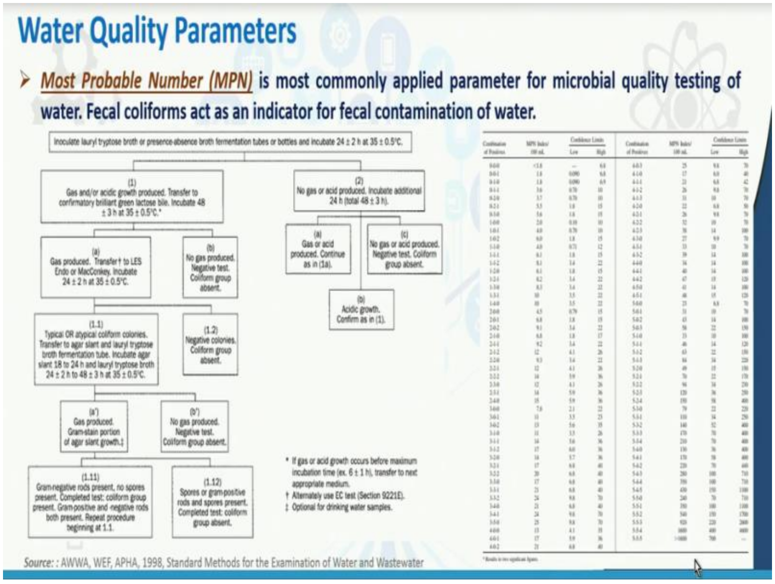

Now, one of the most important water quality parameter is the microwave count because as when we will be discussing the treatment part will talk about it. But generally even if you are not able to provide treatment for any other thing its the microorganisms or a biological pollutants which gives the acute effect. So nobody wants to drink water which is contaminated microbially because that will give an acute effect so that has to be removed and how much whether the water is microbially contaminated or not is tested through these tests.

So, MPN is one of the popular or commonly applied tests for testing the microbial quality of water. The fecal colliform is taken as an indicator for fecal contamination of water. There is typical procedure given in the American water works association manual or American public health association manual that is what typically followed. So there would be basically, samples taken in a series of test tubes and various replicates of test tubes are prepared.

In these test tubes in fact there is basically a sample is taken and we may add nutrient broth so that if any contamination if any microbial contamination is there in the tube, it can actually grow. In the tube again we add a small inverted tube which are known as dorong tube and then we basically plug or with a cotton and other thing, incubate it for 24 hours and then after 24 hours we see if the solution is filled basically up to here.

If the water will be there in the dorong tubes also now if there are microbial contaminants present so when they will respirate they will produce gas because this is a inverted tube, so gas cannot escape and we will see the gas bubble trapping in here. So the gas bubble trapping in here is considered as a positive test and if we don't see any gas bubble in the dorong tubes we consider that as a negative test.

So, positive test means there are microbes present and negative test means there are no microbes present. Now we prepare 3 replicates of the different dilutions and then we count number of positives. For say we get different dilutions means one set we prepare of 3 test tubes as it is no dilution, another we prepare with 10 dilution i.e. 10x and 1x or no dilution dilution and one set again we prepare with 100 times dilutions which is 100x.

So we monitor number of positive in these 3 depending on any such set 2positive here, 4positive here, No positive here that way. And then correspondingly we can get the MPN number and its confidence limit. Thats how basically we report MPN. MPN stands for Most Probable Number and it does not mean that if say value of MPN its typically reported as numbers per 100ml. For say if we report MPN of water sample as say, 20/100 ml. this does not mean that there are 20 microorganisms;

This means the probability of having 20 microorganisms is the highest to probability of having any other number. Remember MPN stands for Most Probable Number it does not state that actual measurement of the microorganisms. Its just measurement of the probable number. It says that probability of having 20 is highest a supposed to any other unit and this is how it is reported generally the numbers per 100 ml is the unit for MPN typically conventional unit for MPN.

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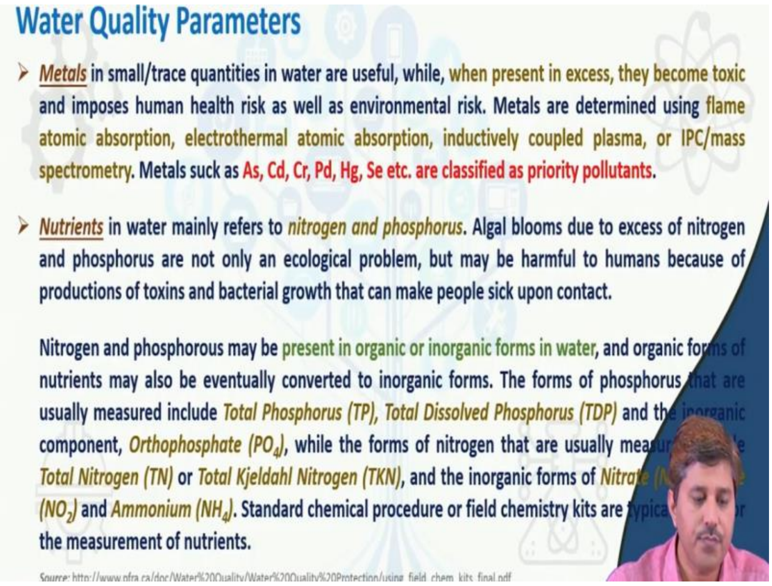

