EFFECTS OF LEAD ON HUMAN HEALTH

Abstract:

Lead is a useful and common metal that has been used by humans for thousands of years. It is also a very dangerous poison, particularly for children, when it is accidentally inhaled or ingested. The main target for the lead toxicity is the nervous system. It is rapidly absorbed into the blood stream and believed to have adverse effects on the central nervous system, the cardiovascular system, kidneys, and the immune system. Rules and regulations prohibit lead in common products like most gasoline and paint, so lead poisoning has dramatically declined. If a building was built before 1978 and has older paint, it should be assumed to have lead paint. However, it is still a real problem that continues to poison thousands of people each year. Hence, Lead Poisoning is a "Silent Menace". The following article will provide various aspects and information about sources of lead in the environment, who is most at risk for lead poisoning, how you can reduce the chances that you or your children will become injured by lead.

Basic Facts of lead as an element:

The term lead comes from similar words in proto-germanic languages. The symbol Pb comes from its Latin name, *plumbum*. Lead has been in use for thousands of years for many industrial uses. Ancient Chemicts believe that lead was associated with the planet Saturn and the oldest metal on the world. Its Atomic No. is 82, Atomic Symbol is Pb, Atomic Weight is 207.2, Melting Point is C.

Lead is a soft, very malleable and ductile element. It has a bluish-white coloring and a very bright luster. It is strongly resistant to corrosion and is sometimes alloyed with antimony to harden. Natural lead has four stable isotopes. Twenty-seven other isotopes of lead are recognized. Lead is a highly poisonous metal when inhaled or swallowed and long-term exposure can be harmful. Lead occurs very rarely in nature. It is most commonly found with galena (PbS) and extracted through a roasting process It's also found in anglesite, cerussite and minim.

Effect of lead on human health - Health effects

Though lead is found frequently in our environment, it has no known purpose in our bodies. When lead gets inside the body, the body confuses it with calcium and other essential nutrients. This confusion can cause permanent damage to the health of both children and adults.
It has been globally decided that the lead safe limit in paint should not exceed 90 mg / kg, and accordingly, the committed industries considered this as the safe limit of lead in zinc also, and it is not liable to go beyond it.
Some internationally based metal coating producers are using ZINC containing lead components, surpassing the safe limits of lead in manufacturing the Galvanized Steel, ignoring its effect to the environment and to human health.

In children, lead is most damaging when they are six years and younger. Children are growing at a very fast rate - growing bones, developing stronger muscles and creating many connections in their brain. When lead instead of essential nutrients is "available" to the body to make bones, muscle, and brain connections, permanent harm to health can occur. Even at low levels, lead can be harmful and be associated with:

- Learning disabilities resulting in a decreased intelligence (decreased IQ)
- Attention deficit disorder
- Behaviour issues
- Nervous system damage
- Speech and language impairment
- Decreased muscle growth
- Decreased bone growth
- Kidney damage

High levels of lead are life threatening and can cause seizures, unconsciousness, and death.

In Adults, Lead exposure is a concern for adults, even though they have finished growing. Since an adult's body is much larger than a child's body, more lead is needed to cause injury but the harm lead can do to an adult is very serious. High levels of lead can cause:

- Increased chance of illness during pregnancy
- Harm to a foetus, including brain damage or death
- Fertility problems in both men and women
- High blood pressure
- Digestive issues
- Nerve disorders
- Memory and concentration problems
- Muscle and joint pain.

General application of lead

Lead's resistance to corrosion and ease of use makes the element a common metal for industrial applications. Romans used the metal to make lead pipes, connecting iron pins for limestone blocks and several other applications. Historically, it has also been used as an additive in paint, in face whitening make-up, as a preservative for food and drink as well as pesticides. Hence, Lead is not used in much of these products any longer due to its highly toxic nature.

Lead is now commonly used in radiation shields around X-ray equipment and nuclear reactors, as a sound absorber and to absorb vibration Lead oxide is used to create "crystal glass" and "flint glass" for achromatic lenses.

