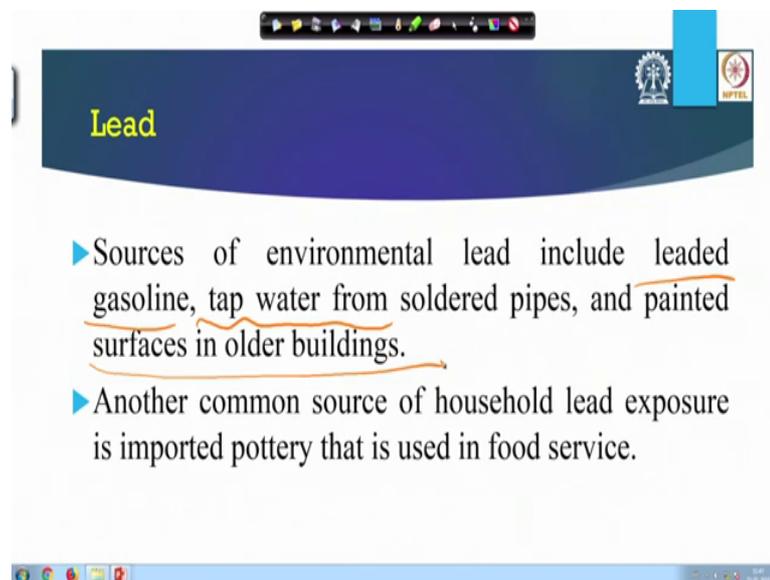


Electronic Waste Management – Issues and Challenges
Prof. Brajesh Kumar Dubey
Department of Civil Engineering
Indian Institute of Technology, Kharagpur

Lecture - 07
Environmental and Public Health Issues (Contd.)

So welcome back. So, we will continue our discussion from the previous video, we were looking at the different individual chemicals, individual elements and their environment, and human health impact a bit in detail. So, we looked at couple of elements.

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Lead

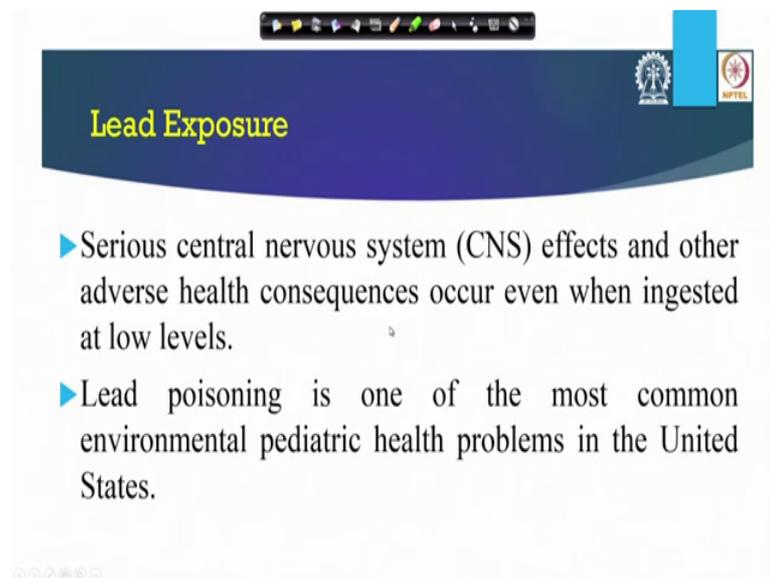
- ▶ Sources of environmental lead include leaded gasoline, tap water from soldered pipes, and painted surfaces in older buildings.
- ▶ Another common source of household lead exposure is imported pottery that is used in food service.

Now will try to see in terms of lead is one of the most important electronic waste, when we talk about electronic waste impact lead is the number one thing which comes to our mind, lead is there in lead was also there in other sources to leaded gasoline. So, when you go to any of these petrol pumps, and you see their label unleaded gasoline. So, what does that mean so; that means, there was lead at some point in our gasoline, in we our petrol diesel we had lead even today, for some of the highly software like a different types of like a for certain vehicles, not our not certain vehicles certain usage especially the army army's army vehicles and army those big tanks, and other stuff we there are certain a places where we still have to use leaded gasoline.

So, but for in general we are not using leaded gasoline anymore. So, that is why it is called unleaded. So, gasoline was this source of lead. So, that is what it is try to say here

the sources of environmental lead, it came from different sources are there including leaded gasoline. So, leaded gasoline is there and tap water, some of the older pipes used to be leaded, as well tap water from soldered pipes paint surface in the old building, some of the old buildings have lead based paints, or the many of the buildings in India still uses lead-based paint, many of the paints in India is still has lead in them. So, and then the batteries poor tree. So, lot of sources of lead is there in the environment and electronic waste, is also one of the major source of a lead in the environment today.

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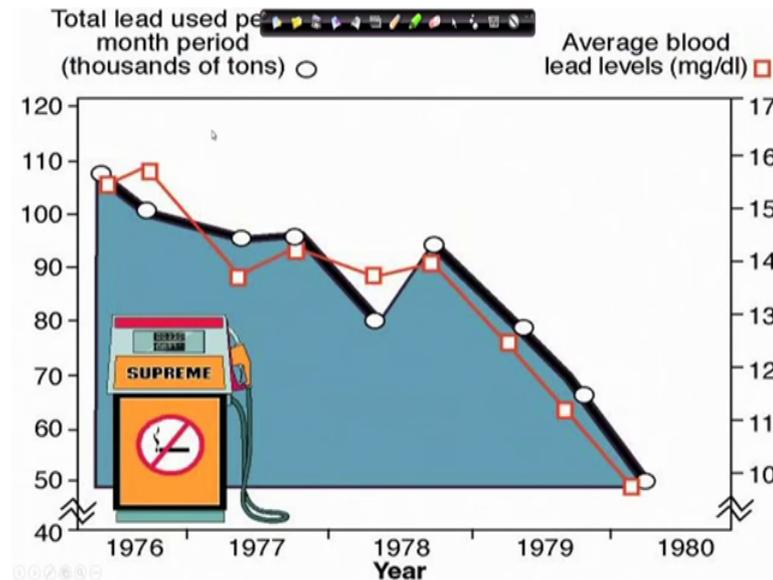


Lead Exposure

- ▶ Serious central nervous system (CNS) effects and other adverse health consequences occur even when ingested at low levels.
- ▶ Lead poisoning is one of the most common environmental pediatric health problems in the United States.

So, again why we are worried about lead is affects the central nervous system. So, that is the major stuff it is affects the surface even at low levels, lead poisoning is one of the one of the biggest environmental pediatric health problem, especially from lead-based paint in the houses and all.

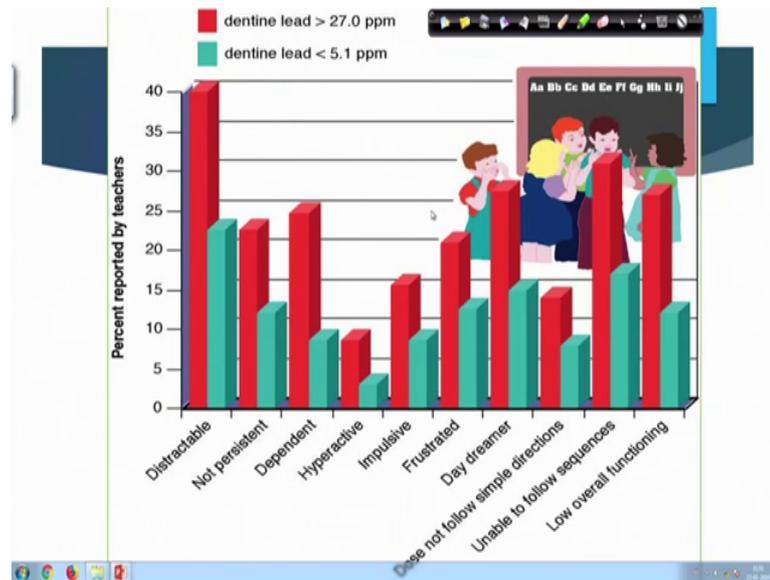
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So, in terms of what why people have how people have seen this they what there have been studies done, then where they found that average blood lead level in in a child actually after a child is born in united states, at least that is what I have seen in my like a firsthand. So, they do take the blood sample of a small infant, and then they try to look at the lead level, because just their goal is to reduce the lead level as much as possible.

So, 1976 when they banned that lead based paint sorry lead leded gasoline, in US, and after that as you can see from there is a drastic drop of lead present in the blood sample. So, it went down from around 16 milligram per day like a dl to around 10 milligram per d l, and then the number will should actually go on even further below and below. So, that is the reason why that lead based paint sorry lead based leded gasoline, was phased out because we do not want to lead.

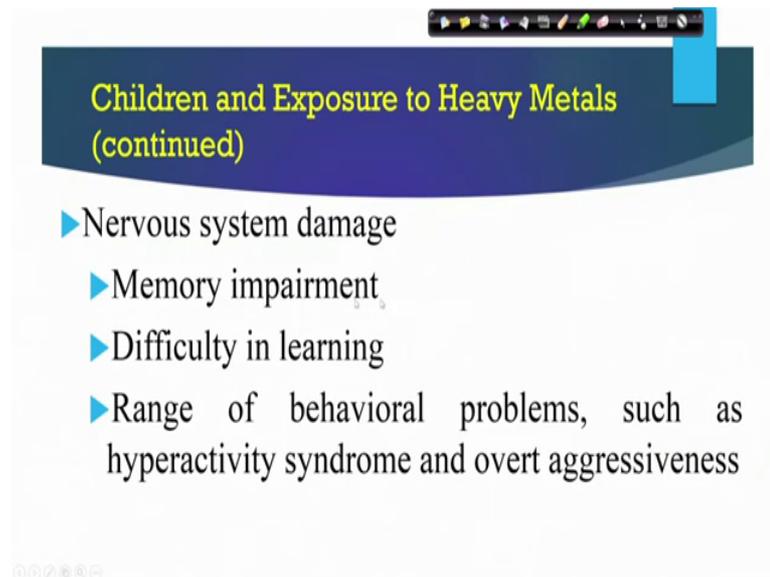
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Why we do not want lead? Because it affects the human body if it does as you can see over here, based on that red one is where we have the concentration is higher, if we can just the in the red one the concentration is greater than 27 ppm for in the lead in the dell in the teeth, and the blue or the green ones is where the concentration is less than 5 ppm. So, as you can see the students behavior in the class is plotted as the x axis, and the percentage reported, but a percentage reported by teacher on the y and these are the different behavior patterns.

So, distractible, not persistent, dependent, hyperactive, impulsive, frustrated, daydreamer, does not follow simple directions, unable to follow sequences, low overall functioning and for all these numbers as you can well red bars are much higher. So, these and the red bars are the students in which if they have a teeth sample was taken after the teeth is fallen down, the baby teeth if the teeth sample was taken and analyzed they had the lead greater than 27 ppm. So, it means more than late exposure the kids are not able to learn, and if they do not learn that become say if they if do not learn good enough it becomes a drain on the economy isn't it. So, that is why we have to this is the reason why you lead is very, very important in terms of the negative impact associated with it.

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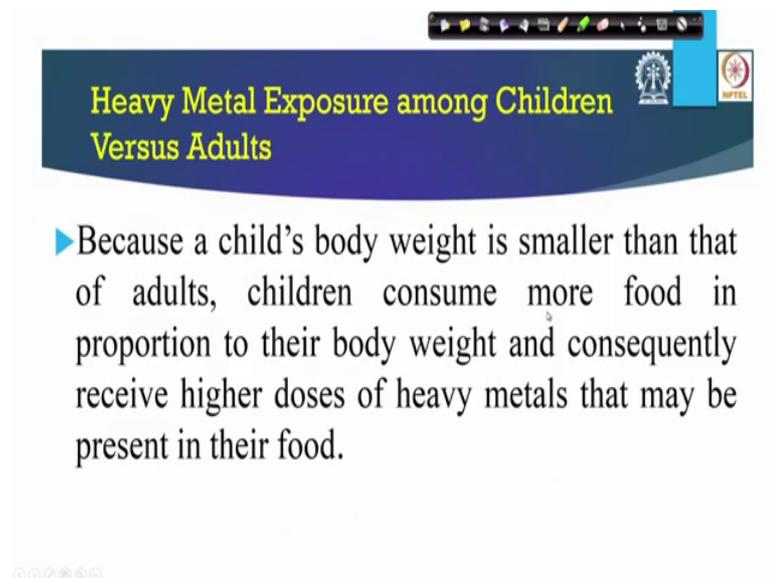


**Children and Exposure to Heavy Metals
(continued)**

- ▶ Nervous system damage
 - ▶ Memory impairment
 - ▶ Difficulty in learning
 - ▶ Range of behavioral problems, such as hyperactivity syndrome and overt aggressiveness

So, nervous system damage, memory impairment, difficulty in learning, ranging behavior problems and all that. So, those we already kind of know about that.