Then there are metals present in the water. These metals some metals are actually useful even though when they are present in excess they become toxic like fluoride is useful to certain extant but higher concentration of fluoride is toxic same is with other various minerals but then the higher concentration of these becomes a problem. The metals are typically detected using atomic absorption, spectrophotometer, electro chemical atomic absorption, inductive coupled plasma equipments IPC/mass spectrometry are also used.

And certain metals like arsenic, cadmium, chromium, lead, mercury, selenium etc. are classified as priority pollutants as well. Water may have nutrients as well which is nitrogen and phosphorus particularly. There are again environmental and health issues of this. Environmental issues of the nutrients are more prominent because they lead to eutrophication or algal bloom whereas these due to algal bloom imparts some toxins into the water which can basically be a health risk basically for human as well if we come into the contact of these kinds of water.

These are generally present in both organic and inorganic forms and organic forms can eventually be converted to inorganic forms. There are different forms of nitrogen and phosphorus which are measured so we may have Total Phosphorus or Total dissolved

Phosphorus or Orthophosphate as the form of phosphorus or Total Nitrogen or Total Kjeldahl Nitrogen (TKN) or Nitrate Nitrite Ammonium forms of the nitrogen. So there are standard chemical procedures or field laboratory kits are available in measuring these nutrients in water.

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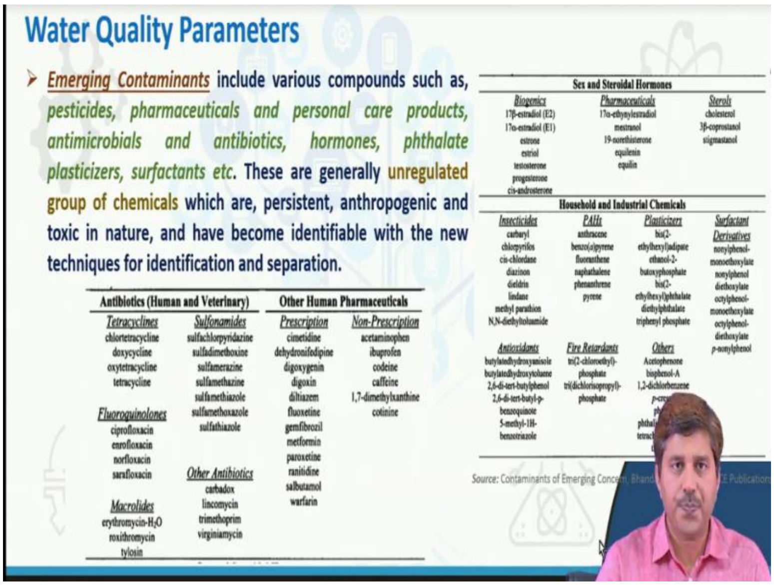

Then there are emerging contaminants which include variety of compounds such as pesticides, pharmaceuticals, personal care products, then other antimicrobials and antibiotics, hormones, surfactants, variety of compounds are considered. These are the non-traditional contaminants which are refereed as emerging contaminants. These are generally unregulated at most places while some countries are coming up with regulation for controlling these emerging contaminants as well but at many places there are still unregulated.

This is a typical list of contaminants like antibiotics, other pharmaceuticals, steroidal hormones, typical household and chemical industries including insecticides, antioxidants, fire retardants, plasticizers, surfactant derivatives. These are also a form of contaminants and can be measured.