Lead usage in paints and the reason for lead usage in the paints

Lead paint or lead-based paint is paint containing lead. As pigment, lead(II) chromate ($PbCrO_4$, "chrome yellow") and lead(II) carbonate ($PbCO_3$, "white lead") are the most common forms. Lead is added to paint to speed up drying, increase durability, maintain a fresh appearance, and resist moisture that causes corrosion.
Lead's poisonous properties have been known for thousands of years, so why was lead ever added to paint, and why is lead paint still being made?

What is 'lead paint'? Any paint that relies on lead compounds for its colour. White lead, or lead(II) carbonate ($PbCO_3$), is a typical example, and was once widely used to paint wooden surfaces in homes. Other lead compounds, like vivid yellow lead chromate ($PbCrO_4$), were used as coloured pigments. As well as giving the paint its tint, lead pigments are highly opaque, so that a relatively small amount of the compound can cover a large area. White lead is very insoluble in water, making the paint highly water-resistant with a durable, washable finish.
Lead carbonate can also neutralise the acidic decomposition products of some of the oils that make up the paint, so the coating stays tough, yet flexible and crack-resistant, for longer.

However, lead paint is cheaper than the alternatives, which seems to have tempted certain Chinese manufacturers to use it in preference to the non-toxic, and legal, replacements.

Effect of lead in paint of PPGI on human health

The most common source is lead paint. Lead carbonate [PbCO3/Pb(OH)2)] was added to paint to speed drying, improve durability, and protect the surface from corrosion. Even though the negative health impacts of leaded paint were known as far back as the early 1900s, lead in residential paint was not banned until 1978.

Children are at particular risk from lead paint because they occasionally eat paint chips (sometimes on purpose). Lead paint can have a sweet taste, and babies and toddlers will often lick or suck windowsills, crib bars, and other objects that may be coated with lead paint. Leaded dust from peeling, chipping, cracking or otherwise deteriorating lead paint will collect onto floors and other surfaces. Children touch the dust, and then put their fingers in their mouths.

Lead paint will only harm you or your family if it is peeling, flaking, or otherwise coming off of the surface.

Leaded dust from paint can be a big problem during remodelling, when lead dust can become a hazard for the whole family, but particularly children. There are many tips for safe remodelling, which guide the use of sanders, scrapers, heat guns, keeping children and pets out of work areas, and how to clean up afterwards.

Modes of lead in PPGI reaching the human or the environment (soil/water/air etc.)

There are various ways for reaching lead in PPGI to humans like roof collected rainwater consumption which can contain both lead contents. Microbiological Quality of roof-collected rainwater is vital in this aspect.

The most common way for lead to get into soil is from exterior house lead paint. If your home was built before 1978, it most likely has some lead in the paint. If your home was built before 1950, the paint contains more lead. Lead paint can be a danger to your children if the paint is chipped, peeling, cracked or chalking; or when repairing or remodelling disturbs it. Approximately 37% of the one million homes in Wisconsin have some lead paint. Due to natural weathering over time, paint dust and chips fall to the ground at the base of the home. When owners scrape off the old paint in preparation for repainting, this too can contaminate the soil. This contaminated area, known as the drip zone (the area where old paint dust and chips has fallen), can contain lead levels as high as some industrial contamination sites.
The table below shows hazard levels of lead in paint, soil and dust, as determined by the California Department of Public Health (CDPH) [(1)]

Lead in Paint Hazard Levels	Lead in Bare Soil Hazard Levels	Lead in Dust Hazard Levels
• Lab test results of 5,000 ppm (parts per million) or 0.5% or more (by weight) • XRF test results of 1.0 milligrams of lead per square centimeter (1.0 mg/cm2) or more	• lab test results of 400 ppm or more in bare soil in areas where children play • lab test results of 1,000 ppm or more in all other areas	• dust from interior floors with 40 micrograms of lead per square foot (40 µg/ft2) or more • dust from interior horizontal surfaces with 250 micrograms of lead per square foot (250 µg/ft2) or more • dust from exterior floors and exterior horizontal window surfaces with 400 micrograms of lead per square foot (400 µg/ft2) or more

Drinking water: Drinking water may have lead in it, though permitted levels in municipal sources are carefully regulated. The largest source of lead in drinking water occurs through leaching from lead-containing pipes, faucets, and solder, which can be found in plumbing of older buildings. If you have older pipes in your home, be sure to run the water for 60 seconds every morning before using it. Do not use hot tap water for drinking purposes.

