Life Cycle Assessment
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Lecture – 09
Risk Assessment Methods (contd.)

Welcome back. So, as I was trying to explain you in the previous module we were looking at the impact of different chemicals because essentially again, some of the stuff that I keep on repeating again and again because we are interested as part of this course what we are interested is in impact of different chemicals on the environment from its cradle to grave. So, that is the life cycle analysis is it not. So, we will that is what we explained you as a life cycle analysis. So, what we are doing right now is trying to get of ourselves ready to do a big life cycle analysis exercise later on in this particular course. So, one of the important aspect is of course, how to do the risk assessment, what are the chemicals involved, what are the toxicity of the chemicals we looked at those aspect in last few modules and we will continue that discussion in this module as well where we look at some of the example chemicals example chemicals and its health effects and what are the health effects of the certain chemicals.

So, we will start with the chemicals would like which is very very common which have a long history of environmental contamination as well as the health impact as well as environmental impact. So, let us look at the first chemical it is you must have heard the term PCBs which is the poly chlorinated biphenyl.

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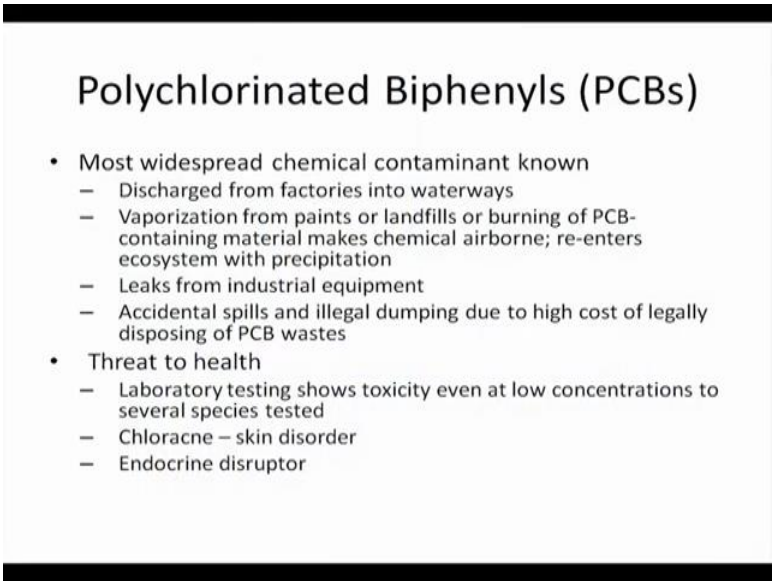

It is the most widespread chemical contaminant known. So, it is very used extensively and its used its gets discharged from factories into the water waste it can vaporize from paints or also it could be from the landfills if you burn something with a PCB containing material, it can go it can become airborne its can go into the airborne chemical it can re enter ecosystem with precipitation can leak from industrial equipment and they could be accidental spills or illegal dumping due to high cost of legally disposing PCB waste. So, PCB uses a most widespread chemical contaminant. So, it is being used in most of the industrialized world this PCB you see getting into the water waste getting into the soil getting into the air why it is important because it is a the threat to the health the laboratory test done on certain species as I said earlier its usually we work with rats mice guinea pigs those tortoise those kind of like a rabbits.

So, laboratory testing shows toxicity even at low concentration to several species which has been tested and they have been found in skin disorder is also endocrine disruptors endocrine disruptor we have a news the term before in this class. So, far endocrine disruptors and you may have heard the term endocrine disrupting compounds endocrine disrupting compounds are the compound which affects the endocrine system of the human of any species body many times you hear that we are seeing femalization of male fish male fish is showing female character or male alligators are showing female

character showing up. So, it is there because of the end of endocrine system endocrine system getting affected and that becomes that leads to feminization of like the male the masculine species getting into the feminization and that actually have an impact on in terms of the reproduction system of different species out there.

So, E disease which is called an E disease is the short form endocrine disrupting compound that is another area of big research and PCB is one of the E disease, E disease are a group of chemical several chemicals which can have an impact on endocrine system PCB is being one of them.

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So, PCB is like contamination of PCB you see a lot happening in water bodies or sediments and other stuff there has been dredging operation there is been lot of PCBs contaminated cleanup is underway this particular picture shows you a Hudson river which is a New York; like New Jersey, New York area, they have started cleaning it up in may 2009 and the cleaning is was in progress for the first phase it went up to 2012 and then they have another face is starting in 2012 and still today still we have traces of PCB showing up in the Hudson river because it is a persistent compound it does persist in the environment does not get degrade very quickly. So, that is why this kind of contaminants it is it becomes a nuisance on a long term basis.

