Chemical Process Utilities
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Lecture - 17
Water Quality standards-I

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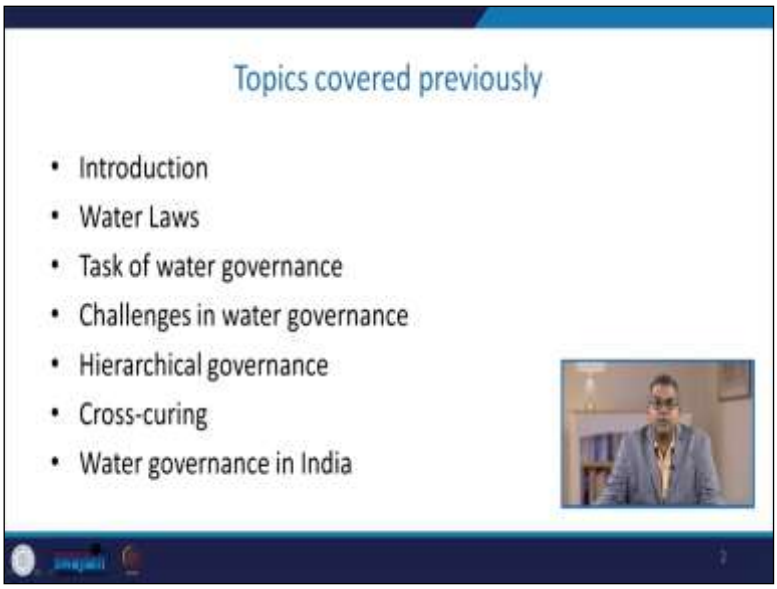

Welcome to the water quality standards under the edges of chemical process utilities. Now before we go into detail in the previous lecture, we have discussed about the various water laws we discussed about the task of water governance. We discussed about the various challenges attributed to the water governance. We have gone through the concept of hierarchical governance discussed about the cross curing and different aspects of water governance in Indian scenario.

In this particular lecture we are going to discuss about the various water properties quality parameters for drinking water.

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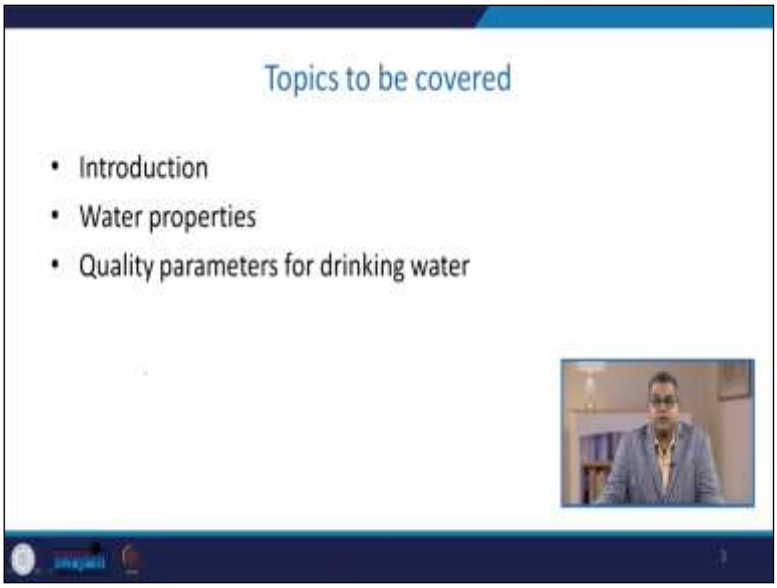

When we talk about the use of water either for human consumption may be that, for drinking water, maybe for day-to-day affairs, even for housekeeping, or we talk about the water requirement for the various manufacturing sector. We need to look that what kind of basic properties we are looking in water. Like, suppose we are talking about water for human consumption. Then definitely the water should be odour free or odourless it should be colour free.

In case it has any kind of coloring compound or in case of any odors. Then definitely, the human perception says this water is not useful for human consumption, especially for drinking purposes. Similarly if we use for any kind of household activities then again there are certain criteria through which we need to fulfill before we use for those particular aspect. Similarly if there is the water is being used for various manufacturing sectors to overcome the various process complexities we the water must possess certain properties.

When we talk about all these properties, there must be a certain categorization of all these properties than when we discussed these different types of properties. Then there must be certain quality parameters. When we talk about the properties and the quality parameters, there must be a certain optimum level. Now beyond the optimum level if we go. Then definitely the cost of that particular water will go on the higher side.

So, all these aspects we are going to cover in this particular lecture. When we discuss the various salient features of water, water is an ideal solvent due to its unique physical and chemical properties. It allows almost all kinds of chemicals to get dissolved into it. Now if a chemical is invisible then it can sometimes form a suspension or colloidal solution in water and turbidity may form. Now water can dissolve both polar as well as nonpolar solutes. Also, it is easily available and cheaper than any other solvent, and the supply of water is in abundance.

The uniqueness of this particular water or compound these enhance its use in different sectors as well as increase its susceptibility to get polluted because it is been universally available. So, any process can make it polluted. Now in one case it is unreplaceable compound of life while in other it can be home for several life-threatening microorganisms and chemicals it is a universal fact. Pure water does not exist naturally neither it is good for consumption it is just like it must possess certain kind of a mineral over it.

So, it is just like you cannot take distilled water for human consumption. Our body continuously requires some essential minerals from water to work properly.

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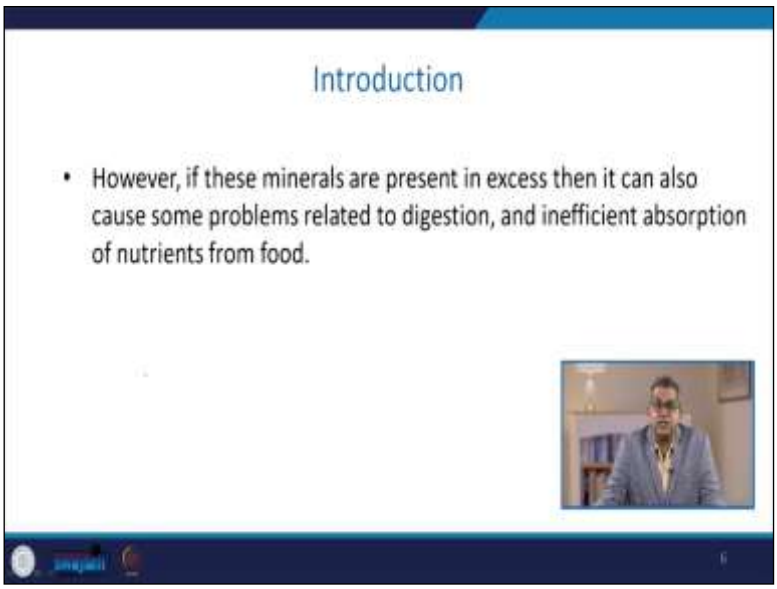

However, if these minerals are present in excess, it can also cause some problems related to digestion and the efficient absorption of nutrients from food. So, you must have an optimum level for the various kinds of minerals.

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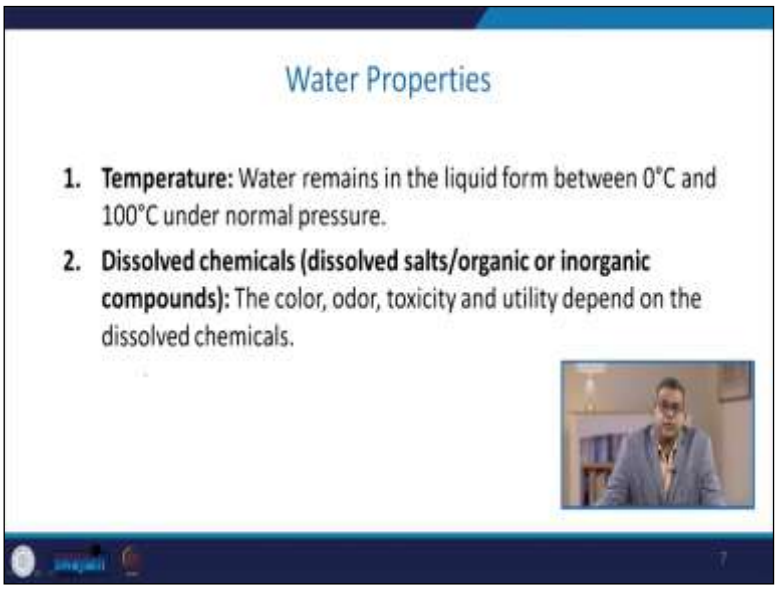

Now let us talk about the water properties and there are certain basic properties which we need to address while having this particular concept into consideration now one is that temperature. Now as we see that in the science world, we are all aware that water remains in liquid form from 0 degrees Celsius to 100 degrees Celsius under normal pressure, then dissolved chemicals or dissolved salts organic or inorganic compound. So, the color, odor toxicity, and utility depend on dissolved chemicals.