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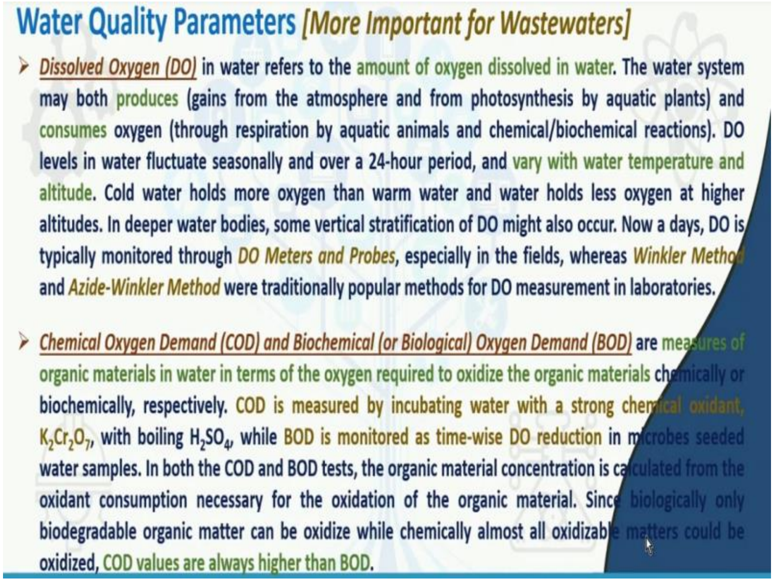

Lastly, will talk about a couple of parameters which are not that important for water supply prospective but more important from the waste water point of view. These are dissolved oxygens which is basically referred to the amount of oxygen dissolved in the water. Water can both produce and consume the oxygen it can produce by the gain from the atmosphere through atmospheric exchange with a layer and it can also gain from photosynthesis by the aquatic plants

Whereas it can consume oxygen in the process of respiration by the aquatic animals and the various reactions which may consume oxygen. So the DO level in water fluctuates, not only fluctuates seasonally fluctuate 24 period as well. Photosynthesis rates are different, so we get, no photosynthesis in the night, highest photosynthesis in the day time. So if you go for measurement of dissolved oxygen in the water body in the afternoons is likely to get more DO as a positive if you measure the same water body in the night.

Also, it varies with the water temperature and altitude, so the cold water holds more oxygen than warm water. As the temperature increases the oxygen kind of do not retain in the water will escape in the atmosphere. Similarly, water at basically higher altitudes will hold less oxygen as suppose to the one that are lower altitudes. So in deep water bodies, basically the water bodies are shallow not much vertical stratification and the oxygen level varies basically. Along with the length of the river but in the deep water bodies we may have vertical stratification in DO as well.

DO is typically measured through DO meters and probes whereas traditionally the Winkler method or Azide Winkler method has been popular method to measure DO in the labs. There are COD and BOD which are Chemical Oxygen Demand and Biological Oxygen Demand or Biochemical Oxygen Demand. Both are measures of organic matter in the water and they do report in terms of oxygen required to oxidize the organic matter.

COD reports the oxygen requirement for oxidizing it chemically whereas BOD reports oxygen requirement for oxidizing biologically or biochemically. So COD is typically measured by incubating water with strong chemical oxidant generally potassium dichromate is used K2CR2O7and it is done in a acidic medium which is basically H_2SO_4 and it is incubated at higher temperature generally boiling temperature 150 degrees is used whereas BOD is monitored as time wise DO reduction in the microbial seeded water samples.

So, we may have water samples if it containing any organic carbon we seed it with micro organisms so that the process of decomposition of organic carbon, the DO level will reduce so we measure the initial DO level and after certain time. Generally, BOD is measured after 5 days so say after 5 days how much oxygen level has reduced is reported as BOD 5. There are other different forms also of BOD requirement for carbonadoes material as CBOD, for nitrogenous material basically for oxidation of nitrogen is required is called as NBOD.

So we may have CBOD and NBOD type that is more prevalent to water systems so will not basically having more discussion on that here but just to give an idea that these are also different important water quality parameters but more important for waste water purposes. As both measures the indirect measurement of organic material but COD measures chemically with a strong oxygen which is oxidized almost all oxidizable. BOD measures the approximate amount of organic matter which can be oxidized biologically.

Biologically only biodegradable organic matter can be oxidized so BOD is actually assessment for the biodegradable component of organic matter whereas COD is assessment for almost all the organic matter present in the matter or all the oxidizable matter present in the water which can be chemically oxidized also. So that’s why the COD values are typically higher than the BOD values.

Because whatever is microbially oxidizable that can also be chemically oxidized so the BOD component is already there in COD. In addition, those cannot be oxidized biologically so non biodegradable compounds which can be oxidized using dichromate are also included in the COD so we get higher COD values than the BOD usually. There are another such parameters TOC Total Organic Carbon which is well co-related to COD because that’s also an approximation of the organic carbon.

Apart from that there are other compounds such as various ions, sulphate those things also. So they have their kind of own implication in the water they also needs to be monitored. As we discussed that actually if we talk about water quality parameter the list is quite extensive. It is not just limited to few; so there are much more water quality parameters, but these were the major ones which we discussed.

So, we will conclude this lecture here and in the next class we will focus on the treatment aspects like why we need treatment and the basic philosophy approach of the treatment is adopted to the municipal water supply system.

See you in the next class. Thank You for Joining!