Fundamentals of Environmental Pollution and Control
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Lecture No. # 06
Water Pollution Modelling - Surface Water

We'll begin, I mean if you say the thing is you know we have little more thing to say about the water pollutants we'll continue by that but in a… Anyway I'll to start with this you know let me make a correction here.

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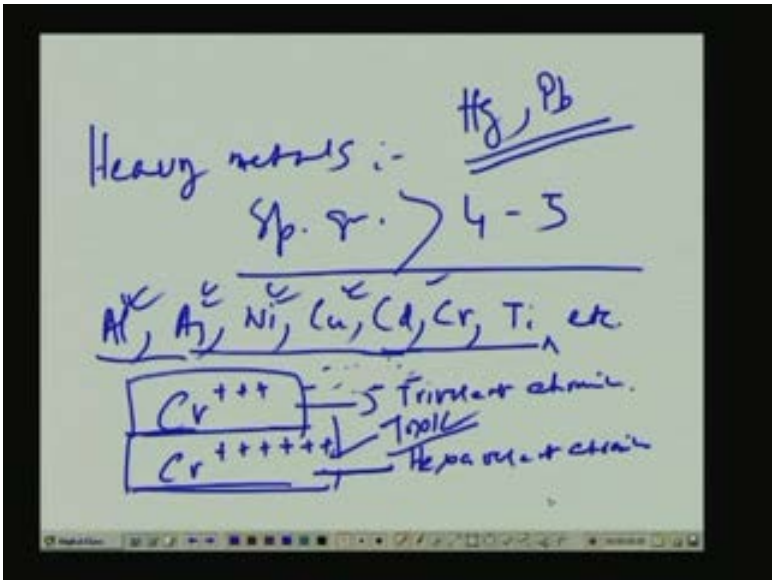

There you know this one is not the toxic one, this one is, this one is toxic, this one is toxic and also in this part here I have not included two very important, two very very important heavy pollutant, a heavy metal pollutant like this one is mercury, one is essentially mercury which is also a heavy metal contaminant and also is another is lead. So the lead, so this mercury and lead please include them these two are important, important metals, these are two are a very important heavy metals which are toxic to, toxic to many of them are known as toxic to human body or toxic to any other kind of organisms right. I will just explain you a case study here are also similar to this is, this you know if you can see this okay. Now what happens in such cases of mostly you know in cases of heavy metals.

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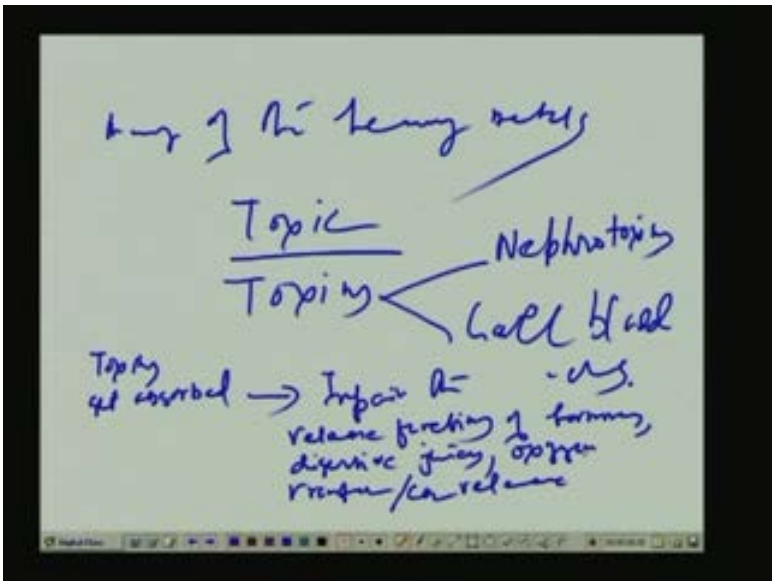

One of this, many of this heavy metals, many of the, many of the heavy metals, many of the heavy metals are you know a toxic, toxic which has toxic, which has they are identified as they are identified toxins, is identified toxins that they are they can relate to nephrotoxins though which are nephrotoxins is the nephron is the basically the kidney, the kidney toxins you know these are nephrotoxins generally known and apart from that you know apart from that you know they are toxins which are, which are, which are generally find a good residence in gall bladders, gall bladders. This toxins I mean there are two if you just observe the role of this toxin in the body physiological, physiological system we just observe this two things like this.

The toxins you know the toxins, heavy metal toxins, toxins get absorbed, get absorbed right impair, impair they release, release a functions, release functions of hormones, hormones then digestive juices, juices impair say this oxygen transfer, oxygen transfer, oxygen transfer then a CO_2 release. The toxins gets absorbed, as they get absorb impair the release functions of the hormones, impair the release functions. There is another impair impairment that takes place is you know there is another impairment that takes place is if you just see this another impairment that essentially take place here is this if you can observe here that you know they can be this say alters, alters, they alters the transfer mechanism, alters the transfer mechanism like you know transfer mechanism is like this, you say transfer mechanism is like this.

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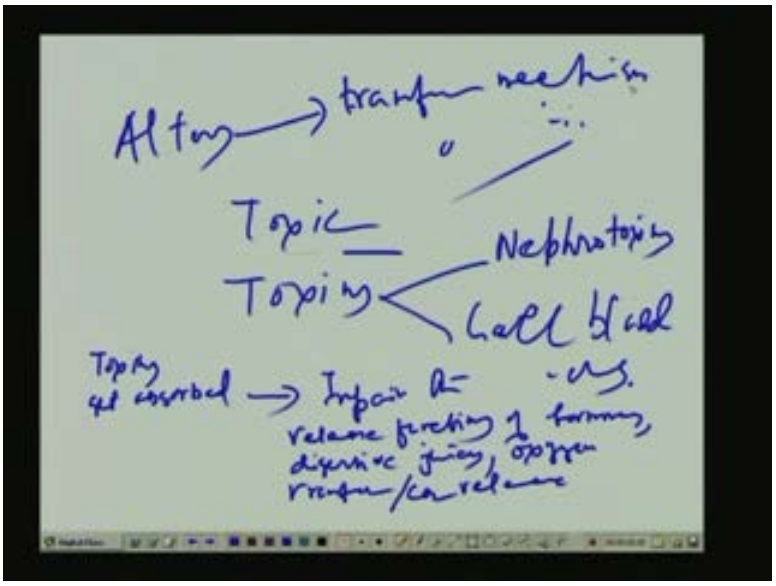

Say if suppose just you know this is very illustrative, very illustrative you know just try to understand this. If there is a body cell, if there is a cell like this if there is a cell we have this, this cell nucleus here, the cell nucleus, cell fluid you just have the cell fluid. Now here the usual functions of the cell, usual function of the cell is to release a carbon dioxide to the blood stream, this is say you know where it is connected by you connected to a blood stream, blood stream, connected to a blood stream.

