ISSN No. : 0972-1266

ENVIS Newsletter

Vol. 16 No. 3 August 2009

Indian Institute of Toxicology Research

(Formerly Industrial Toxicology Research Centre, Lucknow)

August 2009 Vol. 16, No. 3

IN THIS ESSUE

EDITORIAL

Lead was first mined in Asia about 6500 BC. It is a natural compound that exists in elemental, inorganic, and organic forms. It is present in trace amounts in environmental materials i.e. soils, water, and foods. This metal is soft, malleable, blue-gray in color and corrosion resistant with a melting point of 327°C. Above properties, along with its inability to conduct heat and electricity, are the major factors for persistent use of lead by mankind. The utensils and artifacts made-up of lead, dating back 8000 years, have been recovered from Mediterranean excavation sites. At present, lead is used in various occupations viz: mining, smelting, refining, battery manufacturing, soldering, electrical wiring, painting, ceramic glazing, and the making of stained glass. A globally major source of lead emission into environment was leaded gasoline in vehicle fuels thus influencing every part of the environment until its use was phased out in 2000 in India.

Lead toxicity was first recognized as early as 2000 B.C. when Nicander of Colophon wrote of lead-induced anemia and colic. Lead toxicity is termed as "plumbism" or "saturism". It can cause permanent brain damage if exposed prenatally or during early development (1-6 years) and affects several other organs including the hematopoietic, renal, hepatic and skeletal systems in humans. Despite its recognized hazards, lead continues to have widespread commercial application. The highest level of exposure of lead occurs principally among people working in lead smelters. In the general population, the major hazard is for young children who chew and swallow objects contaminated with lead containing paint on walls and woodwork or weathered lead paint dust and flakes leaching from the exterior of residential and commercial structures into adjacent soil and dust.

In recent years considerable concern has been expressed regarding human risks due to environmental lead in India. Several epidemiological and environmental monitoring surveys, experimental studies and case reports have appeared suggesting the gravity of the problem. There is an urgent need for developing countries to generate data on the nature and extent of the problem so that appropriate steps can be taken to prevent lead toxicity. Interventions such as peer education, emphasizing dust control through household cleaning, teaching hygiene such as hand washing, increasing awareness about nutrition, and protective gear in occupational settings can reduce the risk of lead exposure. In this issue of newsletter certain important facets of lead toxicity are covered.

Editorial Team :
Dr. P. Kakkar
Dr. Anvita Shaw
Dr. Abha Sharma

Published by :
Distributed Information Centre on Toxic Chemicals
Environmental Information System (ENVIS)
at IITR, Lucknow

ODDS AND ENDS

Individual susceptibility and genotoxicity in workers exposed to hazardous materials like lead

This study was undertaken to investigate lead-induced toxicity in occupationally exposed humans and to evaluate whether genetic damage can be correlated with the known clinical indicators of lead poisoning. For this purpose, genotoxicity biomarkers along with some clinical indices of lead poisoning were determined in blood samples of battery plant workers and compared with healthy control subjects. Workers had significantly increased chromosomal aberrations, micronuclei and DNA damage compared to the controls. Increased blood lead levels (BLLs), decreased hemoglobin, packed cell volume (PCV) and symptoms of lead poisoning were used as clinical indices of lead toxicity. In addition gene polymorphisms in aminolevulinic acid dehydratase (ALAD) and Matrix γ-carboxyglutamic acid protein (MGP) gene were investigated and correlated with BLL and hemoglobin content. Results showed no significant effects of the ALAD G177C polymorphism on BLL concentrations and it varied to levels much above the normal reference ranges independent of the genotype. Although, significance could not be achieved, ALAD 1-2/2-2 type subjects had numerically higher BLLs (76.2–89.1μg/dl), compared to ALAD 1-1 volunteers (21.8–79.1μg/dl). Similarly, study also identify the relation of some SNPs with emphasis on lead toxicity and since MGP gene is an important biomarker associated with calcium metabolism; it was hypothesized that it may be associated with lead toxicity. However, any significant association of MGP T-138C and lead poisoning did not find. Further studies on the role of gene polymorphisms over a larger population along with genotoxicity parameters and biochemical analyses may serve to understand lead toxicity.

Journal of Hazardous Materials 2009, 168/ 2-3, 918-924.

Oxidative stress in painters exposed to low lead levels

Lead in some paints

Lead is widely used in various paints because of its anticorrosive properties and ability to hold pigments together. Painters who spend a considerable amount of time in either removing old paint from buildings due for renovation or in painting new buildings are at high risk of lead toxicity. In India about 10% of lead is used for manufacturing paints. There was a report that 100 % of Indian paints contained lead at levels above the US limit of 0.06 %.

Due to its high toxicity the study was undertaken to assess the antioxidant status of lead-exposed residential and commercial painters of Lucknow city in Uttar Pradesh, India. Thirty-five painters aged 20 to 50 years who had blood lead levels $\leq$ 400 μg $L^{(-1)}$ were selected for the study from a population of 56 male painters initially screened for blood lead levels. The control group included an equal number of subjects of the same age group without any occupational exposure to lead. The association between low lead level exposure and antioxidant status were studied and found that blood lead levels in painters were approximately seven times as high as in controls [(219.2 ± 61.9) μg $L^{(-1)}$ vs. (30.6 ± 10.1) μg $L^{(-1)}$, respectively]. Among the biomarkers of lead toxicity a significant decrease in the level of delta-aminolevulinic acid dehydratase [(9.13 ± 4.62) $UL^{(-1)}$ vs. (39.38 ± 5.05) $UL^{(-1)}$] and an increase in the level of zinc protoporphyrin [(187.9 ± 49.8) μg $L^{(-1)}$ vs. (26.4 ± 5.5) μg $L^{(-1)}$] were observed in painters compared to controls. Among antioxidant enzymes, painters showed a significant decrease in catalase [(56.77 ± 11.11) $UL^{(-1)}$ vs. (230.30 ± 42.55) $UL^{(-1)}$] and superoxide dismutase [(0.64 ± 0.19) $UL^{(-1)}$ vs. (2.68 ± 0.62) $UL^{(-1)}$] compared to controls. Lipid peroxidation was monitored by measuring thiobarbituric acid reactive substances (TBARS) that were expressed in terms of malondialdehyde (MDA) equivalents. Concentration of MDA in plasma was higher in painters than in controls [(7.48 ± 1.31) nmol $mL^{(-1)}$ vs. (3.08 ± 0.56) nmol $mL^{(-1)}$]. Significant changes were also observed in reduced and oxidised glutathione levels. The strong association between blood lead levels and oxidative stress markers in this population suggests that oxidative stress should be considered in the pathogenesis of lead-related diseases among people with low level environmental exposure to lead.

Archives of Industrial Hygiene and Toxicology 2008, 59/3, 161-9.

Tooth element levels indicating exposure profiles in diabetic and hypertensive subjects from mysore, india.

