Fundamentals of Environmental Pollution and Control
Prof. Jayanta Bhattacharya
Department of Mining Engineering
Indian Institute of Technology, Kharagpur
Lecture No. # 18
Chemical Treatment

Well, we are explaining about the chemical treatment of mine waste, waste water in general and we are discussing about the amphoteric property of most of these metal hydroxides and sulphides. We have also observed that you know that in situations like where a, in a solution, in a solution all this metal hydroxides and sulphides generally show a particular preference of pH when they are, their precipitation rate is high, precipitation rate is highest for them. And also to observe that that you know they show a minimum solubility in water at a particular pH, this particular property of this metal hydroxides, metallic hydroxides and sulphides are greatly used in chemical treatment. I have also discussed you know the procedure essentially is like this.

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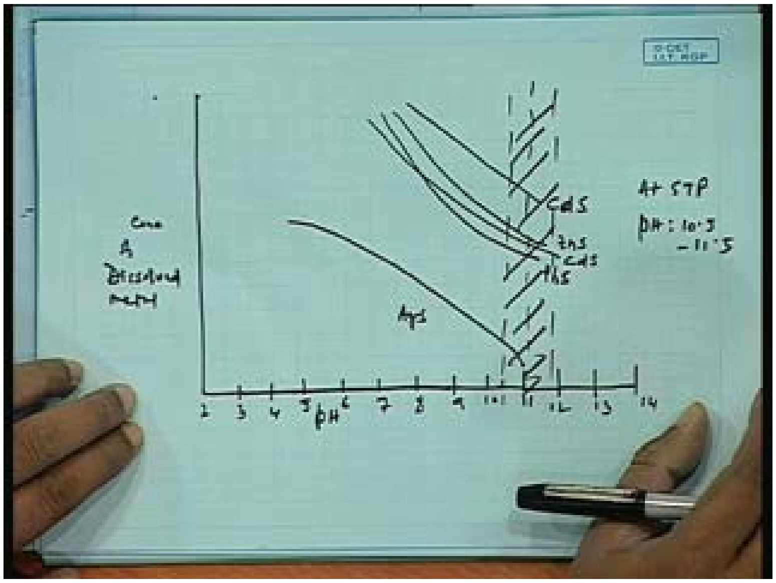

I have given you a particular idea about how this you know the plants can be designed in, plants can be designed in with that in mind. Let me explain you a little bit on this, let me explain you a little bit on this say you know here, if you just observe this amphoteric property in a, in a graphical form this is how it looks like say concentration of dissolved metal, concentration of dissolved metal and if you observe this, if you observe this you know in terms of pH here we also consider the pH 2 3 4 5 6 7 8 9 10 11 12 12 13 and say 14, so here okay.

So, what we observe the pH in which the water can remain. See here what is important here is this to observe here is say at about 11 pH, at about 11 pH, this is the Ags, Ags, it has the Ags has, this is the Ags, this is silver sulphide, so we can find out here this you know this particularly you know has a minimum solubility here. So, what we are trying to do is suppose if we want to precipitate silver sulphide here, what you would try to do is just to maintain the pH at about 11, pH of the solution to be kept at about 11 so that the maximum solubility I mean the minimum solubility takes place and most of the material which were in the saturated condition would come out, would come out of the solution of water and precipitate and precipitate.

Similarly, all this you know if you just observe this for particularly, a particularly for other sulphides, if you just observe about 11, at about 11 this other sulphides, if you just observe this that you know they would also come down like this then this is how, this is how this you know this is how the plot should be say this is one is cadmium cds cadmium sulphide, this is for, this is for the zinc sulphide, this is for, this is for cos cobalt, this is for cds, this is for pbs lead sulphides. So, you know here we can see this you know particularly, particularly like this we observe this plots if you just try to observe this, this is for the sulphides, this is for the sulphides that we observe a similar kind of situation.

So, what is the plants specification is if you are just trying to, if you are interested in, if you are interested in separating out, if you are interested in dissolve in precipitating a say the particularly if you are this salts, particularly Ags, pbs, cds, zinc sulphide and say you know this cos cobalt sulphides you have to maintain the pH at about at open at most at STP, remember this is at STP, that is at STP if you maintain a pH between say here as you can see 10.5 to say 11.5 you can, you can selectively precipitate, you can precipitate all these sulphides from the water, you can precipitate all these, this is what is called the amphoteric property. That is what I explained that all zinc sulphides and zinc, almost all metal hydroxide and metal sulphides show a minimum solubility, show minimum solubility at a particular pH. So, this helps us you know into in preparing for the plant structure, how the plant has to be designed so as to selectively precipitate some of this sulphides, some of this sulphides and hydroxides. Similarly, this one case for hydroxides if you just observe for hydroxides if you this is, this is an amphoteric property. Similarly for hydroxides if you just observe this for hydroxides, this is how it would be looking like.