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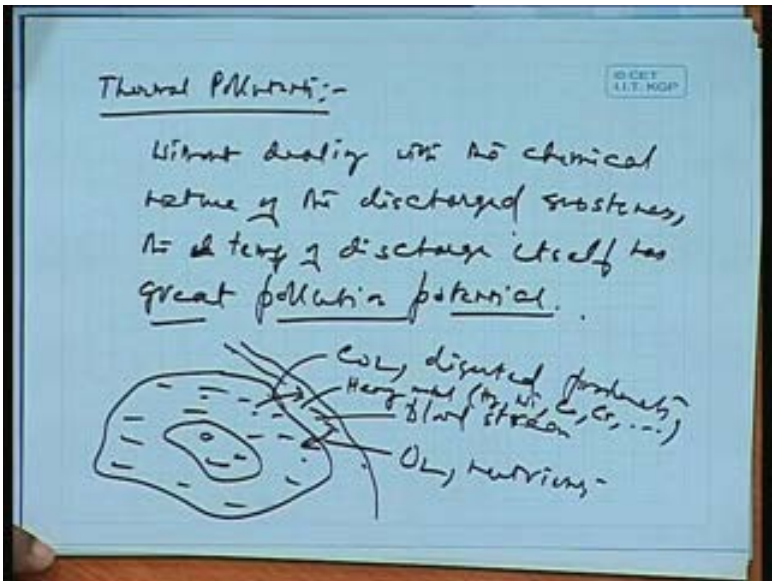

So this blood stream it is supposed to release carbon dioxide right, it is supposed to release carbon dioxide or it is supposed to release many other excreta that we generally gets discharge to

the body like say for urination various say digested products right and should intake, should carry on say this should supply oxygen, should supply oxygen nutrients, cell nutrients. This is what is the, it is, it is normal function. What happens now if this water contains if this, if this blood sorry if this blood contains heavy metal, heavy metal, heavy metal like say mostly the heavy metals like mercury, nickel then cobalt Co, nickel cobalt or sometimes you know chromium then mostly this, mostly this kind of substances. What they generally is this they damage the transfer function, you understand this by means of what happens is the rate of discharge may be altered, rate of absorption rate of discharge would be continuously altered. This would result in, this would result in you know if these things continuously begin to take place, this would result in the permanent damage of the cell structure right.

The cell should naturally or regularly need oxygen, regularly need nutrients unless they get them they would begin to dysfunction, this dysfunction might also the presence of sudden heavy metals which would be generally transferred by this process is called reverse osmotic pressure. Osmosis you know, this typical osmosis that transfer takes place in an osmosis, as an osmotic process where is you know liquid to liquid transfer taking place is basically that transfer phases liquid to liquid or semi liquid to liquid kind of transfer taking place. Here so what happens essentially is the body with the transfer mechanism gets changed. As the transfer mechanism gets changed, the body would be accepting something which it does not want and would reject something which would require. This is the alteration of this physical function that takes place in the presence of this most of this toxins that we have been discussing. This is what is one of them is a nephrotoxins which is essentially impairs the, impairs the kidney function, this is what is called nephro, nephrotoxins. There are another you know as you must, you must be already knowing about, say that you must be knowing already, you must be already knowing about the arsenic pollutants.

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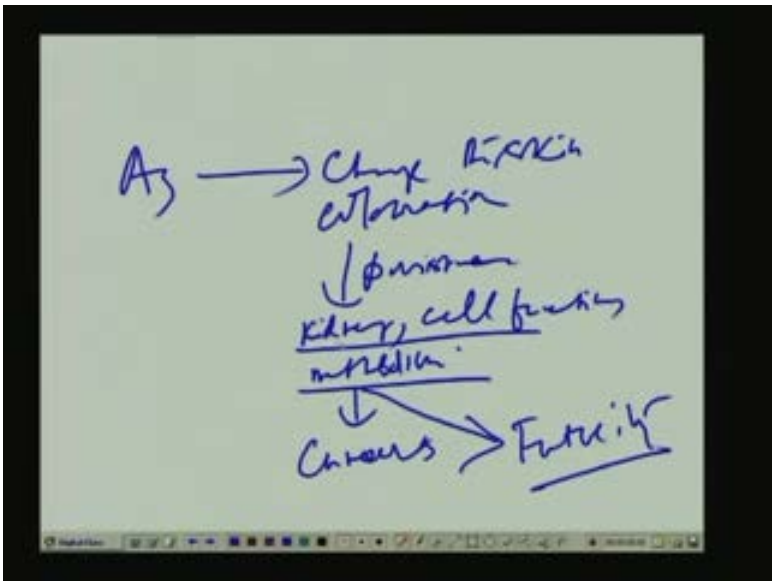

Arsenic, arsenic you know is arsenic can, initially the arsenic would be change the skin coloration persistence, this is if it is a short term might be change, the skin coloration would be

changed persistence if it is persistence, if it is remaining arsenic is remaining in the water, arsenic remaining in water say would relate to would relate to say kidney function, kidney cell functions say kidney cell functions. Then say metabolism, metabolism and can lead to you know this can all these kind of disorders, all these kind of disorders can result into the change, result into the change of the, it can result into the change of the cell structure itself. If it is continuously taking place for a long time, this is what is called as cell mutation. The cell mutation is the initial step of formation of cancer, cell mutation when the cell is supposed to do a certain kind of job its character has been so much changed that it is already doing something else. So this is the early onset of cancer.

When this particularly spreads from one cell to different multitude of cells, this is essentially what is known as cancer. So all of them finally all this dysfunctions, all this changes in the character would finally lead to, finally lead to cancerous, cancer or cancers would lead to cancers and can finally, can finally lead to fatality. They have itself this kidney and all these when the effects are pronounced that can itself lead to this fatality. Importantly, another important thing that is one is very important thing about this many of this heavy metals, many of this heavy metals are another important thing about this many of this heavy metals, some of the heavy metals, some of the heavy metals, some of the heavy metals, some of the heavy metals, some of the heavy metals are also known as micro nutrients, micro nutrients they are useful.

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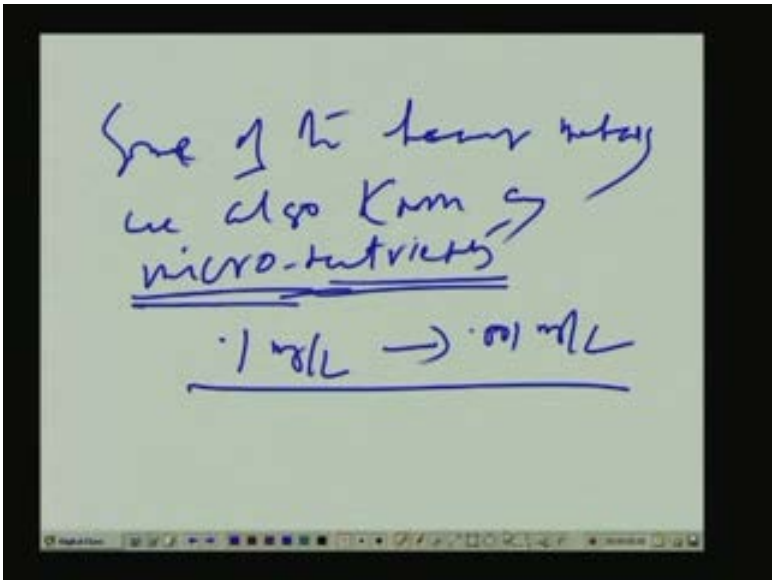

We need a little bit of cobalt; we would need a little bit of chromium also but this again this is when they have said, this one thing that is what it says is that when they at a small quantity, at a small quantity they may be useful at a, at a larger quantity, at a larger concentration they may be extremely harmful, extremely harmful and not only that, you know not only that even in a must many of this heavy metals, many of this heavy metals may be toxic at a very low concentration say you know about 0.1 to 0.01 to 0.001 milligram per litre. They are extremely toxic even at very small level small concentration; they are extremely toxic at very small concentration.