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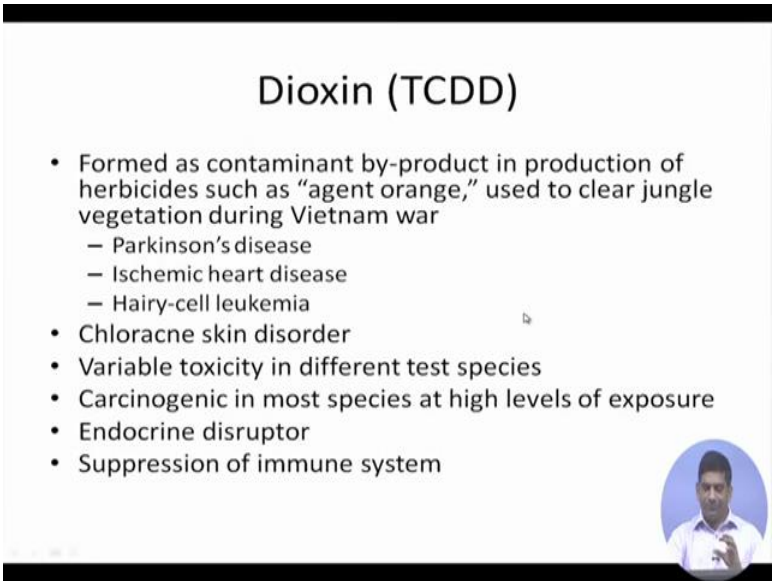

Other thing is of dioxin which is the ones that you see the list that I have on this particular this particular module that type of example that I am showing are the ones which are either widespread which we see at many places around the world or has very high negative impacts. So, dioxin or is dioxins is a potential carcinogenic and it also creates lot of impact on different systems and with a very little level of dioxin it is bad for health and the environment and how it is produced it is produced as a by product the production of herbicide such as a agent orange this is one kind of herbicide which is used which is used to create jungle vegetation during the Vietnam war, during in the Vietnam war to clear the jungle they use this agent orange and the agent orange when they produced this agent orange the one of the product was this dioxin. And how kind of impact what kind of impact it has? It has a Parkinson disease, Parkinson disease is where you start your balance is to you start losing your balance are those of you who may have watch the movie black where use that Amitabh Bachchan, he is starts having that Parkinson problem where used you cannot even do your small day today activities or it also have a impact on heart disease, it can have a leukaemia kind of impact.

So, we dioxin is a big problem and one of the sources of dioxin in the environment today dioxins are also is put under the category of pops which is pops you may have hear the term POPs P O P with a small s, this POPs is persistent organic pollutants. So, these

persistent organic pollutants as the name suggest persistence means persistent in the environment it does not degrade very quickly. So, it is its and it is an organic. So, that is why it is organic and pollutant. So, it is a persistent organic pollutants there is a group of persistent organic pollutants the pops and dioxin is one of the major compound and dioxin is not only one compound dioxin is actually a group of compound there are different compounds together is placed under dioxins similar to PAHPA when you hear the term PAH which is the polycyclic polycyclic aromatic hydrocarbon it is a group of 13-14 different compound which is together is called PAH.

So, dioxins are formed one of the major source of dioxins today is the uncontrolled burning of garbage. So, the waste which is burning say whether you if you see in Kolkata or if you are recently we had a big problem in Mumbai few months back in Mumbai, we had the garbage dump on fire for several days in Delhi recently during the very close to when we had this news of the surgical strike on in the India-Pakistan border around the same time, we had the issue of the landfill catching fire in Delhi and the landfill was not fire for several days.

So, when this garbage burns is this garbage burns because of lot of plastics that we are using today especially those film plastic those thin plastics that we use for the grocery bags and other. So, this actually leads to the production of dioxins and furans. So, this is part of the persistent organic pollutants which are very bad for the environment. So, burning garbage is it total no burning garbage is a very negative impact on the environment and on human health. And as of today on control burning of garbage is the number one source of persistent organic pollutants it is not my data, it has been reported by the united nations environmental protection agency's report which has done a elaborate survey of this burning of garbage throughout the world they looked at the air pollutants coming out of it and they also look at the air pollutants from the other sources and where this POPs persistent organic pollutants are present and they have some they have come to the conclusion that number one source of persistent organic pollutants of which dioxin is one of the major constituent is actually uncontrolled burning of garbage.

