Sources of Exposure

General Populations

- The general population may be exposed to beryllium through inhalation of contaminated air or ingestion of contaminated food or water.
- The general population may also be exposed to beryllium via skin contact with air, water, or soil that contains beryllium.
- People living near beryllium-emitting industries may be at a slightly increased risk of exposure due to contact with contaminated dust.
- Direct contact with beryllium metal and metal alloys is also not likely since these materials are usually enclosed within a protected case.

Occupational Populations

- Occupation exposure occurs in places where beryllium is mined, processed or converted into metal alloys.
- Exposure may also occur during machining of metals containing beryllium and recycling of scrap alloys.

Toxicokinetics and Normal Human Levels

Toxicokinetics

- Inhaled beryllium particles are deposited in the lungs and dissolve into the bloodstream. Some inhaled beryllium may move into the mouth where it is swallowed.
- Beryllium and its compounds are poorly absorbed following oral and dermal exposure; <1% is absorbed through the gastrointestinal tract.
- Absorbed beryllium is widely distributed throughout the body with the highest concentrations found in bone.
- Absorbed beryllium is primarily excreted in the feces. The half-life for whole body clearance ranges from several months to a year.

Normal Human Levels

- Normal background blood levels of 1 ng/g of beryllium have been reported.
- Normal background level of beryllium in urine have been reported to be 0.28–1 µg/L. Recent NHANES data (2007-2008) reports creatinine corrected urine levels <LOD (0.072 µg/L).

Biomarkers/Environmental Levels

Biomarkers

- Beryllium in blood, urine and biological tissues can be used as biomarkers of exposure.

Environmental Levels

Air

- The average concentration in air is 0.03 ng/m^3. In U.S. cities, the average concentration is 0.2 ng/m^3.

Sediment and Soil

- The average range in soil and other superficial materials is 0.63 and <1–15 mg/kg, respectively.

Water

- The average concentration in drinking water is 190 ng/L.
- The average concentration is surface water is 1.9 µg/L.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2002. Toxicological Profile for Beryllium. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Be

ToxGuide™ for Beryllium

Be

CAS# 7440-41-7

September 2002

U.S. Department of Health and Human Services
Public Health Service
Agency for Toxic Substances and Disease Registry
www.atsdr.cdc.gov

Contact Information:
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ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Chemical and Physical Information

Beryllium is a Metal

- Beryllium is a naturally occurring element that is present in rocks, coal, oil, soil, and volcanic dust. Some beryllium compounds are soluble in water.
- Two kinds of minerals, bertrandite and beryl, are commercially mined for the recovery of beryllium.
- The majority of beryllium that is mined is converted into alloys which are used to make electrical and electronic parts or as construction materials for machinery and molds for plastics.
- Pure beryllium metal is used in nuclear weapons and reactors, aircraft and space vehicles structures, instruments, x-ray machines and mirrors.

Routes of Exposure

- Inhalation – Predominant route of exposure for the general and occupational populations.
- Oral – Major route of exposure for the general populations.
- Dermal – Minor route of exposure for general and occupational populations.

Beryllium in the Environment

- Beryllium enters the environment as a result of both natural and human activities. Emissions from burning coal and oil increase levels in the air.
- In air, beryllium exists as fine dust particles that eventually settle over land and water with the aid of snow and rain.
- In water, beryllium settles on the bottom with sediment. Insoluble beryllium compounds can remain suspended in ocean water for a few hundred years before settling.
- A major portion of beryllium will remain bound to soil and is not likely to enter groundwater.
- Chemical reactions in the environment can change water-soluble beryllium compounds into insoluble forms and vice versa.
- There is no evidence of biomagnifications within terrestrial or aquatic food chains.

Relevance to Public Health (Health Effects)

Health effects are determined by the dose (how much), the duration (how long), and the route of exposure.

Minimal Risk Levels (MRLs)

Inhalation

- No MRLs were derived for acute-, intermediate- or chronic-duration inhalation exposure to beryllium.

Oral

- No MRL was derived for acute-duration oral exposure (≤14 days).
- No MRL was derived for intermediate-duration oral exposure (15–364 days).
- An MRL of 0.002 mg/kg/day has been derived for chronic-duration oral exposure (≥1 year).

Health Effects

- The primary target for toxicity of inhaled beryllium is the respiratory tract.
- Exposure to high levels of beryllium can result in acute beryllium disease; symptoms include nasopharyngitis, shortness of breath, labored breathing and chemical pneumonitis.
- Exposure to relatively low levels of beryllium in sensitized individuals can result in chronic beryllium disease which is a systemic granulomatous disorder predominantly affecting the lungs. Effects include noncaseating granuloma and fibrosis.
- In animal studies, the most sensitive effects following oral exposure are ulcerative gastrointestinal lesions.
- Dermal contact with beryllium can result in skin granulomas and dermatitis.
- Increased risk of lung cancer has been found in beryllium workers. DHHS and IARC have concluded that beryllium is a human carcinogen. EPA has classified it to Group B1, a probable human carcinogen.

Children's Health

- Children are expected to be affected by beryllium poisoning in the same manner as adults.