Element contents of teeth elucidate exposure nature, but less is known about association of tooth element concentrations of diabetics and hypertensives with exposure profile.

This study aims to estimate copper, chromium, iron, zinc, nickel, and lead concentrations in the permanent teeth of control, diabetic and hypertensive subjects from Mysore. The results show that lead levels of teeth (Pb-T) are higher in the hypertensives and diabetics, whereas copper levels of teeth (Cu-T) are lower in the hypertensives and users of stainless steel utensils than that of controls and users of mixed utensils. The elevated Cu-T levels found in the users of mixed utensils that being made of several metals are ascribed to leaching effect of sour and spicy food of Indian cuisine. The element levels were influenced by diet (Zn-T), place of living, sex and income (Pb-T) of the subjects, but not by age, drinking water from different sources and certain habits viz., smoking, alcohol consumption, chewing betel and nut. Thus, it is evident that high Pb-T and low Cu-T levels may be related with diabetes and hypertension respectively in the urbanites and the users of mixed utensils may show different exposure profiles from environment and utensils.

Biological Trace Element Research (2009), doi: 10.1007/s12011-009-8371-4.

Lead poisoning from an Ayurvedic herbal medicine in a patient with chronic kidney disease

A 60-year-old man with a history of diabetes and hypertension was referred to a nephrology clinic for investigation of his elevated serum creatinine level. Patient's physical examination and laboratory tests including measurement of whole-blood lead level, body lead burden, urine albumin:creatinine ratio; history of lead exposure, use of herbal medical products and renal ultrasonography were investigated. After examination it was found that he was suffering from stage 3 chronic kidney disease that was probably worsened by consumption of lead in the form of an Ayurvedic herbal remedy. Treatment was begun with cessation of the herbal product, followed by lead-chelation therapy with calcium disodium ethylenediamine tetraacetic acid (EDTA). The patient's whole-body lead burden and blood lead level decreased to acceptable levels and his serum creatinine value was within the normal range at final follow-up.

Nature Reviews Nephrology 2009, 5, 297-300.

Lead toxicity in a family as a result of occupational exposure

Lead acid batteries account for almost 50 % of lead consumption in the world. Workers involved in lead acid battery manufacture are exposed to varying degrees of lead in the air in the form of fumes or particulates. In most highly industrialised countries strict control and improvements in industrial production standards have ensured that occupational lead poisoning is less prevalent than before. In developing countries like India, however, it remains a problem of potentially huge dimensions.

This study describes lead poisoning case in an entire family, manufacturing lead acid batteries. The family of five lived in a house, part of which had been used for various stages of battery production for 14 years. Open space was used for drying batteries. They all drank water from a well located on the premises. Evaluation of biomarkers of lead exposure and/or effect revealed alarming blood lead levels [(3.92±0.94) μmol L$^{(-1)}$], 50 % reduction in the activity of delta-aminolevulinic acid dehydratase [(24.67±5.12) UL$^{(-1)}$] and an increase in zinc protoporphyrin [(1228±480) μg L$^{(-1)}$]. Liver function tests showed an increase in serum alkaline phosphatase [(170.41±41.82) UL$^{(-1)}$]. All other liver function test parameters were normal. Renal function tests showed an increase in serum uric acid [(515.81±86.29) μmol L$^{(-1)}$] while urea and creatinine were normal. Serum calcium was low [(1.90±0.42) mmol L$^{(-1)}$ in women and (2.09±0.12) mmol L$^{(-1)}$ in men], while blood pressure was high in the head of the family and his wife and normal in children. Lead concentration in well water was estimated to 180 μg L$^{(-1)}$. The family was referred to the National Referral Centre for Lead Poisoning in India, where they received treatment and were informed about the hazards of lead poisoning. A follow up three months later showed a slight decrease in blood lead levels and a significant increase in haemoglobin. These findings can be attributed to behavioural changes adopted by the family, even though they continued producing lead batteries.

Archives of Industrial Hygiene and Toxicology 2008, 59/2, 127-33.

Blood lead levels in children of Lucknow, India

Environmental lead exposure is a worldwide problem and has been associated with renal toxicity, cardiovascular disease, hematologic toxicity, and irreversible neurologic damage. Lead can affect individuals of any age, but it has a disproportionate effect on children because their body absorbs high percentage of ingested lead and they exhibit lead toxicity at lower levels of exposure than adults. In the 1960s, a blood lead level (BLL) of 60 μg/dL was considered safe. Due to increased understanding of lead toxicology, the acceptable BLL was reduced to 25 µg/dL in 1985 and 10 µg/ dL in 1991. This study was undertaken to determine BLLs and associated risk factors among the children (3-12 years) of Lucknow, the capital of most populated state, Uttar Pradesh in India following the introduction of unleaded petrol. The use of leaded petrol was phased out on April 2000 in India.

Study revealed that mean BLL of the 200 children was 9.3 µg/dL (range: 1.0-27.9 µg/dL). Seventy-four children (37%) had BLL above the Centre for Disease Control and Prevention's (CDC) level of concern (10 µg/dL). When these data were compared with BLLs determined by the George Foundation among the children of Mumbai, Bangalore, Kolkata, Chennai, Hyderabad and Delhi during the year 1997 when leaded petrol was in use, where 62%, 62%, 87%, 96%, 43%, and 95%, respectively, then exceeded the CDC intervention level. Further, BLL of this study was very close to Mumbai children (age 12 years) estimated following the introduction of unleaded petrol and 33% children had BLL above the CDC concern level with an average 8.4 µg/dL. Low socioeconomic status, proximity of home to traffic density and mother's illiteracy were the factors associated with elevated BLLs in Lucknow children ($P < 0.05$). Overall, results indicate a declining trend of BLL in Lucknow children when compared with those reported from other cities of India when leaded petrol was in practice. A national population-based study is recommended to determine the prevalence of elevated BLLs after the phase-out of leaded-petrol. In addition, future studies on other sources of lead exposure in Lucknow are warranted for public health purposes.

Environmental Toxicology (2009), doi:10.1002/tox

Assessment of lead in cosmetic products

Lead in cosmetics

There have been a number of recent reports in the media and on the internet about the presence of lead in lipsticks. This has drawn researchers attention to assess the safety of various cheap cosmetics sold in market that are imported from countries where safety regulations are poorly enforced as well as they lack perfect conditions for manufacturing. Lead contents were determined in 26 and 8 different samples of lipsticks and eye shadows using the Zeeman atomic absorption spectrophotometer coupled to graphite tube atomizer after an acid digestion procedure. Lead was detected in all the studied samples. The median (25th–75th percentile) lead content in lipsticks samples was 0.73 (0.49–1.793) parts per million (PPM) wet wt. in the range of 0.27–3760 PPM wet wt. Four samples of lipsticks were found lead content above the Food and Drug Administriation (FDA) lead limit as impurities in color additives (20 PPM). The FDA does not set a limit for lead in lipstick. Three of them were extremely high points and considered outliers. The median (25th–75th percentile) lead contents in pressed powder eye shadow was 1.38 (0.944–1.854) PPM wet wt. ($n = 22$) in the range of 0.42–58.7 PPM wet wt. One sample was above 20 PPM the US FDA's lead limit as impurities. The overall results indicate that lead in lipsticks and eye shadows are below the FDA lead limit as impurities and, thus, probably have no significant toxicological effects. Nevertheless, few brands had lead content above 20 PPM that might put consumers at the risk of lead poisoning. Lead is a cumulative and applying lead-containing cosmetics several times a day or every day, can potentially add up to significant exposure levels. Pregnant and nursing mothers are vulnerable population because lead passes through placenta and human milk and affect fetus or infant's developments. Findings call for an immediate mandatory regular testing program to check lead and other toxic metals in lipsticks and other cosmetic products imported to countries in order to curtail their excess and safeguard consumer health.