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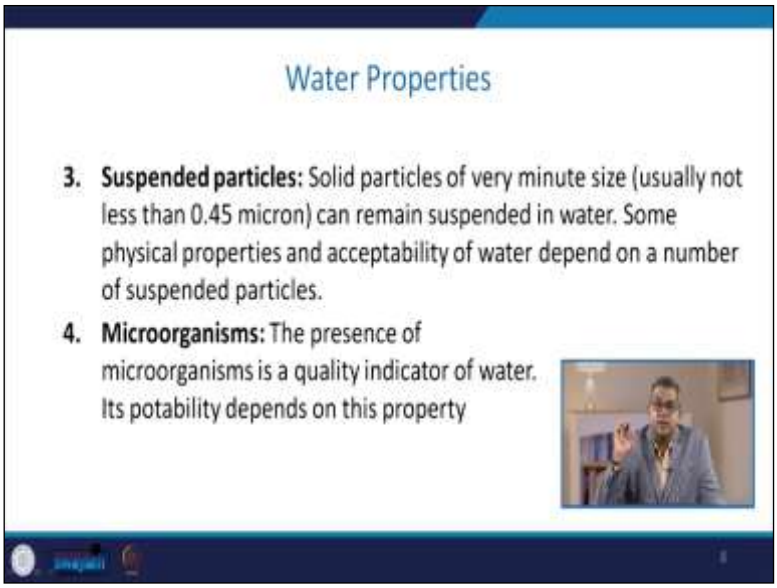

Another important thing is the suspended particles. Now solid particle of very minute size usually not less than 0.45 micron can remain suspended in water and some physical properties and acceptability of water depends on number of suspended particles. So, sometimes they may cause turbidity, and if it is the target, the perception says that we cannot use that water for our day-to-day affairs.

Then micro organism the presence of microorganisms is a quality indicator of water, and its portability depends on this particular property.

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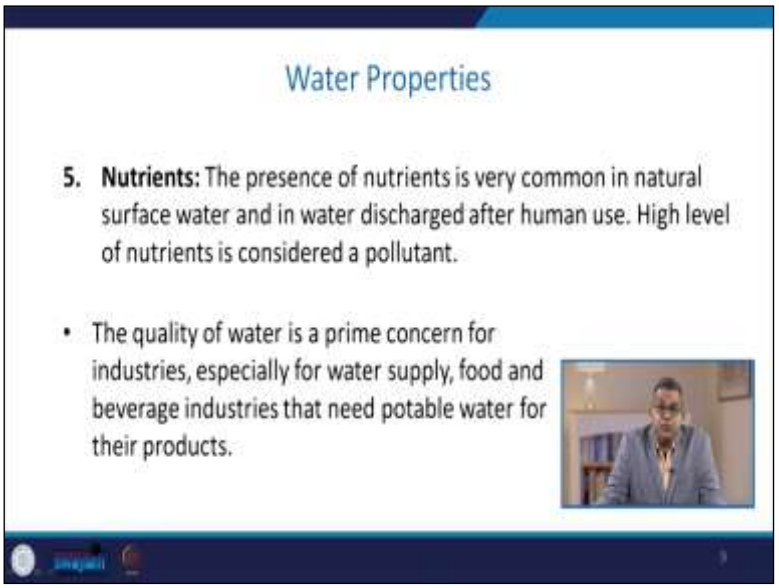

Nutrients the presence of nutrients is very common in natural surface water and in water discharge after human use the high level of a nutrient is considered as a pollutant. So, that means again the issue of optimization come into the existence the quality of water is a prime concern for industries especially for water supply food beverages industries pharmaceutical industries etc and that needs the potable water for their production or high purity of water for their production.

Because it requires mass scale consumption, any disturbance in the water quality or mismanagement of the water quality may become dangerous.

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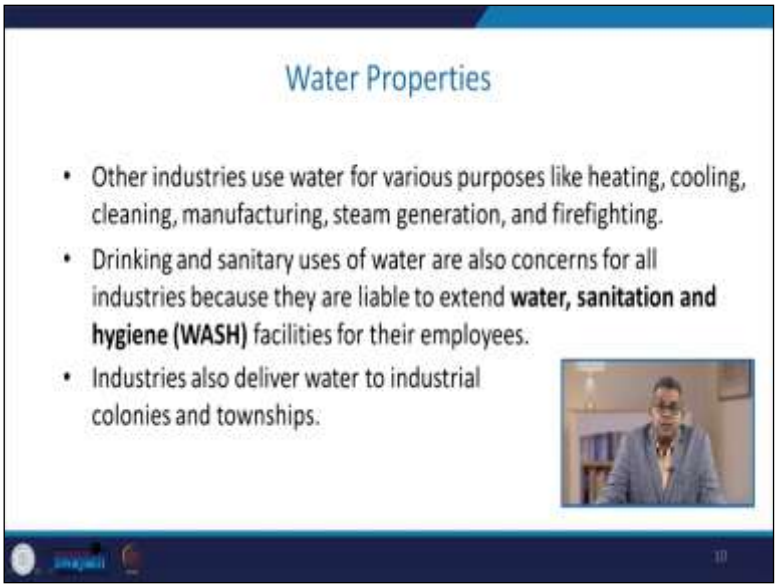

Now other industries apart from this we discussed that they use the water for various purposes like heating cooling cleaning manufacturing steam generation fire fighting etc. Drinking and sanitary use of water are also concerned for all industries because they are liable to extend the water sanitation and hygiene and sometimes refer as washing this facility for their employees. The industry also delivers water to industrial colonies, and the township is useful for drinking and housekeeping purposes.

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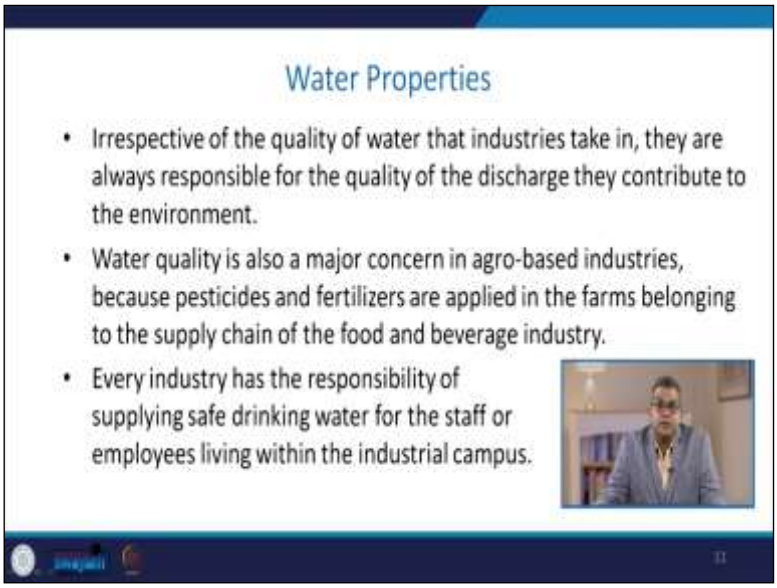

Irrespective of the quality of water that industries taken they are always responsible for the quality of the discharge of their con they contribute to the environment because everywhere we are talking

about the water reuse water recycling and sometimes if the contaminated water become the part and parcel of the aquifer. Then again, it may create a problem. So, that is why to overcome or to reduce the load on the water treatment plant they must the industries are responsible to maintain the appropriate quality of the discharge water.

Water quality is also a major concern in agro-based industries because pesticides and fertilizers they are applied in the forms belonging to the supply chain of the food and beverages industries and sometimes they may become part and parcel of the ground water too. Now every industry has the responsibility of supplying safe drinking water for the staff or employees living in their industrial campuses.

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Water supply industries beverage and medicine or pharmaceutical manufacturers they need the purified water that meets the portable standard or sometimes in an ultra-pure state. They need to maintain the drinking water quality standards for their raw materials and their products. Now let us talk about the quality parameters for drinking water. Now there are many sources of water quality criteria and standards.

Each country has its standards and guidelines. Now, these guidelines do not vary widely from country to country. However, they have adopted guidelines for other countries or organizations to

frame their standards in many countries. Water quality influences the water strategy for the business and impacts capital and non-capital investment in the water sector.

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When we are talking about the quality parameters, the question arises: how we can classify these quality parameters. These may be classified based on organic or inorganic according to their biological properties. Then physical or chemical that is purely based on its physical and chemical properties portable or non-portable that depends on its use for human consumption hazardous or non-hazardous based on its effect on human health and ecology.