So, when we can control the burning we can do a better waste management better municipal waste another waste management where we do not burn this garbage in a

uncontrolled way. Incineration plants are different do not get confused between the waste incineration plant with uncontrolled burning waste, incineration plant is the government of India is also promoting these days waste to energy plant they are there we have a controlled burning of garbage it is not uncontrolled burning I am talking about the garbage dumps open burning many times even on certain places in the cities you see that the street sweeping guy or the garbage collectors in the morning they what they do they put this all these waste in one corner and they torch it that should not be done, that is actually creates lot of problem in terms of dioxin release into the environment.

So, dioxin what it can teach it say it says it has a skin disorder, there a variable toxicity has been found in different test species it is a carcinogenic in most species at a high level of exposure its endocrine disruptors very similar to PCBs it is also has a impact on endocrine system and it also reduces our immune system. So, as you probably if you follow the health aspect the immune system means that what is the resistance of our body against any external factor which we may be harmful to us.

So, that is why if for the very small kid very small babies we say that do not take them out too much do not let them exposed to certain kind of negative environmental conditions because their immune system has not developed yet until the kids are especially of to 5-6 years of age smaller the kid less is the immune system and then when they go into the teenagers by the time most of the immune system is developed and, but when the people gets older again the immune system is starts going down. Somebody by unfortunately if someone has suffers from some sort of diseases like cancer where they have to go through this chemotherapy reduces the immune system of the like the immune what like our it reduces the capability of the body and in terms of their immune system drastically.

So, anybody that say that is why anybody going through chemotherapy we say that we keep them in a house which is clean you do not want too many people meeting them because the virus can get because their immune system is so weak. So, they can get they get suppressed dioxin is also creates a separation of the immune system. So, it is it may not impact you directly, but if you are exposed to dioxin and your immune system goes down; that means, that you can get a lot of other disease in your body much quicker

because your body cannot fight against those disease.

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Dioxin sulphur is has been in recent times in the recent past dioxins has been used as a tool to poison here you see the 2 pictures of this is the Ukrainian president Viktor Yushchenko its photos from the left picture is from the March 2002. So, this is the picture of March 2002 of Ukrainian president and then in December 2004 you see his picture where he is exposed to this dioxide poisoning. So, Yushchenko was discovered by deliberate dioxin poisoning during his 2004 presidential candidacy. So, during his presidential candidacy of 2004 you can see that just in the matter of March 2002 to December 2004. So, it is around one and half years and in between the one and half years what is the drastic impact on the body because this gentleman such a like a it has a because there is a lot of conspiracy theory we do not know how he got exposed to it, but there is one conspiracy theories in terms of he was not friendly to Russia. So, he was kind of anti Russian camp in Ukraine and so Russia got him poisoned Russia does not want him to be the president of Ukraine. So, it he got poisoned by some Russian spy agency or whatever.

But whatever be the case that is not important for like how he got poison, but just look at in one and half years the pictures with 2 on those 2 dates it is such a drastic impact. So,

that is why when I say that dioxin is one of the very very important like a in terms of dioxin exposure it is very very critical in terms of environmental and human health impact. So, this is just an example to illustrate that example that how quickly one can go from like how quickly one body gets destroyed by the dioxide poisoning.

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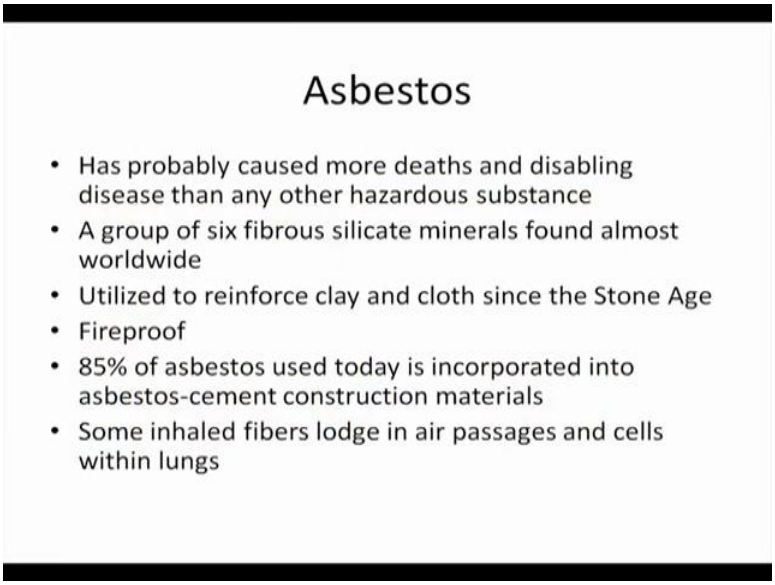

Other big areas which we hear a lot about this asbestos in the western world it is pronounced asbestos in India we call it as asbestos here asbestos is probably cost more death and disabling disease that any other hazardous substances, but we need to be careful here the asbestos seats because I just I do not want to create any controversies.