Well, I'll discuss you know more on this you know on a particularly a case study that I will explain that I will continue that I will begin to that is generally is about a particular case of this is a, this is called you know particular case study that I would like to discuss here you know one of this is that you know mercury in sorry, in a gold mining, use of mercury in gold mining, use of mercury in gold mining is a, is a very potential, highly potential topic for discussion.

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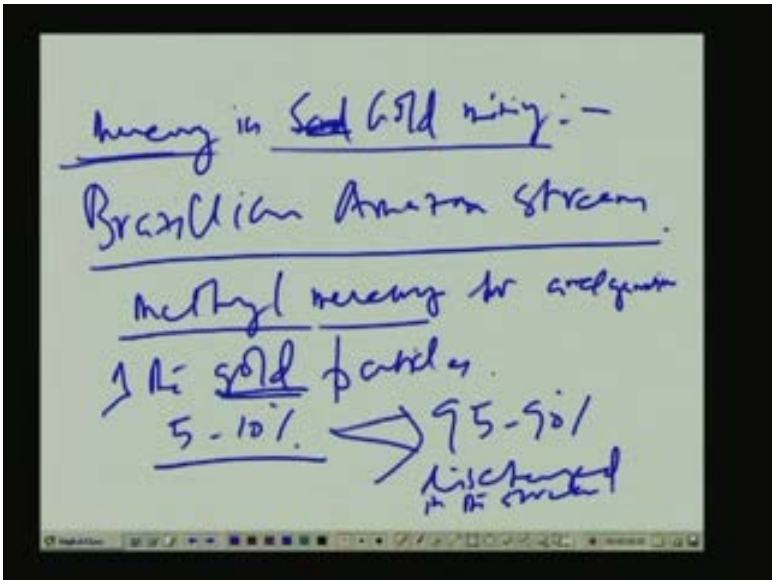

Nowadays gold mining, the recovery of these gold industrial processes where mercury used to be used for gold mining extraction of gold. This process has now been changed, somewhere there are processes, there are industrial processes is say is quite a serious topic of discussion as well where nowadays mercury is no longer used, no longer required in a big industrial plants where they extract gold, non-gold, non-mercury gold extraction processes are becoming more and more common. But in small practices, in small uses mercury still remains a very important substance which is generally used for, generally used for extraction of gold. One of that such situation is you know is a typical case where you have seen you know in many cases in India also you have seen that you know this people, poor people by the riverside they generally use pans for gold panning for you know to collect nuggets of gold that are generally done but this is particularly true in a particularly very common in Brazilian, Brazilian, Brazilian, Amazon, Amazon streams where after Brazilian Amazon streams where you know this part kind of mining is very common. This kind of mining is very common. What is done is, what is done generally is this is the methyl mercury, is methyl mercury, methyl mercury is used, methyl mercury is used for amalgamation, amalgamation, for amalgamation of the gold particles, methyl mercury for amalgamation of the gold particles are generally used, right.

Now this methyl mercury mostly about 5 to 10 % is used of the concentration that is generally used for the purpose of amalgamation of the gold particles, with only 5 to 10 % are used you know which form a bonding with the gold particles rest of about 95 to say about 95 to, 95 to 90% are generally discharged into the, discharged in the stream, is discharged into the stream.

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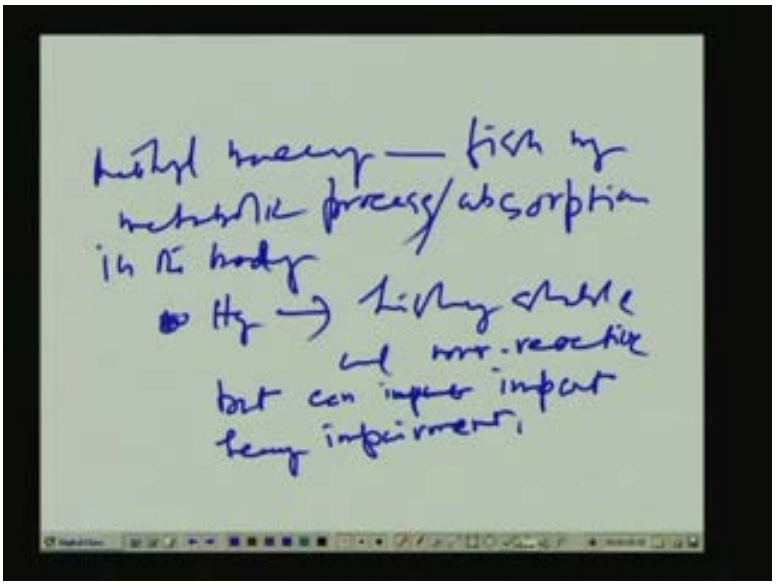

Now this methyl mercury, this methyl mercury if you just observe this methyl mercury now, this methyl mercury, this is methyl mercury gets readily absorbed, this methyl mercury when in water, when in water gets readily observed, gets readily observed into the, into the fish, fish, fish by fish by metabolic, by metabolic process, by metabolic process or absorption, absorption in the body, absorption in the body, absorption in the body now this absorption in the body. Now as a result of which this mercury, this methyl mercury particularly the mercury thus the element mercury, this element mercury is highly stable, highly stable and non-reactive but can impart, but can impart heavy impairment, heavy impairment, heavy impairment particularly in, particularly in, particularly in the nervous system, particularly in the nervous system.

