Lead Compounds

Hazard Summary

Lead is used in the manufacture of batteries, metal products and ammunition. Exposure to lead can occur from breathing contaminated air in or near workplaces that process lead or lead materials, as well as from incidentally ingesting dust or paint chips in houses with lead-based paint. Lead can cause effects on the blood, as well as the nervous, immune, renal and cardiovascular systems. Early childhood and prenatal exposures are associated with slowed cognitive development, learning deficits and other effects. Exposure to high amounts of lead can cause gastrointestinal symptoms, severely damage the brain and kidneys, and may cause reproductive effects. Large doses of some lead compounds have caused cancer in lab animals.

Please Note: The main sources of information for this fact sheet are EPA's Air Quality Criteria for Lead (1), EPA's Integrated Risk Information System (IRIS) (5), and the Agency for Toxic Substances and Disease Registry's (ATSDR's) Toxicological Profile for Lead. (2)

Uses

- The primary use of lead is in the manufacture of batteries. (1,2)
- Lead is also used in the production of lead alloys and metal products, such as sheet lead, solder (but no longer in food cans), and pipes, and in, ammunition, cable covering, and other products. Its use in ceramic glazes, paint and pipe solder has been dramatically reduced. (1,2) Tetraethyl
- lead was used in gasoline to increase the octane rating until lead additives were phased out and eventually banned from use in on-road gasoline in the U.S. by the EPA by 1996. Leaded gasoline is still used for propeller-driven aircraft and some race cars. (1,2)

Sources and Potential Exposure

- Human exposure to lead occurs through a combination of inhalation and oral exposure, with inhalation generally contributing a greater proportion of the dose for occupationally exposed groups, and the oral route generally contributing a greater proportion of the dose for the general population. The effects of lead are the same regardless of the route of exposure (inhalation or oral) and are correlated with internal exposure, as blood lead levels. For this reason, blood lead levels are often used to characterize exposure.
- In the past, the largest source of lead in the atmosphere has been from leaded gasoline combustion, but with the phase-down of lead in gasoline, air lead levels have decreased considerably. Currently, the largest sources of airborne emissions are metals industries, including lead smelters and iron and steel production, manufacturing industries and waste incineration.(1,2)
- Exposure to lead can also occur from food and soil. Children are at particular risk to lead exposure since they commonly put hands, toys, and other items in their mouths, which may come in contact with lead-containing dust and dirt.(1,2)
- Lead-based paints were commonly used until 1978 and flaking paint, paint chips, and weathered paint powder may be a major source of lead exposure, particularly for children.(1,2)
- Lead in drinking water is due primarily to the presence of lead in certain older pipes, solder, and fixtures. A diet that is nutritionally adequate in calcium and iron may decrease the absorbed dose of lead.(1,2)
- Exposure to lead may also occur in the workplace, such as mining, lead smelting and refining industries, steel and iron factories, and battery manufacturing plants.(1,2)
- Lead has been listed as a pollutant of concern to EPA's Great Waters Program due to its persistence in the environment, potential to bioaccumulate, and toxicity to humans and the environment.(3)

Assessing Personal Exposure

- Once taken into the body, lead distributes throughout the body in the blood and is accumulated in the bones. (1,2)
- The amount of lead in the blood can be measured to assess exposure to lead. (1,2)
- The level of lead in the blood is measured in micrograms per deciliter (µg/dL).
- Exposure to lead can also be evaluated by measuring erythrocyte protoporphyrin (EP), a component of red blood cells known to increase when the amount of lead in the blood is high. This method was commonly used to screen children for potential lead poisoning. (2)
- Methods to measure lead in teeth or bones by X-ray fluorescence techniques are not widely available. Such methods are used in research studies to assess cumulative exposure.(1,2)

Health Hazard Information

Noncancer Effects:

- Studies of humans as well as laboratory animal studies have reported effects on the blood, kidneys, and nervous, immune, and cardiovascular systems. (1,2,3)
- Ingestion of large amounts of lead can produce gastrointestinal symptoms, including colic, constipation, abdominal pain, anexoria and vomiting.
- Severe brain and kidney damage can occur in children after exposures resulting in blood lead levels between 70 and 100 µg/dL and in adults at blood lead levels between 100 and 120 µg/dL (3)
- Anemia has been reported after exposure resulting in blood lead levels of 40 to 70 µg/dL in children and blood lead levels of 50 to 80 µg/dL in adults. (1,2)

