Beryllium: metal alert

Version 2.0

Chronic beryllium disease (CBD) was first associated with worker exposures to beryllium in the 1940s.

Protective regulations followed. Many thought them adequate until new workplace clusters of disease began emerging in the 1990s. Today, research continues in the effort to find a "scientifically sound occupational exposure level." However, the International Agency for Research on Cancer has classified beryllium as a human carcinogen casting considerable doubt on this pursuit. Fortunately, some workers and their representatives are not prepared to wait and have convinced their employers to take precautionary action, implementing significantly lower exposure limits and stricter control measures now.

What is beryllium?

Beryllium is a naturally occurring metal mined from beryl and bertrandite rocks. Extremely lightweight and hard, beryllium conducts electricity and heat well, is resistant to corrosion and is nonmagnetic.

Since the early 1930s, this metal has been employed in a range of industrial products and processes. Pure beryllium metal is currently used in the manufacture of aircraft frames, space shuttle brakes and satellite mirrors. The soluble salts of beryllium, including beryllium fluoride, chloride and sulfate, are used in nuclear reactors, in glass manufacture and as catalystsin certain chemical reactions. Beryllium-copper (BeCu) alloys find application in the production of springs and switches in automobiles, computers and telecommunications equipment. Molds or casts to make metal, glass and plastic articles are also constructed of beryllium alloys, as are sports equipment and dental bridges. Newer applications of beryllium include beryllium-nickel alloys used in car air bags and beryllium-aluminum alloys employed in the structural components of fighter planes and commercial helicopters.

Who is at risk?

Workers employed in industries where beryllium is mined, processed, machined or converted into other products are at increased risk of exposure to this metal. Those with the highest potential for exposure include beryllium miners, beryllium alloy makers, scrap metal handlers and processors, ceramics workers, missile technicians, nuclear reactor workers, electrical workers and electronic equipment makers. And with the industrial uses of beryllium and beryllium compounds growing, there is an even greater risk that more workers will be exposed in the years to come. This is particularly true in fibre optics manufacturing and scrap metal refining.

How are workers exposed?

Workers are primarily exposed to beryllium through inhalation of dusts and fumes. Tasks where fine beryllium dust and fumes become airborne, such as sanding, grinding, polishing and welding place workers at risk for exposure. Other processes where there is a potential for occupational exposure include high speed machining, die casting, melting alloys and/or pouring of molten alloys and abrasive blasting. Workplace inspections conducted in the 1980s by the U.S. Occupational Safety and Health Administration (OSHA) found workers in the beryllium extraction and refining, recycling and alloy industries more likely to be exposed to higher concentrations of beryllium than workers in other beryllium operations.

Sadly, beryllium exposure does not end at the plant gate. A 1997 study by the National Institute for Occupational Safety and Health (NIOSH) found workers who engaged in machining of beryllium metal products carried beryllium dust home on their clothes, shoes and hands, inadvertently exposing family members. Although rare, studies have also reported family members of beryllium workers, as well as people living close to beryllium facilities as having developed CBD.

What are the health effects?

Occupational exposure to beryllium dust or fume may lead to the development of one of three forms of lung disease.

Acute Beryllium Disease (ABD):

This form of beryllium disease may occur after short exposure to high concentrations (>1000 g/m3) of beryllium dust or fumes. While incidence of ABD is rare today, these exposures can still result from inadequate engineering controls, or equipment failure or malfunction in industry. Exposure can irritate the lungs initiating a "chemical pneumonia". Historical reports of this disease are most common in workers who inhaled beryllium salts. Symptoms include coughing, burning and pain in the chest and shortness of breath.

Chronic Beryllium Disease (CBD):

While chronic diseases are typically associated with long-term exposure, CBD may result from short-term exposure to low levels of airborne beryllium. The initial symptoms of CBD include persistent cough and shortness of breath, especially with activity. Other symptoms include fatigue, weight loss and/or loss of appetite, chest and joint pain, blood in the sputum, fever and night sweats. The average time from first beryllium exposure to development of symptoms is 10 to 15 years, but the onset of symptoms can vary from a few months to more than 30 years. Once exposed to beryllium, however, in any form, there is a lifelong risk of developing CBD and effects are irreversible. Studies now show that approximately two per cent of all workers exposed to beryllium develop CBD and for those engaged in beryllium alloy machining, where exposure to airborne concentrations of beryllium is high, the incidence is even greater — between eight and 16 per cent.

It is worth noting as well, although primarily a lung disease, CBD may also affect the lymph nodes, skin, spleen, liver, kidneys, and heart.

Beryllium sensitization

Exposure to low levels of airborne beryllium, over even a short time, has been associated with sensitization to beryllium. Beryllium sensitization, or an allergic reaction to beryllium, often leads to CBD, even in those no longer working with beryllium. Beryllium sensitization is detected through use of the beryllium lymphocyte proliferation test (BeLPT). This test measures how lymphocytes (white blood cells) react to beryllium. It is estimated that inhalation of beryllium particles, in the respirable range, can initiate an allergic reaction in two to five per cent of those exposed.