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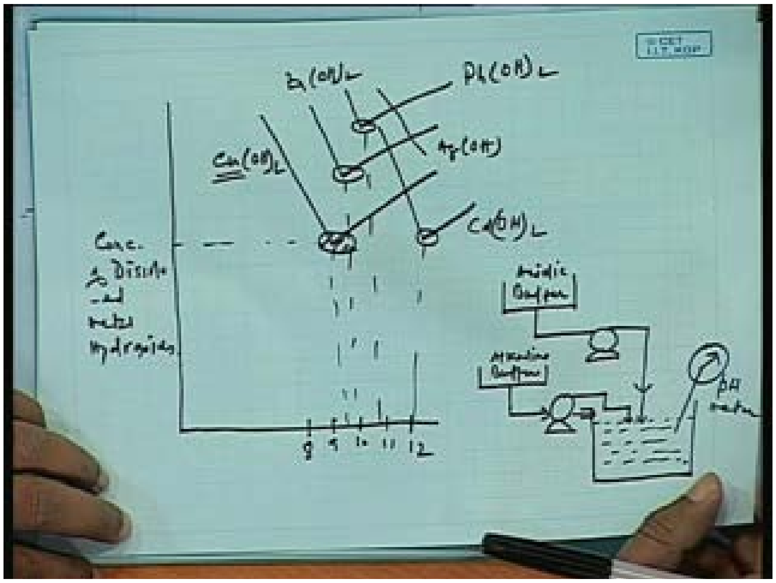

So, this can be, this can be thought of as something like this say you know here if you just observe here say at about say between 8, between 8 pH 8 and say about 12, if you just see 12 8 9 10 11 12 if you just observe this almost all metal hydroxide, copper metal hydroxides almost all metal hydroxides would begin to precipitate here. So, this is, this is how it would be. So, we can some of them are going out actually just because of my drawing but you can see here. So, this is where the minimum solubility is, this is where the minimum solubility is. This is a concentration, concentration of, concentration of dissolved metal hydroxides, metal hydroxides, concentration of dissolved metal hydroxides, this, all these you can see if you just maintain a pH a manipulative pH, so here this one can be, all these can be precipitated selectively. If you want to do it a selectively you can selectively do so, you can selectively do so by targeting the minimum solubility zone, minimum solubility zone.

So, you know you see if you are targeting the minimum solubility zone, you can selectively precipitate say particularly say this is one is for Cd OH 2, Cd OH 2, this is, this is for Ag OH, this is for Cu OH 2, this is for zinc OH 2 like this, this is for, right. All we are trying to do here is, all we are trying to do here is just to you know as I was discussing in the, in the last class you could see that I have talked about the streams by which you know you can if you can maintain a certain pH if you can maintain a certain pH for different metal hydroxides, we can selectively precipitate them, we can selectively precipitate them. This is possible because of the amphoteric property of this metal sulphides and metal hydroxides.

So, the stage here is you know if you just observe it like this what we generally try to do is say this is, this is you know this is if you just see the plant here, this is what is in a pump like this which would be finally discharging onto say this. And similarly there would be another term, we can see here this is, this is what is, this is these are two pumping arrangements, these are two pumping arrangements, these are two pumping arrangements. This is where the water, this is where the water, where the water, influent water is being discharged here, influent water is entering here, influent water, influent water.

Now selectively this is influent water, this is you know this is a alkaline buffer, this is an acidic buffer, an acidic buffer, this is an alkaline buffer, this is an acidic buffer. So, you can see this you would here would be, here would be 1 pH meter. So, you know here would be 1 pH meter. So, depending on, depending on say this, depending on the various the type of pH that we would require we would use either the acid or the alkaline. So, as to get suitable pH, so that at that Ph a certain the particular chemical that has an attention that we have an attention, suppose, if we have a waste particularly say if you consider say metal mining waste say considering metal mining, say mining waste so that three typical kind of wastes we have. This is lead, cadmium and chromium and copper, 4, lead cadmium copper and chromium.

See, these four, these four you can see if you are targeting copper, if you are targeting copper you would run into a stream where you will try to maintain the pH say between 9 to 10 say about 8.5. So, here in this here you would maintain the pH at 8.5, so that most of the copper hydroxides, most of the copper hydroxide precipitates. Say, if their copper hydroxides is precipitating what essentially is happening is the concentration of metal is going down in the solution, all right.

So, this is what is known as the lime treatment, this is what is the famous lime treatment that we generally do in most of the, most of this environmental industry lime treatment is a very standard method of treatment. So, this is a very effective method of treatment for different kinds of metallic irons. Now, it essentially we were trying to do is at standard temperature pressure, we are trying to see the solubility, we are trying to see the solubility and particularly the minimum solubility at that pH where it would begin to come out of the water and it would begin to precipitate. So, this is what as a result of this we would begin to, we would like to get into, we would like to more and more get into this selectively precipitate different kind of, different kind of sulphides and hydroxides.

Now here as you can see you know at times when the acidity would increase say you know we are getting acidity towards say from 7 6 5 4 3 2 like this and if you want to increase it to say, say we want to increase it to 8 or 9 in such cases we have to use more alkali on this. So, you would use the alkaline buffer and in the same case when you require to reduce it say from 11 to 8 or 11 to 8.5 or 6.5 or 7 or say you know about that much, so in such cases we have to use some acidic say acidic buffer so that combining these two continuously monitoring that we can separate out a number of metal hydroxides and sulphides. This is famously known as the lime precipitation technique which is say generally used you know in a, is so to say is very simply and you know is a very, very cheap also as a method of treatment.

It suddenly has its disadvantages and advantages but not to, I mean considering that also considering that also we find a great use of this treatment method, okay. So here we would just try to see so it as you can see in most cases that the binding reaction is basically a, basically the precipitation of a, precipitation of most of this metallic hydroxides and sulphides, metallic hydroxides and sulphides. Some there are certain advantages and disadvantages connected to this.

