NGK Metals Corporation

Speaking Out

Health Hazard Information for Users of Beryllium Alloys

Introduction

The following information is provided to those who process NGK Metals' beryllium alloys. We urge all employers to make sure that their employees receive proper hazard notification and instruction. In an effort to alert people in production operations to the hazard, Material Safety Data Sheets (MSDS's) are provided and we apply warning labels to all of our shipments of beryllium alloys. If you need additional information on safe handling practices or technical information on our alloys, contact NGK Metals Corporation, Manager of Industrial Health and Safety at 917 US Highway 11 South, Sweetwater TN 37874 or call (423)351-0435 Fax (423)351-0362.

The Hazard

Airborne particles of beryllium alloys can, if inhaled to excess, cause irreversible lung damage in people who are sensitive to inhaled beryllium particles. Prevention of this adverse health effect (called berylliosis or, more precisely, chronic beryllium disease) lies in maintaining good air quality.

Chronic beryllium disease is a condition that primarily affects the tissue of the lungs restricting the exchange of oxygen between the lungs and the bloodstream. The disease may manifest itself in various ways; nonproductive cough, fatigue after slight exertion, and chest x-ray changes are typical. It may appear after a long period of latency, an interval sometimes lasting for years, between causative exposure and the onset of illness. There is no cure yet known, but treatment with steroid drugs has succeeded in adding to the comfort of patients and enabling them to sustain a measure of activity.

Other Health Effects

Though we have identified chronic beryllium disease as "the hazard" for purposes of ***Speaking Out***, there are other health effects which follow exposure, not to the alloys, but to such soluble beryllium compounds as beryllium fluoride and beryllium sulfate. All of these effects are acute conditions which occur as nasopharyngitis, chemical pneumonitis, dermatitis, and conjunctivitis. They are problems, not in alloy fabrication, but in extraction and other chemical operations where soluble beryllium compounds are present.

Some Noneffects

Beryllium and beryllium alloys are not radioactive. A contrary impression has come about through a misunderstanding of the function of beryllium in nuclear applications.

Skin Contact

Direct contact with beryllium alloys in solid form presents no hazard**.** Cuts or puncture wounds inflicted by beryllium alloys respond to standard first-aid and medical attention. The presence of beryllium in the alloys creates no necessity for special treatment. It is prudent to remove imbedded chips and dust and to keep any wounds clean and covered to protect particulate from entering the skin.

NGK recommends appropriate measures be taken to protect skin contact with fine particulate and solutions containing beryllium. In accordance with OSHA's Metalworking Fluids Safety & Health Best Practice Manual, skin protection should be used to prevent contact with coolants and lubricants. The key to safely processing beryllium alloys is to maintain a strong housekeeping program and keep particulate out of the lungs, off the skin, off the clothing, and in the work area.

Sensitization

Sensitization to beryllium is a condition in which a person's immune system can recognize and respond to the presence of beryllium. Sensitization is not a disability and there are no health symptoms associated with beryllium sensitization. It is, however; believed that only individuals who become sensitized to beryllium may develop chronic beryllium disease. Beryllium sensitization can be detected through the use of a blood test called the BeBLPT, which stands for beryllium blood lymphocyte proliferation test. This test measures how specific white blood cells called lymphocytes react to beryllium. The test is not foolproof: false positive results (a nonsensitized person's test results indicate sensitization) and false negative results (a sensitized person's test results indicate no sensitization) may occur. Due to the variability in results, two positive tests are generally required to confirm a person is sensitized to beryllium.

Carcinogenicity

The U.S. Department of Health and Human Services 11th Report on Carcinogens lists beryllium and beryllium compounds as known to be human carcinogens based on sufficient evidence of carcinogenicity from studies in humans.

Processing Beryllium Alloys

The amount of beryllium dust or other airborne beryllium contaminant released in the processing of a beryllium product determines the extent of exposure control needed to protect workers. While a foundry producing beryllium copper castings may require a far-reaching control program, a stamping-house producing beryllium copper springs in great volume may operate hazard-free without special precautions. Between these extremes, variations in exposure are many in beryllium alloy fabrication.

The way to learn what the levels of beryllium exposure are in a given workplace is to collect air samples. Measurements may be made both of the beryllium concentrations encountered by individual workers and of the levels in work areas. An industrial hygienist or other qualified professional should be used to establish a sampling plan.

The air-sampling survey will identify concentrations expressed as micrograms of beryllium per cubic meter of air. The employer will wish to compare the beryllium levels found in the survey with the legally enforceable limits imposed by the standard adopted by the Occupational Safety and Health Administration (OSHA) for occupational exposure to beryllium. Besides serving as an index of compliance, the survey results will, if exposure measurements are made at individual operations, show were to concentrate control efforts. A well-designed control program strives to reduce exposure to as low as reasonably achievable, not merely reduce it to some numerical maximum. Though the no-exposure goal may in many instances be unattainable, it is better for exposure to be just above zero than just below the legal limit.

