Aluminum - Al

Properties - Health effects of aluminum -Environmental effects of aluminum

Atomic number	13
Atomic mass	26.98154 g.mol $^{-1}$
Electronegativity according to Pauling	1.5
Density	2.7 g.cm $^{-3}$ at 20 °C
Melting point	660.4 °C
Boiling point	2467 °C
Vanderwaals radius	0.143 nm
Ionic radius	0.05 nm
Isotopes	3
Artificial isotopes	16
Electronic shell	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$
Energy of first ionization	577.4 kJ.mol $^{-1}$
Energy of second ionization	1816.1 kJ.mol $^{-}$
Energy of third ionization	2744.1 kJ.mol $^{-1}$
Standard potential	- 1.67 V
Discovered by	Hans Christian Oersted in 1825

Aluminum

The name aluminum is derived from the ancient name for alum (potassium aluminum sulphate), which was alumen (Latin, meaning bitter salt). Aluminum was the original name given to the element by Humphry Davy but others called it aluminum and that became the accepted name in Europe. However, in the USA the preferred name was aluminum and when the American Chemical Society debated on the issue, in 1925, it decided to stick with aluminum.
Aluminum is a soft and lightweight metal. It has a dull silvery appearance, because of a thin layer of

oxidation that forms quickly when it is exposed to air. Aluminum is nontoxic (as the metal) nonmagnetic and non-sparking.

Aluminum has only one naturally occurring isotope, aluminium-27, which is not radioactive.

Applications

A silvery and ductile member of the poor metal group of elements, aluminum is found primarily as the ore bauxite and is remarkable for its resistance to oxidation (aluminum is actually almost always already oxidized, but is usable in this form unlike most metals), its strength, and its light weight. Aluminum is used in many industries to make millions of different products and is very important to the world economy. Structural components made from aluminum are vital to the aerospace industry and very important in other areas of transportation and building in which light weight, durability, and strength are needed.
The use of aluminum exceed that of any other metal except iron. Pure aluminum easily forms alloys with many elements such as copper, zinc, magnesium, manganese and silicon.
Nearly all modern mirrors are made using a thin reflective coating of aluminum on the back surface of a sheet of float glass. Telescope mirrors are also coated with a thin layer of aluminum.
Other applications are electrical transmission lines, and packaging (cans, foil, etc.).
Because of its high conductivity and relatively low price compared to copper, aluminum was introduced for household electrical wiring to a large degree in the US in the 1960s. Unfortunately problems on the functioning were caused by its greater coefficient of thermal expansion and its tendency to creep under steady sustained pressure, both eventually causing loosening the connection; galvanic corrosion increasing the electrical resistance.
The most recent development in aluminum technology is the production of aluminum foam by adding to the molten metal a compound (a metal hybrid), which releases hydrogen gas. The molten aluminum has to he thickened before this is done and this is achieved by adding aluminum oxide or silicon carbide fibers. The result is a solid foam which is used in traffic tunnels and in space shuttle.

Aluminum in the environment

Aluminum is an abundant element in Earth's crust: it is believed to be contained in a percentage from 7.5% to 8.1%. Aluminum is very rare in its free form. Aluminum contribute greatly to the properties of soil, where it is present mainly as insoluble aluminum hydroxide.
Aluminum is a reactive metal and it is hard to extract it from its ore, aluminum oxide (Al_2O_3). Aluminum is among the most difficult metals on earth to refine, the reason is that aluminum is oxidized very rapidly and that its oxide is an extremely stable compound that, unlike rust on iron, does not flake off. The very reason for which aluminum is used in many applications is why it is so hard to produce.
Several gemstones are made of the clear crystal form of aluminum oxide known as corundum. The presence of traces of other metals creates various colors: cobalt creates blues sapphires, and chromium makes red rubies. Both these are now easy and cheap to manufacture artificially. Topaz is aluminum silicate coloured yellow by traces of iron.
Recovery of this metal from scrap (via recycling) has become an important component of the aluminum industry. Industrial production world-wide of new metal is around 20 million tons per year, and a similar

amount is recycled. Known reserves of ores are 6 billion tones.

Health effects of aluminum

Aluminum is one of the most widely used metals and also one of the most frequently found compounds in the earth's crust. Due to these facts, aluminum is commonly known as an innocent compound. But still, when one is exposed to high concentrations, it can cause health problems. The water-soluble form of aluminum causes the harmful effects, these particles are called ions. They are usually found in a solution of aluminum in combination with other ions, for instance as aluminum chlorine.

The uptake of aluminum can take place through food, through breathing and by skin contact. Long lasting uptakes of significant concentrations of aluminum can lead to serious health effects, such as:

- Damage to the central nervous system
- Dementia
- Loss of memory
- Listlessness
- Severe trembling

Aluminum is a risk in certain working environments, such as mines, where it can be found in water. People that work in factories where aluminum is applied during production processes may endure lung problems when they breathe in aluminum dust. Aluminum can cause problems for kidney patients when it enters the body during kidney dialyses.

Inhalation of finely divided aluminum and aluminum oxide powder has been reported as a cause of pulmonary fibrosis and lung damage. This effect, know as Shaver’s Disease, is complicated by the presence in the inhaled air of silica and oxides of iron. May also be implicated in Alzheimer’s disease.

Environmental effects of aluminum

The effects of aluminum have drawn our attention, mainly due to the acidifying problems. Aluminum may accumulate in plants and cause health problems for animals that consume these plants.

The concentrations of aluminum appear to be highest in acidified lakes. In these lakes the number of fish and amphibians is declining due to reactions of aluminum ions with proteins in the gills of fish and the embryo's of frogs.
High aluminum concentrations do not only cause effects upon fish, but also upon birds and other animals that consume contaminated fish and insects and upon animals that breathe in aluminum through air. The consequences for birds that consume contaminated fish are eggshell thinning and chicks with low birth-weights. The consequences for animals that breathe in aluminum through air may be lung problems, weight loss and a decline in activity.

Another negative environmental effect of aluminum is that its ions can react with phosphates, which causes

phosphates to be less available to water organisms.

High concentrations of aluminum may not only be found in acidified lakes and air, but also in the groundwater of acidified soils. There are strong indications that aluminum can damage the roots of trees when it is located in groundwater.

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