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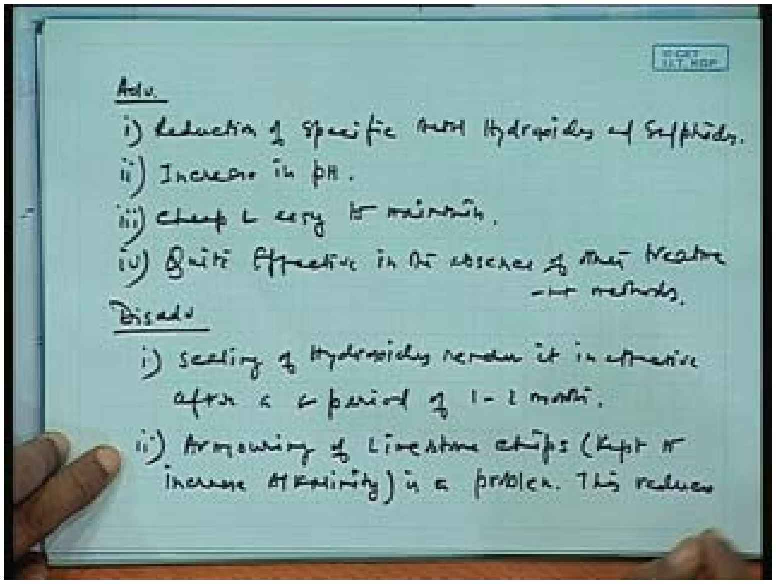

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Adv.

i) Reduction of specific metal hydroxides and sulphides.
ii) Increase in pH.
iii) Cheap & easy to maintain.
iv) Quite effective in the absence of other treatment methods.

Disadv.

i) Scaling of hydroxides renders it ineffective after a a period of 1-2 months.
ii) Armouring of limestone chips (kept to increase alkalinity) is a problem. This reduces

This is, one is the advantages that we can generally observe in cases like this is that you know neutralization is reduction of, specific, reduction of specific metal hydroxides and sulphides, increase in pH, increase in pH helps in reducing a number of things as well, renewal of heavy metals that it takes place, cheap and easy to maintain, cheap and easy to maintain quite effective, quite effective in the absence of other treatment methods, in the absence of other treatment methods, in the absence of other treatment methods. Disadvantage, disadvantages that you can generally observe in this kind of lime precipitation technique is a number one is at a scaling hydroxides render it ineffective, render it ineffective, ineffective, render it ineffective after a period of sorry after a period of, after a period of 1 to 2 months armouring of, armouring of lime chips, armouring of lime stone chips kept to increase, kept to increase alkalinity is a problem. This reduces, this reduces, this reduces armouring, armouring, armouring of lime stone chips kept to increase alkalinity is a problem.

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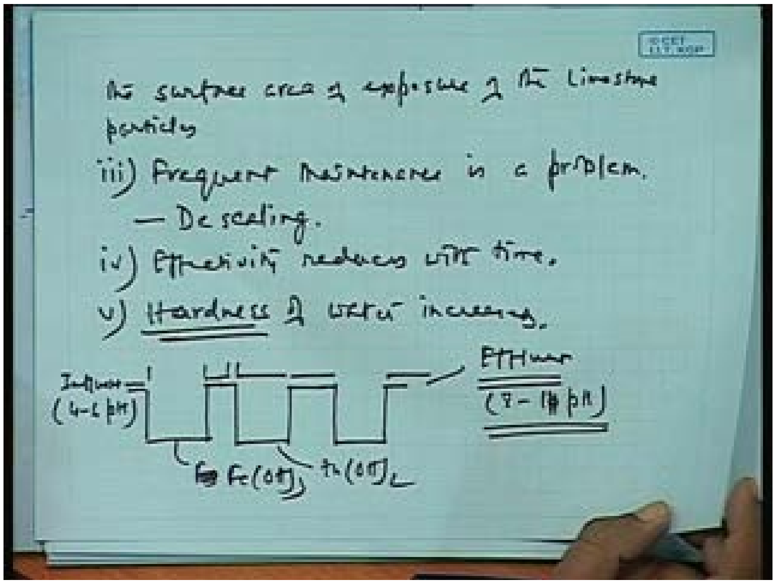

the surface area of exposure of the limestone particles

iii) Frequent maintenance is a problem.

— Descaling.

iv) Effectivity reduces with time.

v) **Hardness** of water increasing.

This reduces, this reduces the surface area of exposure, surface area of exposure of the lime stone, of the limestone particles and thereby rendering it ineffective, thereby rendering it ineffective. Frequent, frequent maintenance, frequent maintenance is a problem, frequent maintenance I mean frequent maintenance for descaling, frequent maintenance is a problem descaling say another important part is effectivity reduces with time, effectivity reduces with time, effectivity reduces with time, effectivity reduces with time. So, now this is effectivity reduces with time. So, you can see this you know this is one big important method for, one big important method for secondary treatment that we have observed, the secondary treatment we have observed and so you know you can see that this is one method, one treatment method that is has a great application that has a great application okay.