Regulatory Toxicology and Pharmacology 2009, 54/2, 105-113.

Association of blood lead concentrations with mortality in older women: a prospective cohort study

Blood lead concentrations have been associated with increased risk of cardiovascular, cancer, and all-cause mortality in adults in general population and occupational cohorts. Khalil et. al., studied association between blood lead level and mortality in older women. Prospective cohort study of 533 women aged 65–87 years enrolled in the Study of Osteoporotic Fractures at 2 US research centers (Baltimore, MD; Monongahela Valley, PA) from 1986–1988. Blood lead concentrations were determined by atomic absorption spectrometry. Using blood lead concentration categorized as < 8 µg/ dL (0.384 µmol/L), and $\geq$ 8 µg/dL (0.384 µmol/L), they determined the relative risk of mortality from all cause, and cause-specific mortality, through Cox proportional hazards regression analysis. Mean blood lead concentration was 5.3 ± 2.3 µg/dL (range 1–21) [0.25 ± 0.11 µmol/L (range 0.05–1.008)]. After 12.0 ± 3 years of > 95% complete follow-up, 123 (23%) women who died had slightly higher mean (± SD) blood lead 5.56 (± 3) μg/dL [0.27(± 0.14) μmol/L] than survivors: 5.17(± 2.0) [0.25(± 0.1) μmol/L] (p = 0.09). Women with blood lead concentrations ≥ 8 μg/dL (0.384 μmol/L), had 59% increased risk of multivariate adjusted all cause mortality (Hazard Ratio [HR], 1.59; 95% confidence interval [CI], 1.02–2.49) (p = 0.041) especially coronary heart disease (CHD) mortality (HR = 3.08 [CI], (1.23–7.70)(p = 0.016), compared to women with blood lead concentrations < 8 μg/dL(< 0.384 μmol/L). There was no association of blood lead with stroke, cancer, or non cardiovascular deaths. Women with blood lead concentrations of ≥ 8 μg/dL (0.384 μmol/L), experienced increased mortality, in particular from CHD as compared to those with lower blood lead concentrations.

Environmental Health 2009, 8, 15.

Lead Exposure and Behavior among Young Children in Chennai, India

Lead exposure has long been associated with deficits in intelligence quotient (IQ) among children. However, few studies have assessed the impact of lead on specific domains of behavior and cognition. In this study associations between lead and different domains of neurobehavior and their relative sensitivity to lead were evaluated. Blood lead was determined using a Lead Care® instrument in 756 children of ages 3-7 years attending pre- and elementary schools in Chennai, India. Anxiety, social problems, inattention, hyperactivity, and Attention Deficit/Hyperactivity Disorder (ADHD), as well as executive function, was assessed in children by their school teachers using the Conner's Teacher Rating Scales–39 (CTRS-39), the Conner's ADHD/ Diagnostic and Statistical Manual for Mental Disorders (DSM-IV) Scales and the Behavior Rating Inventory of Executive Function (BRIEF) questionnaires, with higher scores denoting worse behavior. Analyses were carried out using multivariate generalized estimating equations with comparisons of outcome Z scores to assess the relative strengths of the associations between log-blood lead and the different domains of behavior. Mean blood lead was 11.4 ± 5.3 μg/ dL. Blood lead was associated with higher anxiety (β=0.27, p=0.01), social problems (β=0.20, p=0.02) and higher scores in the ADHD index (β=0.17; p =0.05). The effect estimate was highest for global executive function (β=0.42; p <0.001). Higher blood lead in this population of young children is associated with increased risk of neurobehavioral deficits and ADHD, with executive function and attention being particularly vulnerable domains to the effects of lead.

Environmental Health Perspectives (2009), doi:10.1289/ehp.0900625

Cumulative Lead Exposure and Cognition in Older Women

Many older people in the U.S. population were chronically exposed to lead from paint and gasoline prior to the 1980s. To date, most of the research on lead and cognitive functioning in older age has focused on men, despite the fact that women live longer on average and therefore may be more likely to develop dementia over the course of their life span. Now, in a prospective look at a subset of data from the Nurses Health Study—which began in 1976 and included 121,700 registered nurses aged 30–55 years—researchers report that even low-level cumulative lead exposure may exacerbate cognitive decline in older women.

The study looked at 587 women (now aged 47–74 years) who had undergone bone lead evaluations as part of two studies during the 1990s; to assess long-term exposures, bone lead concentrations were determined at each woman's mid-tibial shaft (shin bone) and patella (kneecap). All but 6 of those individuals had also provided blood samples for assessment of more recent lead exposure. Trained interviewers conducted telephone interviews an average of 5 years after the lead measurements were taken to obtain cognitive data. The interviewers asked participants to perform a variety of tasks related to memory and verbal abilities. The researchers found a significant positive association between cognitive deficits and higher lead levels in the tibia but not in the patella or blood. Because the type of bone in the tibia is known to provide a longer record of lead exposure than other tissues, the research points to long-term exposure to lead but not to current or recent exposures as the most likely source of deterioration in cognitive functioning in this population. One standard deviation increase in lead exposure produced, on average, as much decrement in cognitive functioning as 3 years of aging in the women in the study.

Lead may damage brain neurons through a range of mechanisms, including oxidative damage and programmed cell death. As the population of older adults grows, it becomes ever more critical to understand ways to ward off dementia. Clues to this understanding may come from studying subtle decreases in cognitive functioning, which, as several researchers have found, often precedes the development of dementia. If other studies confirm the observed relationship between cumulative lead exposure and impaired cognition, measures to minimize exposure or reduce the body's lead burden could have a substantial impact on aging-related cognitive impairment.

Environmental Health Perspectives 2009, 117/4, A162.