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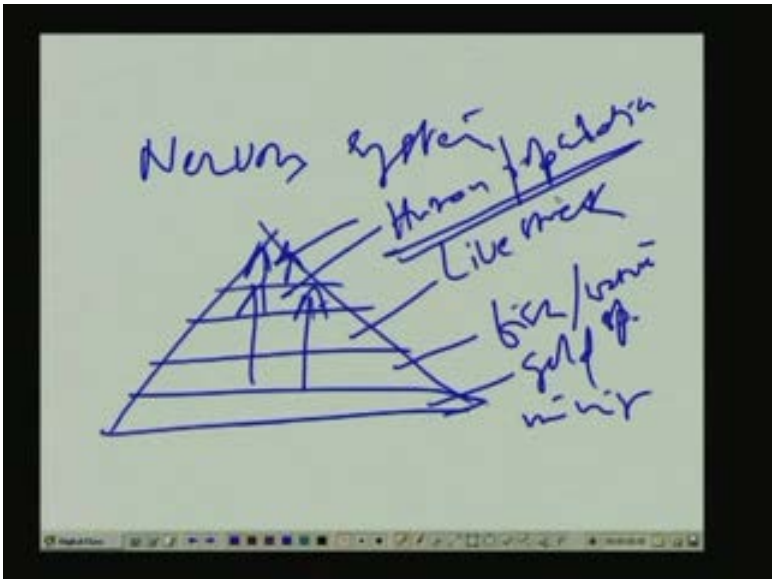

And it goes say from the food chain, it goes from a food chain say this foods chain you know say gold mining if you just observe this gold mining here, gold mining here. Then going to the fish, fish, popular fish and water species, water species, fish and water species would finally find way into this through the vegetation and other things to the livestock or itself it can directly go to the human, human, a population, human population and can go further up in the food chain, can go further up in the food chain. Now here this human population would be directly affected, would be directly affected by the typical kind of mercury related poisoning, mercury related poisoning. The mercury related poisoning are something like this. The initially the impacts are the impacts, if you observe the impacts, if you observe the impacts first of all it would be you know is severe condemnation of the first and the foremost initial symptom is body tremor.

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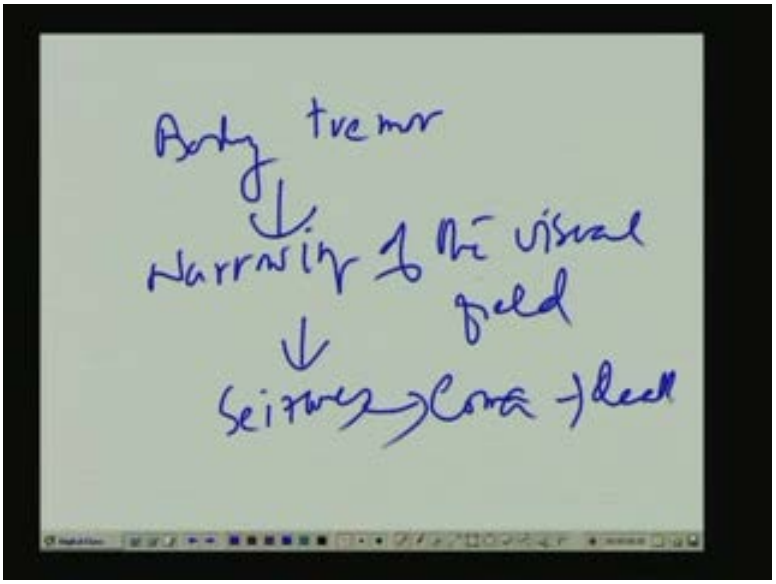

If it is body tremor is the first initial symptom of mercury being absorbed, right. This would be that, this would lead finally to the narrowing of the visual field. If the intake begins to continue, if the intake begin to continue what would observe is the eyeballs, the eyeballs would begin to be reduced and the visibility would begin to impair, the field visibility, the visual field the what you can see under open eyes, normal eyes you would be constricted, you will not be able to see that much right. This would finally lead to, this would leads to seizures, seizures, the body would begin to seizures. Have you seen this, the patients with seizures, particularly those who are, who suffer from say severe nervous disorders generally they undergo seizures you know uncontrolled motions of the different parts of the body, uncontrolled motions, uncontrolled motions of the different parts of the body which can lead to, finally lead to coma and death. Most of, most of the pollutants that we have, most of the heavy metal pollutants that we have discussed can have a serious health related problems as explained.

So you can understand the importance of heavy metals particularly related to industries, particularly all kind of industries say manufacturing industries, production industries, all discharge a huge amount of heavy metals. In many cases, in many cases just for you know a many cases people escape, the industrial houses escape by saying that you know our discharge of

water is of low TDS, low TSS, low turbidity right low, low iron that may not be significant. More important than that is what kind of elements are being discharged say thus I have said if you discharging mercury that mercury may know the concentration of mercury may not be visible in the TDS, remember this that may not be absorbable in the TDS concentration but unless you do the, unless you measure the concentration of mercury in the water itself you would never know the how much mercury you are actually discharging in to the stream.

If you say that you know we are discharging low TDS water that is not sufficient in many cases that is not sufficient, in many industries like if you go to, if you go to industries like mining if you go to any chemical industries they would simply say that we discharge low TDS water. We treat water and we discharge and we reduce say particular pollutant like you know zinc, iron or say other substances like less toxic substances like zinc, iron, aluminium less toxics relatively known, relatively less toxic substances and escape by saying so but in most cases when the water is, water can have a source where there is a possibility of high concentration of arsenic, high concentration of mercury, high concentration of nickel, lead all these, all these can be extremely toxic at very low concentration.

So what is importance in such cases is to know the elemental concentration of all these heavy metals. In many industries it is now important and now necessary to know the elemental concentration of these heavy metals, this not merely sufficient to know about TSS, TDS or dissolved oxygen or parameters like that. Dissolved oxygen's may be more, dissolved oxygen may be sufficient but that is not sufficient for, that is not good enough for drinking water purposes. Even a high arsenic water would may contain oxygen which is sufficient for consumption but not the water is still not potable, still not good for or fit for drinking. Isn't it? So this is what is you know we generally explain that by saying this, this is what is the mostly the heavy metal pollutants that I have discussed and also we go from here, we go from here to other aspects like you know where we deal with this pesticides.

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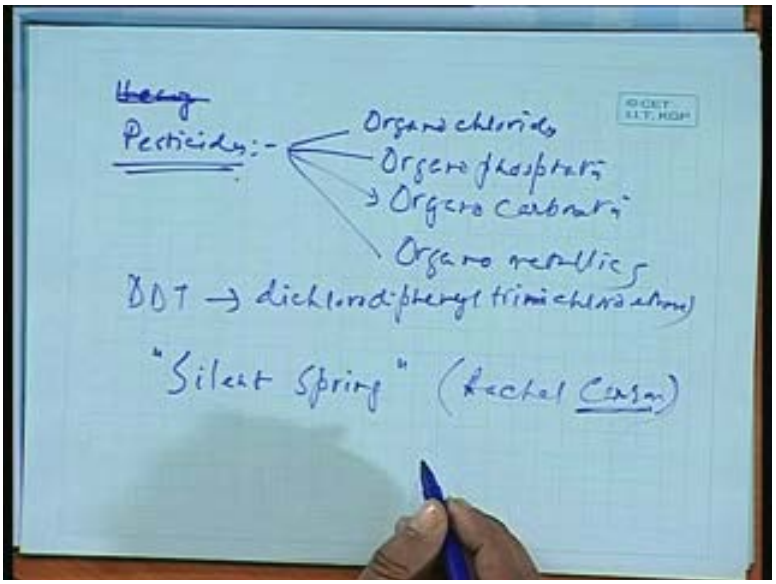

Another important thing about the pesticides, let me explain a little bit about this pesticides because you know you may not be, you may not be much, much conversant with this pesticides, pesticides whenever we are talking about pesticides, the firstly, mostly the things that generally come to our mind is are this the DDT that we know is a essentially a very famously known as, famously known pesticide. But before that the most of the pesticides are essentially say organochlorine, organochlorides, organochloride, organophosphates, organophosphates and organocarbonates, organocarbonates and they can be also other organometallics, organometallics.