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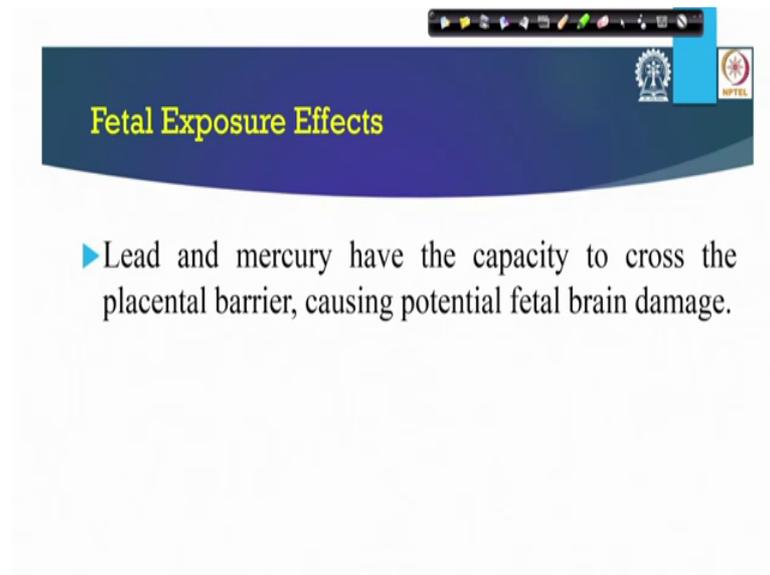
**Heavy Metal Exposure among Children
Versus Adults**

- ▶ Because a child's body weight is smaller than that of adults, children consume more food in proportion to their body weight and consequently receive higher doses of heavy metals that may be present in their food.

And then the heavy metal exposure amongst children versus adult, we look at the child's body and their been smaller, and children's consume more food in proportion to their body weight.

So, they do have that is why we leave high doses of heavy metals, that may be present in their food.

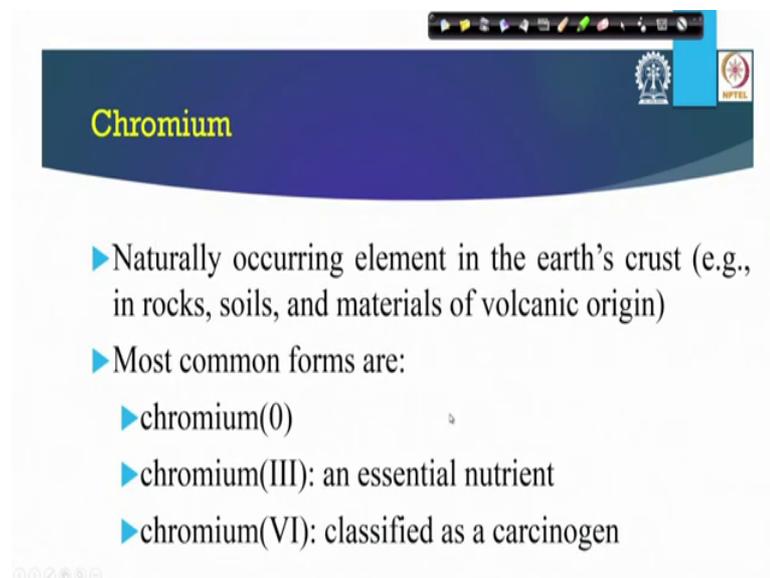
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The slide features a dark blue header with the title "Fetal Exposure Effects" in yellow. Below the header, a single bullet point in blue text states: "▶ Lead and mercury have the capacity to cross the placental barrier, causing potential fetal brain damage." The slide includes a navigation bar at the top with various icons and logos for IIT Bombay and NPTEL.

So, we need to be careful fetal gets exposed as well, lead and mercury have the capacity to cross the placental barrier, and causing for potential fetal brain damage.

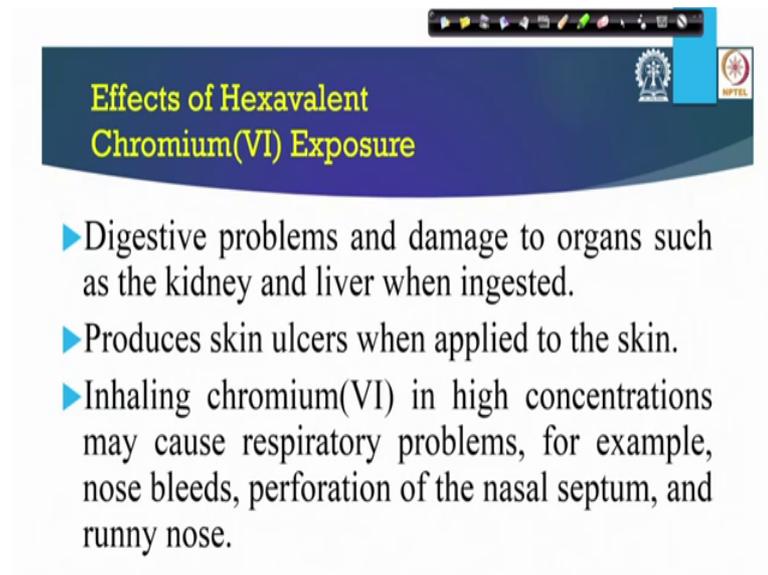
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The slide features a dark blue header with the title "Chromium" in yellow. Below the header, there are three bullet points in blue text: "▶ Naturally occurring element in the earth's crust (e.g., in rocks, soils, and materials of volcanic origin)", "▶ Most common forms are:", and a sub-list with three items: "▶ chromium(0)", "▶ chromium(III): an essential nutrient", and "▶ chromium(VI): classified as a carcinogen". The slide includes a navigation bar at the top with various icons and logos for IIT Bombay and NPTEL.

So, then chromium its chromium is used in different forms, chromium 6 is what is a carcinogen and it is causes.

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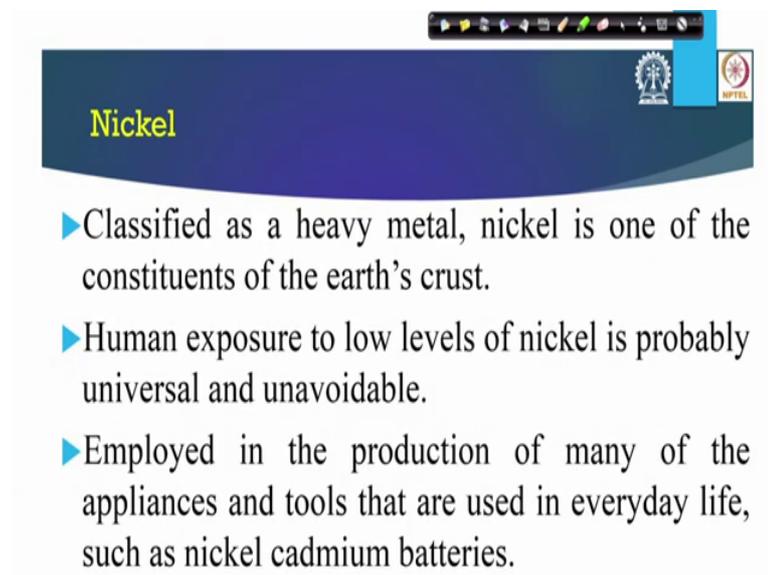
The slide features a dark blue header with the title "Effects of Hexavalent Chromium(VI) Exposure" in yellow text. Below the header, there are three blue bullet points. The slide also includes a navigation bar at the top and logos for IIT Bombay and NPTEL on the right side.

Effects of Hexavalent Chromium(VI) Exposure

- ▶ Digestive problems and damage to organs such as the kidney and liver when ingested.
- ▶ Produces skin ulcers when applied to the skin.
- ▶ Inhaling chromium(VI) in high concentrations may cause respiratory problems, for example, nose bleeds, perforation of the nasal septum, and runny nose.

Digestive problems produces, skin also and then it may cause respiratory problem and all that.

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The slide features a dark blue header with the title "Nickel" in yellow text. Below the header, there are three blue bullet points. The slide also includes a navigation bar at the top and logos for IIT Bombay and NPTEL on the right side.

Nickel

- ▶ Classified as a heavy metal, nickel is one of the constituents of the earth's crust.
- ▶ Human exposure to low levels of nickel is probably universal and unavoidable.
- ▶ Employed in the production of many of the appliances and tools that are used in everyday life, such as nickel cadmium batteries.

Nickel it is a heavy metal again it is a universal and you do get exposed, employed in the production of many of the appliances and tools, that are used in everyday life such as nickel cadmium battery.

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Effects of Nickel Exposure

- ▶ One of the most common reactions to skin contact with nickel is nickel allergy, manifested as contact dermatitis.
- ▶ Cardiovascular-related and renal diseases as well as fibrosis of the lungs
- ▶ Potential carcinogenic action

One of the most common reaction is skin contact with nickel is nickel allergy, and then you have a cardiovascular related renal disease as well, potential carcinogen in action beryllium the heat sink.

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The periodic table shows the following elements and their atomic numbers:

Hydrogen H 1.008	Helium He 4.003																	
Lithium Li 6.941	Beryllium Be 9.012	Boron B 10.811	Carbon C 12.011	Nitrogen N 14.007	Oxygen O 15.999	Fluorine F 18.998	Neon Ne 20.180											
Sodium Na 22.990	Magnesium Mg 24.305	Aluminum Al 26.982	Silicon Si 28.086	Phosphorus P 30.974	Sulfur S 32.065	Chlorine Cl 35.453	Argon Ar 39.948											
Potassium K 39.098	Calcium Ca 40.078	Scandium Sc 44.956	Titanium Ti 47.887	Vanadium V 50.942	Chromium Cr 51.996	Manganese Mn 54.938	Iron Fe 55.845	Cobalt Co 58.933	Nickel Ni 58.693	Copper Cu 63.546	Zinc Zn 65.38	Gallium Ga 69.723	Germanium Ge 72.61	Arsenic As 74.922	Selenium Se 78.96	Bromine Br 79.904	Krypton Kr 83.80	
Rubidium Rb 85.468	Sr 87.62	Yttrium Y 88.906	Zirconium Zr 91.224	Niobium Nb 92.906	Molybdenum Mo 95.94	Technetium Tc 98	Ruthenium Ru 101.07	Rhodium Rh 101.07	Palladium Pd 106.36	Silver Ag 107.868	Cadmium Cd 112.411	Indium In 114.818	Tin Sn 118.710	Antimony Sb 121.757	Tellurium Te 127.603	Iodine I 126.905	Xenon Xe 131.29	
Cesium Cs 132.905	Ba 137.327	* 57-70	Lanthanum La 138.905	Hafnium Hf 178.49	Tantalum Ta 180.948	Tungsten W 183.84	Rhenium Re 186.207	Osmium Os 190.23	Iridium Ir 192.222	Platinum Pt 195.084	Gold Au 196.967	Mercury Hg 200.59	Thallium Tl 204.38	Lead Pb 207.2	Bismuth Bi 208.98	Polonium Po 209	Astatine At 210	Rn 222
Francium Fr 223	Radium Ra 226	** 89-102	Lr 261	Rf 261	Db 262	Sg 266	Bh 264	Hs 277	Mt 268	Uun 288	Uuu 288	Uub 289	Uuq 289					

We already talked about that it is a acts as a potential heat sink.

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What is Beryllium?

- ▶ Second lightest metal
- ▶ Stiff
- ▶ High melting
- ▶ Absorbs and distributes heat
- ▶ Reflects neutrons
- ▶ Transmits x-rays



Beryllium in the Workplace

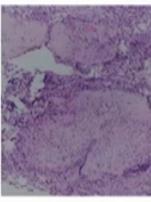
What is beryllium? It is a second lighter metal stiff high melting absorbs, and distributes heat, and it reflects neutrons transmits x rays. So, that is a why the beryllium is used a lot it, but it does cause chronic beryllium disease C B D.

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"Chronic Beryllium Disease"

"CBD"

- ▶ replaces archaic term "berylliosis"
- ▶ granulomas at multiple organ sites
- ▶ 1st the lungs: shortness of breath
- ▶ Also: anorexia, fever, weight loss, night sweats
- ▶ Disabling, but treatable
- ▶ Can be progressive & fatal
- ▶ Signature disease
- ▶ Latency ~6 to 10 years (4 mo. - 30+ yrs)



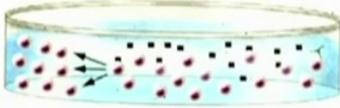
Which is the earlier the term was berylliosis. So, what is that it is a granulomas at multiple organ sites, first the lungs. So, you have a shortness of breath, you get fever, weight loss, night sweat, can be fatal it is a signature disease, it is usually 6 to 10 years of latency period, can be from 4 months to 30 plus years.

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"Beryllium Sensitivity" (BeS)

- ▶ Detects asymptomatic people who have been exposed.
- ▶ Early marker of immune system's recognition of Be as "foreign"
- ▶ Not yet ill

BeLPT

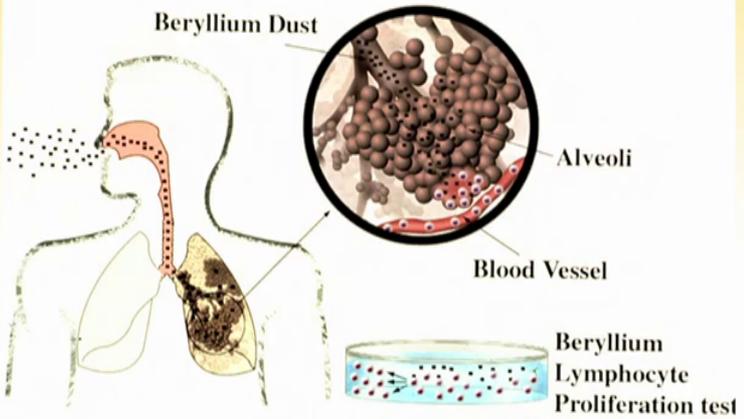


on lymphocytes from peripheral blood

The diagram shows a petri dish with a blue liquid medium. On the left side, there are several red dots representing lymphocytes. On the right side, there is a larger cluster of red dots, indicating proliferation. A small black dot is also visible in the center of the dish.

As well then there is a beryllium sensitivity BeS test detects, asymptomatic people who have been exposed early markers of immune system. So, on they use that I will leave the details to our medical people, but what the reason now we I wanted to put that up here, just to kind of you know that there is these kind of things are available. So, because if you look at some of the data some of the reports you should be able to understand what they are trying to talk about.