Lead contamination of inexpensive seasonal and holiday products

Lead is a potent neurotoxin and

because of this, the US regulatory limit for lead content of paint on items intended for use by children is 0.06% by weight. There were numerous recalls of branded toys in the United States for lead paint contamination during 2007. Most of these items were manufactured in China. Seasonal and holiday items are inexpensive and often directed specifically toward children, yet the use of lead paints in these products has not been widely recognized. This study was undertaken for determining the extent of lead contamination in this product category. Ninety-five samples were tested, including primarily Halloween and Easter products. Twelve of the products were found to contain lead in excess of the current US regulatory limit. The high percentage of products found to be contaminated in this limited sampling implies that many more lead-painted items are being sold. Results suggest that the potential hazards of seasonal and holiday products deserve the attention of government agencies seeking to limit the exposure of children to lead.

Science of the Total Environment 2009, 407/7, 2447-2450.

GFP expressing bacterial biosensor to measure lead contamination in aquatic Environment

Aquatic environments are frequently the final recipients of most of the toxic substances generated by anthropogenic activities either directly or indirectly threatening not only human life but also aquatic biodiversity and aquaculture production. Lead from paints, plumbing materials, waste crankcase oil, batteries, etc. pollute the environment and become available to animals as contaminated forage and water. It has no known biological function, but can accumulate in many organisms until it reaches toxic levels.

Chakraborty et. al., developed a lead-responsive biosensor that has been made by placing the green fluorescent protein (GFP) reporter gene under the control of the lead resistance regulatory element (PbrR) and its operator promoter (PbrO/P) derived from plasmid pMOL30. PbrO/P also controls the GFP reporter gene expression. *Escherichia coli* DH5α is the host organism. GFP response to induction by Pb^{2+} peaked at 250 μM. Decline in fluorescence beyond 250 μM was related to drop in copy number of the biosensor plasmid in the cells. A formula that estimates available Pb^{2+} concentration in test samples with 95% accuracy was derived by multiple regression of fluorescence and cell density values at various Pb^{2+} concentrations at 12 h growth. The biosensor was tested for co-inducibility by Cd^{2+}, Zn^{2+} and Hg^{2+}. Only Zn^{2+} showed mild induction at high concentrations and the highest fluorescence obtained was 8.5 times lower than that obtained with Pb^{2+}. The induction method used here allows water collected from natural resources to be directly tested by using it to prepare the growth medium for the biosensor. This biosensor offers a simple and quick method for detection of available lead in the aquatic environment.

Current Science 2008, 94/ 6, 800-805.

Removal of lead from aqueous solution by hybrid precursor prepared by rice hull

Agricultural waste can be used for production of low cost adsorbent.

Techniques like chemical precipitation, coagulation, complexions, ion exchange, solvent extraction, reverse osmosis, distillation and adsorption have been employed for the separation of heavy metal ions from aqueous media. However, these methods have several disadvantages that include incomplete metal removal, high reagent and energy requirements and generation of toxic sludge or other waste products that requires proper disposal and further treatment. Different types of adsorbent are in use for heavy metal removal but due to high capital and regeneration cost development of low-cost adsorbents is required.

In this study rice hull was taken for the preparation of low cost adsorbent (hybrid precursor) which utilized for the removal of lead (Pb^{2+}) from aqueous solutions. The separation of Pb^{2+} ions using hybrid precursor was observed to be significantly high (95%) at lower concentration however with increase in lead concentration the separation gradually decreased to 50%. The adsorption of lead ions on the hybrid precursor was observed to be spontaneous and exothermic as evidenced by the negative values of gibbs free energy (ΔG) and enthalpy (ΔH) respectively.

Journal of Hazardous Materials 2009, 163/ 2-3, 1194-1198.

Role of activated carbon fabric mask to prevent lead absorption—a short report

Activated carbon fabric (ACF) is a new and fibrous adsorbent, which has been obtained from an appropriate fibrous precursor by an adequate carbonization and activation process. ACF applications include metal ion adsorption, in respiratory devices, air conditioners, industrial effluents and treatment of water. According to test conducted by the division of Toxicology, Central Drug Research Institute, Lucknow, India, the ACF is very effective in trapping pungent fumes, foul odors and smell of fresh or decaying organic matter of animal origin. Another test was conducted at the department of Chemical Engineering, Indian Institute of

Science, Bangalore, India found that the 40% lead metal ions are adsorbed by ACF.

Lead (Pb^{+2}) cannot be removed by chemical chelating agents once enter in the brain. Thus, the only way to control lead poisoning is to prevent lead from getting into the bodies of the workers. An attempt was made to prepare masks in which ACF material is fixed, and the usefulness of these masks in bringing down the blood lead levels of battery workers was studied.

Indigenous ACF masks were provided to eight workers involved in the manufacture of batteries. Their blood lead levels were determined before and after using these masks. There was a substantial decrease in blood lead level after using the mask among those who were under treatment for high blood lead levels. Three workers who were not under treatment for lead also showed a decrease in blood lead level, after using this ACF mask, suggesting the usefulness of ACF in preventing further exposure.

Toxicology and Industrial Health 2008, 24/9, 569-72.

Phytoremediation of Lead in Soil: Recent Applications and Future Prospects

Lead is a very serious contaminant in soil because of its widespread previous application in residential, agricultural, and industrial environments combined with its severe impacts upon human health. A number of approaches have been developed to remove lead from contaminated soil. Traditional approaches involve removing the contaminated material, transporting it to a storage site and replacing it with clean soil. Although this approach has been demonstrated to be effective and provides a permanent treatment solution, it has a very relatively high cost and is disruptive and labor intensive.

An alternative approach involves the use of plants to ameliorate pollutants. A number of related techniques have been developed involving the use of plants to remediate contaminated sites that are called phytoremediation. Phytoremediation techniques may provide reduced cost compared to conventional remediation strategies, as well as providing a "green" solution. Phytoremediation is a non traditional approach to remediate contaminated soil involving the use of green plants. Phytostabilization involves the use of plants to stabilize contaminants to reduce human exposure. Phytoextraction involves the use of plants to accumulate contaminants in aboveground shoots, which can be harvested to recycle or discard. Recent phytomediation work has indicated the importance of determining the chemical forms of lead present at a site to develop the most appropriate remediation strategy. Lead phytoextraction typically involves the addition of a chelating agent in order to increase the bioavailability of this contaminant. Because concerns have been raised regarding the persistence of chelating agents in the environment, several research teams have investigated the use biodegradable compounds for this application. It is anticipated that phytoremediation will continue to be a low-cost approach for the remediation of lead in soil.

Applied Spectroscopy Reviews 2009, 44, 123–139.

Kinetics of sorption of lead on bed sediments of River Hindon, India.