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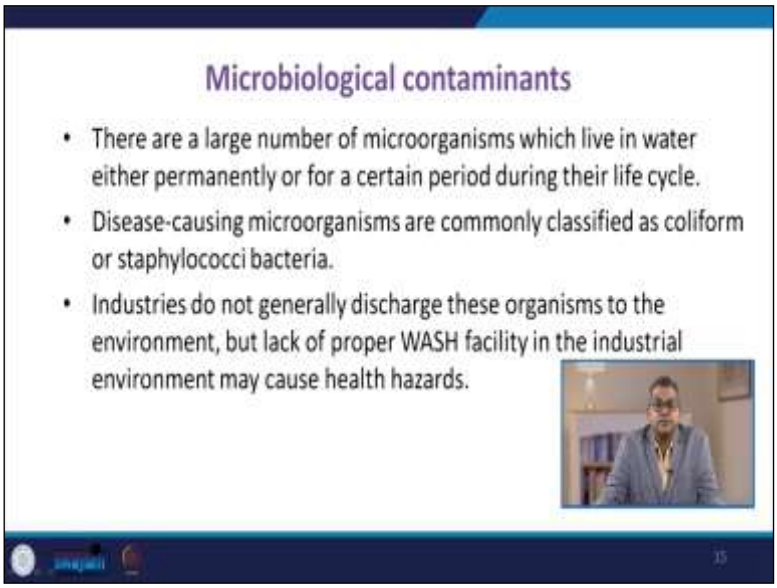

Now let us talk about the microbiological contaminants. Currently, there are a large number of microorganisms that live in water either permanently or for a certain period during their entire life cycle. Various diseases are attributed to the micro organism. So, disease-causing microorganisms are commonly classified as coliform or stato phycology bacteria. Industries do not generally discharge these organisms to the environment, but a lack of proper wash facility in the industrial environment may cause health hazards.

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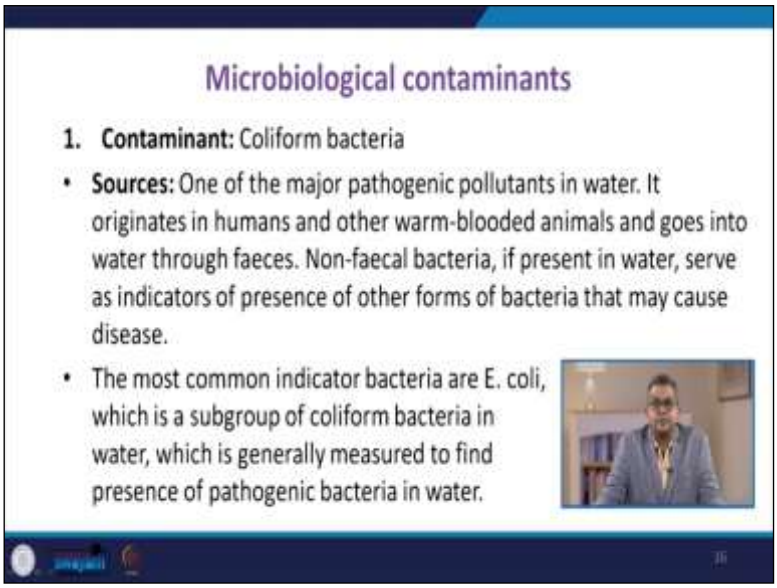

So, when we talk about microbiological contaminants, one contaminant is the coliform bacteria, the source of this particular bacteria. I mean, when we talk about this. Then one of the major pathogenic pollutant in water it originates in human and other warm-blooded animals and goes into water through faces non-physical bacteria if present in water serve as indicator for the presence of other forms of bacteria that may cause disease.

The most common indicator bacteria are equally a subgroup of coliform bacteria in the water, which is generally measured to find the presence of pathogenic bacteria in water.

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Potential health and other effects bacteria cause polio, cholera, typhoid dysentery, infectious hepatitis, and a few lists of bacterial infections are virtually endless. Another contaminant is pathogenic Staphylococci. Now sources are pathogenic microorganisms found in sewage-contaminated water bath water like swimming pools, etc. The potential health and other effects are causing a wide variety of diseases, notably skin disease and food poisoning.

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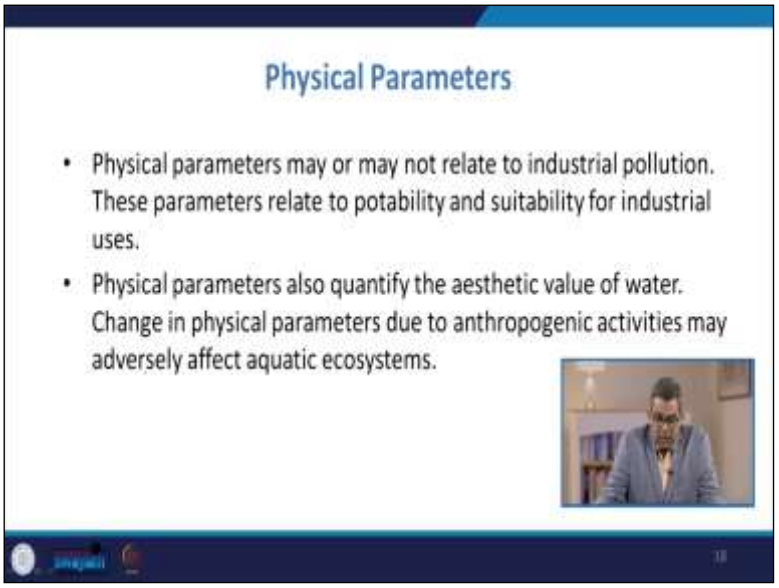

Now various physical parameters need to be addressed. The physical parameters may or may not relate to industrial pollution. Now, these parameters relate to portability and suitability of industrial

uses. Physical parameters also quantify the aesthetic value of water change in the physical parameters due to anthropogenic activities that may adversely affect the aquatic equities system.

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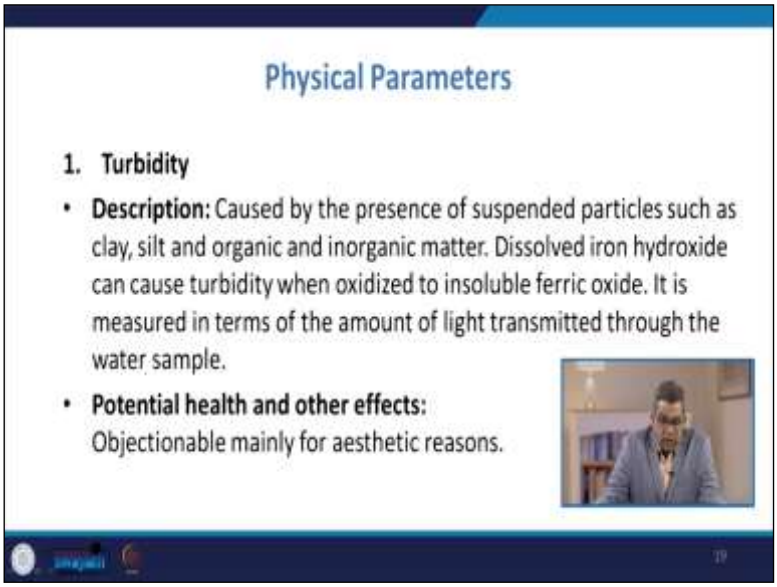

One of the physical parameters, or one of the most important, you can say the physical parameter is turbidity; this is caused by the presence of suspended particles such as clay silt and organic, inorganic matter dissolved in iron hydroxide. This can cause turbidity when oxidized to insoluble ferric oxide. It is measured based on the amount of light transmitted through the water sample. There are various potential health and other effects attributed to stability; basically, it is objectionable mainly for aesthetic reasons.

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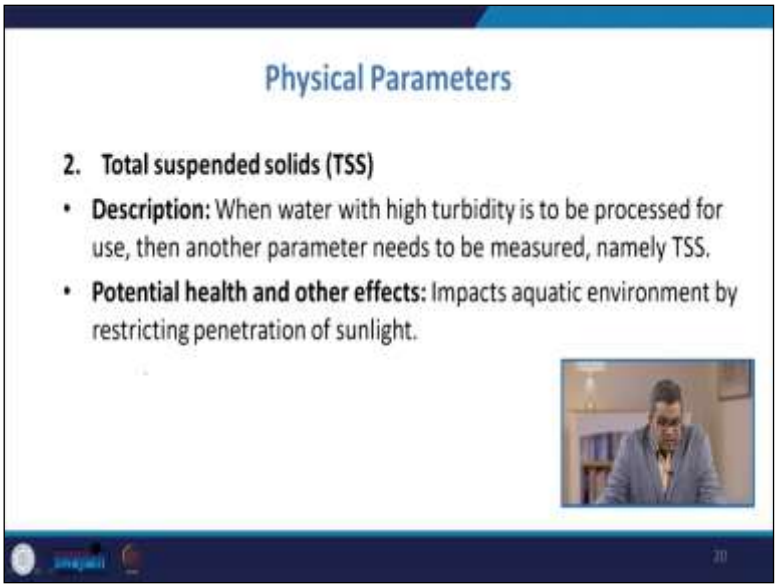

Another is the total suspended solids, sometimes referred to as TSS. Now when water with the high turbidity is to be processed for use then another parameter needs to be measured that is called the total suspended solids or TSS. It impacts the aquatic environment by restricting the penetration of sunlight.