The primary instruments of exposure reduction are engineering controls. Of these, local exhaust ventilation, which captures contaminants at the point of release, is the must useful. Process modification, another engineering control, may also reduce exposure by eliminating, for example, a manual operation. Valuable, and often essential, supplements to engineering measures are work-practice controls. An illustration is providing vacuum-sweeping equipment equipped with a high efficiency filter instead of permitting the use of brooms in the workplace. The importance of a strong housekeeping program to prevent accumulations which might become airborne cannot be overemphasized. Work-practice controls may also take the form of written standard operating procedures (SOP's) that specify safe handling practices.

Wet processing is often an effective means of controlling the generation of airborne particles. Care must be given to prevent splashing or misting that could carry alloy particles away from the operation. Inadequate coolant flow or high tooling speeds may necessitate the need for additional containment or ventilation controls. Machining lubricant should be filtered and changed frequently to reduce the accumulations of particulate.

Still another type of exposure control is the respirator. For a number of reasons, it is the least satisfactory. The worker may wear the wrong type respirator for the level or type of exposure; improper fit may admit dust into the air stream; and finally respirators are uncomfortable. The best practice is to confine the use of respirators to operations for which satisfactory engineering of work-practice controls have not been developed, to maintenance work, to emergency situations, and to operations awaiting the results of exposure measurement.

Clothing issued to workers by the employer, laundering work clothing at the worksite, compulsory showers, and special lockers may be necessary under conditions of potential high exposure.

Stamping

Copper beryllium alloys are widely used in electronic equipment. Strip product can be stamped into a variety of shapes and sizes. Manufacturing operations associated with stamping commonly do not generate small particles and can be performed without any special safety precautions.

Machining

Copper beryllium alloys can be readily machined, typically producing large chips or turnings. Processes that generate large particles can generally be performed with no special ventilation or safety precautions. Appropriate measures must be employed for operations with the ability to generate fine particles. Engineering controls such as wet operations or ventilation are the primary methods of controlling exposure.

Welding (A Special Case)

Users of beryllium alloys as base or filter metals in arc of gas welding must comply with Sec. 1910.252(f) (8) of OSHA's safety and health standards for general industry (29CFR1910) which reads as follows:

***(8) Beryllium**. Welding or cutting indoors, outdoors, or in confined spaces, involving beryllium-containing base or filler metals shall be done using local exhaust ventilation and airline respirators unless atmospheric tests under the most adverse conditions have established that the workers' exposure is within the acceptable concentrations defined by Sec. 1910.1000. In all cases, workers in the immediate vicinity of the welding or cutting operations shall be protected as necessary by local exhaust ventilation or airline respirators.*

Since this regulation covers arc and gas welding, we interpret "cutting" to mean cutting with a gas flame or electric arc and not cutting by mechanical means as with a shear, slitter or saw.

Grinding, Polishing, and Buffing (With a Word on Abrasive Blasting)

In the fabrication of the wrought forms (strip, plate, rod, bar, wire, and tubing) of beryllium alloys, grinding, polishing, or buffing may be necessary. In foundry work, grinding is an often-used means of finishing castings, and the polishing or buffing of beryllium copper molds is commonplace. These operations may release inhalable particles into the air. OSHA requires local exhaust ventilation if grinding, polishing, or buffing is done dry and permissible exposure limits are exceeded. (Not just the limits for beryllium, but also those for any of the several hundred other air contaminants which OSHA regulates.) Sec.1910.94 (b) (2) of OSHA's safety and health standards for general industry (29CFR1910) reads as follows:

***(2) Application**. Wherever dry grinding, dry polishing or buffing is performed, and employee exposure, without regard to the use of respirators, exceeds the permissible exposure limits prescribed in Sec. 1910.1000 or other sections of this part, a local exhaust ventilation system shall be provided and used to maintain employee exposures within the prescribed limits.*
The provisions following the one we have quoted give ventilation specifications in some detail. An affected employer should read the full text. (It may also be appropriate at this point for us to call attention to the regulation of a related process, abrasive blasting, at the beginning of Sec. 1910.94.)

Casting and Alloying

Safe foundry practices must be employed when working with beryllium alloys. Furnace ventilation is required to capture fume and particulate generated during melting operations. The configuration and extent of ventilation must be designed for the specific application. One type of melting furnace, for example, may by its very design create little air contamination, while another may require elaborate engineering controls. Implicit in all foundry operations are the difficulties of handling molten metal and drosses plus the cutoff and finishing operations that are usually involved. A full range of control techniques may be required for adequate control.