This is, this, this is about the lime chemical precipitation technique and in any question you have, anything that is not understood say let me again explain you this that amphoteric property suggests that all metal hydroxides and metal sulphides have minimum solubility at a particular pH, at a particular pH. So, at that point their solubility becomes minimum, so for our plant designed specification we would like to keep the water into those particular minimum pH, in those particular pH values so that the solubility of the metal hydroxides in the solution of water becomes minimum, becomes minimum at that temperature and pressure at STP that we consider. And so if you maintain that way, if we maintain that we can selectively and we can grossly precipitate a number of metal hydroxides and sulphides from the water.

So, as a result of that the water the metallic cations in the water, concentration of cations in the water begin to decrease and as a result of that water begins to be more purified okay but at the same time, it is, it is also as I have said you know hardness increases the another, another important hardness, hardness of water, increases hardness of water, the effluent, the effluent water finally, the effluent water as you was discussing, the effluent water finally would be the, finally the effluent water that I said you know in a different say a different vessels through which this, this water would pass vessels through which the water would pass would essentially.

So, you can see this influent effluent, we can say this, a ferric hydroxide FeoH 3 being deposited here then you can see you can find out zinc here. So, selectively maintaining that we can precipitate a number of these substances but this effluent essentially, this influent in most cases of this nature if it is you know the if effluent pH may be say 4 to 6 pH whatever this effluent pH become 8 to 10 or say when 8 to 11 pH. So, you can see this is as a result of that the alkalinity, increase in alkalinity you know also increases a certain kind of hardness in the water which makes the water otherwise not usable, we have deal with these you know in a separate way we have to find out methods by which say by either by hitting or by any other process to reduce the hardness to a certain extent. So, a case this is if you just observe this, this or this is one very important technique of this.

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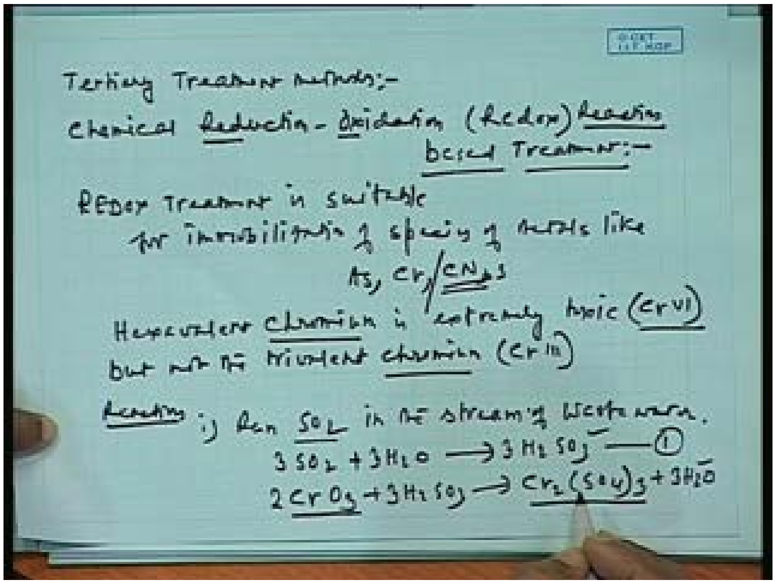

Tertiary Treatment methods:-

Chemical Reduction - Oxidation (Redox) Reaction based Treatment:-

Redox Treatment is suitable for immobilization of species of metals like As, Cr/CNs

Hexavalent chromium is extremely toxic (Cr VI) but not the trivalent chromium (Cr III)

Reaction: i) Run SO_2 in the stream of waste water.

$$3SO_2 + 3H_2O \longrightarrow 3H_2SO_3 \quad ①$$

$$2CrO_3 + 3H_2SO_3 \longrightarrow Cr_2(SO_4)_3 + 3H_2O$$

Another kind of tertiary treatment you know will not find time to discuss all the method of tertiary technique, tertiary treatment methods, tertiary treatment methods, tertiary treatment methods we just observe this tertiary treatment methods you know here we could talk about chemical, chemical reduction, reduction oxidation redox based treatment, based treatment. See, in as you know in a, in any, any kind of, any kind of chemical equation if something gets reduced, something gets oxidized say essentially that particularly that kind of feature always exist. So, we can see is that we can observe you know particularly what this is we generally observe here is say we would, it particularly this kind of redox techniques, this kind of redox treatment, redox treatment, redox treatment is suitable, particularly suitable for a, suitable for immobilization. This is the word immobilization of, immobilization of say immobilization of species of, species of, metal species of metals like, like immobilization of species of metals like chromium, chromium then cyanides, chromium cyanides and chromium okay it chromium then you can see arsenic chromium and cyanides, cyanides immobilization of species of metals like arsenic, chromium and also decomposition of this cyanides, decomposition of this cyanides.

The cyanides are you know extremely toxics, cyanides are extremely toxics, so are this arsenic and chromium but remember one thing here what is the property that we see is we generally this is the hexavalent chromium, hexavalent chromium that is chromium 6 we call it hexavalent chromium, hexavalent chromium, hexavalent chromium is extremely toxic, this is called chromium 6. This chromium 6 is extremely toxic but not the trivalent chromium. This is Cr 3. See, this is what is called species, this is what is called species which have when the same metallic irons would undergo, same metallic irons would undergo changes in the valency, you know they will have different valencies is like you know you know that if iron, ferrous iron and ferric iron that the valencies are different.