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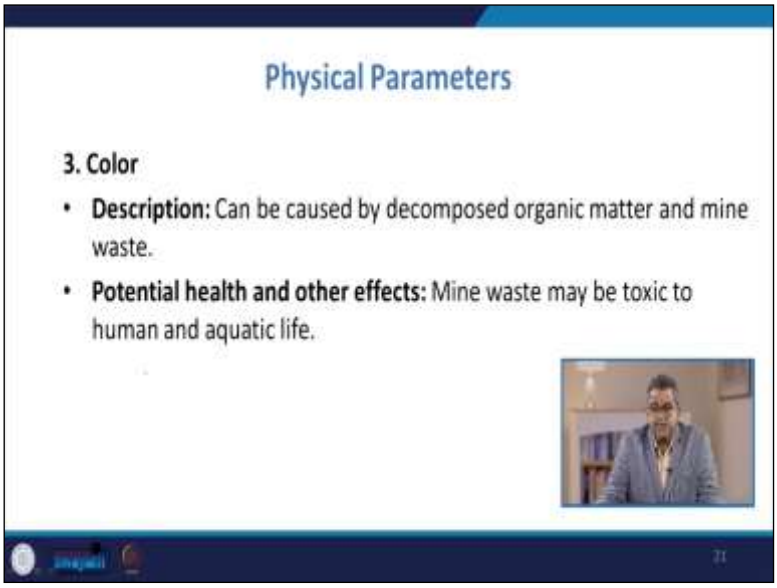

Another important physical parameter is color. This can be caused by decomposed organic matter and my waste etc. I talked about previously that if the water has a certain coloring compound, it is again highly objectionable, and people do not like it. Certain health and other effects like mine

waste may be toxic to humans and aquatic life. So, proper analysis of all these coloring compounds must be required before they can be used for portable purposes.

pH water generally has a pH from 4.5 to 10. Now, if the pH of water is above 7, it is called alkaline best suitable pH range for human consumption, aquatic life, or industrial use is from 6.5 to 8.5. The pH of water determines the solubility, which is the amount that can be dissolved in the water, and biological activity, which is referred the amount that can be utilized by the aquatic life or the chemical constituents such as nutrients like phosphorus, nitrogen, carbon, etc. and heavy metals.

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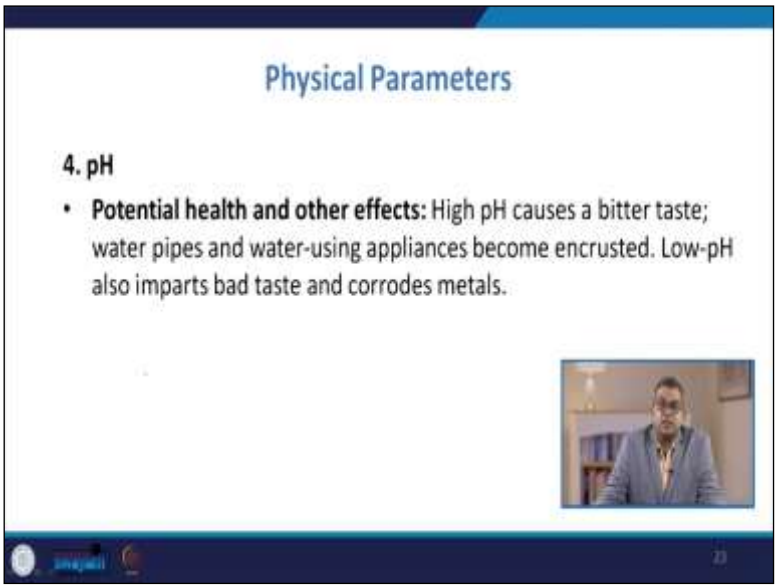

High pH causes a bitter taste in water pipes, and water-using appliances become encrusted low pH also imparts bad taste and it can corrode the metals.

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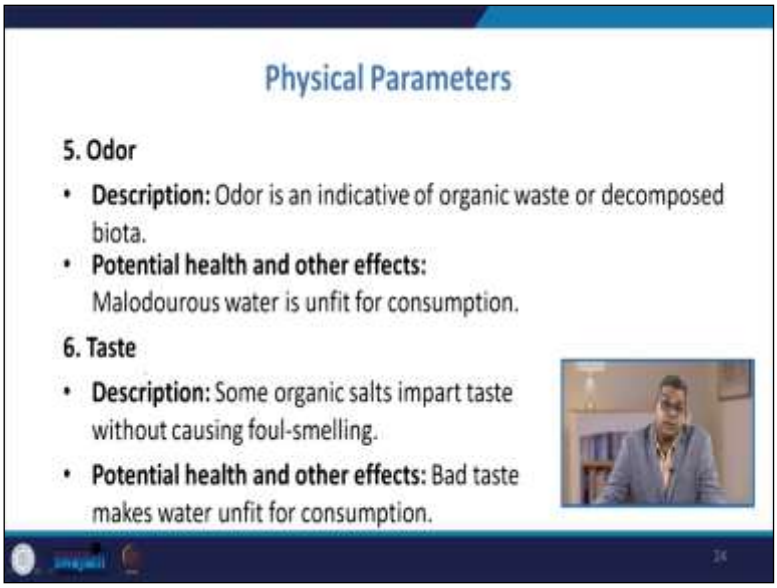

Then odor again, if we are using potable water for drinking, it is a perception that it must be odorless. So, odour is an indicative of organic waste and decomposed but bad odour or off odour water is unfit for human consumption Then next is the next physical parameter is the taste. Now some organic salts impart taste without causing foul-smelling. Now the bad taste or of taste makes water unfit for human consumption.

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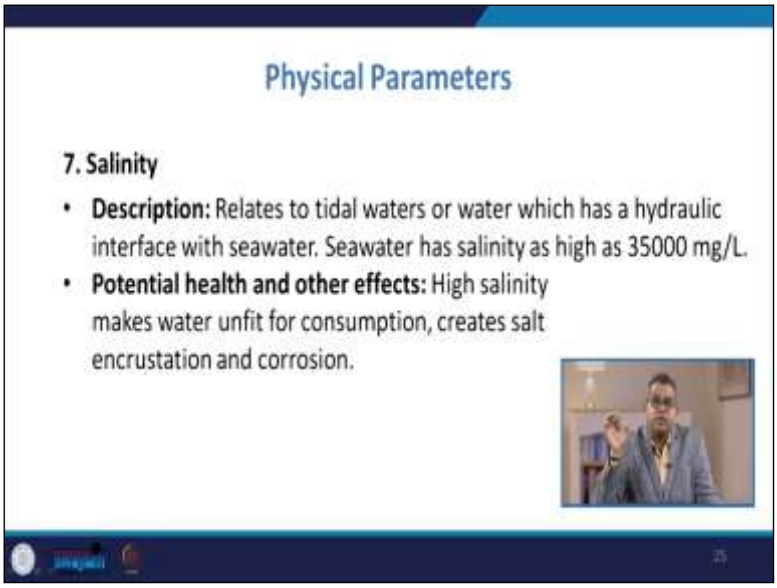

Another physical parameter is salinity. Now this relates to tidal water or water which has the hydraulic interface with the sea water. Sea water has a salinity as high as 35000 milligrams per

liter. High salinity makes water unfit for consumption, and it creates various problems. If we are using this particular water for industrial purposes, it may cause corrosion.

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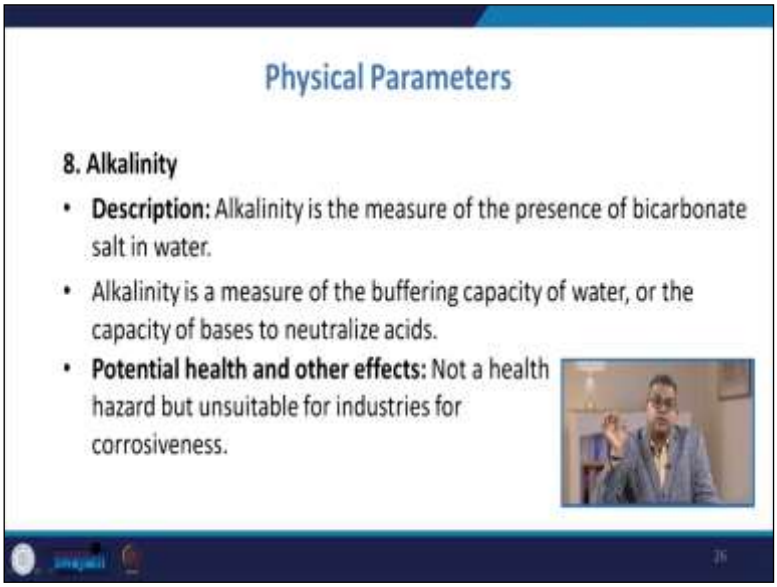

Another physical parameter which is very important that is alkalinity this is the measure of the presence of bicarbonate salt in water it is also the measure of the buffering capacity of water or the capacity of a basis to neutralize acid. There are various things we need to address about health and other effects. So, not a health hazard. It does not pose any kind of health hazard but is unsuitable for industries because of its corrosiveness.

