Beryllium – Health Effects

What Health Effects Are Associated With Beryllium?

According to NIOSH (the National Institute for Occupational Safety and Health, 2011), “workers exposed to particles, fumes, mists and solutions from beryllium-containing materials may develop beryllium sensitization or chronic beryllium disease, a potentially disabling or even fatal respiratory disease.”

Depending on how workers are exposed, the diseases can affect different tissues and organs. Breathing in fumes or dusts of beryllium compounds may injure the lungs. While most commonly associated with diseases of the lungs, beryllium may also affect such organs as the liver, kidneys, heart, nervous system, and the lymphatic system.

Direct contact with beryllium fumes or dusts may injure the exposed areas of the body, such as the eyes or the skin. Skin sensitization may also occur.

Beryllium is also a known cancer causing substance, with higher levels of lung cancer being reported. It is classified as a Group 1 – Carcinogenic to humans by the International Agency for Research on Cancer (IARC), and as an A1 – Confirmed human carcinogen by the American Conference of Governmental Industrial Hygienists (ACGIH).

What Is Acute Beryllium Disease?

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.

What Is Beryllium Sensitivity?

Exposure to beryllium can lead to sensitization – an allergic-type response. Not all workers will develop sensitivity to beryllium. In most cases, a worker may be sensitized but there are no health symptoms.

A blood test called beryllium lymphocyte proliferation test (BeLPT) can measure how blood cells react to beryllium. This test can be used for medical surveillance programs. NIOSH states that “it is believed that a person must first be sensitized before beryllium in the lungs can cause the lung damage (called granulomas) of chronic beryllium disease. However, the overall proportion of all sensitized individuals who will eventually develop chronic beryllium disease is not known.”

The Centers for Disease Control and Prevention (CDC) states that “sensitization has been found in one to ten percent of workers in cross-sectional studies, with chronic beryllium disease diagnosed in ten to 100 percent of the sensitized”. This statement

means that between 1 to 10% of workers who work with beryllium may become sensitized. Of those workers who become sensitized, 10% or all may later develop chronic beryllium disease. Another study stated that on average, 1 to 6% of exposed workers may develop sensitivity, but it may be as high as 16% in workplaces with high exposure levels.

What Is Chronic Beryllium Disease?

Chronic beryllium disease primarily affects the lungs. But it may also affect other organs because the blood transports beryllium throughout the body. The mechanism of beryllium disease is not absolutely known. Most likely, once in the body, beryllium combines with certain proteins, causing the release of toxic substances. These are responsible for the lesions seen in the lungs. Certain cells form masses of tissue called granulomas in response to beryllium. 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.

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. 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.

What Are The Industrial Uses Of Beryllium?

Beryllium is a metal widely used in industry because of its important properties including light weight, high melting point, high strength, and good electrical and heat conductivity. It is also non-magnetic. The beryllium-containing materials that industry commonly uses are the metal itself, beryllium oxide, and beryllium alloys. Industrial uses include the manufacture of thermal coating, nuclear reactors, rocket heat shields, brakes, x-ray tubes, and dental plates. The occupations listed below may involve exposure to beryllium. This list is not complete.
Industrial processes that use beryllium or products that contain the metal include:

- Extraction of beryllium (smelting and refining).
- Beryllium metallurgy (production of beryllium metal and compounds) and laboratory work involving beryllium.
- Ceramic manufacturing.
- Precision machining.
- Nuclear applications.
- Electronics, microcircuits, guidance and control systems, computer components.
- Stamping, cutting.
- Die casting.
- Plastic moulding.
- Welding electrodes.
- Handling, assembly.
- Dental plates manufacturing.
- Thermal castings.
- X-ray tube window manufacturing.
- Guidance and navigation systems manufacturing.
- Rocket parts and heat shields.
- Sporting goods.

How Can We Prevent Beryllium Disease?

Workplaces need to identify sources of beryllium. In addition to the health hazards

described above, beryllium is also a flammable solid and a dust explosion hazard. If beryllium is present in the workplace, workplaces should develop an exposure control plan or code of practice.

Very stringent measures are required to prevent possible exposure to beryllium. They are:

- Elimination or substitution.
- Engineering controls:
  - Process modification.
  - Process enclosure.
  - Automation of the work procedures.
  - Local exhaust ventilation systems.
- Administrative controls:
  - Good housekeeping.
  - Protective clothing.
  - Convenient washing facilities.
  - Good sanitation practices.
- Training and education.
- Personal protective equipment (PPE).

Elimination or substitution with a less hazardous substance is the preferred form of protection. However, if beryllium is the only appropriate product, steps can be taken using the hierarchy of controls to reduce exposure.

Engineering controls include:

- Using pellets instead of powders.
- Using the smallest amount possible.
- Isolating or enclosing processes separates workers from harmful substances.
- Using adequate local exhaust ventilation systems prevent toxic substances from escaping into the workroom.
- Using wet processes, such as cutting fluids and wet grinding, honing and polishing. Avoid generating dust and fumes.
- Having light and sound warning devices attached to detectors in areas where there is a potential of massive contamination.
- Ensuring air from the area ventilation and local exhaust system is exhausted to the atmosphere through high-efficiency filtration equipment.

Administrative and work-practice controls include good housekeeping which includes proper storage of substances, frequent disposal of waste, prompt spill clean-up, periodic maintenance of the equipment and wet mopping (do not dry sweep). Limit the number of workers who may be exposed to beryllium. Use high-efficiency particulate air (HEPA) vacuums to clean equipment and the floor. Never use compressed air to clean.

Workers should remove contaminated clothing in change rooms only. Workplaces need to conveniently locate washrooms, toilets, showers, and locker facilities. Separate locker facilities will ensure that work clothes do not contaminate street clothes.

Training and education is required to inform workers of the hazards, what control measures are in place, and to instruct them how to work safely with beryllium.

Personal protective equipment includes respiratory protective devices and protective clothing. If workers must use respirators for breathing protection, the employer should have a written respirator program that describes the proper procedures for respirator selection, care, and use.

Guidance for developing a program can be found in the current CSA Standard Z94.4 “Selection, use, and care of respirators”. Workplaces must follow all legal

requirements for respirator use and approval. These may vary between jurisdictions. NIOSH recommends using a self-contained breathing apparatus or a supplied air respirator, and to use a full facepiece.

Workers should also use protective clothing such as coveralls, headgear, and shoes

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