So, that you do not get into like you do not get confused the asbestos we do use lot of asbestos sheets in India. So, using of asbestos sheets as a roofing material which is typically when we use it in India we use it with a concrete it is mixed with a concrete material. So, as long as it is mixed to the concrete material it is there in encapsulated is not you are not exposed to the asbestos chemical directly it is not a problem. So, the problem comes when you are exposed to the asbestos chemicals directly. So, when you have the concrete layer on top of it, it keeps you it prevents you from getting exposed to asbestos. So, that is be clear on that, but say if you are if you work in a plant where this asbestos material is being used if you are work in a mining area where this asbestos

material is being mined that is where the problem is also when this asbestos roofing material will get like broken down.

So, if you are, if it gets broken down into smaller pieces if you make a powdery material out of that for some reason then that case again you can get potentially get exposed to asbestos. So, you need to be careful of the exposure scenario. So, it is does not mean that using the asbestos roofing material is bad, but say in case that roofing material gets broken down for some reason to do the due to any natural disasters or due to you are replacing this roofing material with a newer roofing material handling of those material is important in a safe manner. So, that you are do not get exposed to the asbestos chemical which is present in that material.

So, what is asbestos it is a group of 6 fibrous silicate material it is found almost worldwide Canada is one of the major source of asbestos in Canada and many other countries they have stopped using asbestos now and in India we still use it, but in many of the developed countries they do not use asbestos anymore asbestos has a very good fire insulation property that is why it was be it was used it was used because it has a very good fireproofing facility. So, many of the older buildings for the fire proofing they used to use this asbestos material the newer building they using some other material and then they are replacing this asbestos materials out there actually asbestos material is used as basically as the asbestos material no layer of concrete or thing in they.

So, it is used mostly for fireproof and its utilise to reinforce clay and cloth since the stone age eighty five percent of the asbestos use today is incorporated into asbestos cement construction material. So, if it is encapsulated with the cement construction cement it may not be that bad, but if you are exposed directly to the asbestos material it is a problematic. So, what is the problem it is if you inhale it the fibres lodge in air passage and cells within lungs? So, you are fibres get into the air passage and then it gets its beastly your like you will have pulmonary problem you will have the lungs problem and your pulmonary respiratory systems problem.

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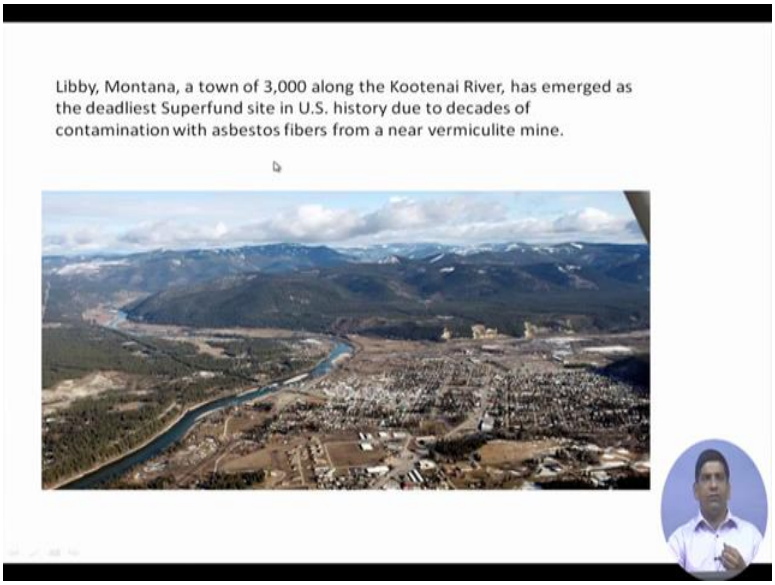

So, this is a Montana which village in Montana its a town is small town maintain its only three thousand people population it is along the Kutenai river in Montana which is in the united states has emerged as the deadliest superfund site, superfund site means the contaminated site when we say superfund side it is actually a used term will at some point in one of the module later on I will explain you what the superfund how this term came out. But for now just think about the superfund site means a contaminated site it is a contaminated sites which is contaminated by hazardous waste by the hazardous material which is coming in to the environment. So, it is one of the deadliest superfund site in the US history because due to be 2 decades of contamination of asbestos fibre from a near vermiculite mine.