Now it has you know very important consequence, pesticides are not only used nowadays for you know for agricultural purposes or food conservation purposes, pesticides are being used in paints also nowadays. There you know sometimes that people say you know it's a termite proof board. What does it mean, why it, how it can be termite proof? If it is a natural substance, a typical organics say you know plant material, a typical plant material, it cannot be termite proof because the termite would still find it good for their, good for eating. Isn't it? So how it becomes termite proof? So in fact it becomes only termite proof because you must be lacing that wood with huge quantity of pesticides, only if you are laced it if you are pasting, if you are painting with organopesticides that substance become termite proof. But there is a risk, the risk is that is not been told when it is said the termite proof the advertisers or the manufacturer would not say how it has become termite proof, what is the process they have made. The same way this is number one.

Secondly you might have saved yourself from the termite but you have added another problem to your living that is the pesticide itself. The children would use those substances, people would normally use those substances, so there is a, there is a, you are reducing one problem by inviting another or you are eliminating one problem by inviting another. So this is where you know, this is where is the implication I will just briefly discuss about you know about one pesticide or one pesticide that is very famously known is that organochlorine pesticide, organic chloride pesticide. That is DDT which is nothing but you know dichloro diphenyl, phenyl trinitrate, trichloroethane, sorry trichloroethane, trichloroethane. DDT is considered to be a wonder chemical in fact you know much of our agricultural revolution that world can at least give a some food to the majority of population of 6 billion people throughout the world is because of one of the chemical because of is, this is DDT. DDT is though you know it's banned in some uses but it still very much used in very many of this poor countries advanced developing countries DDT is still being used because it is very cheap. And the manufacturing of DDT is also easy, so you know it's a, is a less costs intensive material but it is highly DDT is also having a very important feature in terms of pollution, it has a very important feature in terms of pollution.

One important thing is you know about DDT is that you know DDT as I have said you know DDT is a wonder chemical you know till about say a till about 1960's. DDT was considered to be the wonder at least you know saviour of human kind because you know if human kind used to grow in that number they are there, there was a requirement of a substances like DDT. So unless we know as I have said wouldn't have got food enough to eat, if there was no DDT but DDT has this is DDT is where first one of the first instances where DDT was the reason where this environmental movement actually began. In 1966 you know there was one very, any one very important book or document that was that came about is that the silent spring is by Rachel

Carson, is by Rachel Carson. She was a, she was essentially a kind of marine biologist and a reporter as well.

Carson is later known to be a more as a reporter. This is she is you know she was considered to be one of the hundred most important figures of the last millennium, right. So is Carson is a considered to be there you know because of the, because you know Carson first found out the dangerous effects of DDT. What she observed was that you know in a particular river system of US, USA I think in a mostly in the Hudson river system there she found that you know this the river pelicans that they generally flock that area, river pelicans that flock that in that area they could not, they could not breed their offspring's because due to the high incidence of, high incidence of DDT in their metabolic system by that time DDT was being used in the agricultural farm fields so that DDT, the excess DDT that was not absorbed in the farm fields where basically being trickled down by the water and that water is used to be consumed by this, by this pelicans.

So what happened is their eggs, the egg shells where becoming thinner, egg shells where becoming thinner. So when they were trying to incubate the eggs, the birds found I mean, I mean the Carson Hartsel found that the due to the body weight of the birds, the eggs were being broken, okay the eggs were being broken. So Carson first observed that she didn't know essentially that it is because of DDT, she further investigated and found that you know this because of the DDT possibly that you know this kind of situation is taking place that has, that has started a revolution you know the Carson is considered to be one of the revolutionaries in environmental science or revolutionaries of environmentalism where typical the ideas, the start of environmentalism that we know off. So, the Carson was one of the visionary of, one of the visionary of that kind who actually modelled the movement of environmentalism in the world. So is if you can see this, now this DDT is also a, DDT is another very important aspect of the, another important aspect of DDT is that you know DDT is, DDT is DDT is not known, is not known to be a, to be a, not known to be a toxin, not known to be a toxin or it is not known to be toxic, not known to be toxic.

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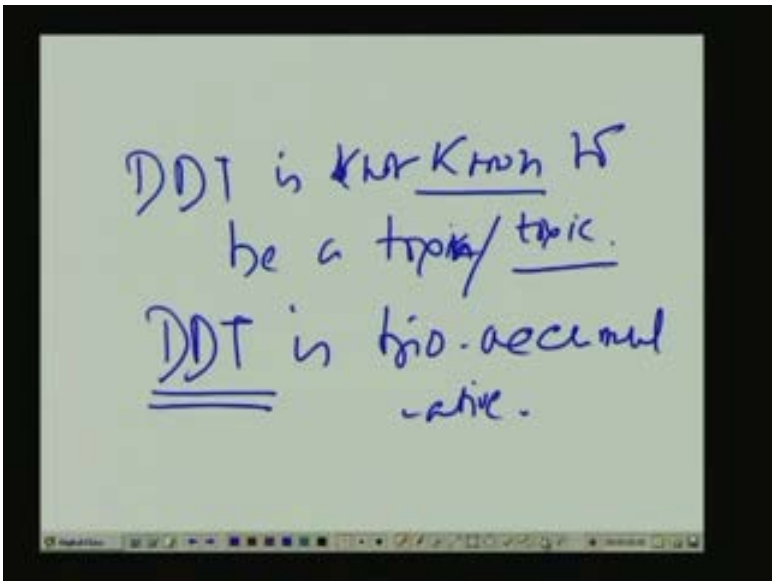

There is no physical or internal changes due to the high incidence of DDT. Just to let you know all of us have a good amount of DDT in our intestinal systems now because the foods that we have contains DDT and this DDT gets accumulated in our body. So but DDT we generally have even the humans have, almost all humans have certain amount of DDT stored in their intestinal system okay. Now what is, but DDT has another very important thing is that is DDT is bioaccumulative, DDT is bioaccumulative like many pesticides are they are bioaccumulative.