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Beryllium Dust

Alveoli

Blood Vessel

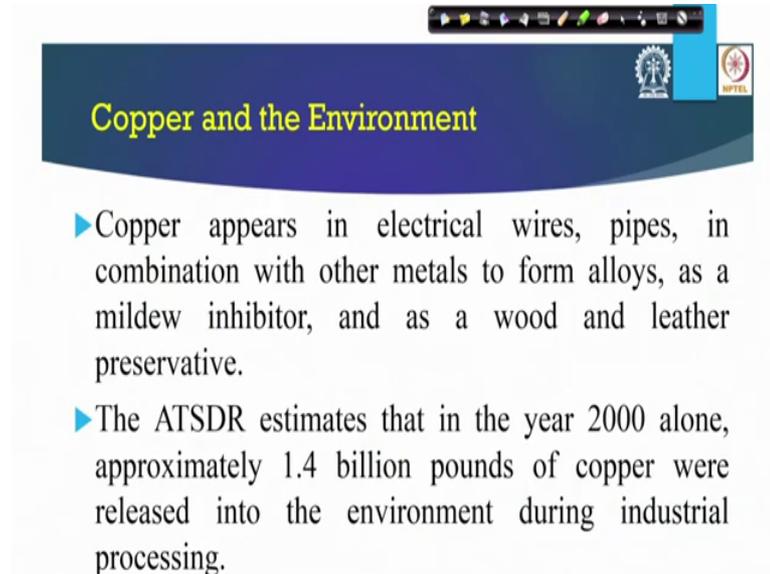
Beryllium Lymphocyte Proliferation test

on lavaged lymphocytes

The diagram illustrates the process of beryllium dust exposure. On the left, a human silhouette shows dust particles entering the respiratory system. A circular inset provides a magnified view of the alveoli, where beryllium dust particles (represented as brown spheres) are shown interacting with a blood vessel. Below this, a petri dish shows a Beryllium Lymphocyte Proliferation test, with red dots representing lymphocytes that have proliferated in response to the dust. The copyright notice at the bottom reads: © 2007 JONES AND BARTLETT PUBLISHERS

Then beryllium dust is also a problem it beryllium, on it can go to our lens and that lymphocytes and then creates a problem over there.

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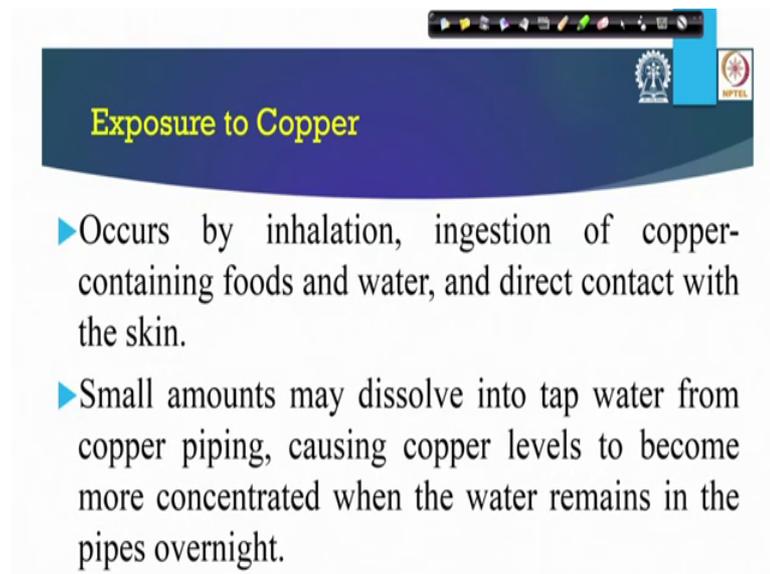


The slide features a dark blue header with the title "Copper and the Environment" in yellow. Below the header, there are two bullet points in blue. The slide also includes a navigation bar at the top and logos for IIT Bombay and NPTEL on the right side.

- ▶ Copper appears in electrical wires, pipes, in combination with other metals to form alloys, as a mildew inhibitor, and as a wood and leather preservative.
- ▶ The ATSDR estimates that in the year 2000 alone, approximately 1.4 billion pounds of copper were released into the environment during industrial processing.

Copper is used in electrical wires pipes another places, and we do produce lots of copper and they release into the environment.

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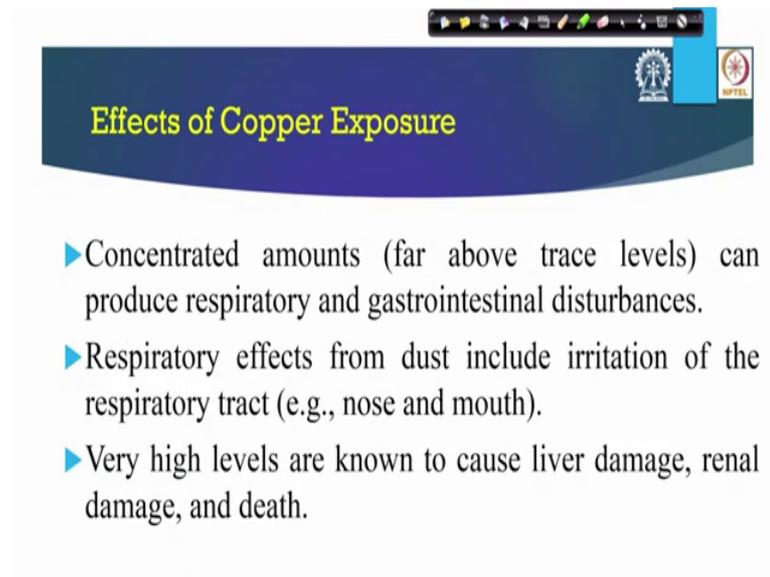


The slide features a dark blue header with the title "Exposure to Copper" in yellow. Below the header, there are two bullet points in blue. The slide also includes a navigation bar at the top and logos for IIT Bombay and NPTEL on the right side.

- ▶ Occurs by inhalation, ingestion of copper-containing foods and water, and direct contact with the skin.
- ▶ Small amounts may dissolve into tap water from copper piping, causing copper levels to become more concentrated when the water remains in the pipes overnight.

Usually for the humans it is not that of a issue, but for aquatic species it is, but it does like a in terms of exposure inhalation ingestion, those things are made is already top water.

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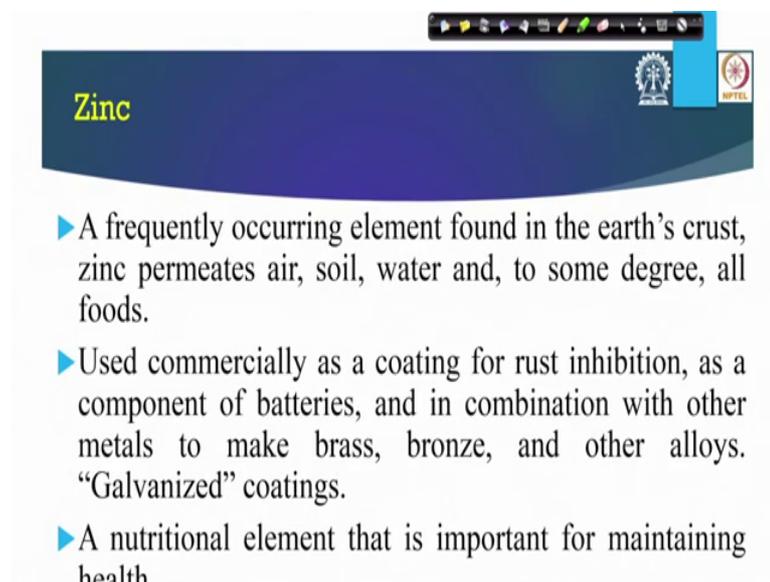


The slide features a dark blue header with the title "Effects of Copper Exposure" in yellow text. Below the header, there is a list of three bullet points, each preceded by a blue right-pointing triangle. The slide also includes a navigation bar at the top with various icons and logos on the right side.

- ▶ Concentrated amounts (far above trace levels) can produce respiratory and gastrointestinal disturbances.
- ▶ Respiratory effects from dust include irritation of the respiratory tract (e.g., nose and mouth).
- ▶ Very high levels are known to cause liver damage, renal damage, and death.

So, in terms of the exposure yeah, it can produce respiratory problem gastrointestinal problem, dust nose and respiratory intact, high very high level could cause liver damage, but that is what those things are there.

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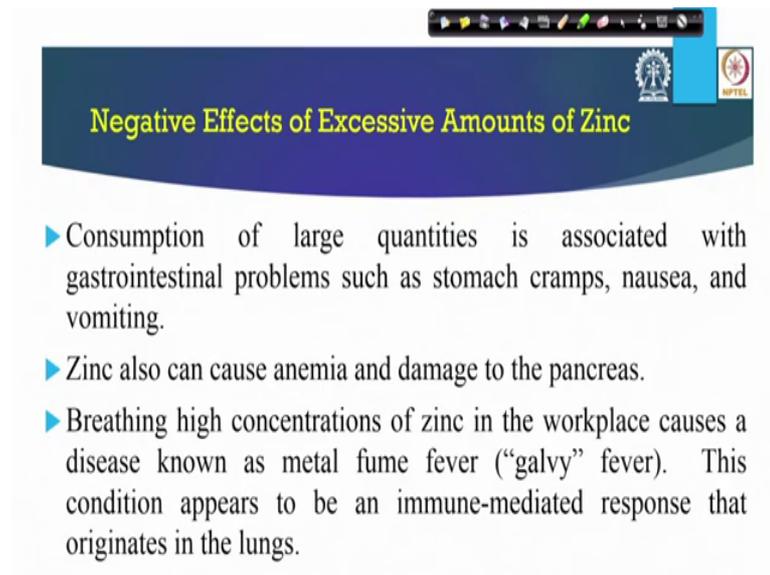


The slide features a dark blue header with the title "Zinc" in yellow text. Below the header, there is a list of three bullet points, each preceded by a blue right-pointing triangle. The slide also includes a navigation bar at the top with various icons and logos on the right side.

- ▶ A frequently occurring element found in the earth's crust, zinc permeates air, soil, water and, to some degree, all foods.
- ▶ Used commercially as a coating for rust inhibition, as a component of batteries, and in combination with other metals to make brass, bronze, and other alloys. "Galvanized" coatings.
- ▶ A nutritional element that is important for maintaining health

Zinc again zinc is used in different places, zinc can come as a coating for rust inhibition, component of batteries, to make brass bronze and other alloys galvanized coating a nutritional element, you do use as a multivitamin as well.

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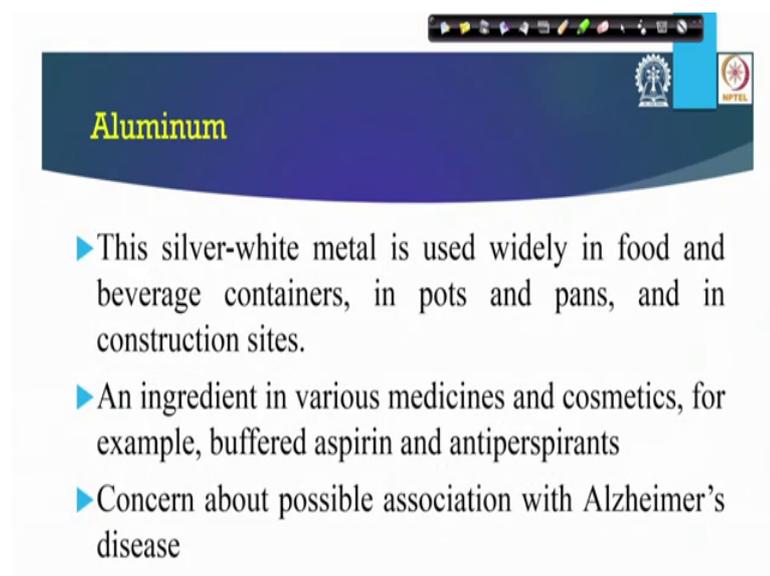


Negative Effects of Excessive Amounts of Zinc

- ▶ Consumption of large quantities is associated with gastrointestinal problems such as stomach cramps, nausea, and vomiting.
- ▶ Zinc also can cause anemia and damage to the pancreas.
- ▶ Breathing high concentrations of zinc in the workplace causes a disease known as metal fume fever (“galvy” fever). This condition appears to be an immune-mediated response that originates in the lungs.

But there are if you take a large quantity stomach cramps, nausea vomiting also cause anemia damage to pancreas, breathing high concentrations of zinc causes a disease known as metal fume fever like a galvy fever, this condition known to be immune mediated response. So, that is depending on hu that depending on different people may get different affect.