So, in the near there was a mine nearby where they were where they were extracting all these asbestos material and since they were extracting all this asbestos material the people got exposed to it the water got exposed the air soil everything got exposed and this is one of its a small town 3000 people not too big of a town its almost possibly less than a big village in India where we have more than sometimes like 10-15000 people in the in a village, but it is a small town of 3000 and they had this is one of the deadliest superfund site in the us history coming from asbestos poisoning.

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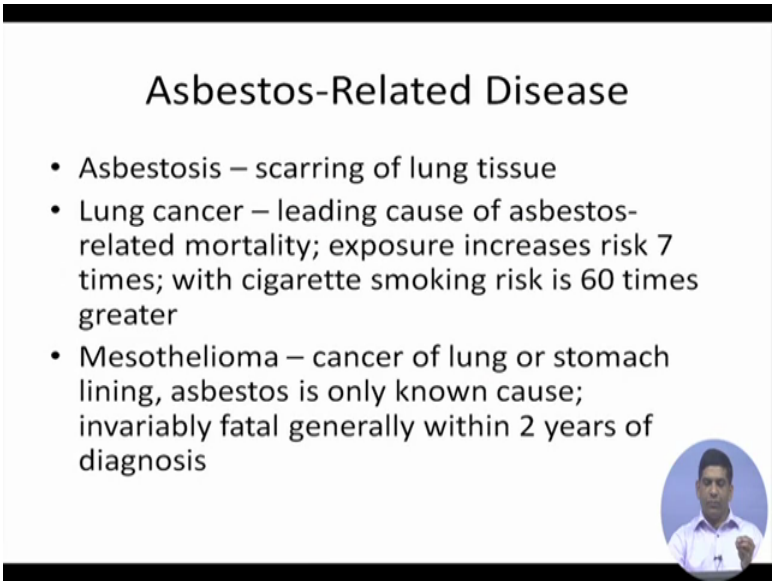

What it causes it say as I said earlier it is a lung issue we usually we are mostly worry about the inhalation path through asbestos exposure. So, at least to scarring of lung tissue you have was scarring of lungs it can lead to lung cancer exposure risk increases this seven times with cigarette smoking risk is 60 times.

So, it a not as bad as a cigarette smoking, but again it does causes increased risk by seven times and also at leads to mesothelioma which is the cancer of lung or the stomach lining asbestos is the only known cause invariably fatal generally within 2 years of diagnosis. So, if you have asbestos poisoning I see you have a some sort of expose asbestos exposure at a higher level again look at remember the dose response curve we are looking at from if you look at the typical S curve we talked about if you are in the if you are at the lower level where you do not have that no exposure there will be no impact, but once you have the exposure remember that we had this S curve going up. So, when you have the higher exposure limit where things you will you will get exposed to it says that a higher concentration within 2 years of diagnosis within 2 years of diagnosis people have been found to be it has been found to be fatal too many people.

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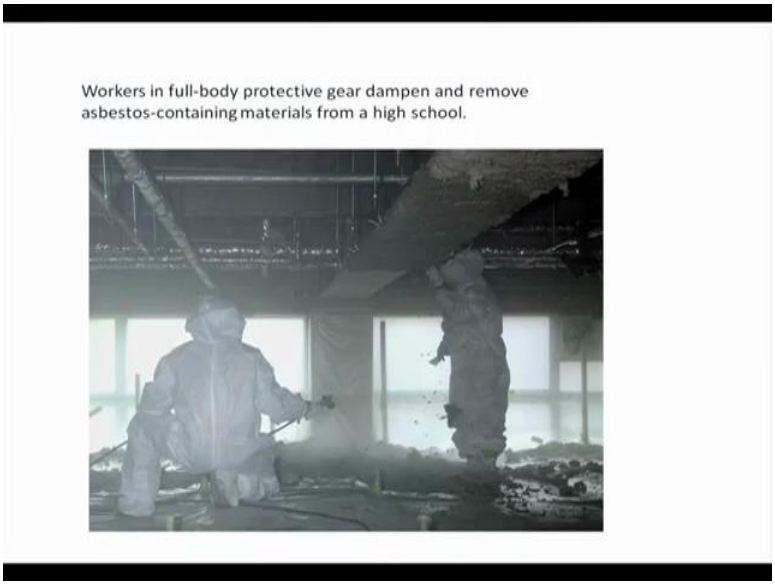