A number of low cost waste sorbents have been used for removal of heavy metals, however, few studies have been carried out on the sorption process on riverbed sediments in their natural state of occurrence. Stream sediments adsorb certain solutes from streams, thereby significantly changing the solute composition, but little is known about quantitatively describing sorption phenomena and rates of these processes. In this investigation, sorption of lead ions on river bed sediments of river Hindon, a tributary of river Yamuna, India has been studied to demonstrate the role of bed sediments in controlling metal pollution. The effect of various operating variables, viz., initial concentration, solution pH, sediment dose, contact time and particle size has been studied. The sorption of lead ions increased with respect to pH and sorbent dose and decreased with sorbent particle size. Two important geochemical phases, iron and manganese oxide, also play important role in the sorption process. The sorption data were analysed using Langmuir and Freundlich isotherm models to determine the mechanistic parameters related to the sorption process. Further, although lead ions have more affinity for the fine fraction of the sediment, but the overall contribution of coarser fraction to sorption is more as compared to clay and silt fraction. The kinetic data suggest that the sorption of lead on bed sediments is an endothermic process, which is spontaneous at low temperature. The uptake of lead is controlled by both bulk and intraparticle diffusion mechanism.

Environmental Monitoring and Assessment 10.1007/s10661-008-0510-4

Biosorption of Pb(II) from water using biomass of *Aeromonas hydrophila*: Central composite design for optimization of process variables.

Biosorption has emerged as an alternative method with the advantage of being ecofriendly in nature, technically easy, potential for regeneration, excellent performance, sludge free operation and is a low cost domestic technique for remediating even heavily metal loaded water over conventional methods.

Biomass of *Aeromonas hydrophila*

was taken for the removal of lead from aqueous solution and effect of process variables such as pH, initial Pb^{+2} concentration, biomass dose and temperature on the uptake of lead were investigated using two level four factor (2(4)) full factorial central composite design with the help of MINITAB((R)) version 15 software. The predicted results thus obtained were found to be in good agreement (R(2)=98.6%) with the results obtained by performing experiments. The multiple regression analysis and analysis of variance (ANOVA) showed that the concentration has positive and temperature and biomass dose have negative whereas pH has curved relationship with the uptake of Pb^{+2}. The maximum uptake of Pb^{+2} predicted by optimization plots was 122.18 mg/g at 20 °C, initial Pb(II) concentration of 259 mg/L, pH 5.0, temperature 20 °C and biomass dose 1.0g. Langmuir isotherm model was applicable to sorption data and sorption capacity was found to be 163.3 mg/g at 30 °C, pH 5.0 and Pb^{+2} concentration range 51.8-259 mg/L indicate that the biosorbent was better in comparison of the biosorbent reported in the literature. Dubinin-Radushkevich (D-R) isotherm model was also applied and it was found that sorption was chemisorption (E=12.98 kJ/mol). Fourier transform infrared spectroscopy (FT-IR) studies indicate the involvement of various functional groups present on biomass surface in the sorption of Pb^{+2}.

Journal of Hazardous Materials 2009, 168/2-3, 1155-1162.

Screening of brick-kiln area soil for determination of heavy metal Pb using Laser-induced breakdown spectroscopy (LIBS)

Soil acts as major absorber for metals released into the environment from a variety of anthropogenic sources e.g. emissions from high temperature processes such as coal combustion, mining, smelting, brick-kiln, use of biosolids in agricultural and the past use of antiknock gasoline additives and waste excretion etc. In soil, some of these metals persist for longer time like Lead (Pb) because of their fairly immobile nature, while other metals, migrate to either ground water aquifer or plants due to its mobile nature. Pollution due to Pb, irrespective of source, is a matter of major concern because of its long residence time in the soil and it causes developmental problems in children and developing fetuses. Thus detection, quantification and controlling the accumulation of Pb in environment are important from health point of view. Hence, in this study concentration of toxic heavy metal (Pb) in the agricultural field, adjacent to brick-kiln area was determined using Laser-induced breakdown spectroscopy (LIBS) technique which was found rapid & more efficient than conventional methods.

The study was carried out for the first time, in an Indian agricultural soil, in the vicinity of brick-kiln area, Phaphamau, near Allahabad, India, by using a novel technique LIBS. LIBS spectra of soil has been recorded in the wavelength range from ultraviolet (UV) to infrared region (200-1100 nm). The suitability of Pb lines for drawing the calibration curve is checked and realized, for the first time, that 220.3 nm, which is observed in the UV region of LIBS spectra, is completely interference free and best suited for the quantification of trace amount of Pb in soil instead of any other Pb lines, because it has best linear regression coefficient and smallest standard deviation of the background signal. The detection limit for Pb in soil is found to be 45 ppm. The concentration of Pb in agricultural soil of brick-kiln area in Phaphamau is found to be congruent with 570 ppm, which is more than the regulatory standards imposed by US Environmental Protection Agency (400 ppm) for the presence of lead in soil, therefore, it is of great concern to us.

Environmental Monitoring and Assessment 2009, 148/1-4, 437-447.

DID YOU KNOW ?

- Lead exposure can harm young children and babies even before they are born.
- World-wide, six sources appear to account for most lead exposure: gasoline additives; food can soldering; lead-based paints; ceramic glazes; drinking water systems; and cosmetic and folk remedies.
- Lead is not biodegradable. It persists in the soil, air, drinking water and in homes.
- Deficiency of iron, calcium, zinc, copper and protein increase absorption and effects of lead.
- Lead has a half-life time of 25-40 days in blood and in soft tissues and more than 25 years in non-labial portion of bones.

NON-CONVENTIONAL LEAD EXPOSURE: A CONTINUOUS THREAT TO HEALTH

F. N. Jaffery and Abha Sharma
ENVIS CENTRE
Indian Institute of Toxicology Research, Lucknow

Mankind has been using lead for over 6000 years, and solely as a result of anthropogenic activities lead has become the most ubiquitous toxic metal. Lead's toxicity was recognised and recorded as early as 2000 BC and its widespread use has been a cause of endemic chronic plumbism in several societies throughout history. With the industrial expansion in the last two centuries the problem has become more serious, as evident from the Antarctic and Arctic ice core data showing presence of lead in such far off places. The last three centuries also witnessed the worst outbreaks of lead poisoning among adults which were occupational in origin. Many reviews and references are available in literature related with health effects of exposure to lead (Pb). In contrast with developed countries, where lead exposure is on the decline due to implementation of environmental and occupational regulations, in developing countries Pb poisoning continues to be a serious problem. A detailed study on occupational and lifestyle determinants of blood Pb levels had been carried out in Chennai (Potula & Hu 1996). Such studies even though limited, have importance in risk assessment and mitigation. Without proper corrective action, Pb exposure would remain a threat to many generations in the developing world.