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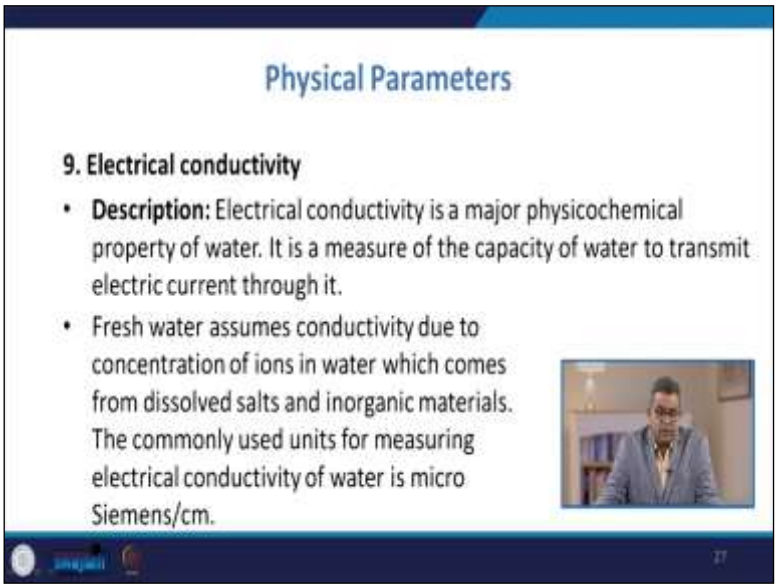

Electrical conductivity This is the measure of the chemical properties of water. It is the measure of the capacity of water to transmit the electric current through it. Now fresh water assumes conductivity due to the concentration of ions in water which comes from dissolved salt and inorganic materials. The commonly used unit for measuring electrical conductivity of water is micro siemens per centimetre.

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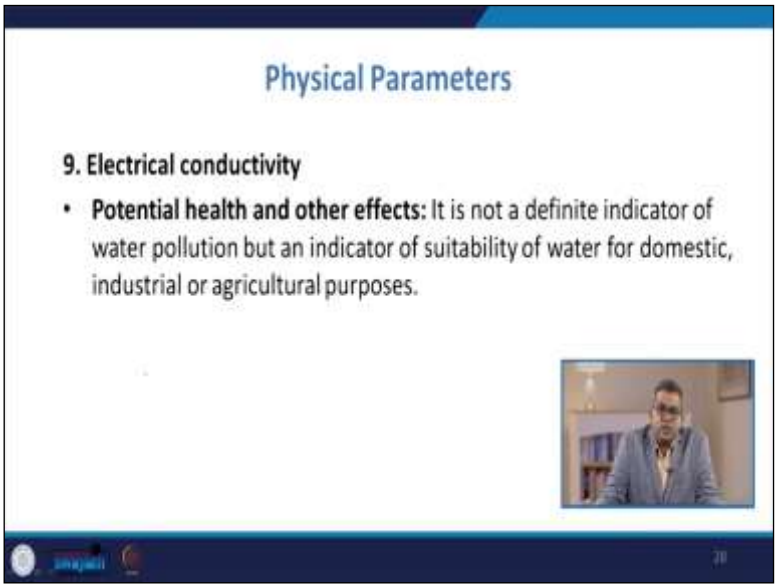

It is not a definite indicator of water pollution but an indicator of suitability of water for either domestic or industrial or agricultural purpose.

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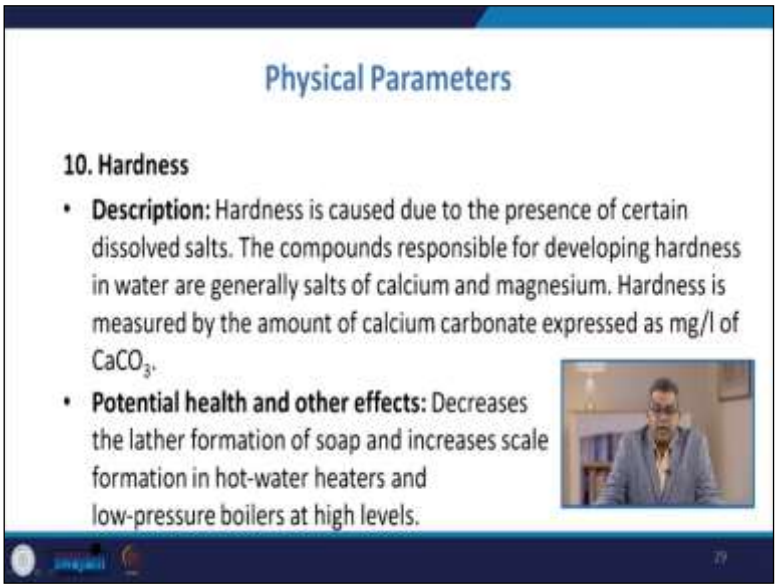

Hardness, hardness is caused by due to the presence of certain dissolved salts. The compound responsible for developing hardness in water are generally salts of calcium, and magnesium hardness is measured by the amount of calcium carbonate expressed as milligram per liter of calcium carbonate. This decreases the leather formation in soap, increasing the scale formation in water heaters and low-pressure boilers at high levels.

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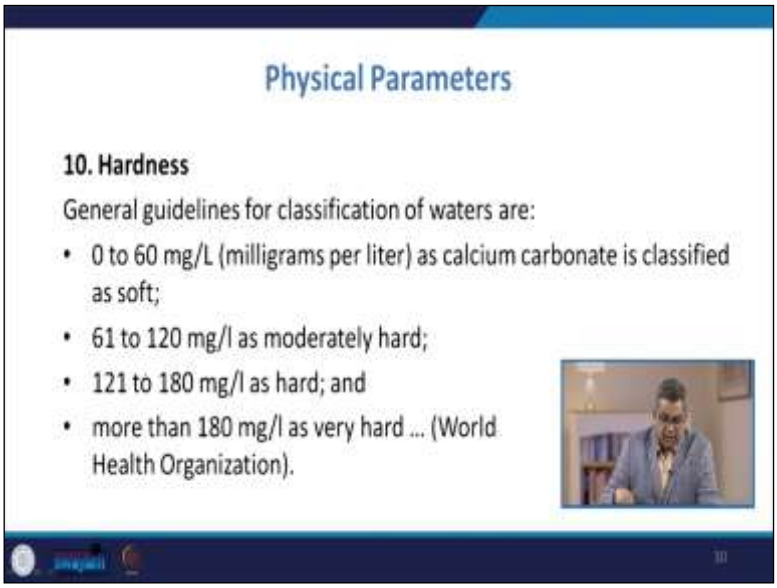

Now the general guidelines for the classification of waters, especially regarding the hardness, is 0 to 60 milligram per liter as the calcium carbonate is classified as soft, 61 to 120 milligram per liter as moderately hard, 120 to 180 milligram per liter as hard and more than if the water is having the hardness more than 180 milligrams per liter is a very hard and that is based on the who guidelines.

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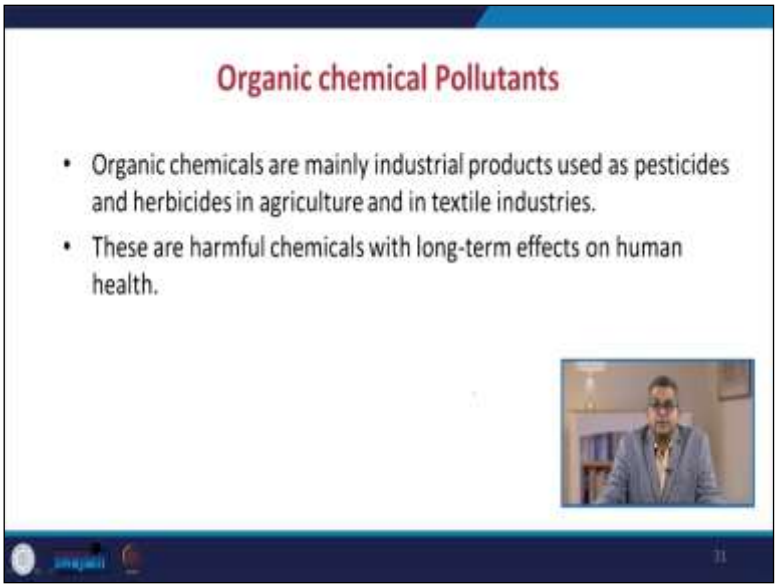

Now there are certain organic chemical pollutants. Organic chemicals are mainly industrial products used as pesticides and herbicides in agricultural and textile industries. These are harmful chemicals with long-term effects on human health. So, a due care is needed while addressing such kind of a chemicals in various aspects of life.