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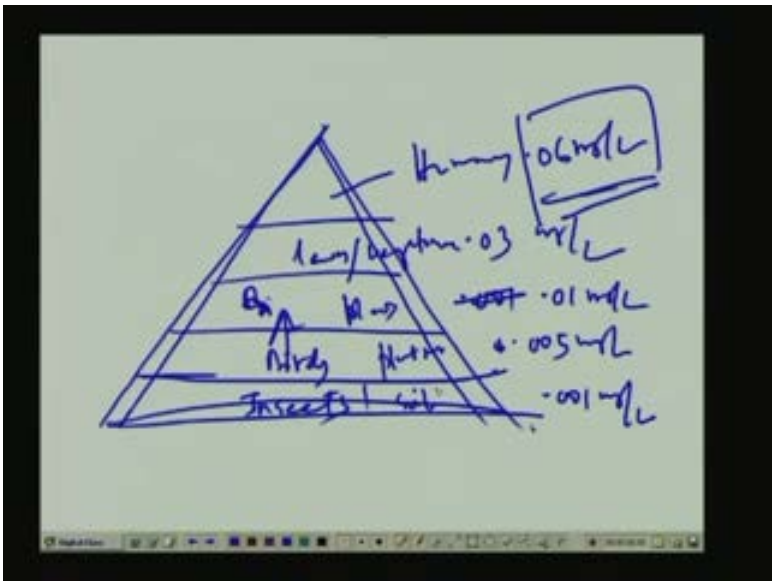

This bioaccumulative means that it would, it would continuously, it would, it would continuously moving the food chain. If it is in food pyramid if you observe in the food pyramid, the DDT would continuously move say that the first say you know just to observe the insects. Insects would have this, insects from the insects the birds would have a, birds of they then the birds then the larger bird preys, from the birds you know finally it would go finally higher to say birds or say you know even, even this is one stream, this is one stream there would be another stream like you know say this vegetation through the vegetation some soil, from soil to say the to the plant root, plants, to the plants, to the leaves, vegetables, leaves and leaves and vegetables to humans. And so what has, what has started, what has according to the mass, according to the mass this what has started to be a very small concentration say you know at about say if it is say 0.001 milligram per litre at the insect level or that the soil level this would keep on accumulate. So you can see you know in the next level it would be say 0.005 milligram per litre.

Then in the next level it would be 0.001 say point say 0.01, 0.01 milligram per litre okay. Say on the next face, it would may be 0.03 milligram per litre. So in a finally when it is coming to human it may be 0.06 milligram per litre, this is the concentration, this is called the bioaccumulative nature. It would continue to accumulate in the organic systems, it will continue to accumulate in the organic systems and it is this is what is the bioaccumulative. DDT does not have, DDT does not have a, DDT is not known to be a, as I have said DDT is, DDT is not known as a toxin but DDT influences, influences the metabolic function, influences the metabolic function.

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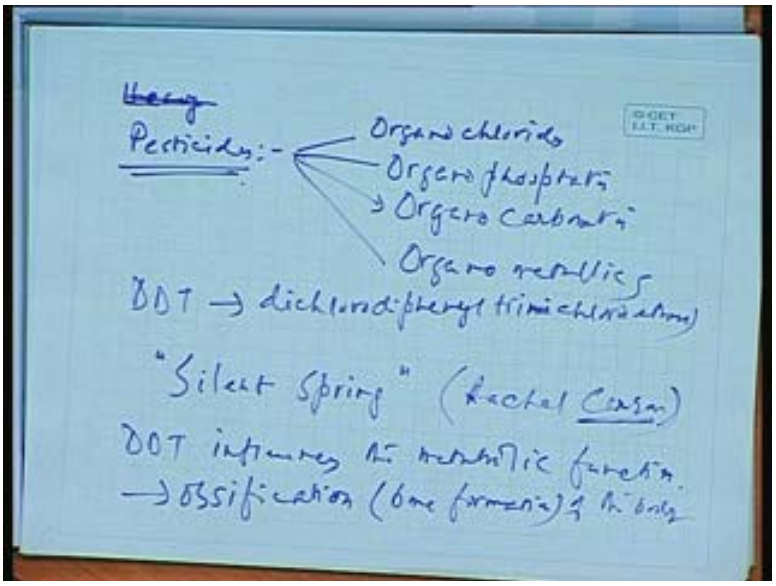

It also influences this ossification of the body, ossification or the bone formation though ossification of the body, ossification of the body.

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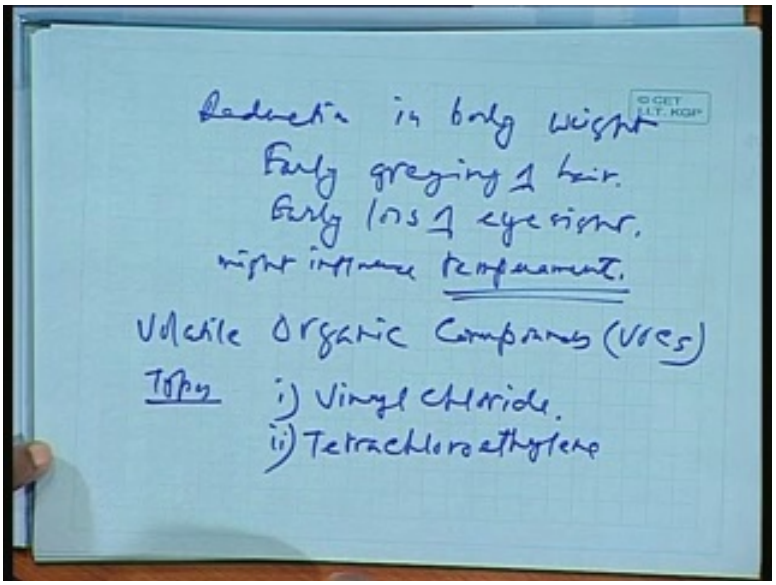

Though it would not be generally observable, though it would not be generally observable so but you can see the direct effect of DDT or similar pesticide says that reduction in body weight, early greying, early greying of hair, early loss of, early loss of eye sight, early loss of eye sight and also you know might influence, might influence, might influence temperament, might influence temperament that's a person becomes suddenly angry, the person becomes suddenly angry or the

person becomes suddenly very hostile might be related to a concentration of DDT or similar pesticides in the body. Understood?

So, what I mean to say here is DDT though it would not manifest, you cannot have a clear correlation between DDT, concentration of DDT and the incidence of a certain kind of behaviour but though are not being a toxin which would be readily absorbable, the DDT can influence the bodily functions, the growth, the physical growth, the mental growth, all these features can be directly influenced by the pesticides of similar nature DDT. So, as you can see you know it is it might be one incidence that you know that the children today are becoming of lesser weight. The children becoming are failed nowadays, children and the youngsters having problems of related to you know the digestive disorders, early greying of hair might relate to the high incidence of DDT in our food system, okay.

Another important thing you know that is you know will just bring in the discussion is that volatile organic compounds, volatile organic compounds, volatile organic compound this is known as VOCs. We would know them as VOCs, volatile organic compounds. There are many volatile organic compounds like but you know this to name few, to name few is this you know tetrachloroethylene say this volatile most toxic of this you know there are the typical type of them is the I'll explain you. The types are, types are the vinyl chloride, vinyl chloride tetrachloroethylene, tetrachloroethylene, trichloroethylene, 1, 2- dichloroethane. What is their specialty? Specialty is, specialty is they are, they are volatile, they are volatile in STP standard temperature pressure.