In India, monitoring of Pb and other heavy metals has been undertaken under an Integrated Environmental Programme on Heavy Metals (IEPHM), Ganga Action Plan, and Rajiv Gandhi Drinking Water Mission. Several studies have revealed that the sources of Pb pollution in the air are smelting in unorganized sector industries, refuse burning, lead and battery industries. In order to reduce the lead load in air, use of leaded gasoline has been banned with effect from February, 2000. However, exposure to lead still looms large especially due to the prevalence of home based cottage industries. These cottage industries are generally located in areas of dense population. Health of children is of particular concern since these non-regulated businesses deliver the Pb into the homes where children live or play. Children can also be exposed to Pb dust which their working parents bring from work on clothes, in hair, shoes, etc. thereby problems of occupational exposure become community problems. Traditional industrial use of lead in paints, batteries etc. also have increased considerably. In infants and young children, exposure to Pb has been shown to decrease IQ scores, slow their growth and cause hearing problems and kidney damage. These effects are persistent and interfere with school performance and are caused by exposure to such low levels of lead which were once thought to be safe. The developing fetus is at maximum risk of Pb toxicity. Exposure of pregnant women can transfer significant amount of this metal to the developing fetus which may result in premature birth, low birth weight or even abortion. Infants born to mothers exposed to high level of Pb show significant signs of neurological deficits. Lead is well known to inhibit the biosynthesis of heme, and consequently of hemoglobin and to decrease the life span of circulating red blood cells. Iron deficiency and Pb toxicity can be synergistic and potentially devastating, upto 50% more Pb may be absorbed in children with iron deficiency. In countries, where a major proportion of people are prone to anemia due to a variety of reasons, Pb exposure can be more serious. Possible sources of lead exposure in India are given below:

- Contaminated soil and dust
- Mining
- Cooking and storage vessels containing lead (tinned polish);cans
- Ceramic pottery with painted lead glaze
- Country liquor, beverages
- Food adulterant in ice cream, tobacco and tobacco products
- Toys, pencils
- Cosmetics (sindoor, surma)
- Herbal medicine
- Paints, pigments
- Industrial effluents: disposal
- Water pipes
- Contaminated aquifers: mining, smelting, processing, recycling
- Occupational exposures: silver jewelry making; battery breaking and manufacturing; welding; repairing automobile radiators; papier mache workers; etc

Lead in paints

In a small survey conducted on Indian paints, it was found that the lower lead concentration paints are the white, blue, and brown-red paints, while in order of increasing lead concentrations are the green, red, orange and yellow paints. Of the 24 samples analysed, 17 had Pb concentrations exceeding 0.5% Pb by weight, 13 had >10% whereas 5 exceeded 10% Pb (Alphen 1999). Some Indian paint samples tested had Pb concentrations exceeding 1% by weight, the pigment present was mostly lead chromites. Weathered lead chromate paints are toxic when ingested and have been eliminated from sale in developed countries since 1960s and 1970s. Use of white Pb (Pb(OH) $PbCO_3$) and red lead (Pb_3O_4) pigmented paints needs to be evaluated. In another study conducted in 2005, 10 paints obtained from Bangalore and 19 from Gujarat were analyzed for lead concentration. Out of 29 samples, 11 had lead concentrations = 1.0 mg/ cm^2 after the application of one to three coats. Yellow and yellow derivative paint colors (green and brown) had the highest lead content. New enamel paints from China, India and Malaysia were found Pb concentrations to have varying between 600 ppm & > 5000 ppm (Clark et. al., 2005). However, in comparison, several samples of latex paints from India analyzed by Kumar & Gottesfeld (2008), were found to have lower levels of Pb but in enamel paints the level ranged between 26,100 & 140, 000 ppm. Use of bright yellow and other colors is quite common for children's play equipments throughout India. The playground equipment in Mangalore was the only one tested for play equipment. As numerous lead-containing yellow paints were found to be readily available, it is quite possible that many other playgrounds are contaminated. Later investigations revealed that two manufacturers of playground equipment used in Mangalore indicated that their equipment was painted with lead-based paint. On the findings of this study lead-based paint on the playground equipment in Mangalore was subsequently replaced with lead-free paint (Clark et. al., 2005).

In some Asian countries, lead is still used in ceramic industries. There are cases of severe abdominal colic due to lead poisoning have been found among ceramic industry workers where exposure occurs through inhalation or ingestion of Pb (Shiri et. al., 2007).

Lead in foods

Pb contamination of food could occur through the use of Pb arsenate pesticides or fertilizers contaminated with Pb and other heavy metals. Particularly at risk are root vegetables grown in contaminated soil, leafy vegetarian exposed to Pb dust, food stored, cooked, reheated or served in pots "tinned: with a Pb-Sn mixture or ceramics using Pb glazes. Drinking water also may be a source of Pb. Lead pipes and corrosion of Pb plumbing material ("safeda") in the water supply or houshold plumbing eg, lead and PVC piping, lead soldered joints in copper and brass faucets and other fittings. A 2 year old Indian boy was found with high blood lead level and after interrogating his family, came to know that they purchased a mixture of spices called kozhambu (lead content: 310 mg/kg) while traveling in India (Woolf & Woolf 2005). A 10 year survey of coloured foodstuff in U.P. revealed the use of 5 non permitted colours containing Pb levels higher than permissible levels (Khanna et al, 1976).

Other sources of poisoning identified is the migration of lead from food containers. A study has reported the recoating of the inner surface of brass utensils with a mixture of Pb and tin, ("tinning"), this is widely practiced by artisans in India. The Sn-Pb alloy contained 55 to 70% lead levels, and water containing tamarind had 400-500 ug Pb/L after boiling for 5 min. Such acidic foods can leach out Pb. Lead leaching from Indian pressure cookers while cooking especially from the rubber gasket and safety valve, are minor sources of Pb concentration of cooked food (Raghunath and Nambi, 1998).

Lead in herbal remedies

Folk and herbal remedies from India have been found to contain high concentration of heavy metals and unsupervised treatment has resulted in toxicity. A study was carried out in India to estimate heavy metal contents in 28 commonly used medicinal plants. Lead was estimated in leaf, stem bark, root or seeds depending on the medicinal value of the plant portion. The mean lead concentration in medicinal herbs ranged between 2.624 to 32.757 ppm. Lead concentration was higher in leaf than in stem bark or roots, and the lowest values was recorded in seeds. The presence of Pb in different plants led to the conclusion that prolonged consumption of such medicinal plants may be detrimental to health (Dwivedi & Dey 2002).

There have been several case reports of lead toxicity due to contamination of Indian herbal medicines. A patient with hepatitis was found to have lead poisoning where the source was traced to herbal medicines he had been taking for diabetes (Keen et. al., 1994). A Western European developed severe anemia after ingestion of several ayurvedic drugs obtained during a trip to India. Laboratory findings showed high Blood Pb, urinary Pb concentrations and an increased urinary excretion of delta aminolevulinic acid (ALAD) (Spriewald et. al., 1999). A developmentally delayed person was given a herbal vitamin from India to strengthen his brain showed significant lead burden (Moore & Adler 2000). A 32-year-old man was repeatedly hospitalized for paroxysmal abdominal pain with constipation, weight loss, anemia and mild elevation of liver enzyme levels showed lead poisoning. Investigation revealed that the lead source was self-medication with an ayurvedic remedy (Garnier & Poupon 2006). A powdery herbal medicinal preparation used for skin rashes, prickly heat and other skin infection contained high levels of lead (138.19 µg/g). In ophthalmologic preparations upto 106.37 µg/g lead concentration was found. These findings should alert us to the possibility of heavy metal content in traditional Indian remedies and motivate us to consider means of protecting consumers from such risks (Nnorom et. al., 2006).

