



Beryllium

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Beryllium is a metal (atomic number, 4; relative atomic mass, 9.01).

Beryllium is an element that occurs naturally. It is present in a variety of materials, such as rocks, coal and oil, soil, and volcanic dust.

It is the lightest of all solid chemically stable substances, and has an unusually high melting-point. It has a very low density and a very high strength-to-weight ratio. Beryllium is lighter than aluminum but is greater than 40% more rigid than steel. It has excellent electrical and thermal conductivities.

Because of its low atomic number, beryllium is very permeable to X-rays. Neutron emission after bombardment with α or γ rays is the most important of its nuclear physical properties, and beryllium can be used as a neutron source. Moreover, its low neutron absorptiveness and high-scattering cross-section make it a suitable moderator and reflector in structural materials in nuclear facilities; where most other metals absorb neutrons emitted during the fission of nuclear fuel, beryllium atoms only reduce the energy of such neutrons, and reflect them back into the fission zone.

The chemical properties of beryllium differ considerably from those of the other alkaline earths, but it has several chemical properties in common with aluminum. Like aluminum, beryllium is amphoteric and shows very high affinity for oxygen; on exposure to air or water vapour, a thin film of beryllium oxide forms on the surface of the bare metal, rendering the metal highly resistant to corrosion, to hot and cold water, and to oxidizing acids [IARC].

Usage and exposure

Beryllium enters the air, water, and soil as a result of natural and human activities. People working in industries where beryllium is mined, processed, machined, or converted into metal, alloys, and other chemicals may be

exposed to high levels of beryllium [ATSDR].

Beryllium is primarily used in its metallic form, in alloys, or in beryllium oxide ceramics. Its physical and mechanical properties make it useful for many applications across a range of industries. These properties include: outstanding strength (when alloyed), high melting-point, high specific heat, excellent thermal properties, electrical conductivity, reflectivity, low neutron absorption, and high neutron-scattering cross-sections, and transparency to X-rays.

Industries using beryllium and beryllium products include:

- Aerospace (e.g. altimeters, braking systems, engines, and precision tools), automotive (e.g. air-bag sensors, anti-lock brake systems, steering wheel connecting springs);
- Biomedical (e.g. dental crowns, medical laser components, X-ray tube windows);
- Defence (e.g. heat shields, missile guidance systems, nuclear reactor components);
- Energy and electrical (e.g. heat exchanger tubes, microwave devices, relays and switches);
- Fire prevention (e.g. non-sparking tools, sprinkler system springs), consumer products (e.g. camera shutters, computer disk drives, pen dials);
- Manufacturing (e.g. plastic injection moulds);
- Sporting goods (e.g. golf clubs, fishing rods, naturally occurring and manmade gemstones);
- Scrap recovery and recycling, and telecommunications (e.g. mobile telephone components, electronic and electrical connectors, undersea repeater housings).

Approximately 75% of manufactured beryllium is used in alloys, 95% of which is copper alloy [IARC].

In Israel, according to the Occupational Safety Regulations (Occupational Hygiene and Health of Workers in Certain Metals), 1993, the use of beryllium-containing alloys in dentures is strictly prohibited.

Routs of exposure

Inhalation, skin and/or eye contact

The occupational environment is the predominant source of beryllium exposure for humans. Inhalation of beryllium dust and dermal contact with beryllium-containing products are the main roots of occupational exposure [IARC].

Target organs

Eyes, skin, respiratory system [CDC]

Health hazards

People working or living near beryllium industries have the greatest potential for exposure to beryllium. Lung damage has been observed in people exposed to high levels of beryllium in the air.

About 1-15% of all people occupationally-exposed to beryllium in air become sensitive to beryllium and may develop chronic beryllium disease (CBD), an irreversible and sometimes fatal scarring of the lungs [ATSDR].

Acute beryllium disease may develop after a short and heavy exposure and usually last for less than one year. The disease has symptoms similar to pneumonia or bronchitis. NIOSH reports that occurrence of acute beryllium disease is now considered rare as long as protections are in place to control worker exposure to beryllium [CCOHS].

Symptoms of chronic beryllium disease are breathing difficulties (shortness of breath), coughing, fatigue, weight loss, fever, and night sweats. Signs include enlargement of the liver, spleen and right heart, and kidney stones. The course of chronic beryllium disease varies. Granulomas mark chronic beryllium disease and are typically found in the lungs. But granulomas may also occur in the skin, liver, spleen, kidney, bone, nervous system, skeletal muscles, lymph glands and the wall of the heart. Some affected people may have few or no symptoms at all for many years followed by eventual deterioration. Chronic beryllium disease is confirmed by using a number of medical tests beyond the BeLPT and may include a lung biopsy, chest x-rays, scans or lung function tests [CCOHS].

Beryllium is classified as a Group 1 - Carcinogenic to humans by the International Agency for Research on Cancer [IARC].

References:

- ATSDR. Agency for Toxic Substances Disease Registry. Beryllium.
<https://www.atsdr.cdc.gov/toxfaqs/tfacts4.pdf>
- CCOHS Canadian Centre for Occupational Health and Safety. OSH Answers Fact Sheets. Beryllium - Health Effects.
<https://www.ccohs.ca/oshanswers/diseases/beryllium.html>
- CDC. Center for Disease Control and Prevention. The National Institute for Occupational Safety and Health (NIOSH). NIOSH Pocket Guide to Chemical Hazards. Beryllium and Beryllium compounds (as Be).
<https://www.cdc.gov/niosh/npg/npgd0054.html>
- IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Beryllium and beryllium compounds. Volume 100 C: pp:1-301.
<https://monographs.iarc.fr/wp-content/uploads/2018/06/mono100C-7.pdf>