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Aluminum

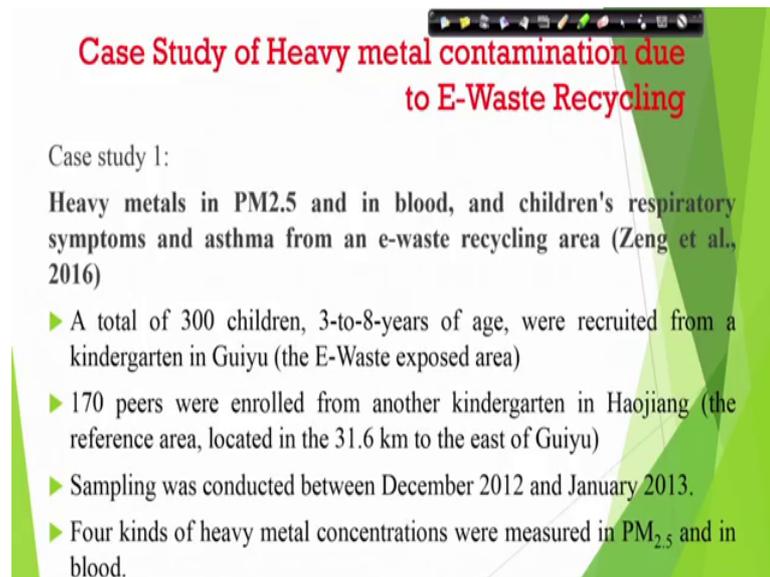
- ▶ This silver-white metal is used widely in food and beverage containers, in pots and pans, and in construction sites.
- ▶ An ingredient in various medicines and cosmetics, for example, buffered aspirin and antiperspirants
- ▶ Concern about possible association with Alzheimer’s disease

Aluminum again used in pots and pans, construction sites, various medicines, cosmetics, buffered aspirin and antiperspirants they are used and, but there is an association people

are associated worried about aluminum's association with Alzheimer disease. There have been some research which has presented that aluminum does cause Alzheimer, but problem. So, for example, the soda bottle if you use the aluminum cans usually these soda bottles has very low pH, and when they have the low pH. The aluminum from the cans has a tendency to get into those soda, and those get into this Pepsi and so, if they get into this soda it becomes a problem in terms of your, like over the time when you are consuming this soda you are not only consuming soda you are getting a little bit of aluminum free of cost and these aluminum free of cost, is becoming a problem in terms of looking at it creating your Alzheimer kind of problem Alzheimer disease.

So, there is no conclusive research yet, but there have been a lot of studies have been suggesting that, aluminum can cause Alzheimer problems. So, that is why a usage of aluminum pots and pans and other stuff, few people say that we should not use that. So, again anything we have we need to be careful we need to be, but with exposure to all these different elements at a high concentration could lead to certain problems. So, basically you need to have a balanced approach. So, what we have seen so far is we looked at the different elements that is present, and what are the ill effects of that I did not go into each and every slide in great detail because, that is more like a reading material and the reason we put all those text in there. So, that you can read it, otherwise you will all you will have to find the similar information. So, we basically summarized it and put it in a form for you to easily read that now will try to take this discussion, forward and look at some of the case studies some of the work that a work that has been published in terms of a looking at what is the impact, heavy metal contamination and from the e waste recycling facility, where mostly informal recycling.

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Case Study of Heavy metal contamination due to E-Waste Recycling

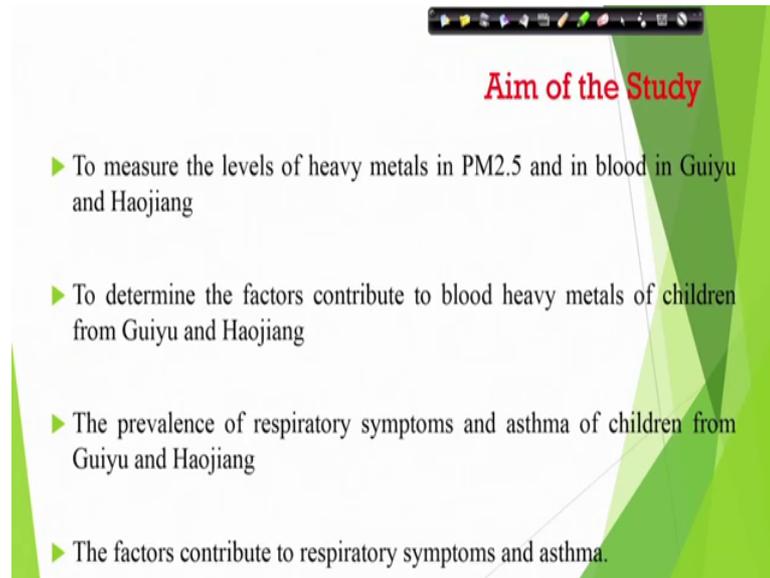
Case study 1:

Heavy metals in PM_{2.5} and in blood, and children's respiratory symptoms and asthma from an e-waste recycling area (Zeng et al., 2016)

- ▶ A total of 300 children, 3-to-8-years of age, were recruited from a kindergarten in Guiyu (the E-Waste exposed area)
- ▶ 170 peers were enrolled from another kindergarten in Haojiang (the reference area, located in the 31.6 km to the east of Guiyu)
- ▶ Sampling was conducted between December 2012 and January 2013.
- ▶ Four kinds of heavy metal concentrations were measured in PM_{2.5} and in blood.

So, let us look at some of these case studies so, this case study one it is where this work most of these work as you will see is actually showing up in from china. So, if you look at this heavy metals and heavy metals as well as the p m 2.5 in blood and they will looked at the children respiratory symptoms and asthma from an e waste recycling area. So, that is what the paper talks about it published 2 years ago like 2016. So, what the date they took 300 children total of 300 children 3 to 8 years of age, they recruited from a kindergarten from a kindergarten in the e waste exposed area, guiyu is one of the very famous place in terms of the informal us recycling. So, in guiyu you they took around 300 kids and 3 to 8 years of age, and then they did they study with them. So, 100, 70 peers were enrolled from another kindergar10 in haojiang, which is the reference area which is around 32 kilometers from the east of guiyu, that area does not have e waste test informal recycling, this guiyu area has e waste recycle, and then sampling was done between December 2012 with January 2013, 4 kinds of heavy metal concentration or measure and p m 2.5 and in the blood.

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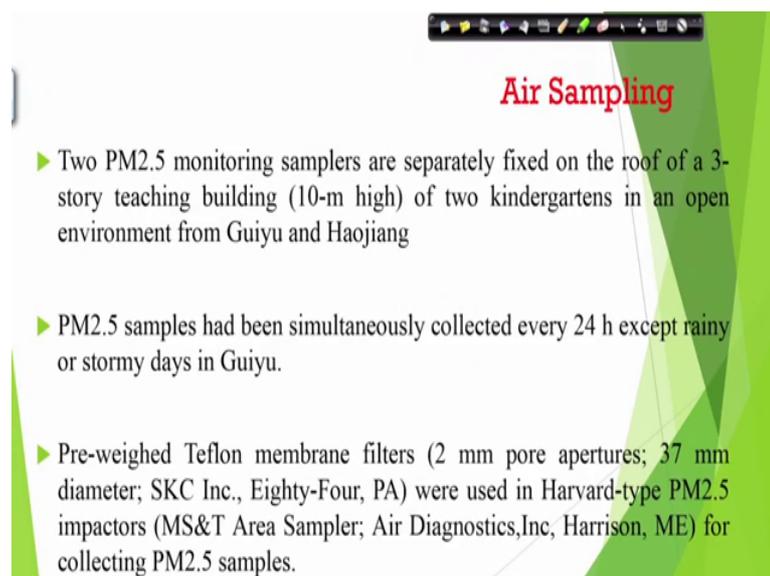


Aim of the Study

- ▶ To measure the levels of heavy metals in PM2.5 and in blood in Guiyu and Haojiang
- ▶ To determine the factors contribute to blood heavy metals of children from Guiyu and Haojiang
- ▶ The prevalence of respiratory symptoms and asthma of children from Guiyu and Haojiang
- ▶ The factors contribute to respiratory symptoms and asthma.

So, the blood sample was taken and the air sample was taken around that area, and then the heavy metal was. So, what was the aim, aim was to measure the level of heavy metals in both places, but to and then this haojiang will act as a background, and then guiyu will act as a contaminated site. So, determine the factors contribute to the blood heavy metal in f of the children, the prevalence of respiratory symptoms and asthma children, what are they are.

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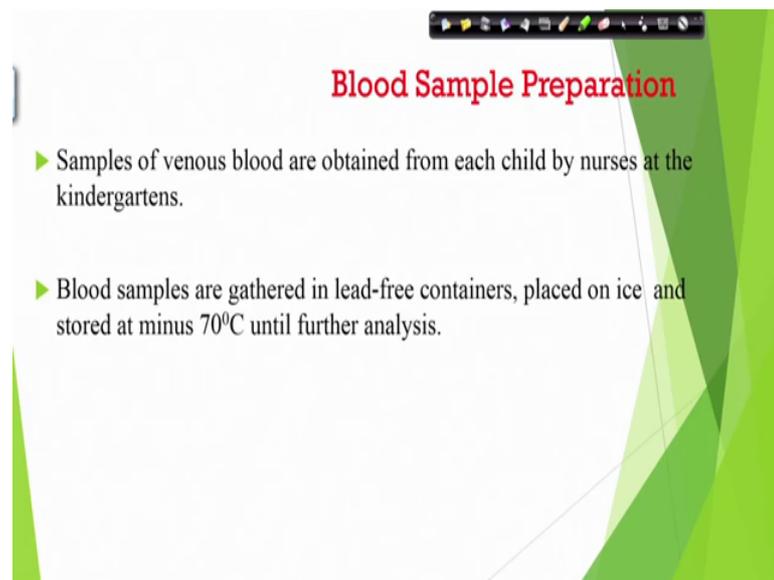


Air Sampling

- ▶ Two PM2.5 monitoring samplers are separately fixed on the roof of a 3-story teaching building (10-m high) of two kindergartens in an open environment from Guiyu and Haojiang
- ▶ PM2.5 samples had been simultaneously collected every 24 h except rainy or stormy days in Guiyu.
- ▶ Pre-weighed Teflon membrane filters (2 mm pore apertures; 37 mm diameter; SKC Inc., Eighty-Four, PA) were used in Harvard-type PM2.5 impactors (MS&T Area Sampler; Air Diagnostics, Inc, Harrison, ME) for collecting PM2.5 samples.

Prevailing factors contribute to respiratory systems and asthma all that. So, the tooth's p m 2.5 samplers were fixed on a roof of a 3-story teaching building of 2 kindergartens in an open environment from Guiyu and Haojiang, p m 2 points sample have been simultaneously collected every 24 hours except rainy or stormy days, pre-weighed Teflon membrane filters were used in harbor type p m 2.5 impactors air diagnosis for collecting p m 2.5 sample and all that.

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So, sample of various venous blood were connected from each child by nurses of the kindergar10, blood samples were gathered in lead free containers placed on ice and it stored at minus 70 degree until further analysis. So, if you look at in terms of the data sorry in terms of age the study.

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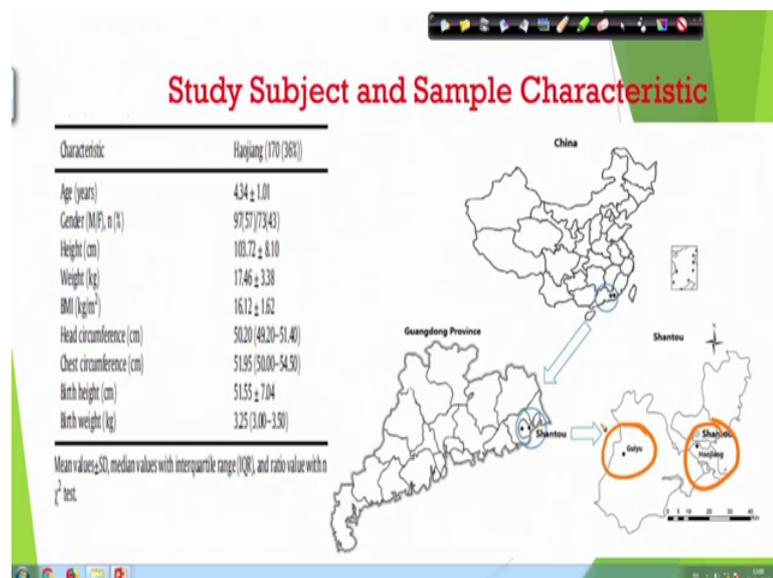
Study Subject and Sample Characteristic

Characteristic	Haojiang (170 (36%))	Guiyu (300 (64%))	p value
Age (years)	4.34 ± 1.01	4.66 ± 1.25	0.005 ^a
Gender (M/F), n (%)	97/57 (73/43)	150/50 (50/50)	0.141 ^d
Height (cm)	103.72 ± 8.10	104.43 ± 8.62	0.383 ^a
Weight (kg)	17.46 ± 3.38	17.07 ± 3.20	0.224 ^b
BMI (kg/m ²)	16.12 ± 1.62	15.61 ± 1.82	0.001 ^b
Head circumference (cm)	50.20 (49.20–51.40)	50.00 (49.16–51.09)	0.422 ^c
Chest circumference (cm)	51.95 (50.00–54.50)	51.18 (49.50–53.48)	0.025 ^c
Birth height (cm)	51.55 ± 7.04	49.87 ± 5.35	0.020 ^a
Birth weight (kg)	3.25 (3.00–3.50)	3.10 (3.00–3.40)	0.009 ^a

Mean values±SD, median values with interquartile range (IQR), and ratio value with n (%); a: T-test; b: T-test based on ln-transform; c: Mann-Whitney U; d: Pearson χ^2 test.

Subject. So, they were average age was 4.34 plus minus 1.01 in haojiang enjoy you 4.66 gender mostly like a male 9 more male less female, oh no sorry it is more less in haojiang we had 57 male and 73 female, and in percentage wise 43 percent in terms of and then guiyu, we had around 50 male and so, that should be 100 isn't it so, that is something around better far as a female said on 50 percent was a then height, weight head circumference, chest circum, birth weight, birth height, birth weight and all those things data was collected for the sample.

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So, that is where we are looking at this is the Guangdong province that is a Shantou and then we do not that we have guiyu, and the haojiang was some is over here as you can see, this is the haojiang area and if we can put it through this this is the haojiang area and that is the guiyu area. So, those are the 2 areas we have tried to compare.