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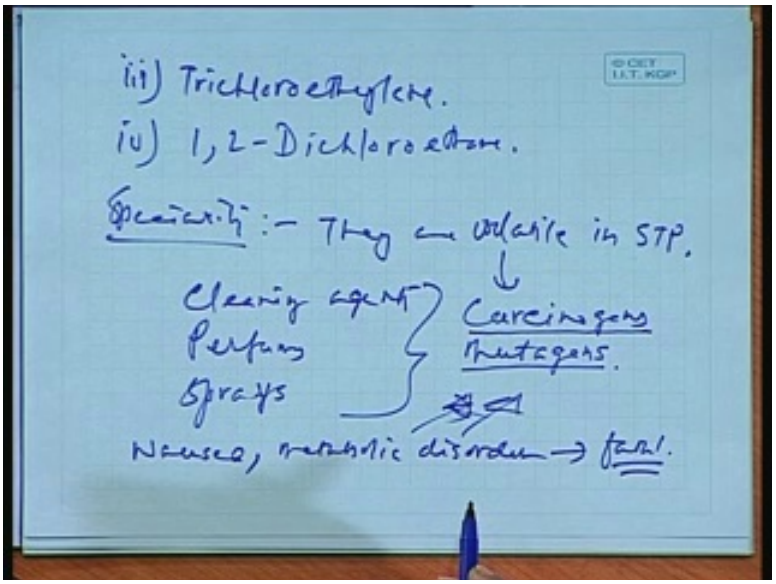

That is why they derive a name of, they derive a name of volatile organic compounds, volatile organic compounds, volatile organic compounds. They are essentially organic nature but as you can see they may have say this may, they may have the halides in them, they may have say the different types of chlorinated substances, they might have you know any other substances you know organics they might also have some organics in some cases.

So if this can be the, they can have certain metals, metallic's also in that, so specialty is that they are volatile in standard temperature pressure that is very important. What are those cleaning agents? Cleaning agents, many cleaning agents are basically this volatile organic compounds may be this perfumes, sprays, perfumes, sprays and they are and many of them are, many of them are known as carcinogens, many of them are known as carcinogens or mutagens, carcinogens or mutagens, carcinogens or mutagens. What is this mutagens all about? The mutagens are you know these mutagens may be not leading to carcinogen, not generally leading to carcinoma or cancer but they can also have local changes, local abruptive changes it can take place, local abruptive changes they can take place.

So usual phenomena you know particularly of this apart from being carcinogen themselves they have, they cause nausea, this is the vomiting tendency. This is nausea, the vomiting tendency say then you know metabolic disorder. If it is constant, consistent nausea or consistent say unrest metabolic disorder, metabolic disorder and this can finally be fatal also. In most cases it is if it is persistent this all this disorders, if this disorders are if there somebody is having a serious metabolic disorders this can be fatal at one point of time. Apart from that you know they are very you know great use, they are in they are almost used in various sectors of the industries.

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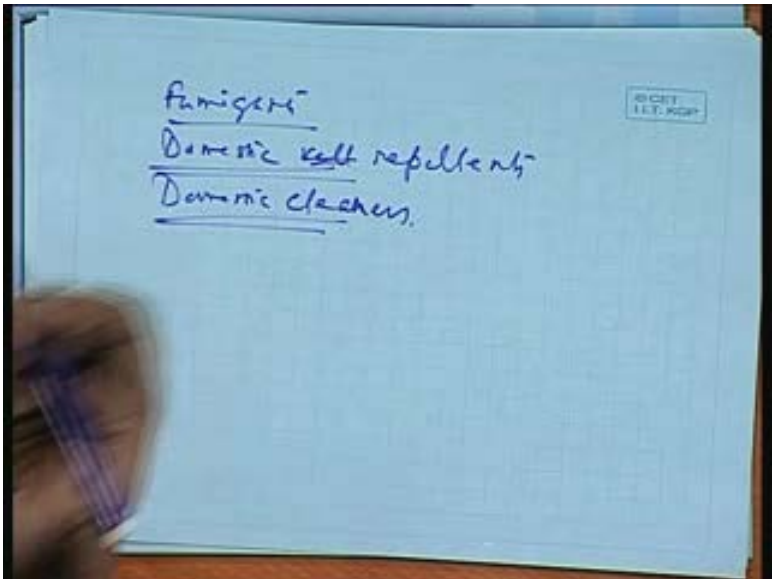

All these fumigants that you know of or this then this fumigants then domestic repellents, domestic repellents then you know they are a cleaners as you know domestic cleaners, all these can result in the… Whenever you are, you are smelling something you must be knowing it's must be a VOC in most cases, in most cases other than say camphor's or things like that in most cases it is a volatile organic compounds. So whenever you are seeing a, seeing a cleaner or any kind of agent where you can smell, you may be sure that there is some volatile organic compound. I'll just tell you know a simple case where you, if you go to say this petrol pumps next time just go the petrol pumps many of you go regularly, you would see that most of this people most of those fuel fillers are those who users thus they typical helpers in those in the service stations, they would complaint of vomiting tendency, they would complaint, generally

complaint of vomiting tendency. And also you would see in many cases unless that place is very well protected, very well ventilated, is very well ventilated in such cases you will see that they always complaint of some vomiting tendency then turning of heads then migraine then you know pain in the brain, pain in the forehead, things like that and usually you will find they take up you know they handle this thing by a using say pan, this is particularly like pan parag's kind of substances chewables which essentially help them to get out of this vomiting tendency and dizziness, nauseatic tendencies things like that.

So, here in they are the people who are likely to be effected and the mostly likely to be affected. If the condition is not good you will find the, their working life in that particular area is very low, very very little. A person may be working there for 10 years, 15 years but that is what they can sustain after that he has to go out and mostly he would suffer, mostly he would suffer because, largely because they are poor people, so you know they are likely to suffer also. And mostly in a society like ours where there is no kind of self-protection or things like that most of them, most of this people are finally end up dying unattended.

So these are typical features you know typical aspects of this pollutants that we discussed you know we will continue with the discussion of water pollutant modelling in the next class. Let me see I have asked for them for the class, if it is available to us we will get into that. With this we now end the today's class. Thank you.

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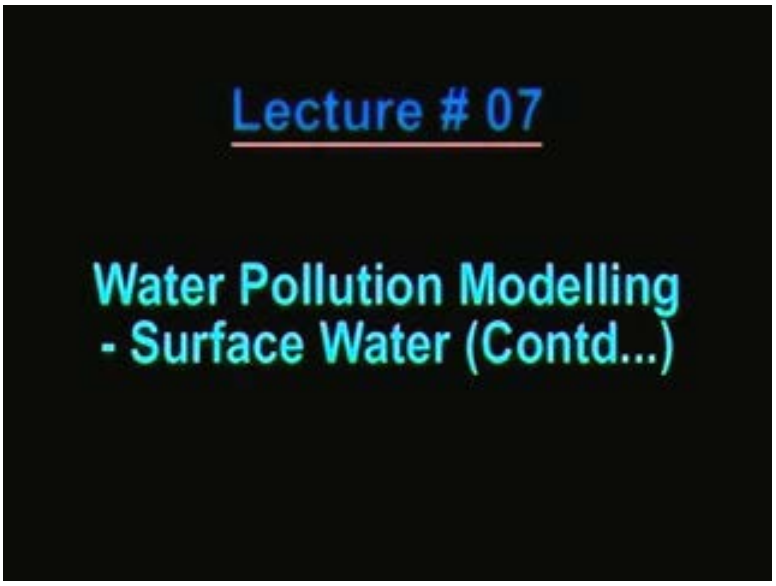

To start with you know today will begin with discussion on this biochemical oxygen demand.