So, asbestos again is one of the major problem here you see a picture of workers in full body gear they are removing asbestos containing material from a high school actually this as I said earlier most of the older buildings asbestos was used as a fire proofing material. So, now, in the developed countries they have stopped using asbestos in the Indian scenario since most of the buildings we make it still is a concrete bricks. So, concrete and brick itself acts as a fire proofing material. So, we do not have to really have a fire proofing material goes in there, but nowadays when we are going on 2 more into the modular building where we have beams and columns and the walls are just the partition walls and we are going for the gypsum drywall gypsum drywall has a layer of a like a basically layer of paper on top of it they are not there are no more fireproof.

So, in between the gypsum drywall we put some fire proofing material and we use different type of fire proofing material, but we do not we are not using asbestos material especially in the western world and gradually in the developing countries also we are not using asbestos material, but asbestos is a very good fire proofing material that is what it was being used. So, here in this particular picture what you see these workers in the full body protective gear because asbestos was used as a fire proofing material. So, in between they are trying to remove those asbestos material. So, this to not to get exposed to this asbestos material they are using all these suit you that is called actually a TYVEK

suits they are all totally covered with mask and all that. So, that they do not get exposed to it for getting any sick.

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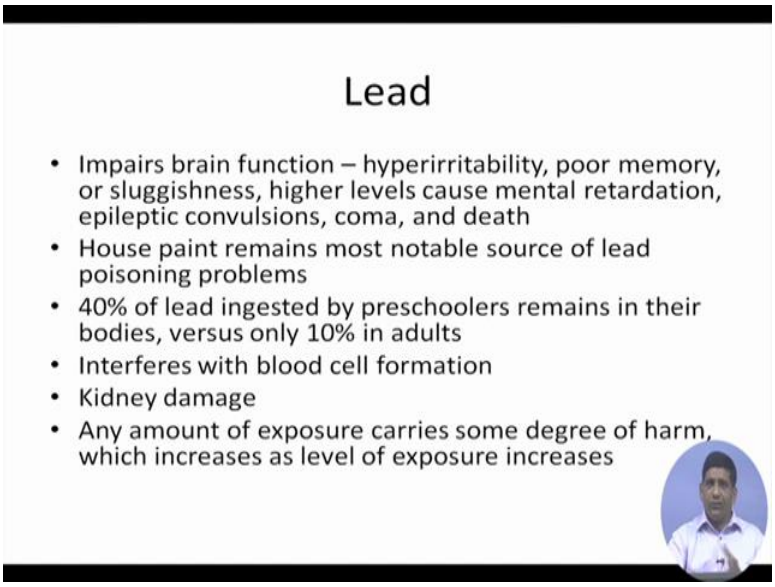

So, that is another example again I just said we are just looking at some of the this is not a total exhaustive list we are just looking at some of the example chemicals which are prevalent which have been used a lot either in the past or presently being used. So, next we will look at is on lead as you know as if you think about today lead we think of today mostly from the electronic waste. All of us carry some sort of Smartphone these days most of us do carry Smartphone out I should not say all of us, but most of us do carry Smartphone in the middle class, upper middle class population and then we also carry a laptop like some I-Pad or any kind of your pad kind of system like a small tablet and all of these wherever you have a electrical circuit board if you remember electrical circuit board those soldering iron that we used to use for our high school projects or a science project the soldering iron the chemical that is used for soldering iron that is like a small that you see the thread that you had where you used to use it for the soldering iron that soldering material is has used to have lot of lead. And we are trying to get rid of those lead from those soldering iron as well and many of these newer electronic does not has lesser and lesser amount of lead.

So, lead is used in a soldering iron, lead used in the house paint it is a house lead was used in the gasoline in the petrol that is why you see unleaded gasoline next time you visit to a petrol pump look at that label very carefully it says unleaded, unleaded means what at some point of time it has lead that is why it is unleaded now. So, why we want to get rid of lead from our system? As you can see in this particular slide if you go like some of the bullets lead is it in pairs brain function.