So, this you know this is what is this you the valency the hexavalent chromium, hexavalent chromium is toxic but not the trivalent chromium. So, what we try to do is here we do not want to reduce of, we don't want to precipitate chromium here, we may write to make it, render it some hexavalent chromium to convert into trivalent chromium so that if we can make it trivalent chromium, it would be largely immobilized that is you know it will not move from one place to another this is number one and secondly, secondly in any kind of say you know digestive tract or any others passages through which it will pass, it will not be reactive, it will not be reactive, it would remain as it is. You know it will completely pass neither it would be observed in the, in the physical system neither it would be you know form any compound with any other substances.

So, it would just merely go into the food passage through the, through food passage and through the excretory channels, it will just simply come out of the body but it will not react but not that particularly that property is not good for hexavalent chromium. Hexavalent chromium is highly observable, it will be observed in the different streams of the body during the movement in the, movement through the digestive canals. So, here what would what we try to do is we would the water containing a hexavalent chromium will be reduced to trivalent chromium with the idea this hexavalent chromium is, chromium is particularly where chromium is used you know chromium is used for steel finish, in steel chromium is used, chromium is used in an, in an number of polishing industries where there are metal polishes are required.

Say the metal fine metal finishes that you see you know generally in your, in all say industrial complexes and things like that massly layered thickly by chromium. So, the chromium is a very highly usable material is highly used but as such what we try to do is we generally would like to reduce the trivalent chromium, reduce the hexavalent chromium into a trivalent chromium. So, what we generally try to do is we run sulphur dioxide in an control manner, this is sulphur dioxide. The sulphur dioxide, the reactions are running sulphur dioxide, run sulphur dioxide you just say run sulphur dioxide, run So 2 in the stream of, in the stream of waste water, in the stream of waste water.

What we are trying to do is we are this 3 So 2, 3 So 2 plus 3 H 2 o this is combining with water as you can know this is 3 H 2 So 3 it will make. This H 2, H 2 So 3 would combine with then this 2 H 2 So 3 this the next stage of reaction is hence say the reactions that would be forming a 3 So 2 plus 3 H 2 o forming say sulphurous acid, sulphurous acid number one, this then this equation as you can see here this would be dealing with, this would be then dealing with chromium oxide, chromium oxide. You can see this, the valency is hexavalent, chromium 6 here hexavalent chromium. This one is would be dealing with 3 H 2 So 3, 3 H 2 So 3 to form Cr 2, Cr 2 So 4 3 plus 3 H 2 o plus 3 H 2 o plus 3 H 2 o. You can see this you know this should be forming 3 H 2 o, so this one you can see now this particularly this chromium, hexavalent chromium has been converted into a trivalent chromium.

So, nothing actually is getting precipitated only the conversion from hexavalent chromium to trivalent chromium is taking place. It is within the solution itself, nothing is coming out of the solution but simply because we have been able to convert this chromium, hexavalent chromium into a trivalent chromium, our purpose is solved. So, you can see here this hexavalent chromium is becoming reduced okay. So, as a result of this we can see this, this is the reaction you know which is a, it’s a typical redox reaction that is generally done to neutralize, to neutralize the highly reactive chromium 6 into non-reactive, non-reactive and stable chromium 3, okay. There is, this is another, another important area is, another important area for this kind of analyzes is you know is where we use generally say there is the cyanides, another is the cyanides that we generally use that is say the destruction of cyanide say you know destruction of cyanide, destruction of cyanide, a destruction of cyanide.

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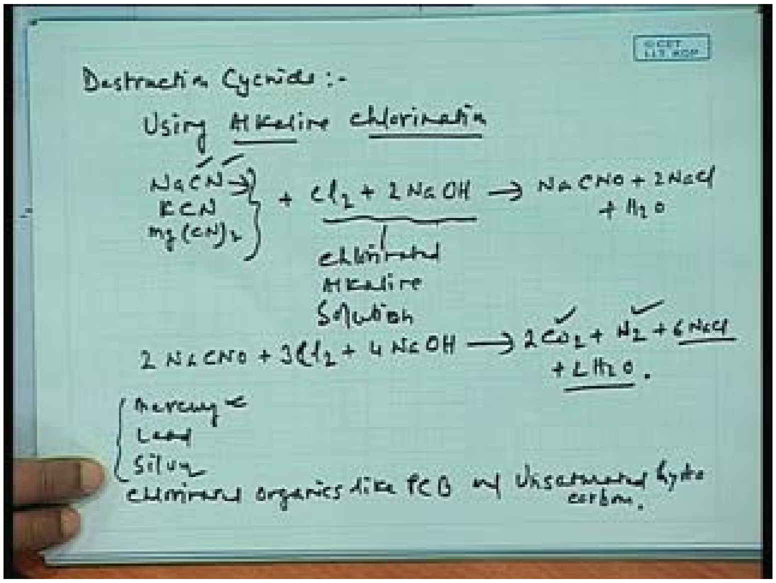

Destruction Cyanide :-

Using Alkaline chlorination

$$\left.\begin{array}{l} NaCN \\ KCN \\ Mg(CN)_2 \end{array}\right\} + \underbrace{Cl_2 + 2NaOH}_{\text{chlorinated alkaline solution}} \rightarrow NaCNO + 2NaCl + H_2O$$

$$2NaCNO + 3Cl_2 + 4NaOH \rightarrow 2CO_2 + N_2 + \underline{6NaCl} + \underline{2H_2O}.$$

Mercury
Lead
Silver
chlorinated organics like PCB and Unsaturated hydrocarbon.