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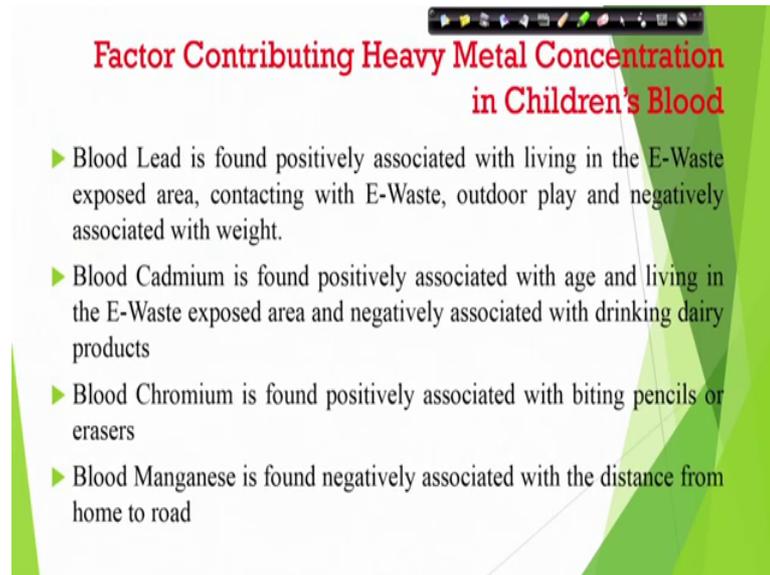
Results from the study

Blood Heavy metals	Guiyu	Haojung
Pb (µg/dL)	4.55-8.00	3.98-5.76
Cd (µg/dL)	0.442-0.779	0.372-0.642
Cr (µg/dL)	6.30-10.29	5.76-11.38
Mn (µg/dL)	24.39-35.48	23.28-35.04

Particulate Heavy Metals	Guiyu	Haojung
PM _{2.5} (µg/m ³)	34.83- 74.83	26.36-53.21
Pb (ng/m ³)	90.71-329.67	45.87-138.30
Cd (ng/m ³)	3.61-9.03	1.93-6.51
Cr (ng/m ³)	3.47-12.39	3.89-12.30
Mn (ng/m ³)	10.29-35.86	10.18-41.42

. So, blood level as you can see lead, cadmium, chromium and manganese. So, all these numbers are elevated compared to that haojiang it is Haojung which is elevated with respect to this, and then pat p m pat p m numbers are also high actually pretty high, as opposed to Haojung and the chromium it is a little bit chromium is actually looks almost the similar. And so, as the manganese, but manganese slightly looks actually less so, those problems are there so, what we need to. So, what is the take home message from this to it is a basically what trying to say that most for the most parameters, what we see if a Haojung is the background in guiyu area we see elevated concentration. So, we need to do something in terms of cleaning that area. So, that people do not get sick people do not get affected.

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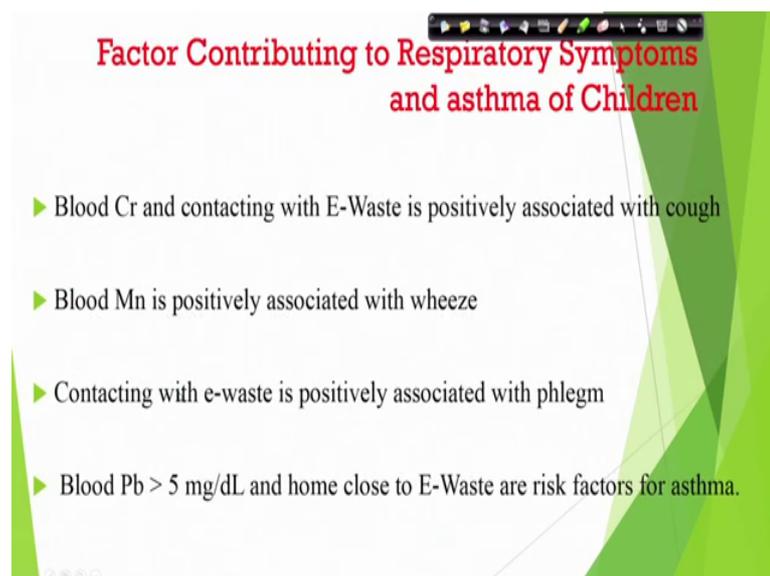


Factor Contributing Heavy Metal Concentration in Children's Blood

- ▶ Blood Lead is found positively associated with living in the E-Waste exposed area, contacting with E-Waste, outdoor play and negatively associated with weight.
- ▶ Blood Cadmium is found positively associated with age and living in the E-Waste exposed area and negatively associated with drinking dairy products
- ▶ Blood Chromium is found positively associated with biting pencils or erasers
- ▶ Blood Manganese is found negatively associated with the distance from home to road

So, in terms of the factor affecting blood levels in found positively associated with living in the e waste exposed area, again contacting with e waste outdoor play negatively associated with the weight blood cadmium this found associated to be the age, and the living in the e waste exposed area, blood chromium respond positively associated with biting pencils or eraser, blood manganese was found negatively with a distance from the home to road.

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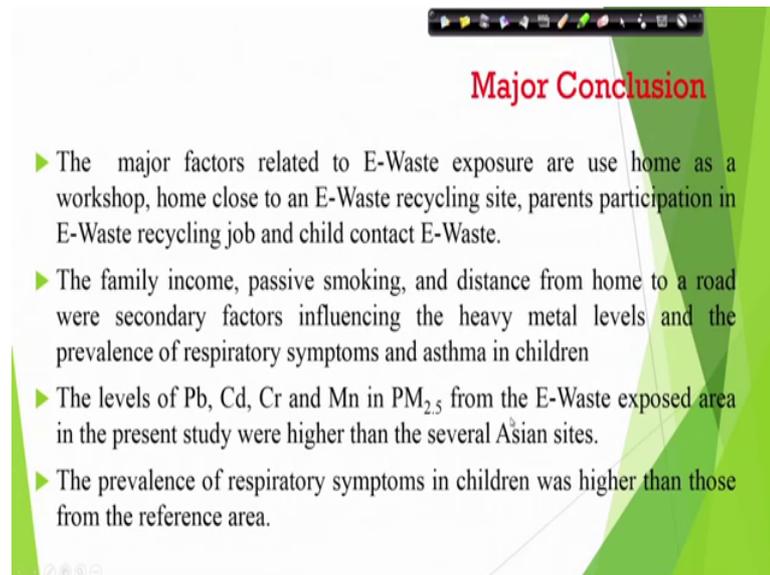


Factor Contributing to Respiratory Symptoms and asthma of Children

- ▶ Blood Cr and contacting with E-Waste is positively associated with cough
- ▶ Blood Mn is positively associated with wheeze
- ▶ Contacting with e-waste is positively associated with phlegm
- ▶ Blood Pb > 5 mg/dL and home close to E-Waste are risk factors for asthma.

So, blood chromium positively associated with the cough, blood manganese is associated with the wheezing, contacting with e waste is positively associated with the phlegm, blood level greater than 5 milligram per liter blood lead level and with the home close to e waste and the risk factor for asthma.

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Major Conclusion

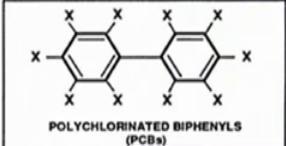
- ▶ The major factors related to E-Waste exposure are use home as a workshop, home close to an E-Waste recycling site, parents participation in E-Waste recycling job and child contact E-Waste.
- ▶ The family income, passive smoking, and distance from home to a road were secondary factors influencing the heavy metal levels and the prevalence of respiratory symptoms and asthma in children
- ▶ The levels of Pb, Cd, Cr and Mn in PM_{2.5} from the E-Waste exposed area in the present study were higher than the several Asian sites.
- ▶ The prevalence of respiratory symptoms in children was higher than those from the reference area.

So, the major conclusion that they found was that e waste exposure are used home as a workshop home close to an e waste recycling facilities, parent's participation in the and the child's contact to the e waste the family income passive smoking distance from home to road. Where the secondary factors as well the levels of lead, cadmium, chromium, manganese and p m 2.5 from the e waste exposed area that were higher than the several Asian cities sites the prevalence of the respiratory systems and children was higher than those from the reference area.

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What Are PCB's?

- ▶ Mixtures of up to 209 individual chlorinated compounds (known as congeners).
- ▶ PCB's are a fat-soluble, water-insoluble hydrocarbon containing 1 to 10 chlorine atoms.
- ▶ Common Structure $C_{12}H_{10-x}Cl_x$:
- ▶ PCB mixtures are known in the U.S. by the trade name Aroclor.



POLYCHLORINATED BIPHENYLS
(PCBs)

So, that is. Ah. So, those kind of give you some idea about in terms of how this and whatever we are talking about how these knowledge is being applied, and what that does mean. So, when we get all these information we can use that data to better design the e waste management system. And it is to change some of those legislation if you have to. So, those are the reason why we need to collect these kind of data. So, some other background in terms of the PCBs we have a mixture of 209 individual oriented compounds, they are PCBs are fat soluble water-soluble hydrocarbon, common structure $c_{12} h_{10} \text{ minus } x c l_x$.

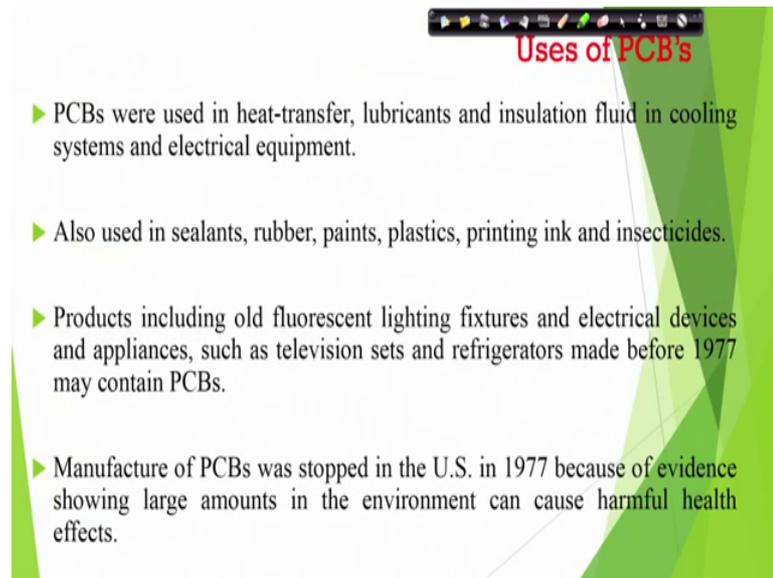
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Polychlorinated Biphenyl

- ▶ PCB's are either oily liquids or solids, some exist as a vapor in air.
- ▶ Colorless to light yellow
- ▶ PCB's have no smell or taste
- ▶ Extremely stable, withstanding temperatures of up to 1,600°F (870°C).
- ▶ PCB's are fire-resistant and an electrical insulator.

PCB mixtures is known as in the e waste a trade name aroclor, and they are either oily liquid colorless to light yellow no smell extremely stable up to 870 degree centigrade, fire resistance an electrical insulator, and they used as a heat transfer lubricants insulation fluid.

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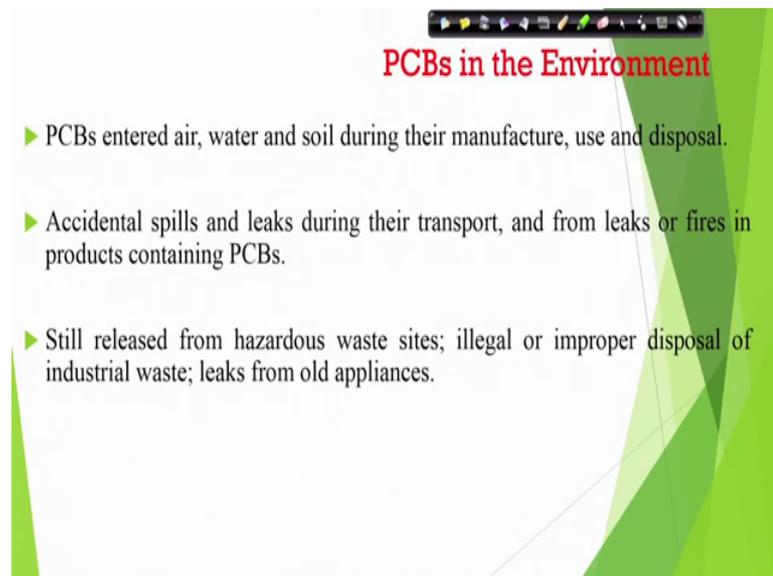


Uses of PCB's

- ▶ PCBs were used in heat-transfer, lubricants and insulation fluid in cooling systems and electrical equipment.
- ▶ Also used in sealants, rubber, paints, plastics, printing ink and insecticides.
- ▶ Products including old fluorescent lighting fixtures and electrical devices and appliances, such as television sets and refrigerators made before 1977 may contain PCBs.
- ▶ Manufacture of PCBs was stopped in the U.S. in 1977 because of evidence showing large amounts in the environment can cause harmful health effects.

Also used for sealants paints plastics old fluorescent lightning fixtures, electrical device, manufacture of PCB actually stopped in 1977, because they found that it can cause high large amount of it can cause the harmful health effects.

