

Introduction

Lead is one of the most useful of all the metals, but it is also one of the most dangerous. It has been used as far back as ancient Egypt, Greece and Rome. It is even mentioned some nine times in the bible. The Romans used lead so widely in their plumbing that they had standardized sizes and lengths, and even now some of it is still intact and serviceable.

The chemical symbol for lead (Pb), is derived from the Latin word for lead - plumbum. It is also where the plumbing comes from.

Lead and the Environment

Unfortunately lead has been spread widely over the environment because of man's activities, particularly from smelting, vehicle exhausts and the weathering of lead paints. This has been shown by changes in the annual layers of snow that have fallen for the past several thousand years in Greenland. Current levels of snow lead are about 0.25 ppm, whereas before the industrial revolution it had consistently remained at about 0.001 ppm.

Because lead has become so widespread there are cases of cattle, horses, cats and dogs suffering from lead poisoning. In cities, pigeons have been found to be contaminated, and earth worms by busy roadways have been found to contain enough lead in some cases to be lethal to small worm-eating animals.

Properties

Lead is a soft, bluish-grey metal which rapidly tarnishes to dull grey when exposed to air. It has a specific gravity of 11.3, a melting point of 327 deg C and boils at 1740 deg C.

Its weight makes it great for sinkers for fishing, and also for bullets giving them maximum striking power with minimum air resistance. The relatively low melting point allows it to be alloyed with other metals to form low melting solders which are so useful for the electronics industry. It can be hammered or pressed into thin sheets, or be permanently stretched without breaking. It resists corrosion by water, sulphuric and hydrochloric acids, but will dissolve slowly in nitric acid.

Uses

The largest single use of lead today is for lead-acid batteries.

Compounds of lead such as red lead in paint to confers rust resistance in iron and steel, lead carbonate and lead chromate as paint pigments, lead azide as an initiating explosive in detonators, and lead arsenate as an insecticide. With increasing restrictions

and understanding of its environmental impact many alternatives have since been found. In particular the use of tetraethyl lead as a fuel additive.

Lead is also used to cover cables to protect from corrosion and moisture. It is used as flashing in the construction industry, in solders, in ammunition and as shielding from X-rays. There are still many occupations where lead is still used in some way today.

Lead in Petrol

As a fuel additive tetraethyl lead was used as an antiknocking agent. By antiknock we mean the prevention of preignition of the air/fuel mixture as it is being compressed in the cylinder before the position is at the top of its stroke. It can be heard as a pinging sound and can cause considerable damage to the engine.

After combustion about 70 to 80% of the lead is emitted as small particulates of lead chlorobromide, which very quickly settle a short distance from the tail pipe. Once in the environment it is very quickly converted into the far more insoluble lead sulphate. The remaining 20 to 30% lead is retained in the car, either being taken up in the lubricating oil, or settling in the exhaust system.

Hazards

The hazards of lead are due to its cumulative effects rather than a high acute toxicity. The Exposure Standard for lead is 0.15 mg/m³ (TWA). It is far lower than another material known for its extreme toxicity, hydrogen cyanide (HCN) with an Exposure Standard of 10 mg/m³. (TWA).

These values differ by a factor of 67 and illustrate why the Exposure Standard is not necessarily a measure of acute toxicity. Even though HCN is extremely toxic, the body is able to detoxify it to a limited extent up to 10 mg/m³, whereas inhalation of the same quantity of lead will cause it to accumulate in the body to a point where toxic symptoms eventually will be experienced.

This corresponds with about 0.6 milligrams (or a 500th of an aspirin tablet) of lead that can be ingested in one day.

The most frequent symptoms of poisoning are:

- headache
- irritability
- loss of appetite
- indigestion
- muscle weakness
- lassitude
- insomnia

- weight loss
- facial pallor
- anaemia
- paralysis of the wrist and foot muscles
- colic
- constipation
- lead line on the teeth
- memory loss.

The only way that has been found to determine if a person has been excessively exposed has been by measurement of lead in the blood.

A blood lead concentration of 40 micrograms per 100 millilitres is the upper tolerance limit for adults, and anything higher will eventually lead to symptoms of poisoning.

Lead and Children

Lead exposures involving children have far greater consequences. The reasons include their smaller size, but also a greater vulnerability since they tend to absorb 50% or more of ingested lead, whereas adults only absorb 5 to 15%.

Children also tend to be more exposed, particularly during play, to environmental lead.

Lead affects development of the brain and nerves in a growing child, to the point where it has been found that children who have been exposed have lower intelligence scores relative to those who have not been exposed.

Lead Poisoning

The following are examples where lead exposure has lead to poisoning:

1. At firing ranges.
2. A new drinking water supply in the Northern Territory when a bore was drilled through rock bearing lead ore.
3. A luncheonette worker who dispensed fruit juice every day from one of several tanks used on the premises. The tank had been soldered and the acid in the fruit juice was solubilizing the lead from the solder up to 180 ppm.
4. Police using white lead salts for fingerprint detection.
5. Eating game containing lead shot.
6. Children; as parents bring home contaminated clothing and shoes as a result of their jobs (lead batteries, motor vehicle exhausts and radiators).
7. Painters removing lead based paint prior to repainting (e.g., Sydney Harbour Bridge).

Other events where lead poisoning has occurred include people drinking liquids particularly acidic ones such a fruit juices that are stored in poorly glazed containers, people eating food or drinking wine contaminated with lead arsenate sprays, and children eating lead based paints in older houses.

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