How we do the destruction of cyanide? What we generally find out is you know we using alkaline chlorination, using alkaline chlorination. We are, we would be destructing, destructing of cyanide takes place using alkaline chlorination. Alkaline chlorination is this, this is say NaCN, this can be NaCN, this can be any other substances like you know sodium cyanide, this can be KCN also, this can be KCN then it can be mg CN to right, all these substances there should be a reacted is alkaline chlorination. This is a chlorine, the gas of chlorine and the chlorinated alkaline solution, chlorinated alkaline solution that is NaOH chlorinated alkaline solution. We can see this chlorinated, chlorinated alkaline solution, chlorinated alkaline solution, chlorinated alkaline solution leading to, leading to Na CNo in the first stage 2 Nacl this is pure simple sodium chloride and H 2 o. So, we are using this one, we are using this one but you can see, you can very well write for other substances also.

You can see KCNO, KCNO then this Kcl, Kcl like this you can find out in an H 2 o, this is that the reactions can take place like this KCNO, Nacl like this, H 2 o would form. This a, this one would be then 2 NaCNO, 2 NaCNO again reacting with chlorinated, chlorinated alkaline solution 4 Na OH, 4 Na OH would give rise to 2 Co 2 plus N 2 plus N 2 plus 6 Nacl plus 2 H 2 o. So, here you can see this finally, this C, this N, this C and this N finally being destructed into carbon dioxide and nitrogen, carbon dioxide and nitrogen. This is also another kind of redox reaction where the destruction of this cyanides take place, the destruction of cyanides take place.

So, we can, we can think of this redox reactions, we can see the usual experimental procedure is to measure the cyanide before being treated with chlorine and sodium hydroxide and finally the effluent, which is influent and effluent the concentration of cyanides would be measured to find out, to find out how this is actually what are this typicals, the breakage into carbon dioxide and nitrogen. And so finally the water that we would generally find out if you just stir the water quite a while this nitrogen does not remain, nitrogen is not a soluble, much soluble material in water so it would live the water, so would be the carbon dioxide at STP and so what we find out is sodium chloride and 2 H 2 o. So, the water being almost completely purified by, from cyanides okay.

So, this is you know this is a, this is a typical tertiary treatment, this is a typical tertiary treatment that are generally found a good use, found a good use, this is also, this can be this that there are different kind of other substances that are generally dealt with is a mercury lead, mercury lead, silver, silver and chlorinated organics, chlorinated organics like PCB and also and unsaturated, unsaturated hydrocarbons, hydrocarbons, unsaturated hydrocarbons, unsaturated hydrocarbons, unsaturated hydrocarbons means you know which is the bonding has not been saturated yet. It can be further saturated.

A saturated hydrocarbon and a hydro unsaturated hydrocarbon is the difference is the unsaturated hydrocarbon would continuously try to link more and more carbon and hydrogen bonding. So, this would continuously develop. This is known as unsaturated hydrocarbons. When the saturated hydrocarbons or the hydrocarbons which are not generally add further into that. Say you know mostly the fat, the fat can continuously combine, continuously combined. So this is would be, this would be known as unsaturated hydrocarbons. Similarly, this carbohydrates, carbohydrate are essentially saturated hydrocarbons, they will not attach anything else with the bonding. So, the carbohydrates the one the fix is there, so it would continuously remain in that. So, here it is, so this is what is you can see that you know in particularly when you are targeting, when you are targeting a particular metal, when you are targeting say you know you are targeting mercury you have in a particular source of industrial water or any other water for drinking water purposes you have high dose of mercury. This mercury may not be replaced cannot be, cannot be simply taken out by say a line precipitation technique. You have to have a technique like redox reactions where these things would be separately can be handled. So, this is where when there is a particularly very specific pollutants to be reduced, specific pollutants to be eliminated from the waste water we would go for tertiary treatment and one of the very famous tertiary methods of tertiary treatment is redox reactions. There are few more, there are many more actually there are many more but you know this just gives you the basic of where and how this techniques can be used, okay.

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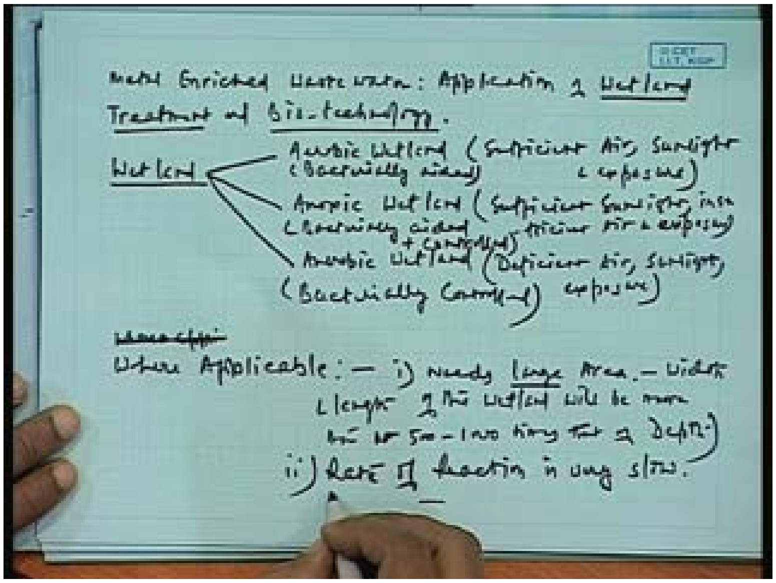

Metal Enriched Waste water: Application of Wetland Treatment and Bio-technology.