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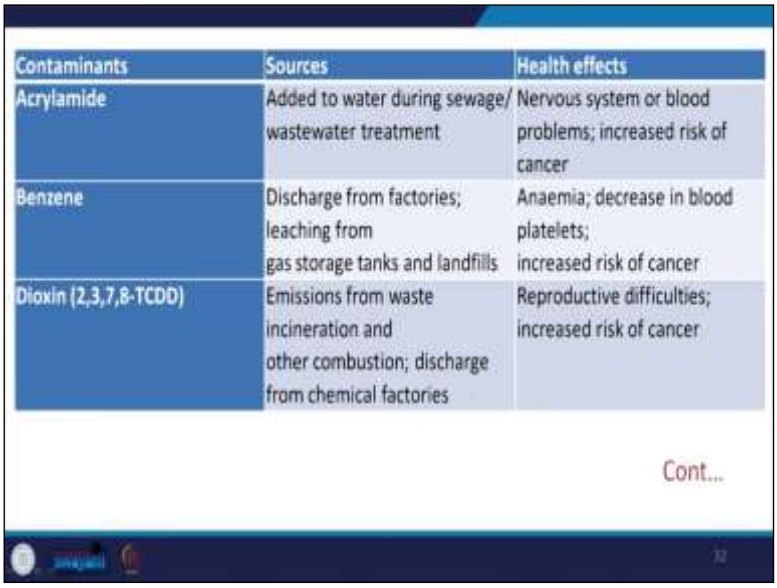

Now let us talk about it. This table discusses the contaminants and different types of sources attributed to them and their health effects. Now, if we; talk about the acrylamide added to water during sewage and wastewater treatment. So, that is a source, and the health effects attributed to

the nervous system or blood problems increase cancer risk. So, over some time, one may experience this dangerous aspect.

Then benzene discharges from the factories leaching from gas storage tanks in landfills. I mean, the use of benzene is enormous. It may cause anemia it can, decrease blood platelet counts, and increase the risk of cancer. Then dioxin 2378 TCDD the emission from the waste incineration and other combustion discharge from the chemical factories and sometimes the insecticide or herbicides production units. It can create a problem of reproductive difficulties and again be attributed to the enhancement of cancer.

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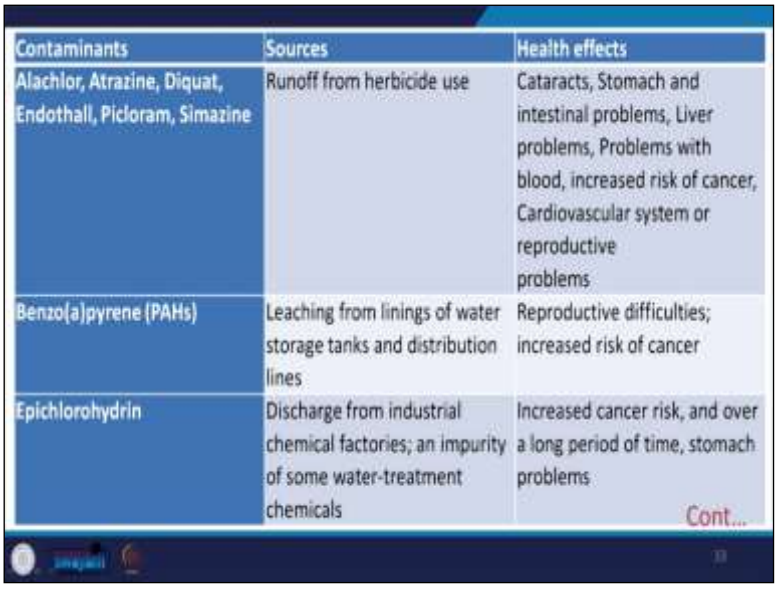

Then alkaloid atrazine dicot endothall pilon simazine. Sometimes, they are from the runoff from herbicides or insecticide use. It may create a problem of cataracts, stomach, and intestinal problems liver problems. Sometimes, it may create a problem with blood increased risk of cancer, cardiovascular system, reproductive problems, etc. Then benzene pyrenes the leaching from water storage tanks and distribution lines lining.

This again may create reproductive difficulties, and again the increase may increase the risk of cancer. Then epichlorohydrin is the discharge from the industrial chemical factories and impurity of some water treatment chemicals. This can increase the cancer risk, and over a long time, one may suffer a systemic problem.

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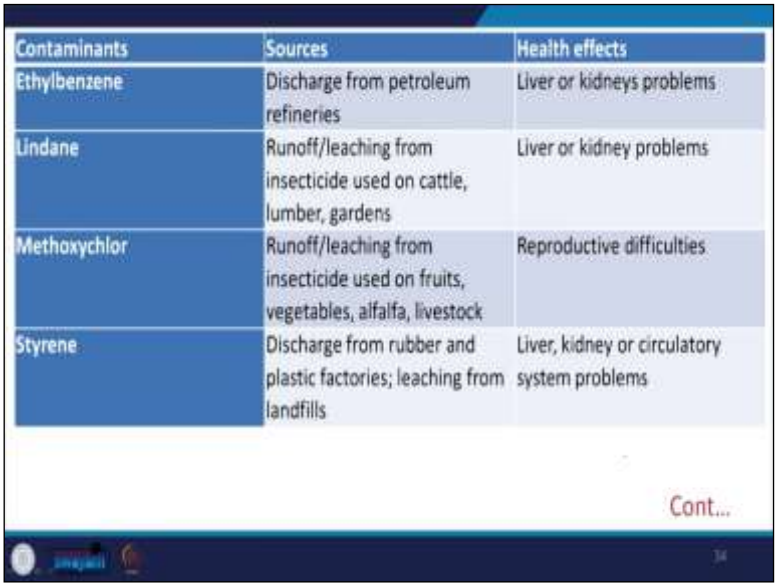

Then ethyl benzene can be discharged from the petroleum refineries, and it may create liver or kidney problems if somehow it can go into the body system. Then lindane, this is runoff or leaching from insecticide use on cattle, lumber gardens again the liver and kidney problems may be attributed with this particular chemical. Then methoxychlor is often leaching from insecticide used on the fruits vegetable alpha livestock again it may create a problem with reproductive difficulties.

Styrene is a basic ingredient of various rubber and plastic manufacturing units, so discharge from rubber and plastic factories leaching from landfills again the liver-kidney circulatory system problems can be attributed to styrene.

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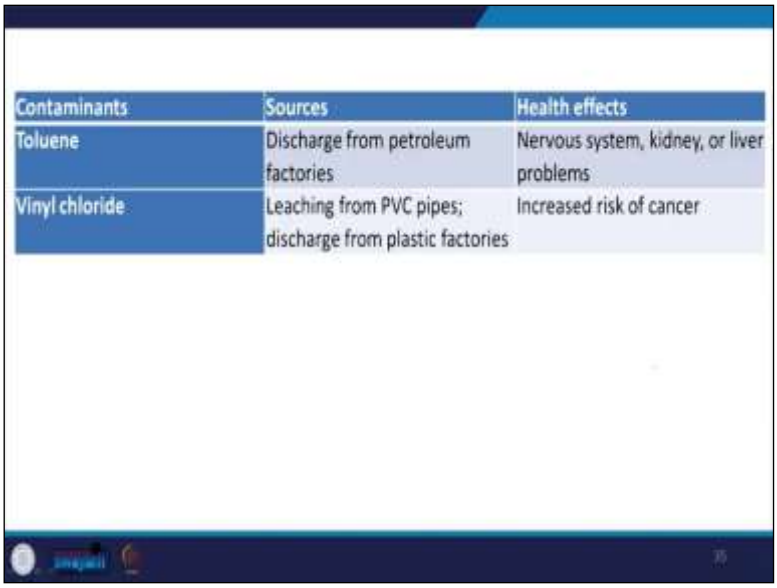

Then Toluene again, the integral use of Toluene in the petroleum factories it can create a problem to the nervous system, kidney lever, etc. Then vinyl chloride is again the integral part of polyvinyl chloride pipes. So, leaching from the PVC pipes discharged from the plastic factories it can increase the chances of cancer.