The importance of controlling airborne beryllium contaminant from drosses in an alloy foundry can not be overlooked. Chemical analysis has shown that drosses frequently carry higher concentrations of beryllium than the alloys originally melted. Dross, moreover, is easily airborne, a characteristic which intensifies the need for careful management.

There is a more compelling need in foundries for a company-issued work clothing, laundering on the premises or in a specialized commercial laundry, compulsory showers, and separate lockers for street and work clothes than in other workplaces handling beryllium alloys. We mention the availability of disposable coveralls; they may make it possible to avoid laundering.

The OSHA Standard

The OSHA standard for occupational exposure to beryllium and beryllium compounds appears in Table Z-2 of 29CFR Part 1910.1000. At the time of this printing it prescribes an 8-hour time-weighted average exposure of two (2) micrograms of beryllium per cubic meter of air. The time-weighted average accommodates excursions above and below the two-microgram mean, but the standard imposes an acceptable ceiling of five (5) micrograms of beryllium per cubic meter of air. There is, in addition, an acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift. This peak is twenty-five (25) micrograms of beryllium per cubic meter of air for maximum duration of thirty (30) minutes.

In September 1999 OSHA issued the Hazard Information Bulletin, Preventing Adverse Health Effects From Exposure to Beryllium on the Job. OSHA published the bulletin to alert employees working with beryllium about the hazards associated with their work and describe engineering controls, work practices, and personal protective equipment recommended for controlling exposure.

The Clean Air Act

Under the authorization of the Clean Air Act, the Environmental Protection Agency (EPA) established a National Emission Standard for Beryllium in 1973. Some emission sources were permitted to achieve compliance by meeting an ambient air quality criterion of one one-hundredth (0.01) of a microgram of beryllium per cubic meter of air (as a monthly average) in the community surrounding facilities. That option is now closed, and all sources coming under regulation must control emissions that they not exceed ten (10) grams of beryllium over a twenty-four-hour period. The standard applies to the following:

(a) Extraction plants, ceramic plants, foundries, incinerators, and propellant plants which process beryllium ore, beryllium, beryllium oxide, beryllium alloys, or beryllium-containing waste.

(b) Machine shops which process beryllium, beryllium oxides, or any alloy when such alloy contains more than 5 percent beryllium by weight.

Since there are no machinable beryllium copper or beryllium nickel materials containing as much as five percent beryllium, machine shops may process our alloys without risk of violating the standard.

As we have indicated, incinerators must comply. The standard also prohibits the burning of beryllium-containing waste except in incinerators. (See the **Waste Disposal** section for specific, detailed recommendations.)

Foundries handling our beryllium-containing casting alloys are subject to the standard. Prior to melting any beryllium-containing alloys, EPA at the appropriate Regional Office should be contacted. The agency will either instruct how to comply with the standard or, in states to which EPA has delegated enforcement authority, refer questions to the appropriate state agency.

Waste Disposal

For the purposes of ***Speaking Out***, wastes are considered to be all those beryllium-containing materials which have no further utility to the alloy producer or fabricator. Commercial scrap is not waste by our definition. It is a material usable by the original producer for recycling. In this publication, we discuss scrap under its own heading.

The presence of copper or beryllium does not cause a waste to be classified as hazardous waste under federal regulations. Some copper beryllium alloys may contain substances such as lead or may be coated or plated with metals regulated under federal hazardous waste standards. Various liquid and solid wastes generated in processing beryllium material may be classified as hazardous under the Federal Resource

Conservation and Recovery Act of 1976 (RCRA), the Federal Comprehensive Environmental Response, Compensation and liability Act of 1980 (CERCLA) and similar State stature which govern the proper means of disposal.

Waste materials must be packaged, labeled, transported, and managed in accordance with federal, state, and local requirements.

As regulations governing the handling and classification of wastes often change, we urge those who generate beryllium-containing wastes to keep abreast of federal, state, and local requirements.

Scrap (Recyclable Materials)

Residual beryllium alloy has value as a recyclable material. The customer will get the best price for beryllium alloy scrap if it is segregated by alloy type and scrap classification and kept free from contamination. The guide for meeting the quality requirements to obtain the best price for scrap is our published **Scrap Schedule** which is reissued from time to time to reflect price changes. You may obtain a copy from your NGK Metals Corporation sales contact or from the Purchasing Department, NGK Metals Corporation, 917 US Highway 11 South, Sweetwater, TN 37874. Phone: 423-337-5500.

Useful Literature

Rossman, M.D. 1991. *Beryllium Biomedical and Environmental Aspects*. Baltimore, Williams & Wilkins.

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