One of the theory behind the demise of roman empire if you if you are following the history we had a roman empire and the roman empire collapsed towards the end of the roman empire the people that the kings and the people of the ruling class became very crazy one of the theory that is put forward is during those particular period they were using the utensils those utensils had the lead lining, had lot of lead lining in those utensils and those utensils they were using to consume alcohol and the alcohol has a typically lower pH, I assume that you understand pH, pH is what is the how much is the acidity of the system. So, at low pH most of the heavy metals are in solution. So, they come into solution. So, when these people consume this low pH like with a with alcohol with low pH some of the lead which is lined in those vessels were getting dissolved into this alcohol and they were consuming this lead as well and the with the consumption of lead their brain function is starts getting impacted they become hyper and they have poor they will have like, they will have very hyper activity.

So, that is why they got into all those having those fight between say tiger or lion with a men with a convict or a criminal those kind of things were kind of what you saw towards the end of roman empire it is because the people with this one theory is it is because of the hyper their brain they got so much their brain started getting impacted and gradually they lost the Roman Empire; the Roman Empire collapsed. So, it does impact brain and it is greatest to happen irritability poor memory and you lose your memory or sluggishness high level causes mental retardation you have the epileptic convulsions, epilepsy, comma it will lead to death higher lead pollution.

So, house paint remains the one of the most notable source of lead poisoning problem and many western countries have already banned lead in the house paint unfortunately in the Indian scenario we are still using lead in our houses. So, that is becomes a problem.

40 percent of the lead ingested by preschoolers remains in their body verses 10 percent in the adult. So, because of that is why we do not either priests impact the small kids. Interfere with the blood cell formation leads to the kidney damage and also cause some degree of harm where exposure carry some degree of harm which increases with the level of exposure increases.

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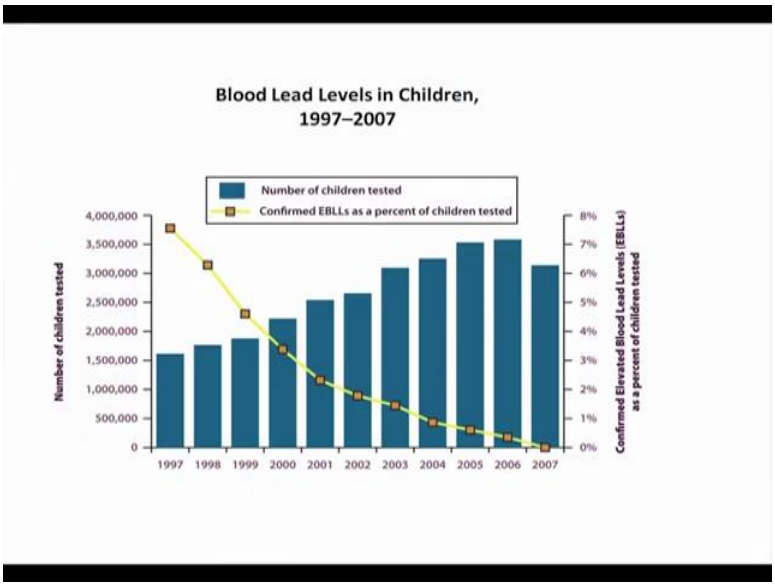

So, that is kind of the big picture on the lead and if you look at this particular graph this is how the with removal of lead in the petrol which was one of the contaminated if you look at from the y axis here is the number of children tested x axis is the different years from 1997 to 2,000 and 2007 and on the y axis over here is the confirmed elevated blood lead levels as a percentage of the children tested. So, here the how much children were tested here we are looking at the percentage of the kids that tested. So, as the lead was removed as the lead was removed from this gasoline we start seeing decrease in the blood level of the kids. So, this study was done in us, but it similar thing will show up in other countries as well and, but if you look at here the columns represents the number of children tested and this small rectangles where with yellow line is actually showing us confirmed elevated blood levels as a percentage of the children tested and as we remove the lead from this gasoline from the petrol and diesel our blood level went down so almost to 0, so that is in the developed countries.

In the developing kind, here they have already band lead based paint in 1976. So, they are not using lead in the lead based paint. In a country like India where we are still using lead based paint we are doing lot of electronic waste recycling in a very informal way which has lot of lead present there we may not see a 0 in our blood, but we do we probably have to do it we do not have a data like that we need to have a data like this where we can compare where our blood level exist in terms of our kids.