Cancer

Inhalation of beryllium dust or fumes can cause lung cancer as well. In 1997 the International Agency for Research on Cancer (IARC) and the United States Department of Health and Human Services determined there is enough evidence to conclude beryllium and beryllium compounds are carcinogenic to humans.

WHSC WORKERS HEALTH & SAFETY CENTRE
Training for What Matters Most

Information Bulletins for health, safety and environmental representatives

Resource Lines

What legislation exists?

The Ontario *Regulation Respecting Control of Exposure to Biological or Chemical Agents*, (R.R.O. 1990, 833) establishes a time-weighted average exposure limit of 0.00005 mg/m3 (0.05 µg/m3) for beryllium and its compounds.

As is the case with many hazards though, some of the lowest exposure levels for beryllium currently in place are not in fact legislated, but have been instituted in individual workplaces in response to worker concerns.

For instance, an increase in the number of workers suffering from CBD at former nuclear weapons manufacturing facilities in the 1990s prompted the U.S. Department of Energy (DOE) to investigate workplace exposures to beryllium. This assessment resulted in the 1999 DOE Beryllium Rule that institutes an action level of 0.0002 mg/m3 — 10 times lower than OSHA permissible exposure limit (PEL) of 0.002 mg/m3 — to protect workers from exposure. At the time, OSHA acknowledged its PEL "may not be adequate" to prevent CBD in all workers.

What about control measures?

In the metalworking industries, appropriate substitutes for beryllium in alloys may be possible, but information is scant. Thus, for the vast majority of applications, engineering controls are presently by far the most feasible and effective means to reduce worker exposure to beryllium. All casting, cutting, grinding or polishing tasks with beryllium-containing alloys should be completed using properly designed and installed local exhaust ventilation equipped with high-efficiency particulate air (HEPA) filters. Similarly, vacuum systems used to clean equipment contaminated with beryllium should also be equipped with HEPA filters. Alternatively, cleaning might also be completed using a wet process. Enclosure of all manufacturing processes that use beryllium and restrictions on worker entry to areas where beryllium is used and/or processed should also be considered.

Appropriate work procedures and hygiene practices provide another layer of protection. Eating or drinking in areas where beryllium is used or processed should be prohibited. Further, in an effort to contain beryllium contamination, workers should have access to designated shower and change facilities. Work clothes for use in beryllium areas should be provided, cleaned and maintained by the employer. And, where beryllium operations cannot be enclosed or ventilated, workers should be provided with appropriate equipment.

In Canada, worker health and safety representatives and their unions in Quebec and Ontario have been at the forefront of measures to control worker exposure to beryllium. After two workers were diagnosed with CBD at the Horne Smelter in Rouyn, Quebec, Noranda-Falconbridge Incorporated responded to concerns by introducing a company-wide initiative to control the risks of exposure to beryllium. Launched in 2000, the Risk Management Program for Beryllium is multifaceted — incorporating restrictions on the concentration of beryllium in recyclable materials entering refining facilities, monitoring of workplace airborne levels of beryllium at specific locations to ensure concentrations are as low as practicable and worker education on the recognition, assessment and control of beryllium exposures.

Since this time, more than 3,000 workers at Noranda-Falconbridge have been screened for beryllium sensitivity with 56 cases of sensitization confirmed as of 2002. Of these, 30 were diagnosed with CBD. An exposure limit of 0.0001 mg/m3 or 20 times below the legal limit has been instituted and an information program on beryllium extended to students, contractors and visitors to all facilities.

A similar initiative was introduced at the Metallurgical Site of Kidd Creek Mines, in Timmins, Ontario. In 2001, in an effort to prevent workers from developing beryllium sensitization, a site-specific exposure limit of 0.0001 mg/m3, significantly lower than the provincial exposure limit, was established. And, for those with a known or suspected sensitization to beryllium, an even lower limit of 0.00001 mg/m3 was adopted.

Additionally, the Site's current purchasing policy requires all prospective suppliers to prove scrap material, designated to be refined, does not contain more than 200 ppm of beryllium. Workers are further protected with use of disposable clothing and most importantly, half-face or fullface 100 series air-purifying respirators (type P, N or R) when handling this material. All those required to work with beryllium undergo regular biological surveillance and participate in training on beryllium hazards and their control.

Governing legislation and workplace control measures aside, as scientific evidence increasingly demonstrates that workers can develop CBD even after brief or intermittent exposures, the question remains: Is there a "safe" level of exposure to beryllium? Unfortunately, there are no easy answers. While many work towards zero exposures at facilities across the province, at a minimum, the above measures must be implemented.

NOTE: CAREX Canada offers a substance profile on beryllium here: https://www.carexcanada.ca/profile/beryllium. For more information and training options, contact a WHSC training services representative in your area.

WHSC WORKERS HEALTH & SAFETY CENTRE

Training for What Matters Most

Resource Lines

Published by the

Workers Health & Safety Centre

675 Cochrane Drive, Suite 710
East Tower, Markham,
Ontario L3R 0B8

416-441-1939

Toll free: **1-888-869-7950**

whsc.on.ca

contactus@whsc.on.ca

Executive Director: **Andrew Mudge**

Director, Policy and Programs: **Loretta Michaud**

Editor: **Yvonne Laurent**

Submissions are encouraged.

@WHSCtraining

cope:343