Other traditional uses causing Pb exposure

Henna, surma, kwali, and kohl are traditional cosmetics used in the past decades & are still in use, in Asia, Africa and Middle East is as sources of lead exposure (Nnorom et. al., 2006). Surma and Kohl is an example of the use of Pb as an eye cosmetic or medicine. Surma is available as fine powder or heavy crystal mineral PbS containing 34-92% Pb w/w (Nir et. al., 1992). Several studies have associated increased Blood Pb with the use of surma although studies conducted in India did not find any such links. However, before concluding that this source is harmless, more detailed study is required in India which would help clarify the risk from this cosmetic.

Human uptake of trace metals from foods varies geographically depending upon the dietary habits and life style. Regular consumption of alcoholic beverages also shows significant elevation of blood Pb in population not occupationally exposed to lead (Hense et al, 1992). The provisional tolerable weekly intake for lead in adults, according to FAO/WHO (1984) is 50 mg/kg body weight or 3 mg/.week for a 60 kg adult. In India, the prevention for adulteration act does not mention or recommend any permitted lead level in alcoholic beverages. In a study carried out in India that majority of the brands of beer had Pb concentration of over 10 mg/L (with a mean of 13.2 mg/L) (Srikanth et. al., 1995). Mean Pb concentrations were found to be slightly higher than beer Pb concentration of U.K.

It is clear from the foregoing that exposure to lead from occupational and community environment, contaminated food and consumer items, and water is of major concern. Prioritizing identification, monitoring of sources and implementation of regulatory norms is the need of the hour.

References

1. Clark CS, Thuppil V, Clark R, Sinha S, G Menezes, D'Souza H, Nayak N, Kuruvilla A, Law T, Dave P and Shah S (2005). Lead in paint and soil in Karnataka and Gujarat, India. J Occup Environ Hyg. 2/1:38-44.
2. Dwivedi SK and Dey S (2002). Medicinal herbs: a potential source of toxic metal exposure for man and animals in India. Arch Environ Health. 57/3:229-31.
3. Garnier R and Poupon J (2006). Lead poisoning from traditional Indian medicines. Presse Med. 35/7-8:1177-80.
4. Hense HW, Filipiak B, Novak L and Stoeppler M (1992). Non-occupational determinants of blood lead concentration in general pupulation. Int J Epidemiol. 21:753-762.
5. Keen RW, Deacon AC, Delves HT, Moreton JA and Frost PB (1994). Indian herbal remedies for diabetes as a cause of lead poisoning. Postgrad Med J. 70:113-114.
6. Khanna SK, Singh GB and Hasan MZ (1976). Metal contaminants in various food colors. J Fd Sci Agric. 27:170-174.
7. Kumar A and Gottesfeld P (2008). Lead content in household paints in India. Sci Total Environ. 407/ 1: 333-337.
8. Moore C and Adler R (2000). Herbal vitamins: lead toxicity and developmental delay Pediatrics. 106/3:600-2.
9. Nir A, Tamir A, Zelnik N and Iancu TC (1992). Is eye cosmetic a source of lead poisoning ? Isr J Med Sci. 28:417-421.
10. Nnorom IC, Osibanjo O and Eleke C (2006). Evaluation of Human Exposure to Lead and Cadmium from Some Local Nigerian Medicinal Preparations. J Applied Sci. 6/14: 2907-2911.
11. Potula VL and Hu H (1996). Occupational and lifestyle determinants of blood lead levels among men in Madras, India. Int J Occup Environ Health. 2: 1-4.
12. Raghunath R and Nambi KS (1998). Lead leaching from pressure cookers. Sci Total Environ. 224: 143-148.
13. Shiri R, Ansari M, Ranta M and Falah-Hassani K (2007). Lead Poisoning and Recurrent Abdominal Pain. Industrial Health 45/ 3:494-496.
14. Spriewald BM, Rascu A, Schaller KH, Angerer J, Kalden JR and Harrer T. (1999). Lead induced anaemia due to traditional Indian medicine: a case report. Occup Environ Med. 56:282-283.
15. Srikanth R, Ramana D and Rao V (1995). Lead uptake from Beer in India. Bull Environ Contam Toxicol. 54:783-786.

16. Van Alphen M (1999). Lead in paints and water in India. In: Lead poisoning prevention and treatment: Implementing a national programme in developing countries. February 8-10, Bangalore, India. Proceedings of the International Conference on Lead Poisoning Prevention and Treatment, pp. 265-272.

17. WHO (1984). Guidelines for drinking water Quality. Vol. I: Recommendations. World Health Organisation.

18. Woolf AD and Woolf NT (2005). Childhood lead poisoning in 2 families associated with spices used in food preparation. Pediatrics. 116/2:314-8.

CURRENT CONCERNS

Lead is widely distributed and mobilized in the environment and human exposure to this non-essential element has been consequently increased. At high levels of human exposure there is damage to almost all organs and organ systems, most notably the central nervous system, kidneys and circulatory system leading to death at excessive levels. At low levels, biochemical, psychological and neuro-behavioral processes are affected. Lead continues to be a significant public health problem in developing countries in Asia, not only among humans, but also among various species of terrestrial organisms. Heavy metal pollution affects various species of plants even in protected forest reserves. The levels of toxicity may go undetected or unrecognized without systematic scientific studies and monitoring.

Unless India takes serious steps to curtail the increasing toxic pollution, it may soon lead to unbearable magnitude. Real environmental consciousness can come about only through the emergence of an informed, educated and healthy citizenry who are able to place environmental protection into social, political and economic contexts at local, regional and international levels.

Therefore, the recognition of the occurrence, importance, and effects of contaminants on food chains and ecosystems must lead to the development of stringent monitoring research in India aimed at directly measuring the levels of contaminants in various organisms, and bio-monitoring schemes.

It's time for the government and non-government organizations including the local scientific community to be vigilant and to initiate appropriate environmental pollution monitoring schemes to understand and to minimize heavy metal toxicity in nature, especially in the delicate and dwindling forest ecosystems.

REGULATORY TRENDS

The permissible limits of lead in various media and commodities should not be exceeding values which are mentioned below:

Focus	Level	Agency
Ambient air	24 hr Time Weighted Average (TWA): 0.75 $\mu g/m^3$ for sensitive areas; 1.0 $\mu g/m^3$ for residential areas; 1.5 $\mu g/m^3$ for industrial areas	CPCB (1995-96). Standards for liquid effluents, gaseous emission, automobile exhaust, noise and ambient air quality. Pub. No. PCL/4/95-96.
Water	0.05 mg/L for drinking water	BIS IS: 10500:1992 (Reaffirmed 1993)
Effluents	0.10 mg/L for discharge of industrial effluents in inland surface water.	CPCB (1995-96). Standards for liquid effluents, gaseous emission, automobile exhaust, noise and ambient air quality. Pub. No. PCL/4/95-96.
Edible Oils (Vanaspati)	5.00 ppm	Ecomark IS 10633:1986
Tea	6.5 ppm	Ecomark IS 3633:1972
Paints	1000 ppm	BIS IS 15489:2004
Cosmetics	20 ppm	Ecomark IS 4011:1982

Apart from this lead used in batteries shall be recovered and manufactured through a process complying under the provisions of Water (Prevention & Control of Pollution) Act 1974, Water (Prevention & Control of Pollution) Cess Act 1977 and Air (Prevention & Control of Pollution) Act 1981 along with the authorization, if required under Environment (Protection) Act 1986.