Regulations/legislations on lead in paints and Zinc.

The Global Lead Advice and Support Service (GLASS) provides information and referrals on lead poisoning and lead contamination prevention and management, with the goal of eliminating lead poisoning globally and protecting the environment from lead. GLASS is run by The LEAD Group Incorporated ABN 25 819 463 114. Most national governments have failed to regulate the removal of old leaded paint, as well as the use of lead as an additive in new paints

In 12 countries tested, with at least 10 samples from each country, results showed: - Several countries had large percentages of paints with lead levels above 600ppm: (A meeting in May 2010 in Geneva of the Global Alliance to Eliminate Lead in Paint (GAELP) recommended a limit of 90ppm [0.009%]) - Of the samples tested, China had 32.8% with lead levels above 600ppm, Singapore - 36.6%, Thailand - 90.6%, and Nigeria - 96%. [(2)]

This prompts the question that if unleaded paints are available, why are they unused? It comes down to two major points: lack of government regulation, combined with public ignorance, which allow leaded paints to remain on the market and be purchased. “Lead makes the mind give way”

Major developments of legislation regarding lead in paint by national governments – During 1909, France, Belgium and Austria ban white-lead interior paint. In 1922, League of Nations bans white-lead interior paint. Tunisia and Greece ban white-lead interior paint. The Health Acts Amendment Act in Queensland Australia dictates that no paint containing more than 5% soluble lead should be used on or within four feet of buildings accessed by children under the age of fourteen (GLASS 2008). [(3)]

In 1926, Great Britain and Sweden ban white-lead interior paint. 1971, United States Lead Based Poisoning and Prevention Act Passed (Title X, spoken as “Title Ten”) In 1978, United States bans

white-lead paint (limit below 0.06% for lead in paint). In 1991, Canadian Paint and Coatings Association voluntarily agrees to limit lead content in consumer paint to 0.06%. In 1992, Maximum lead content of paint in Australia reduced to 0.25% [(4)]. In 1996, Organisation for Economic Co-operation and Development (OECD) declares lead highest priority for country specific management plans. In 1997, maximum lead content of domestic paint in Australia drops to 0.1%. In 2004, World Health Organisation/Europe (WHO) Europe include lead on the list of hazardous chemicals.

World's Best Practice in Regulating Lead in Paint - The United States has long been recognised as having the world's best practice in regulating lead in paint This is due to the unparalleled regulations contained in the Title X ("Title Ten") Act 1971. Thus, United States Lead Based Poisoning Act. [(5)]

The legislation was targeted specifically at government housing. This included government-owned buildings to which children have prolonged exposure, such as schools.

The Global Alliance to Eliminate Lead in Paint (GLAEP) has highlighted several areas that need to be addressed by countries in developing legislation to eliminate lead in paint. These action points provide a crucial scaffolding tool for countries developing new legislation, as well as highlighting areas in which existing legislation can be improved.

Lead usage in zinc for galvanizing and the reasons for its addition

Various Galvanizing Industries use lead in zinc

- to protect the bottom of steel baths used to hold the molten zinc against corrosion through Zn/Fe alloy formation;
- to give a "sparkle" to the finished galvanised work;
- to "wet" the steel so that the final zinc coat is strongly adhering to the steel.

Effect of lead in zinc of GI on human health

Water from leaded water pipes enters human body and increases lead level in blood which results in

- Increased Blood Pressure and cardiovascular diseases.
- Mental Retardation,
- Anaemia
- Decreased Renal Function.

Modes of lead in GI reaching the human or the environment

Metal Dust Produced By galvanized grinding activities and steel coated with zinc often used in metal forming processes involving operations such as welding and grinding cause fumes and dust that easily may be inhaled by technicians/fabricators. If the lead content in zinc exceeds the recommended safe levels, it may cause heath complications and respiratory diseases.

Test methods of lead (Quick tests & lab tests)

There are three main approaches for determining the lead content in paint:

1) Test the paint for lead in situ using a chemical test kit.

2) Measure the amount of lead in paint in situ using a portable X-ray fluorescence (XRF) device.