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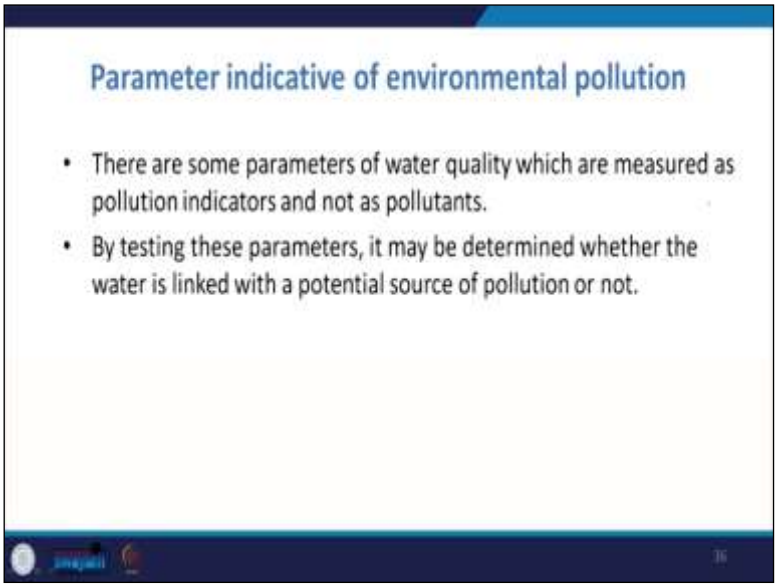

Now let us talk about the parameter indicative of environmental pollution. Now there are some parameters of water quality that are measured as a pollution indicators and not as pollutants. By testing these parameters, it may be determined whether the water is linked with the potential source of pollution or not.

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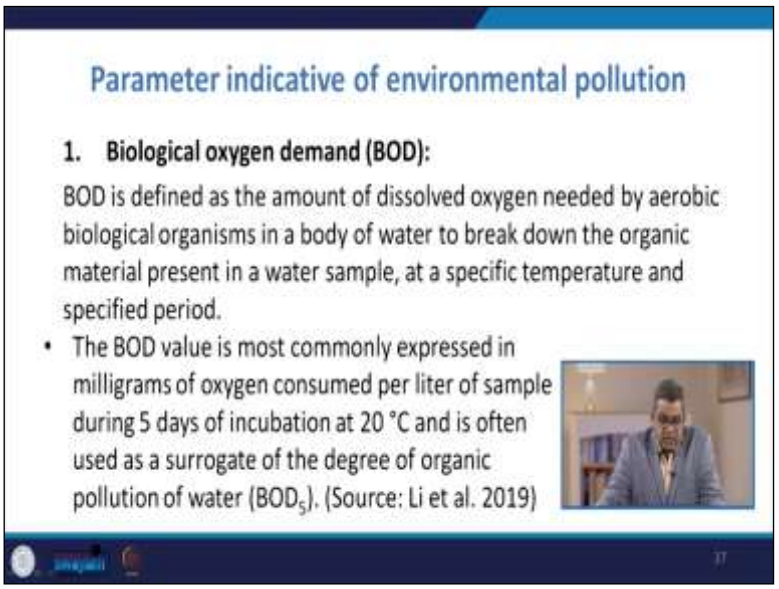

One is the biological oxygen demand BOD, commonly known as BOD. The body is defined as the amount of dissolved oxygen needed by anaerobic biological organisms in a body of water to break down the organic material present in a water sample at a specified temperature and specified period. The biological oxygen demand value is most commonly expressed in milligram of oxygen consumed per liter of sample during the 5 days of incubation at 20 degree Celsius and is often used as a surrogate of the degree of organic pollution of water BOD 5.

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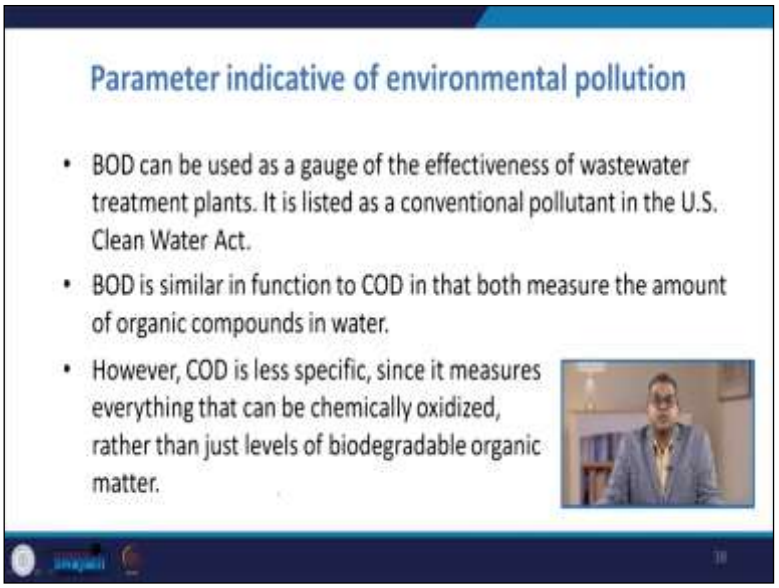

This body can now be used as a gauge of the effectiveness of wastewater treatment plants. It is listed as a conventional pollutant in the United States Clean Water Act. Now BOD is similar in the function of COD. The chemical oxygen demand in both measures the number of organic compounds in water. However, the chemical oxygen demand is less specific since it measures everything that can be chemically oxidized rather than just levels of biodegradable organic matter.

So, let us talk about the chemical oxygen demand. Now the cod is the estimate of oxygen required for the portion of organic matter in wastewater subjected to oxidation and the amount of oxygen consumed by organic matter from boiling acid potassium dichromate solution.

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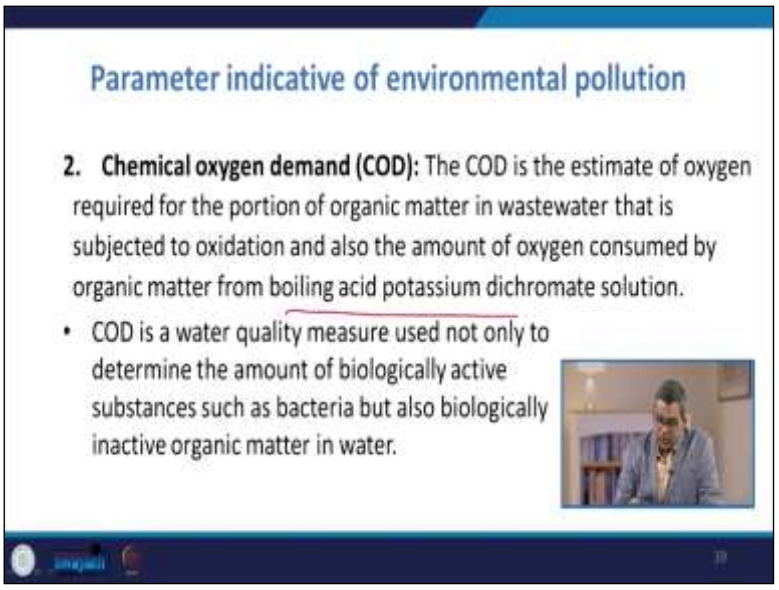

Now COD is a water quality measure used to determine the amount of biologically active substance such as bacteria and biologically inactive organic matter in water.

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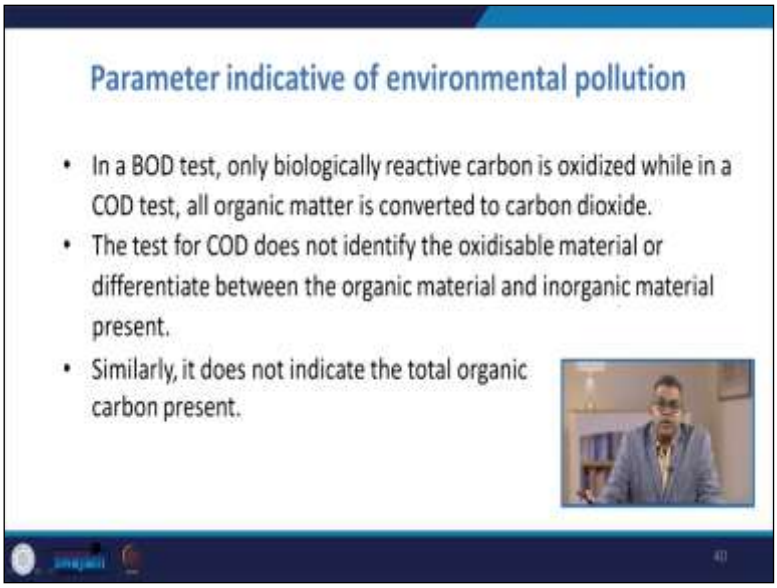

Now in a BOD test only biologically reactive carbon is oxidized while in COD test all organic matter is converted into a carbon dioxide. The test for COD does not identify the oxidizable material or differentiate between the organic material and inorganic material present. Similarly, it does not indicate the total oxygen total organic carbon present.