Wetland
- Aerobic Wetland (Sufficient Air, Sunlight & exposure) (Bacterially aided)
- Anoxic Wetland (Sufficient Sunlight, insufficient Air & exposure) (Bacterially aided + controlled)
- Anaerobic Wetland (Deficient Air, Sunlight, exposure) (Bacterially Controlled)

Where Applicable :— i) Needs Large Area. — Width & length of the wetland will be more than 50 – 100 times that of Depth.)
ii) Rate of reaction is very slow.

So, having gone from this you know here we have mostly discussed about this treatment of waste water, I just deal with you know highly say metal enriched, metal enriched, metal enriched waste water, metal enriched waste water application of, application of, application of wet land treatment, wet land treatment and biotechnology application of wet land treatment, wet land treatment and biotechnology, application of wet land treatment and biotechnology. This is the emerging area, these are the emerging area of metal enriched waste water. We have discussed so far say this, the treatment which are chemical precipitation technique. I have also said during the disadvantage that it also creates a certain amount of alkalinity, it also creates a different hydroxide sludges.

See, this you know in particularly this lime precipitation technique you see you are producing calcium hydroxides, so that is also another kind of waste that has to be disposed of. Isn't it? So, calcium hydroxide even if it is not very harmful but you know you have to dispose it. You know this can be an irritant I mean even if it is not harmful, it can be an irritant in the process in the technology process. It can be, if it is remaining there in the process which would lead to disruptions in the methods.

So, here you know there here we would be discussing about some of those wet land treatment methods, treatment methods and the use of biotechnology in this particular area. I will just briefly discuss about the principles of use, okay. Wet land treatment, wet land treatment I would discuss with this wet land treatment is, wet land treatments are generally split into aerobic treatment, aerobic wet land, aerobic wet land, anoxic wet land and we can further differentiate this into anaerobic wet land okay.

Aerobic wet land treatment you can see this say sufficient, sufficient air, sunlight, sunlight, air and sunlight and exposure. Here this would be sufficient, sufficient sunlight but an insufficient air and exposure. Here in such cases in aerobic wet land we have both deficient, deficient air, sunlight, sunlight and exposure. So, this is what is known as the anoxic, aerobic wet land, anoxic wet land, anaerobic wet land, anaerobic wet land we can see this is a structure you know here if it is see this. What is important here is in all this cases in all this cases, this is particularly the treatment here is this is, this is the reactions here it is a bacterially, the bacterially aided, bacterially aided but this one is you know bacterially aided and controlled, bacterially aided, bacterially aided plus controlled, okay.

The first one is bacterially aided anaerobic wet land, bacterially aided you know but it’s not controlled by bacteria. The next one is bacterially aided plus controlled I mean you know in a, in equal measure in equal measure is not fully controlled by bacteria neither it is fully, this is aided by bacteria and not fully control by bacteria but in anaerobic wet land treatment the whole process, the condition of this the reactance, the reaction process, the rate of reaction the say the equilibrium of the reactions, all these are actually bacterially controlled, bacterially controlled.

Separate you now difference distinct species of bacteria’s actually aid this processes, distinct species of bacteria’s use, aid this processes. Remember the aerobic bacteria will not survive in anaerobic environment neither the anaerobic bacteria would survive in aerobic environment and there is a tremendous competition between this two groups in a natural environment, in a natural environment. So, you know you can see this you know under situation like this we would consider this wet land treatment as this under this we know we will discuss some of the parts of wet land treatment.

See, one important particularly of this kind of treatment method is the wet land where applicable, where applicable, where applicable, where applicable. Number one this wet land treatment needs a, needs large area, needs large area. What happens is I will explain you with say it needs a large area, as a large area this is about the area where the width would be, width of the wet land, width and length of the wet land will be, will be more than more than, more than 500 to 1000 times that of depth, that of depth, a depth of the where applicable needs large area. Let’s say the rate of reaction you know this another important consideration about this wet land treatment is a rate of rate of reaction. Rate of reaction is very slow, rate of reaction is very slow. So, you know this is has to be one another important thing that has to be generally kept in mind that is has to be generally because of no artificial catalysts or you know enzymes are used generally for this purpose this wet land treatment. These are all naturally aided process, the naturally aided process are sunlight, wind, all these aiding to this particular reactions.

So, you know here we generally this particularly in such situation only this should be used where you can wait and we can wait and not only that you can although expand the operation over a large area so that even if small reactions takes place overall it becomes large okay. I will come back to this in the next lecture about this more, okay.

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Preview of next lecture

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Lecture # 19

Wetland Treatment and Bio-Technology Applications

Well, we start this class you know here you know you would be discussing about the wetland treatment and some biotechnology applications. So, this is you know this the scheme of wetland treatment, aerobic wetland treatment, schematic scheme.