3) Collect a paint sample and measure its lead content in a laboratory using various analytical techniques.

Chemical test kits: There is a range of chemical test kits, from simple qualitative tests to more sophisticated semi quantitative tests. Many rely upon a colour change to indicate the presence of lead above a certain concentration. In the simplest kits, the result is either positive (i.e. lead is present above a certain concentration) or negative (i.e. lead is absent above a certain concentration), according to whether a colour change occurred. The threshold concentration for the colour change depends upon the test kit used and may be regulated in the country where the test is marketed. In the USA, for example, test kits should detect concentrations above 0.5% lead by weight (5000 mg/kg). Depending on the context in which they are meant to be used, some chemical test kits may have lower limits of detection.

Chemical test kits are relatively cheap and do not require specific training, although training of the user will give more reliable results. The results are immediate.

Portable X-ray fluorescence (XRF) spectrometry XRF spectrometry is based on the fact that, when exposed to high-energy radiation, lead (like many other elements) emits X-rays at a characteristic frequency. The intensity of the rays can be measured and correlated to the amount of lead per unit area (usually in units of milligrams per square centimetre). As regulatory standards for lead in paint may be expressed in other units (e.g. parts per million or per cent concentration by weight), the XRF results may need to be converted. Portable XRF instruments can measure the total amount of lead in a painted surface in situ without damaging the paint or the substrate.

Laboratory analysis - This approach requires that a sample of paint, either new paint or dry paint removed from a surface, be collected and analysed in a laboratory using various techniques. Laboratory analysis requires careful sample collection and preparation.

A minimum sample size of about 300 mg is usually required to conduct an analysis, although this depends on the concentration of lead, sample preparation and the method of analysis.

Flame atomic absorption spectrometry (FAAS), Graphite furnace atomic absorption spectrometry (GFAAS), Inductively coupled plasma atomic emission spectrometry (ICP-AES).

Swab Test: **3M™ LeadCheck™ Swabs** are EPA recognized, non-toxic and provide an instant test for lead on most surfaces, including wood, ferrous metal (alloys that contain iron), drywall and plaster. When lead is detected, M™ LeadCheck™ Swabs and/or the surface being tested turns pink or red depending on the concentration of lead present. In the vast majority of test situations results are obtained in less than 30 seconds. When detecting low levels of

lead, or lead chromate containing pigments, results may take longer to develop. Each kit contains test confirmation cards to verify individual test results. Since their introduction in 1992, M™ LeadCheck™ Swabs have been used to detect lead under a wide variety of field test conditions. Recognized by industry professionals for superior accuracy and sensitivity, M™ LeadCheck™ Swabs have outperformed other screening methods in every government evaluation conducted over the past 15 years.

Recommendations for effective implementation of regulations / legislations

There can be various effective methods to ensure proper implementation of the regulations including

- Policy Framework for Effective and Efficient Financial Regulation at Govt. and ministry level.
- Public Campaigns to educate Social Responsibility in the society and awareness by Individuals, NGOs and Corporate Sector.

The UNICOIL initiative - Unicoil sets standards in pre-painted steel industry by educating the customers thru Fliers, Media and Corporate SMS services.

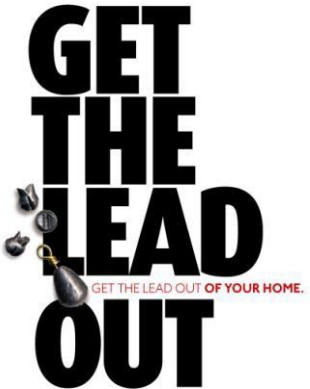
Conclusion

In most cases, lead poisoning is preventable by preventing its exposure. Preventive Strategies can be classified into

- Individual - measures taken by family,
- Preventive medicine - identifying & Intervening with High Risk individuals,
- Public Health - With Govt. & Corporate support which includes Substitution, Isolation, Good House Keeping, Annual Check-up for employees, Implementation of HSE, Personal Hygiene, Awareness, PPEs.

The effort for keeping this world safer for next generation should be a culture for each individual which is supported by corporate responsibility indeed.

Lets' hope for a better tomorrow & healthy growth across generations by above mentioned responsible actions.



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