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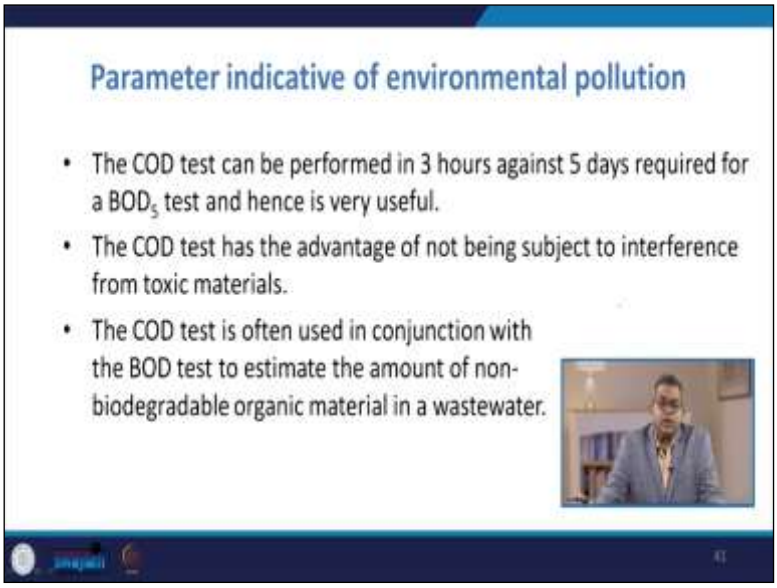

When we talk about the cod, the cod test how to analyze and what is the protocol for the cod. So, the cod test can be performed in three hours against five days requirement for BOD 5 test; therefore, it is very useful. The cod test has the advantage of nonbeing subjected to interference

from toxic materials. The COD test is often used in conjunction with the BOD test to estimate the amount of non-biodegradable organic material in the wastewater.

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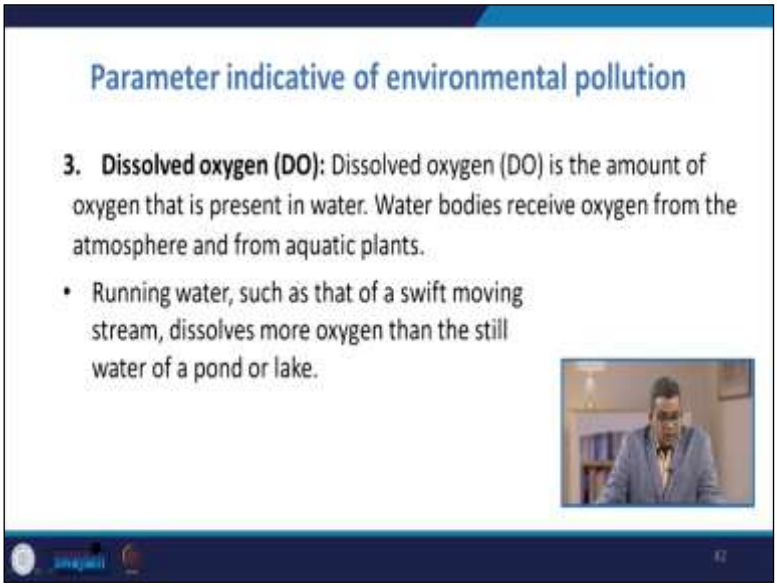

Another important parameter is dissolved oxygen and sometimes referred as DO. So, the dissolved oxygen is the amount of oxygen that is present in water. Water bodies receive oxygen from the atmosphere and aquatic plants. Running water such as that of a shift-moving stream dissolved more oxygen than the still water of a pond or lake.

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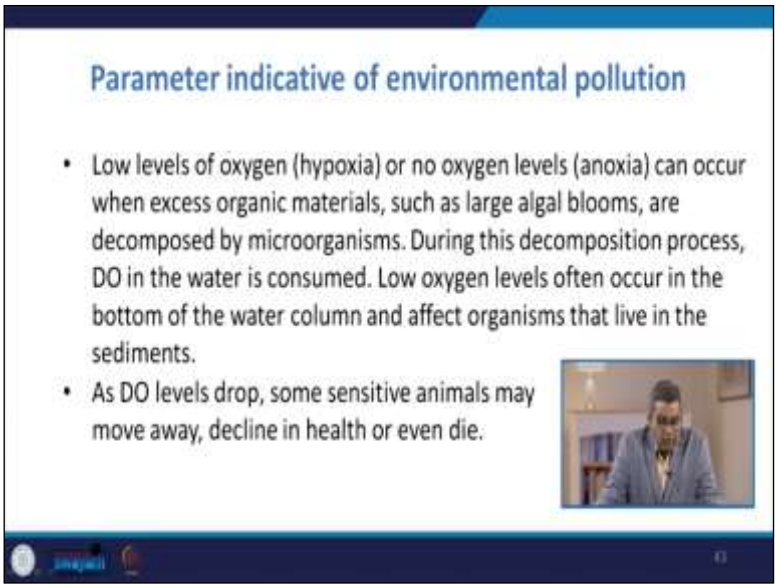

Now low level of oxygen sometimes referred as hypoxia or no oxygen level anoxia this can occur when excess organic material such as large algal blooms. The microorganism decomposes them. During this decomposition process, the dissolved oxygen in the water is consumed. Low oxygen levels often occur at the bottom of the water column and affect the organism that lives in the sediments.

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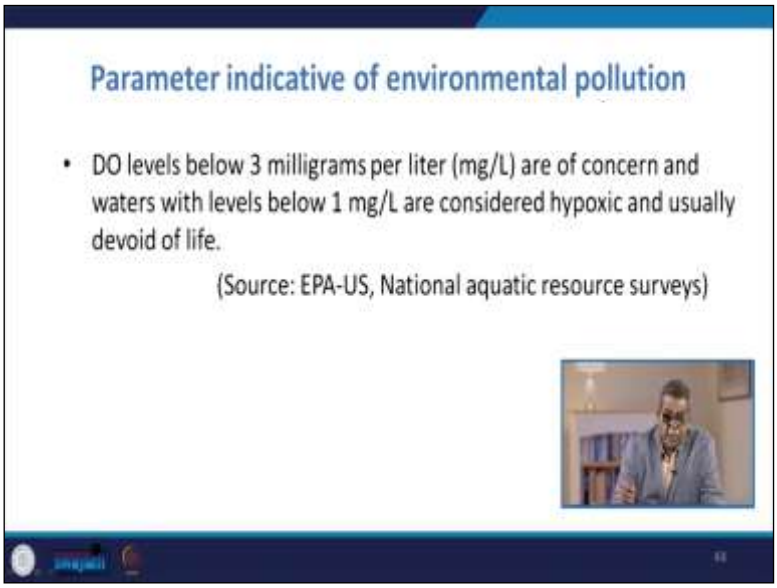

Now, as dissolved oxygen level drops, some sensitive animals may move away and decline in health or even die. Now dissolve oxygen levels below 3 milligrams per liter are of concern, and waters with a level below 1 milligram per liter are considered hypoxic and usually devoid of life. So, at last in this particular lecture we discussed about the water management criteria what are quality indicators.

We discussed the various parameters referred to about the water quality etc, and may be useful for assessing the water quality.

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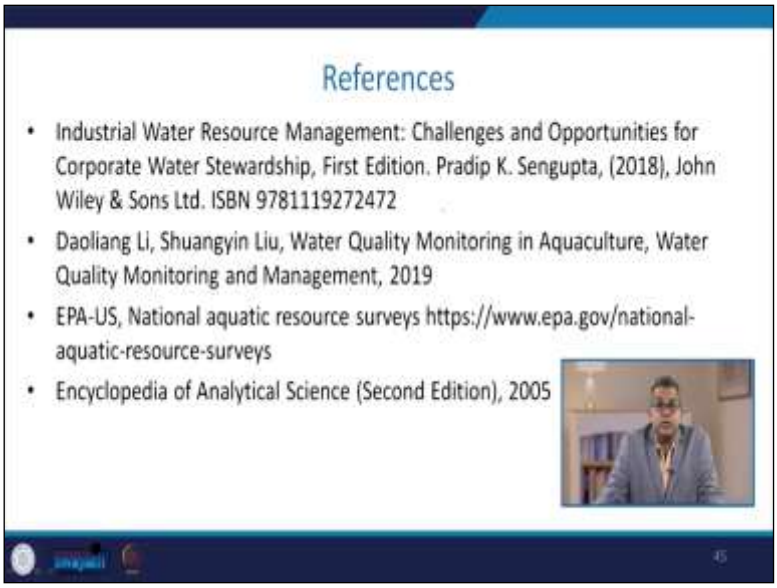

For convenience, we have enlisted four different references and if you wish to have a further reading or further knowledge you can refer these references, thank you very much.