In India, the technologies used by lead smelters, battery re-conditioners and allied trades in Lead Acid battery sector are mostly environment unfriendly. Realising this, on May 25, 2000, the Government of India's Ministry of Environment and Forests (MoEF) gave notification of draft Battery (Management and Handling) Rules 2000 under the Environment Protection Act, 1986. After discussions, the Battery (Management and Handling) Rules have been enacted on May 16, 2001. Implementation of the new legislation is expected to improve the environmental performance of the Lead Acid Battery sector. Hence there is a need for capacity building and training of the people involved in this sector so that they are better prepared for the ensuing changes and associated improvements in environmental performance.

ON THE LIGHTER SIDE

An old man visits his doctor and after a thorough examination, the doctor tells him, "I have good news and bad news, what would you like to hear first?"

Patient: Well, give me the bad news first.

Doctor: You have cancer, I estimate that you have about two years left.

Patient: OH NO! That's awful! In two years, my life will be over! What kind of good news could you probably tell me, after this???

Doctor: You also have Alzheimer's. In about three months you are going to forget everything, I told you.

ON THE WEB

http://www.atsdr.cdc.gov/csem/lead/pbphysiologic_effects2.html

This website contains information on lead toxicity viz- neurological effects, renal effects, hematological effects, endocrine effects, gastrointestinal effects, cardiovascular effects, developmental effects & other related information.

http://www.epa.gov/lead/

This link provides information on sources and hazards of lead.

http://ntp.niehs.nih.gov/

This website contains information about toxicological and human health hazard evaluations of substances in our environment.

www.who.int/water_sanitation_health/diseases/lead/en/ -

Provides information on lead in drinking water and its preventive measures.

CONFERENCES

4th International Congress of Chemistry and Environment ICCE 2009

30 October -1 November, 2009

Website: http://www.chemenviron.org

Email: conference@chemenviron.org, tangshir@hotmail.com

Environmental Health Risk 2009

21-23 September, 2009

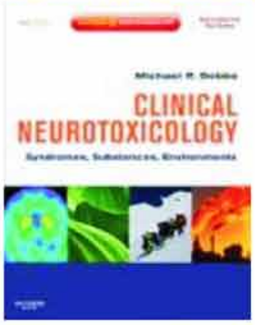
Website: http://www.wessex.ac.uk/conferences/2009/ehr09/index.html

BOOK STOP

Public Health Risk Assessment for Human Exposure to Chemicals (Environmental Pollution)

Author: K. Asante-Duah
Publisher: Springer
ISBN-10: 1402009216
ISBN-13: 978-1402009211

Clinical Neurotoxicology



Author: Michael R. Dobbs
Publisher: Elsevier Health Sciences
ISBN: 0323052606, 9780323052603

Some Observations on the Contamination of Water by the Poison of Lead

Author: James Bower Harrison
Publisher: Biblio Bazaar
ISBN: 1103060600, 9781103060603

MINI PROFILE OF LEAD DIOXIDE

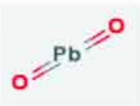
Synonyms: Lead peroxide, lead (IV) oxide, lead brown and lead oxide brown.

CASRN: 1309-60-0

Molecular Formula: PbO2

Molecular Weight: 239.20

Molecular Structure:



Properties: Dark-brown powder, Melting Point: 290 °C, Density/ Specific Gravity: 9.38 g/cm^3, Insoluble in water; soluble in HCl with evolution of Cl_2; in dilute HNO_3 in presence of H_2O_2, oxalic acid, or other reducers; soluble in alkali iodide solution with liberation of iodine; soluble in hot caustic alkali solution and an oxidizing agent.

Uses: Electrodes in batteries; in manufacture of dyes, pigments & paints; as discharge in dyeing with indigo; manufacture of rubber substitutes; with amorphous phosphorus as ignition surface for matches; pyrotechnics; in analytical chemistry. Curing agent for polysulfide, low-molecular weight butyl and polyisoprene.

Occupational Exposure Standards :

Recommended Exposure Limit: 10 hr Time-Weighted Average: 0.100 mg/m^3

Immediately Dangerous to Life or Health: 100 mg/m^3

Threshold Limit Values: 8 hr Time Weighted Average (TWA): 0.05 mg/m^3

Toxicity Data:

Intraperitoneal: Guinea pig-LD_{50}: 220 mg/kg

Intraperitoneal: Mouse-LD_{50}: 291 mg/kg

Route	Symptoms	First Aid	Target Organ
Inhalation & Ingestion	May cause CNS depression, gastrointestinal irritation, nausea, vomiting, diarrhea, severe hemolytic anemia, hemoglobinuria and kidney damage.	Never give anything by mouth to an unconscious person. Do not induce vomiting. Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid immediately.	Central & peripheral nervous systems, respiratory, cardiovascular, gastrointestinal, renal, reproductive, endocrine and hematologic systems.
Contact	Irritation	Flush eyes & skin with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.	Skin and eye

Personal Protective Equipment: Wear appropriate protective eye glasses or chemical safety goggles, gloves, protective clothing & respirators.

Antidotes: Chelating agents such as calcium EDTA, d-penicillamine and succimer are used in lead poisoning.

Handling & Storage: Minimize dust generation and accumulation. Avoid contact with eyes, skin and clothing. Keep container tightly closed. Use only with adequate ventilation. Avoid breathing dust. Store in a cool, dry, well-ventilated area away from incompatible substances.

MAY WE HELP YOU

To keep abreast with the effects of chemicals on environment and health, the ENVIS Centre of Indian Institute of Toxicology Research, deals with:

Maintenance of toxicology information database on chemicals

Information collection, collation and dissemination

Toxic chemical related query response service

Preparation of monograph on specified chemicals of current concern

Publishing Abstract of Current Literature in Toxicology

for further details do write to

Scientist In-Charge

ENVIS CENTRE

INDIAN INSTITUTE OF TOXICOLOGY RESEARCH
(Formerly Industrial Toxicology Research Centre)

Post Box# 80, Mahatma Gandhi Marg, Lucknow-226 001 India.
Phone : (0522) 2284 591, Fax : (0522) 2628227
Email : itrc@envis.nic.in
web : http://www.itrcenvis.nic.in; http://www.envisiitr.org.in