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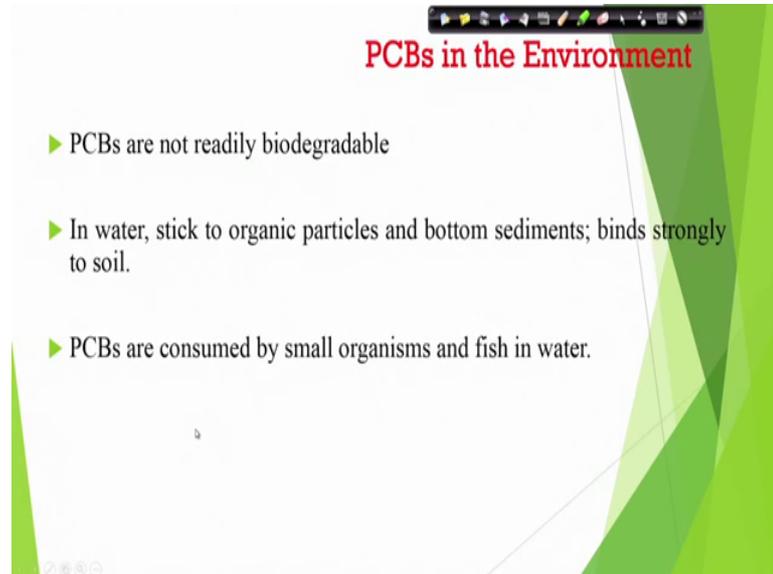


PCBs in the Environment

- ▶ PCBs entered air, water and soil during their manufacture, use and disposal.
- ▶ Accidental spills and leaks during their transport, and from leaks or fires in products containing PCBs.
- ▶ Still released from hazardous waste sites; illegal or improper disposal of industrial waste; leaks from old appliances.

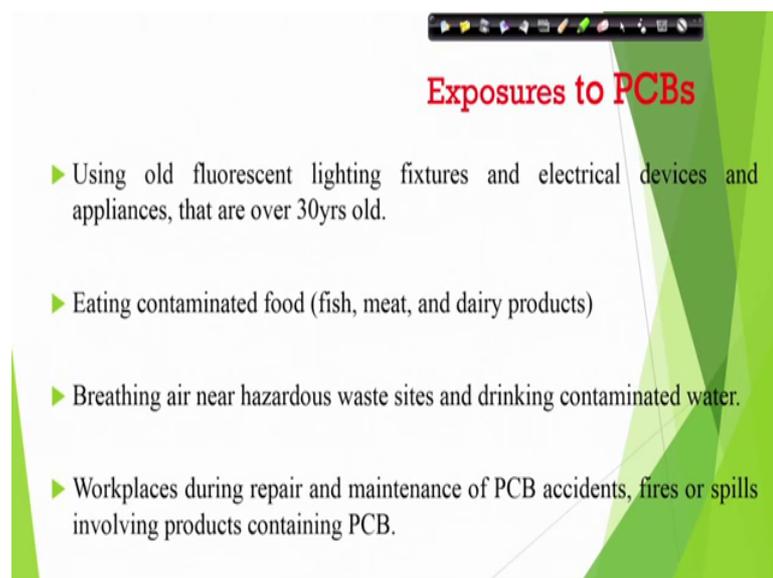
PCBs can enter air water soil during the manufacturer accidental spill can happen, they still released from the hazardous waste sites.

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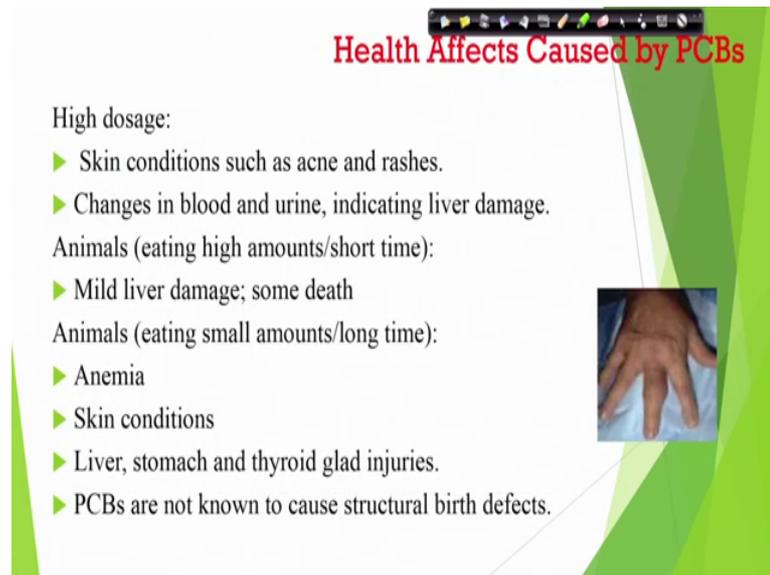
So, those other way can come to the environment are not readily biodegradable, in water is stick to organic particles in the and bottom sediments, it is binds strongly to soil, PCB's are consumed in the small organisms and the fish in water, then it will the big fish and then what the ultimately the humans can get exposed.

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PCB's are used here old fluorescent lighting fixtures, if you use more than 30 years old heating contaminated food like this production daily production, breathing air near the hazardous waste site workplace during workplaces, during repair and maintenance of PCB accidents or fires, or spills involving products containing PCB.

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Health Affects Caused by PCBs

High dosage:

- ▶ Skin conditions such as acne and rashes.
- ▶ Changes in blood and urine, indicating liver damage.

Animals (eating high amounts/short time):

- ▶ Mild liver damage; some death

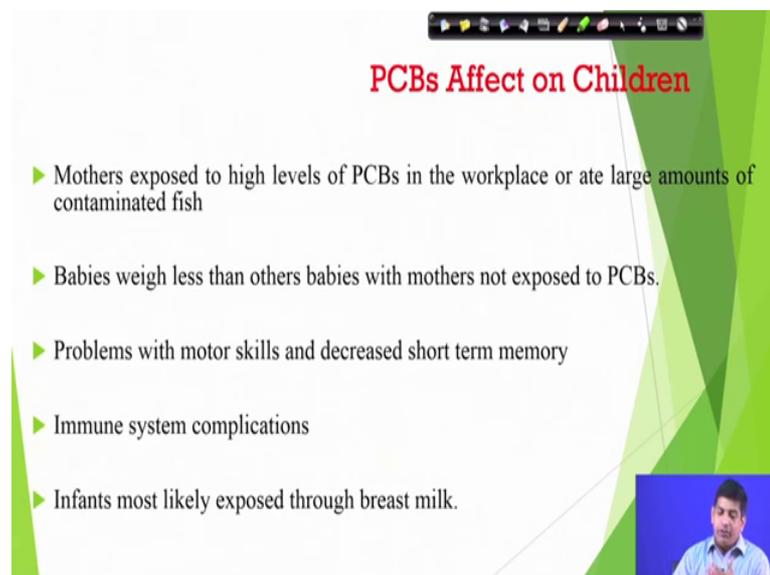
Animals (eating small amounts/long time):

- ▶ Anemia
- ▶ Skin conditions
- ▶ Liver, stomach and thyroid gland injuries.
- ▶ PCBs are not known to cause structural birth defects.



So, there are health effects skin conditions, changes in blood pressure, changes in blood and urine indicating liver damage, the animal's mild liver damage, animals then anemia skin conditions.

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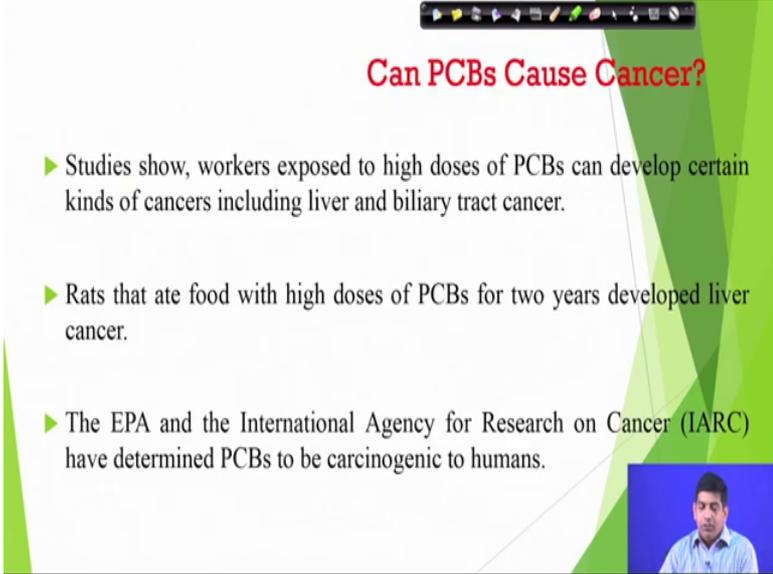
PCBs Affect on Children

- ▶ Mothers exposed to high levels of PCBs in the workplace or ate large amounts of contaminated fish
- ▶ Babies weigh less than others babies with mothers not exposed to PCBs.
- ▶ Problems with motor skills and decreased short term memory
- ▶ Immune system complications
- ▶ Infants most likely exposed through breast milk.



And those things are there PCBs does affect on children mothers exposed to high level of PCB in the workplace, or a large amounts of contaminated fish babies weight less than the other babies with a mother not exposed to PCB's, problem with motor skills and decreased short term memory, immune system complications. In fact, most likely to be exposed through breast milk.

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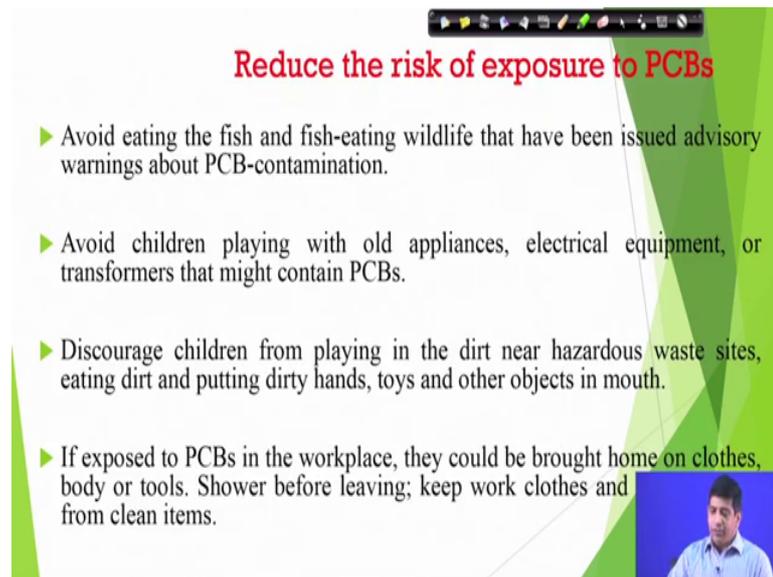
Can PCBs Cause Cancer?

- ▶ Studies show, workers exposed to high doses of PCBs can develop certain kinds of cancers including liver and biliary tract cancer.
- ▶ Rats that ate food with high doses of PCBs for two years developed liver cancer.
- ▶ The EPA and the International Agency for Research on Cancer (IARC) have determined PCBs to be carcinogenic to humans.

The slide features a green and white background with a navigation bar at the top. A small video inset in the bottom right corner shows a man in a blue shirt speaking.

Can PCB cause cancer study so, that workplace exposed to high dose of PCB can develop certain kind of cancers, including liver and biliary tract cancer, rats that ate food with high doses of PCB for 2 years developed liver cancer. The EPA and the international agencies for research on cancer have determined PCB's to be carcinogenic for humans. So, that is a has been has been used.

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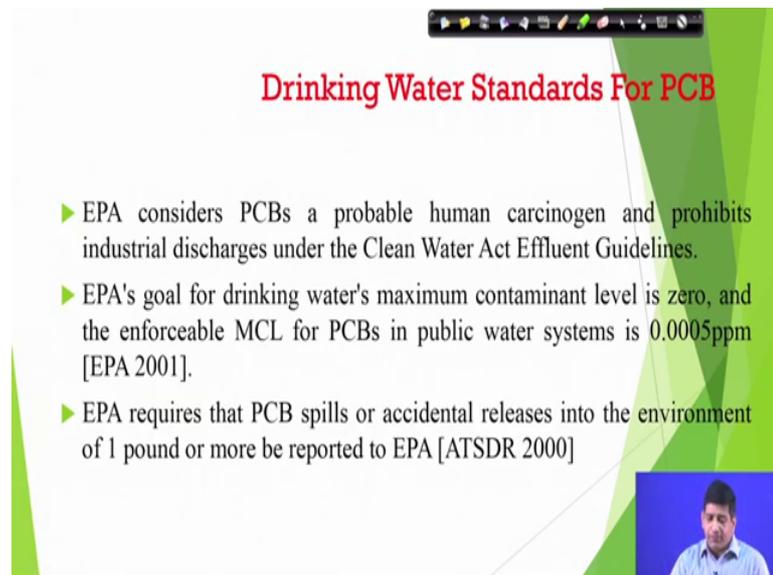
Reduce the risk of exposure to PCBs

- ▶ Avoid eating the fish and fish-eating wildlife that have been issued advisory warnings about PCB-contamination.
- ▶ Avoid children playing with old appliances, electrical equipment, or transformers that might contain PCBs.
- ▶ Discourage children from playing in the dirt near hazardous waste sites, eating dirt and putting dirty hands, toys and other objects in mouth.
- ▶ If exposed to PCBs in the workplace, they could be brought home on clothes, body or tools. Shower before leaving; keep work clothes and from clean items.

The slide features a green geometric background on the right side and a small video inset in the bottom right corner showing a man in a light blue shirt speaking.

So, in terms of reducing avoid eating fish, avoid children playing with old appliances, discourage children are playing in that in the dirt near hazardous waste facilities, exposed to PCB's they could be brought home on clothes body or soil or tools, sour before you leave leaving, keep wore clothes and tools separate from the inside.