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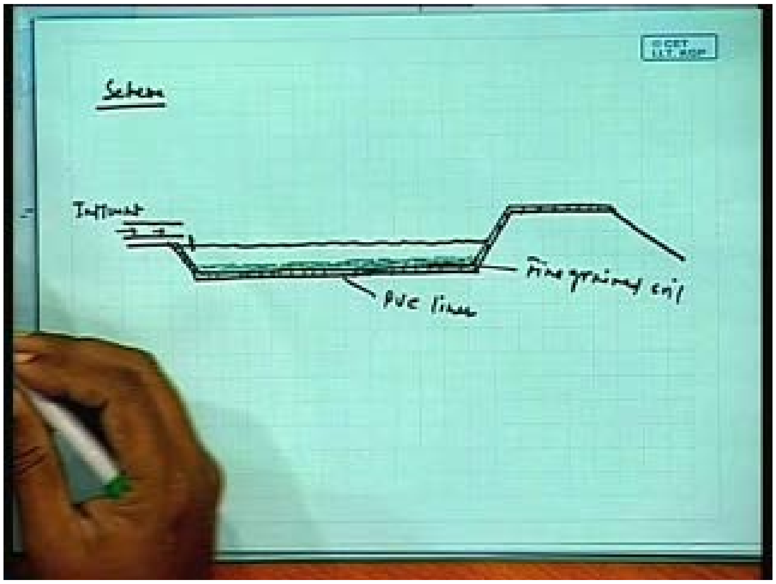

What is generally done here is like this. If you just observe a wetland treatment system, this is you say waste flow coming in say this is as I have said if we remember to have said, I have said this is requires a very open land, an open land like this. Here this is what would be okay. Here, you see this, this is what is the, in this influent, the waste water that is coming, this would be discharged here, this would be discharged here and this is where the wetland would be, wetland would be.

There are different ways to do it, different waste to design a wetland. The most common one there are, there are in some cases optional. Remember this, this is purely optional to have a liner at the bottom, it’s not necessary that all wetlands would require a liner. If there are, if it can be the whole thing can be insulated, so better it would be insulated. So, we have generally a liner in some cases but as I have said this is not mandatory, this is not mandatory just to. Well, this is what is the waste, this is what the waste water would be. There would be few other things here, there would be few other things here as you can see in some cases, in some cases we will find that you know some substrate see the fine soil substrates are also generally spread over.

If it is a designed wetland, if it is a designed wetland this is, this is what is a designed wetland we can see find out. This is the fine grained soil, this is a fine grained soil, soil PVC liner, non-reactive liner certainly non-reactive, it should not react with the waste water. This is the fine grained soil, this is the fine grained soil, this is the fine grained soil, this fine grained soil essentially works in for one very important reason is this, this is works as a natural buffer, this also works as a natural buffer, okay. Now here this is, this is the wetland, this is the water you can see this is what is the water is, this is how it would look like.

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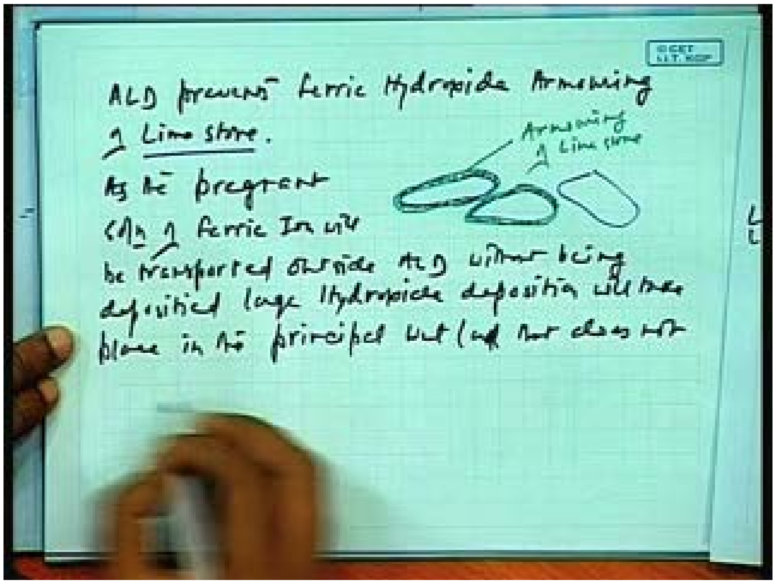

ALD prevents ferric Hydroxide Armouring
of Lime stone.
As the pregnant
soln of ferric Ion will
be transported outside ALD without being
deposited large Hydroxide deposition will take
place in the principal wetland that does not

This should, the ALD, ALD is prevents, prevents ferric hydroxide I mean ferric hydroxide armouring of lime stone. This is what is an armouring this is what is an armouring, say you know in all these particles, all this, this limestone chips that would be present there what would happen is the ferric hydroxide, the ferric hydroxide would deposit on top of this, the ferric hydroxide would deposit on top of this. As a result of this, the ferric hydroxide as it is depositing on top of this, there would be lesser surface area exposed for the lime stone to activate, lime stone to activate.

As a result of this you know here so we would stop this ferric hydroxide deposition here, we would reduce the ferric hydroxide. This is called the armouring, armouring of lime stone, armouring of lime stone, the lime stone, the chips, the limestone. So, a ferric hydroxide armouring of limestone, ferric hydroxide armoring of lime stone will prevent ferric hydroxide limes armouring of limestone. And as this, as the pregnant solution of, as the pregnant solution of say this is ferric ion will be transported outside ALD, outside ALD without being deposited, without being deposited. Large hydroxide deposition will take place in the principal wetland, principal wetland that does not, that does not contain.