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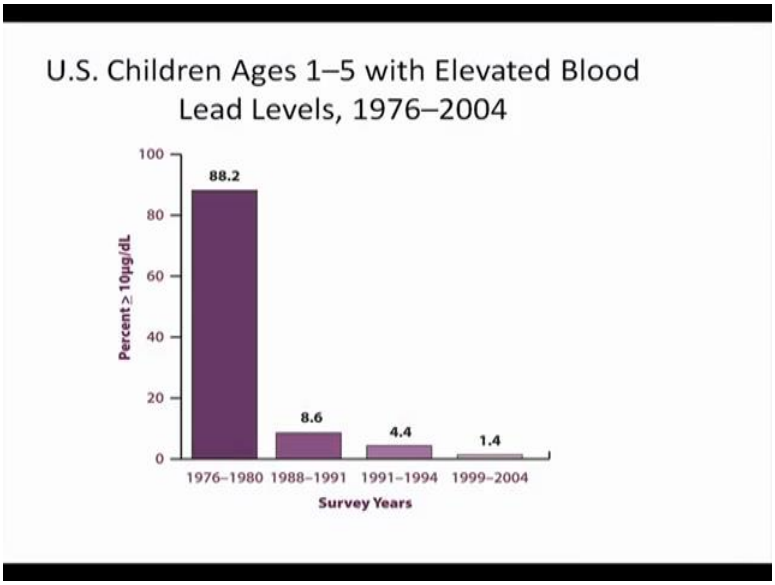

But why it is important? So, we can this is their blood level at very beginning 1976 to 1980, it was 80.2 percent where greater than ten micrograms per day per decilitre, but in 1999 to 2004 it is going down to 1.4 percent. So, they had a drastic drop in terms of the lead level in the blood which is really good.

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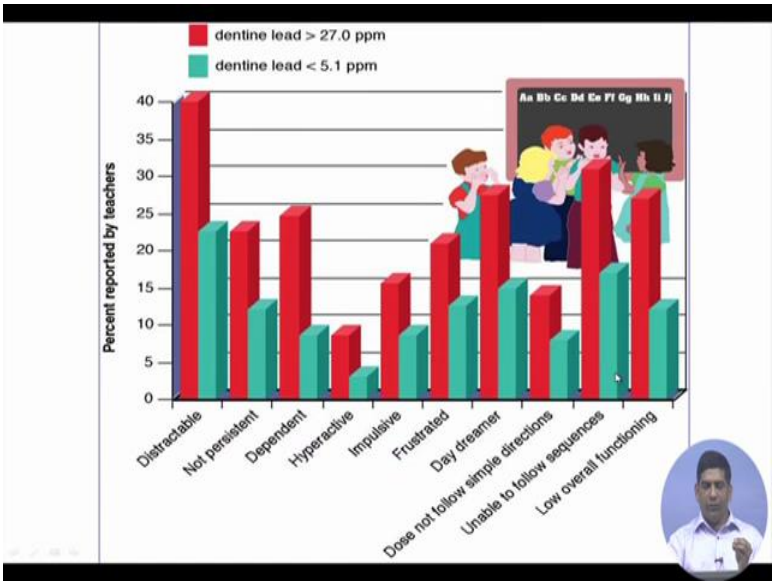

So, why it is important? Which we will look at here if you look at this particular graph and which with after this graph will kind of end this particular module, this here we have a if you look at the concentration of the lead them here we are the red bars are where the lead concentration is better than 27 parts per million and you are blue sorry the green ones is where the lead is less than 5.1 ppm and which it says dentine lead dentine lead means the lead in their tooth samples. So, a small kids they lose their teeth the baby teeth goes away. So, that tooth has been taken and then this has been analysed.

So, here in terms of their behaviour as reported by the teachers of the elementary school as you can see the red ones is the higher lead level. So, the higher the lead level, they teach the students were distractible they were not persistent they were dependent too much on the teachers they were hyperactive they were impulsive they were frustrated they were day dreamers does not follow simple directions unable to follow sequence and they have low over all functioning. So, as if you look at all these parameters what it is telling is because of the higher level of lead the neurological issues shows up in the kids. So, that is why having too much lead is actually a problem. So, that is why we have tried to remove this lead from different sources in, so we gasoline and the petrol and the diesel that is what the one area of too much of the exposure.

So, in totality we looked what we looked at in this particular module is will look at few chemicals of interest again this is just a few example chemicals you can go and read about several other chemicals a lot of studies have been done where people have looked at this kind of work by arsenic cadmium other things can be looked at as well, but just to give you some example how this impact is studied and what are some of the impacts we looked at from the PCBs from the dioxin from lead and other sources in terms of and also asbestos. So, those 4 from 4 different type of like a category will looked into this like potential environmental and human health harm.

So, in the next module will continue this discussion and we will go in to some of this risk assessment bio availability and all those aspects. So, with that we conclude this module and I will look I look forward to seeing you again in the next module.

Thank you.