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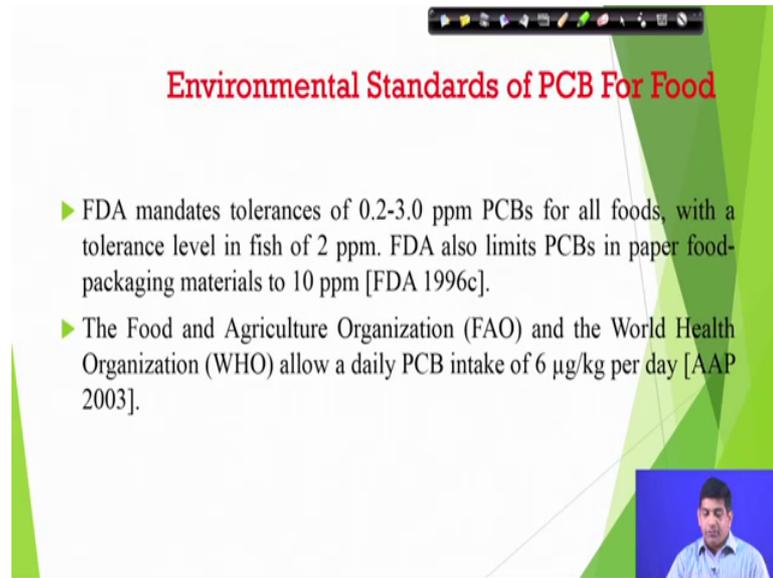
Drinking Water Standards For PCB

- ▶ EPA considers PCBs a probable human carcinogen and prohibits industrial discharges under the Clean Water Act Effluent Guidelines.
- ▶ EPA's goal for drinking water's maximum contaminant level is zero, and the enforceable MCL for PCBs in public water systems is 0.0005ppm [EPA 2001].
- ▶ EPA requires that PCB spills or accidental releases into the environment of 1 pound or more be reported to EPA [ATSDR 2000]

The slide features a green geometric background on the right side and a small video inset in the bottom right corner showing a man in a light blue shirt speaking.

So, there is a drinking water standard for p c b, EPA goal is to have a 0, but you cannot really have 0. So, it is a .0005 ppm. PCB's spill or accidental release into the environment of one pound or more can be reported by PCB in 2000 itself.

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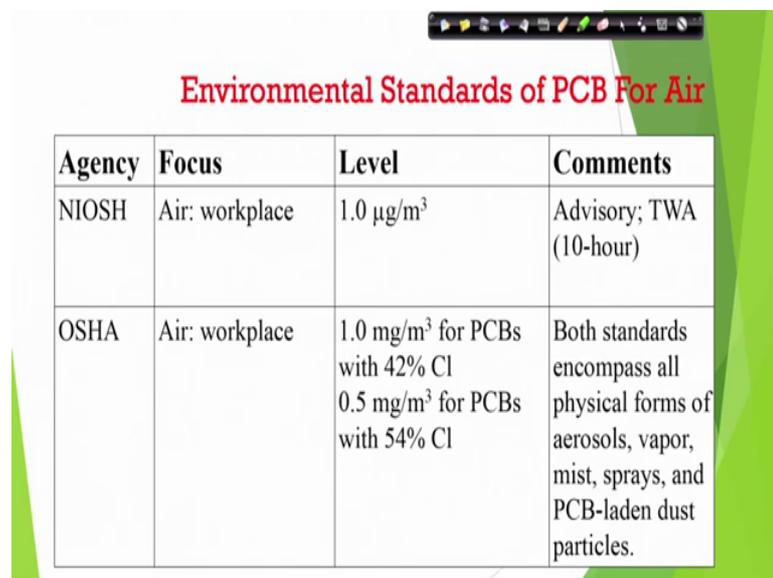
Environmental Standards of PCB For Food

- ▶ FDA mandates tolerances of 0.2-3.0 ppm PCBs for all foods, with a tolerance level in fish of 2 ppm. FDA also limits PCBs in paper food-packaging materials to 10 ppm [FDA 1996c].
- ▶ The Food and Agriculture Organization (FAO) and the World Health Organization (WHO) allow a daily PCB intake of 6 µg/kg per day [AAP 2003].

(Note: The slide also features a small video inset of a presenter in the bottom right corner.)

So, so EPA has a mandate of around point 2 to 3 ppm all food and other stuff food and agriculture organization also has it. So, these numbers are only for your standard.

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Environmental Standards of PCB For Air

Agency	Focus	Level	Comments
NIOSH	Air: workplace	1.0 µg/m ³	Advisory; TWA (10-hour)
OSHA	Air: workplace	1.0 mg/m ³ for PCBs with 42% Cl 0.5 mg/m ³ for PCBs with 54% Cl	Both standards encompass all physical forms of aerosols, vapor, mist, sprays, and PCB-laden dust particles.

So, in terms of PCB's from air, we have the different agencies this occupational health and safety, you have 1 microgram per meter cube, 1 milligram per meter cube, for PCB's for osha the top one was niosh, the second one is osha and both the standard we have the all physical forms aerosol vapor mist sprays and other stuff is part of that.

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**PBDEs: High Production Volume Chemicals
(Common name: Bromkal, Tardex, Saytex)**

3 commercial mixtures (Penta and Octa no longer made)

- Penta-BDE (*used in foam; 40% tetra, 45% penta, 6% hexa*)
 - 18.3 million pounds per year in the Americas
 - 98 % of world use is in the Americas
 - All congeners highly bioaccumulative
 - 86 to 99% of congeners found in human tissues
- Octa-BDE (*plastics, textiles; 10% hexa, 40% hepta, 30% octa, 20% nona*)
 - 3.0 million pounds per year in the Americas
- Deca-BDE (*plastics, textiles; 98% deca and 2% nona*)
 - 53.6 million pounds per year in the Americas

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So, PBDE is similar to PCB's, PBDE is there let say of mixture of 3 penta octa, penta and octa is no longer made. So, it is mostly 3 types of PBDEs which is being used. So, it is mostly tetra penta used in form 18.3 million pounds per year in the America. So, 90.98 percent is your used in in the Americas itself, all congeners highly bioaccumulative 86 to 99 percent of the found in human tissue.

So, you have octa b d e, penta b d e, octa b d e, and deca b d e. So, these 3 are there. So, octa b d e 3 million pounds per year, and deca b d e 53.6 million pounds per year.

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“They’re everywhere”

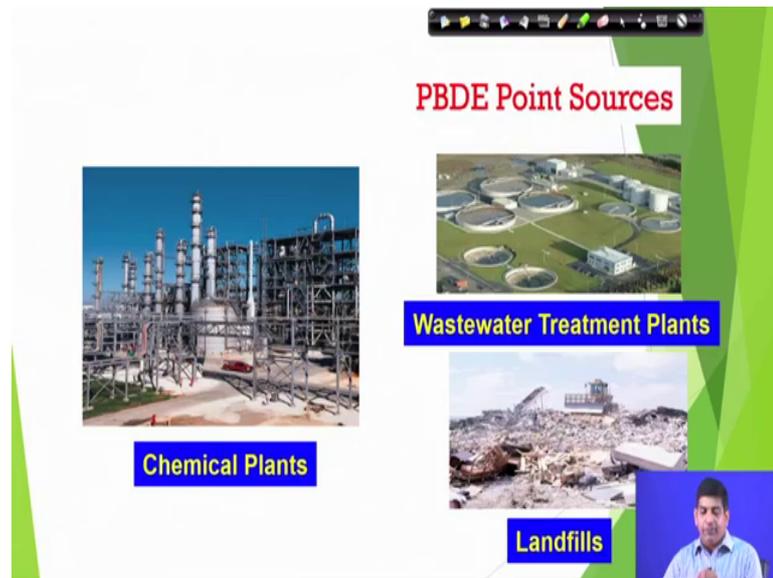
PBDEs are now ubiquitous environmental contaminants:

- Indoor and outdoor Air
- House and office dust
- Rivers and lakes and sediments
- Sewage sludge
- Remote Arctic regions (i.e., long-range transport)
- Food
- Biota (terrestrial & marine mammals, fish, humans)



So, that is a lot of a PBDE coming out. So, they are everywhere. So, PBDEs are now ubiquitous environmental they are indoor and outdoor air, housing and office dust, rivers and lakes sewage sludge, remote arctic regions biota. So, they are basically showing up everywhere.

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So, PBDEs point sources are wastewater treatment plant landfills, chemical plants.

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And non-point sources is plastics electrical industry, furnishing foam, front and then those things are also people ease are used there as well. So, that is in terms of the non-point source then.

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They in terms of the human exposure we can get it through the breast milk, through the fetus transfer, through the diet, indoor house, office dust can be from the occupational from the exposure.

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Ah in in the workplace. So, in terms of dietary intake again be based on the agent food group as you can see, p b the people are getting exposed to different types of a diet from dairy, from meat, from fish, from egg, from fat product, from human milk.

So, think about the PBDEs and other things present in the electronics, and they are making into the food and then they are coming on your plate and then you are consuming it, and then you are getting exposed to that. So, again it is kind of gets a lot of chain goes around. So, it is that is where you see all these exposure coming out, from infants like a male the elder males, and as you can see here from the dairy we see that from human milk there is for the very small babies, and then after that you see from the dairy products the milk and other stuff as we grow older we try to use loss less meat is a major source of PBDE and egg.

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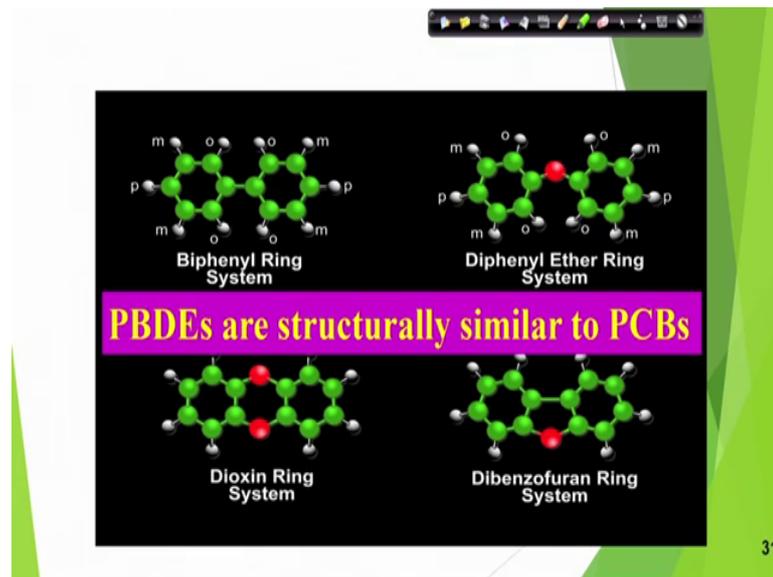
The slide features a title in red text: "Why do we care about Polybrominated diphenyl ethers?". Below the title are three green arrows pointing to the following text:

- Persistent, bioaccumulative, and structurally similar to PCBs, DDT, and other POPs.
- Levels are rapidly increasing in the environment and biological samples
- Effects seen in animals are similar to those seen with PCBs

In the bottom right corner of the slide, there is a small video inset showing a man speaking. The slide also includes a navigation bar at the top and a footer with icons at the bottom left.

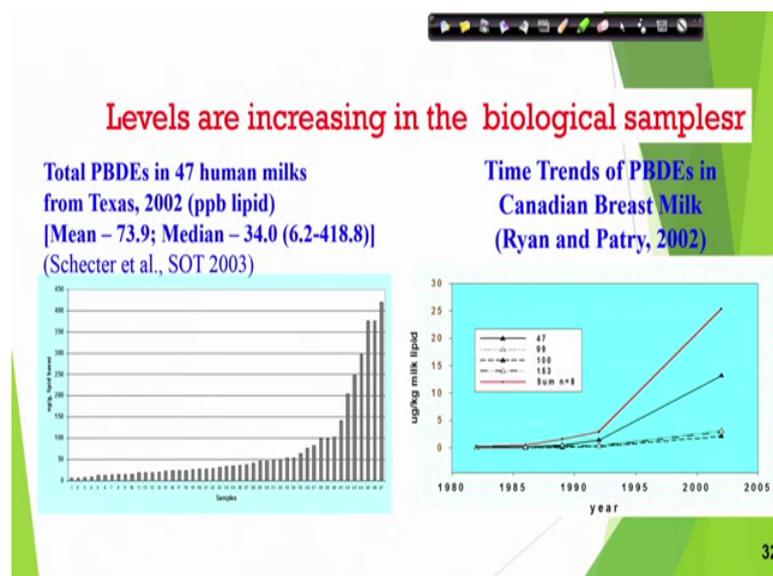
Fat products and those things are also other sources. So, why do we really care again from time to time, you need to ask this question why this course why we it actually care about these stuff. They are persistent bioaccumulative and it is structurally similar to PCB's DDT and other pops, and they are rapidly increasing in the environment, and effect seen in animals are similar to those seen with PCB's. So, PBDEs and the PCB's they so, similar effect and then that PCB and then you may already kind of talked about the effect of PCB's. So, that is what we need to be worried about that.

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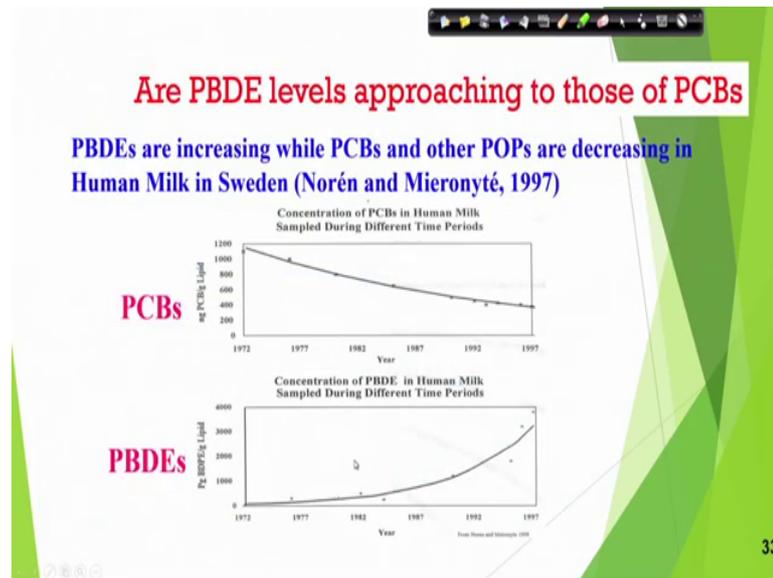
P b d e is structurally actually similar to PCB's. So, that is the they have a similar structure, by biphenyl ring system they have a diphenyl ether ring systems let us say then you have a dioxin ring system, the dibenzofuran ring system as you can see they have a very similar structure and the similar structure is actually causing with them to behave similar. So, levels are increasing in the biological sample as you can see some of the examples here again.