- Other effects from chronic lead exposure in humans include effects on blood pressure and kidney function, immune system effects and interference with vitamin D metabolism. (1,2,3)
- Lead also affects the nervous system in occupational-exposed adults. Neurological symptoms have been reported in workers with blood lead levels of 40 to 60 µg/dL, and slowed nerve conduction in peripheral nerves in adults occurs at blood lead levels of 30 to 40 µg/dL. (2) Children
- are particularly vulnerable to the neurotoxic effects of lead. Exposure to low levels of lead early in life have been linked to effects on IQ, learning, memory, and behavior. (1,2)
- Exposure to lead during pregnancy has been associated with toxic effects on the human fetus, including increased risk of preterm delivery, low birthweight, and impaired mental development, including decreased IQ scores. These effects on mental development have been noted at maternal blood lead levels of 10 to 15 µg/dL and somewhat lower. (1,2)
- Studies on male lead workers have reported severe depression of sperm count and decreased function of the prostate and/or seminal vesicles and suggests an impact on male fertility at blood lead levels of above 40-45 µg/dL. (1,2,3)
- Human studies are inconclusive regarding the association between lead exposure and other birth defects, while animal studies have shown a relationship between high lead exposure and birth defects. (1,2)

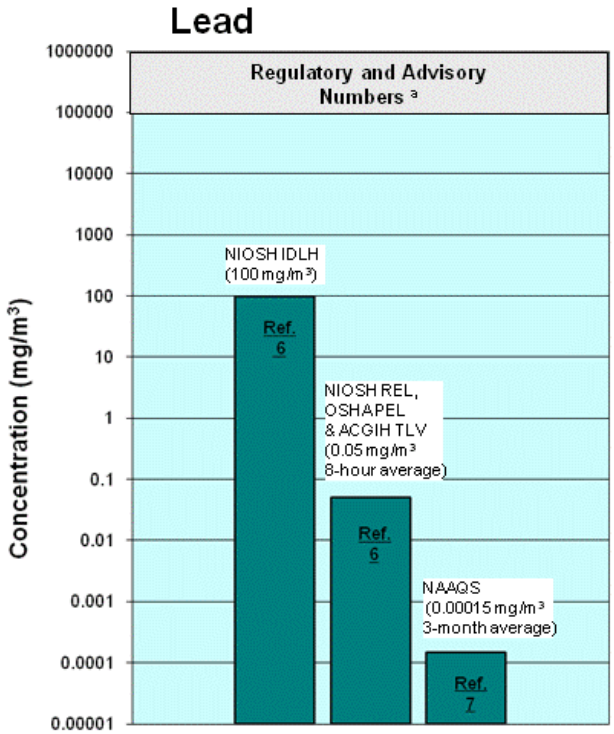
Cancer Risk:

- Human studies are inconclusive regarding lead exposure and an increased cancer risk. Animal studies have reported kidney tumors in rats and mice exposed to lead via the oral route. (1,2,5)
- EPA has considered lead to be a probable human carcinogen, and, under more recent assessment guidelines, it would likely be classified as likely to be carcinogenic to humans.(1,5)

Physical Properties

- Lead is a naturally occurring, bluish-gray metal that is found in small quantities in the earth's crust, predominatly in lead ore, the most important of which is galena. (1,2)
- Lead is present in a variety of compounds such as lead acetate, lead chloride, lead chromate, lead nitrate, and lead oxide. (1,2)
- Pure lead is insoluble in water; however, the lead compounds vary in solubility from insoluble to water soluble. (2)
- The chemical symbol for lead is Pb and the atomic weight is 207.2 g/mol. (2)
- The vapor pressure for lead is 1.77 mm Hg at 1000 °C. (2)

Conversion Factors (only for the gaseous form):
To convert concentrations of lead in gaseous compounds in air (at 25°C) from ppm to mg/m^3: mg/m^3 = (ppm) × (molecular weight of the compound)/(24.45). For lead: 1 ppm = 8.5 mg/m^3.



ACGIH TLV--American Conference of Governmental and Industrial Hygienists' threshold limit value expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effects.
NIOSH REL--National Institute of Occupational Safety and Health's recommended exposure limit; NIOSH-recommended exposure limit for an 8- or 10-h time-weighted-average exposure and/or ceiling.
NIOSH IDLH -- NIOSH's immediately dangerous to life or health concentration; NIOSH recommended exposure limit to ensure that a worker can escape from an exposure condition that is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from the environment.
NAAQS-- National Ambient Air Quality Standards. EPA sets NAAQS that protect public health and the environment for six commonly found pollutants: ozone, particle pollution, nitrogen oxides, sulfur dioxide, carbon monoxide and lead. The NAAQS for lead is 0.15 $\mu g/m^3$. The rolling 3-month average of lead in total suspended particles may not exceed this level.
OSHA PEL--Occupational Safety and Health Administration's permissible exposure limit expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effect averaged over a normal 8-h workday or a 40-h workweek.

The regulatory and advisory values cited in this factsheet were obtained in September 2011. Regulatory numbers are values that have been incorporated in Government regulations, while advisory numbers are nonregulatory values provided by the Government or other groups as advice. OSHA and NAAQS numbers are regulatory, whereas NIOSH and ACGIH numbers are advisory.

Summary created in April 1992, updated September 2011

References

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