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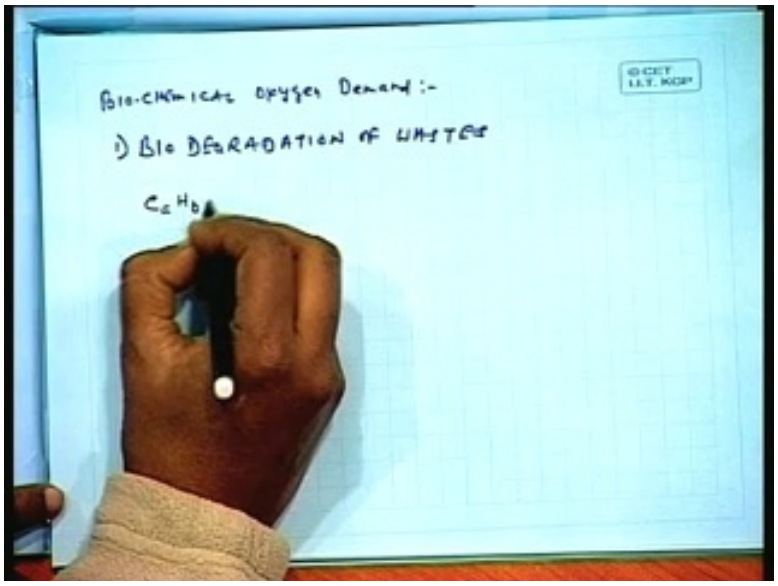

Biochemical oxygen demand, biochemical oxygen demand, biochemical oxygen demand okay you just write you know you can write it carefully right important. Two important things that I have said earlier in the classes let us begin I mean let us, let us deal with this oxygen demand part as such. See here there are two, two differences few differences to be made. One is you know when you are discussing biochemical oxygen demand, before we go in to the detail of biochemical oxygen demand I want to discuss about two things. This is number one is this is very important for engineers outside or the environmental is working outside say civil waste or say sewage waste like this. Most in cases I, in the last class also classes I also discussed this biochemical waste is the nature of the biochemical waste that I have said the human excreta say the dead bodies, dead leaves all these comprise of oxygen demand.

They are these substances are mostly in the nature you know they call that they are, they are of bio chemical origin and that is why since they have a very great demand in fact as I have said that mostly the environmental engineering started with sewage and sewage engineering. So you say basically there is a, there is a strong correlation of biochemical waste with environmental engineering but as such there are few things to know about this you know biochemical oxygen demand or oxygen demand as such. What happens is there are one important part here is to this general biodegradation of wastes you know this is what we would say biodegradation, degradation, biodegradation of wastes, biodegradation of wastes, right. The biodegradation of wastes you know this can be very well be you know if we just try to see this from this plot here you know from this, this doesn't come centre, okay. So is mostly say this biodegradation of first we can write on a particular say equation which should be incomposing that complete reaction that actually takes place say know C this is carbon being a very integral part of this kind of resources, this kind of wastes.

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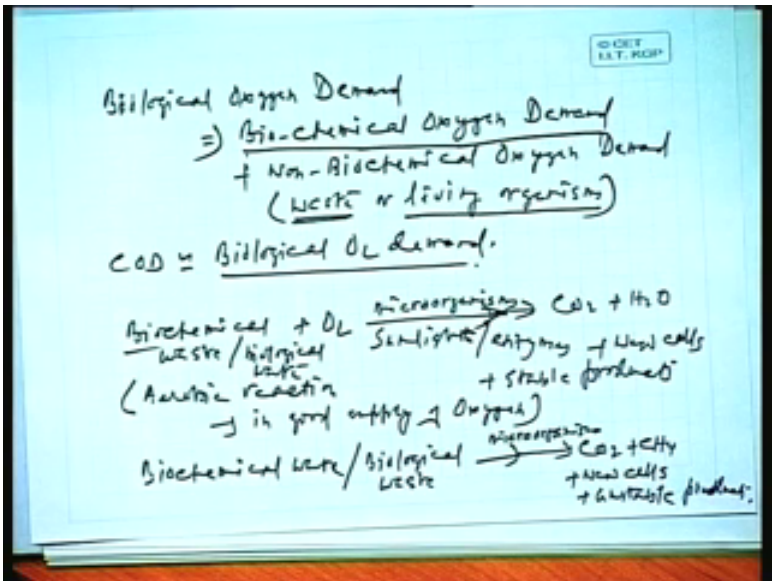

This particularly the aerobic reactions taking place okay, aerobic reactions taking place. As the oxygen level would be decreased, also the sources of energy would be decreased, sources of other source of energy so sunlight getting decreased or we are not allowing another other energy source to go into, in such cases generally in the deep of water, in the deep of water if you consider you know in the depth of water in the, if you see the top column of a pond would be mostly be, mostly the reactions that we generally observe would be aerobic reactions. But as you go in the depth when there is rays of sunlight and also the water is depleted of oxygen in such situation we would find the second stage this is the biochemical waste or biological waste getting depleted by this inorganic, this by depleted by the microorganisms, anaerobic microorganisms in the absence of oxygen and sunlight to form carbon dioxide, methane, carbon dioxide, methane, new cells and unstable products. So this is how this mostly this organic substances get decomposed in water, okay.

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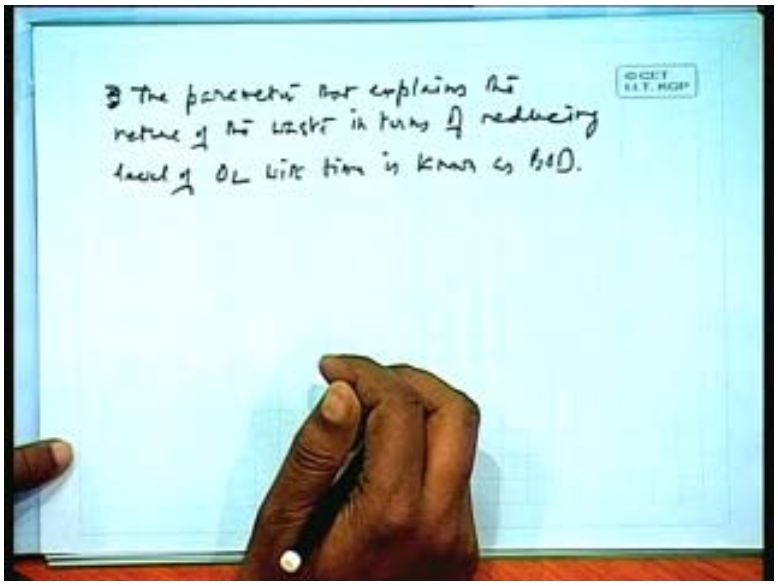

Now having said this that you know there is a, in a very standard thing that we generally find out that you know 5 day BOD test say one okay, the parameter in terms of reducing level of oxygen the parameter that explains the nature of waste in terms of reducing level of oxygen with time is known as BOD, right biochemical oxygen demand, biochemical oxygen demand.