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In 47 human milk from Texas, you can see that mean and median values, and those are shown over, here as you can look at the nano gram per gram of the lipid base, then here also in the milk we see that concentrations are increasing. So, that is levels are increasing in the biological sample.

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So, we need to be careful with that, and are the PBDE levels approaching those are PCB's we see that PBDEs are increasing, where PCB's and other pops are decreasing. So, that is in the human milk in Sweden as you can see the PCB's is are decreasing, and PBDEs are increasing. So, it is we are so, we replace one problem with another problem. So, the PCB's were used as a coolant and other place other stuff now we are using PBDEs as a flame retardants. So, we are we have to make sure that PBDEs because they are. So, similar effect.

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**Developmental Neurotoxicity of PBDEs,
similar to PCBs**

- Both mice and rats
 - Mice very sensitive (clear effects at 0.8 mg BDE-99/kg) in infantile period
- Sensory and Cognitive Effects
- Mechanism Unknown
 - Depression in serum T4
 - Effects on Intracellular signaling
 - Effects on neurotransmitters

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So, we need to manage them properly. So, they have been some work on development in neurotoxicity of PBDEs similar to PCB both mice and rats were tested, look at the sensory and cognitive effects. We do not know the mechanism yet, but depression was in serum t 4 effects on intracellular signaling effects on neurotransmitter.

So, it. So, those a things were there now, quickly let us look at the one of this developing country problem we had a chance like I had a chance to visit Ghana, where we looked at the electronic waste issues. So, here just to another like a time to time we talked about Indian scenario, but let us look at some other country, just to have a perspective how things are over there and they are very similar situation as you will see.

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INTRODUCTION

GHANA

- ▶ Ghana (formerly known as the Gold Coast because of the vast deposits of gold) became the first country in sub-Saharan Africa to gain independence in 1957.
- ▶ Is located in the western portion of the African continent, bordered by the Gulf of Guinea, Togo, Burkina Faso and the Coted'Ivoire; has a total land area of 238,540 sq. km.
- ▶ The economy of Ghana is mainly agriculture controlled and is one of the leading exporters of cocoa in the world.
- ▶ The climate is tropical, experiences both wet and dry periods and has two rainy periods in the year except the northern sector. The average annual temperature is about 26°C (about 79°F). Annual Rainfall: 736.6mm / 29".
- ▶ English is the official language, a legacy of British colonial rule.

I will skip this part for you to kind of look at where is Ghana, and all that that is not that important for the e waste management point of view, but that you should know a little bit about that country. So, I put these slides up there it is it is become the first country in sub-Saharan Africa to gain independence in 1957. So, 10 years after us. So, economy Ghana is mainly agriculture and one of the leading exporter of cocoa in in the world.

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INTRODUCTION GHANA - WASTE ELECTRONIC AND ELECTRICAL EQUIPMENT

- ▶ The demand for electronic and electrical equipment (EEE) has been on the increase in the last decade as a result of accelerated economic growth, coupled with urbanization around the world.
- ▶ Some of the equipment are household appliances like kitchen blenders, refrigerators, computers, stereo systems, televisions, mobile phones, etc.
- ▶ Similarly, in Ghana, there has been remarkable growth in the consumption of EEE since the mid-1990s.
- ▶ Today, Ghanaians have access to computer facilities, mobile telephones, microwaves, refrigerators, washing machine, entertainment electronics, etc. which are serving a good purpose in their daily lives and supporting the development of the Ghanaian economy.
- ▶ Nowadays, these EEE have a short lifetime (only few months to years), so large volumes of mix waste EEE (popularly called *electronic waste or e-waste*) are generated annually in Ghana.

So, all if you love your chocolates. So, then you basically gets a lot of stuff from that coming from Ghana.

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E-WASTE PRODUCTS ON THE GHANAIAAN MARKET

- ▶ In Ghana, both brand new and used EEE products are found on the market. However many have the belief that the used EEE products are inexpensive and better than the latter. Hence, the higher patronage.
- ▶ Presently, large volumes of e-waste are imported legally/illegally into the country. Items such as computers, televisions, stereos, electric irons, blenders, refrigerators, air conditioners, etc. are abundant in the Ghanaian society.
- ▶ The dumping of these goods have risen lately, from Europe and United States into developing countries including Ghana for reasons like lack of adequate recycling infrastructure, exorbitant fees in the disposal of e-waste and potential environmental pollution.
- ▶ At the end of their useful life, everyone of these products becomes waste, forming the complex mixture of materials that make up the EEE waste stream.

So, lot of electrical equipment's are being formed there to Ghana is using lot of electronics e waste is being produced in Ghana, in both brand new and the new older products are coming up dumping of those wastes are also coming.

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SOME OF THE E-WASTE ON THE GHANAIAAN MARKET



Some brown goods on display at a market in Ghana

In. So, let us look at some of these pictures that I wanted to show you, some of these e waste on the Ghanaian market you see the recyclable resale once refurbished once.

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Showing up again. So, again refurbished once are being.

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So, it is being sold some grey goods and other display in the market in Accra which is a capital city.

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And white coats and other display you see those as well. So, there is a lot of e waste being produced.

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EXTENT OF E-WASTE PROBLEM IN GHANA

- ▶ With advancement in technology, nationals of the developed world tend to replace their old EEE, whereas the developing nations are the sinks for the obsolete products; this is the source of the ever increasing stream of e-waste in the developing world.
- ▶ Ghana does not manufacture EEE goods, but imports both new and old EEE into the country.
- ▶ Cheaper e-waste product has led to increase patronage in Ghana, coupled with increased dumping from the developed world into the country.
- ▶ Quantity of waste EEE entering the country, domestically generated (stored in artisan's workshops), households, institutions/companies, etc are unknown.
- ▶ At the end of EEE life span, group of youth called "scrap boys" are seen moving round to buy disposed end of service EEE products, who in turn sell to recyclers and artisans who isolate precious minerals (e.g. gold, silver, copper). This informal practice is popular in almost all the regional capitals as well as some municipal towns; number of people involved in this informal business is uncertain.
- ▶ Likewise, there is no statistical data as regards the quantity of waste generated (*secondary e-waste*) after recycling and recovery for re-use or for export.
- ▶ The recycling and disposal methods of e-waste are inappropriate, usually rudimentary. E-waste is processed in open air and enclosures (small workshops and ramshackle wooden/metal buildings) by manual dismantling (stripping to recover essential components like metals, printed wiring boards, cables, batteries, etc). The emerging wastes contain hazardous materials (e.g. toxic metals, PCBs, BFRs, burnt plastics). These are discharged/ dumped/stock-piled along the streams, rivers and or dispersed on large tracts of land. These could pose severe impacts on human health and the environment. A case in point is, Agbogbloshie, a well-known market in Accra, for e-scrap buying, selling and processing.
- ▶ Some scenes as regards e-waste are illustrated:

And lot of chemicals all those things are coming in stockpile.

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And the deal now let us some of the disposal dysfunctional e waste.

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An additional workshop e waste ready for processing is stripping extraction recycling.

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Some scenes of e waste disposal on the side of the road and very similar situation you can see if you watch carefully in India, too in many places you can see the river is being damaged.

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And scavengers working on a stockpile e waste and they trying to get some material out of that stockpiled e waste.

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Again, dump sites secondary e waste scraps are being trying to recover, sorting, processing, residential and dump sites

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So, impact we see that again very similar impacts you can read that atmospheric pollution.

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Water body is getting polluted we see that sediments and all those things are getting affected.

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As you can see in these pictures.

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IMPACT OF E-WASTE IN THE GHANAIAN ENVIRONMENT

- ▶ E-Waste contains several components having toxic chemicals which could impact human health and the environment.
- ▶ Atmospheric pollution –fumes of mixed obnoxious and toxic gases and particulate emissions from opening burning of plastic-metal parts and precious metals via acid leaching at recycling centres and dumped sites.
- ▶ Water bodies as well as soils are contaminated; e-scrap piles remain ages on the land at the mercy of the sun and rain. Chemical leachates thus reach water bodies with ease, the consequences are untold on aquatics and other users.
- ▶ Possible long term health effects on people involved due to exposure to toxic chemicals during processing e.g. dermal absorption during rummaging piled e-waste in dumps, inhalation during burning of the waste. Serious repercussions for residences in proximity to areas where e-waste is recycled or burnt.

So, there are certain challenges in there as well no pollution prevention recycle control is presently there no basically structure is there the laws are being there.

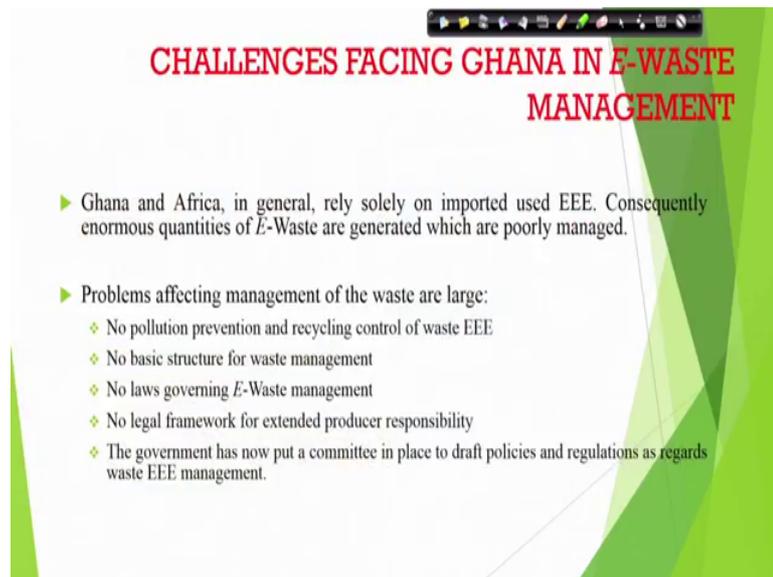
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E-WASTE DISPOSAL AND IMPACTS IN ACCRA



Impact of e-waste activities on aquatic and terrestrial environments of some parts of Accra

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CHALLENGES FACING GHANA IN E-WASTE MANAGEMENT

- ▶ Ghana and Africa, in general, rely solely on imported used EEE. Consequently enormous quantities of E-Waste are generated which are poorly managed.
- ▶ Problems affecting management of the waste are large:
 - ❖ No pollution prevention and recycling control of waste EEE
 - ❖ No basic structure for waste management
 - ❖ No laws governing E-Waste management
 - ❖ No legal framework for extended producer responsibility
 - ❖ The government has now put a committee in place to draft policies and regulations as regards waste EEE management.

Now laws are coming up legal framework and those things are.

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States Government: **OG/LSG Pilot** E-WASTE MANAGEMENT SCHEME

(W2W)=WASTE TO WEALTH

3Rs Recovery
Recycle Re-use

THE ENVIRONMENTAL PROTECTION AGENCY/STEA
PUBLIC-PRIVATE PARTNERSHIP (PPP)

MSC: MAINTENANCE SYSTEM CONSULTANT
(GOVT. APPOINTED E-WASTE MANAGER)

SITE: KI KAMALU SETTLEMENT, IKORODU, SAGAMU RD., OGUN STATE, NIGERIA.
TAKE OFF SITE/FACTORY

Being developed and there has been some like a waste of wealth and other.

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Things are going there in similarly in Lagos in which is the neighboring Nigeria they are trying to do some much stuff as well.

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Where they are trying to develop some of these electronic waste.

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So, I have several pictures.

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Ah which we went there, we had certain meetings and other stuff. So, these are some of the pictures where again similar stuff, and I will put these on the web for you to look at there is nothing much to talk about here, very similar scenarios again this wanted to show you that this is not only a India problem this is a global problem, and it is a big problem electronic waste developing countries as well as the in the developed countries. And some in most of the developing countries are struggling to manage it properly,

including in our country in India. So, as you can see this is these are all pictures from Nigeria

So, we did had a chance to go to like I had a chance to go to Nigeria as well. So, I took these pictures over there, and as you can see all these electronics not being managed properly just on the side of the road, and just waiting for some sort of disposal and just lying over there and again some more pictures you see all those stuff just on the road just on the ground.

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Things may leech to the ground as well, many of the c r ts were broken. So, those things were also there, based I guess a smoke detectors, mercury lamps you see some broken lamps there as well they are just sitting there waiting for to be disposed.

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C r t tubes again on the side. So, this is again lot of problem they are trying to do some stuff.

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But it is still many of these needs and they were trying to do some sort of recycling of lead from there, which was again not much air pollution control, a little bit not open burning I will say, but a little bit of controlled environment, but air pollutants was escaping out as well. Kind of gives you some idea about electronics being managed in in different countries including India and some African countries here. So, with that let us

stop here and then we will start with the risk assessment part of this aspery of environmental and human health aspect in in the next video. So, again thank you keep watching and I hope you are enjoying the course, if you have any questions any concerns feel free to contact us we will be happy to answer.

Thank you.