Beryllium and beryllium-containing materials can be used in a safe manner under most circumstances, but may present health hazards when used under conditions involving adverse exposure. The purpose of this statement is to identify these health hazards and the exposure conditions under which they may arise.

The recognized health effects of such adverse exposure to the various types of beryllium-containing materials include skin disease as well as acute and chronic lung disease. These adverse effects are not seen with all beryllium materials, but will vary from material to material, depending upon a number of factors, including the chemistry, solubility, physical size, and concentration of the material. It is important, therefore, to identify the specific adverse effects, if any, of the particular form of beryllium materials involved. Some forms of beryllium have produced tumors in selected species of animals. Despite the response noted in animals, there is no generally accepted evidence that beryllium is a human carcinogen. Although some studies purport to show such a relationship, they remain controversial.

SKIN EFFECTS

Two types of skin reaction have been seen in individuals involved in the manufacture of beryllium products. The first involves the implantation of either beryllium oxide or metallic beryllium under the skin. This material may be introduced through cuts, abrasions, or contamination of open wounds. It then sets up a foreign body reaction which will continue to fester until the material is removed. Removal may involve careful cleansing or surgical removal in some cases. Once the material is removed, the wound heals readily without lasting reaction.

The second skin reaction is an irritant or contact dermatitis or rash which is associated with direct contact with the soluble salts of beryllium (usually beryllium chloride, beryllium sulfate, or beryllium fluoride, the most reactive of all). These forms of beryllium are utilized only in the beryllium producer’s refinery and extraction plants or in research laboratories. This localized skin reaction to beryllium presents no hazard for the users of beryllium, beryllia, or alloys of beryllium.

ACUTE LUNG DISEASE

No case of acute beryllium disease has been reported in the past twenty five years. This disease entity was caused by exposure to large concentrations (in the order of 100 micrograms) of soluble salts of beryllium. Engineering controls, installed in beryllium refinery and extraction plants where these compounds are utilized in the basic beryllium production processes, have reduced the airborne concentrations of these materials to a level low enough to prevent this disease. Although an accidental exposure in such plants is still possible, the probability is quite remote. Today, acute beryllium effects on the respiratory system are a matter of historical interest only, and, outside of the basic beryllium producer’s plants, of no practical significance.

CHRONIC BERYLLIUM DISEASE

The most serious health effect of adverse exposure to beryllium is Chronic Beryllium Disease (CBD), once called “berylliosis”. This is an allergic type of lung response resulting from inhaling airborne concentrations of beryllium particulates in the form of dusts, mists, or fumes. In order to contract this disease three conditions must be present. These are:

1. An immunologically responsive individual. In layman’s language, one must be "allergic" to beryllium to develop the disease. About three to five percent of the population appears to be susceptible. Recent research suggests that this selectivity in CBD may be due to the presence of a genetic predisposition in this susceptible population. Further research, designed to shed additional light on the role of genetics in the development of the disease, is now underway.
2. Minimum particle size. Since CBD can be caused only by inhalation, the beryllium particles must be of a respirable size. In order to develop CBC, beryllium particles must be small enough (less than ten microns to enter and be retained in the air sacs in the lower portion of the lung. Particles larger than ten microns are filtered out by the nose hair or trapped in the mouth or the lining of the bronchial tube before reaching the air sacs of the lung. These particles will be swallowed and then excreted through the gastrointestinal tract without ill effect.

3. Adequate concentration. A sufficient number of these minute, respirable beryllium particles must enter the lung to induce an immunological reaction. This threshold level, below which no reaction occurs, may vary from one susceptible individual to another. Accordingly, airborne concentrations of beryllium should be kept as low as possible. The OSHA standard intended to address CBD is an average concentration over an eight hour day not to exceed two micrograms of beryllium per cubic meter of air measured. Thus, in any event, airborne concentrations of beryllium should never be permitted to exceed the approved standard.

SUMMARY

There is no known skin hazard connected with touching or handling solid forms of beryllium oxide, metallic beryllium or beryllium-containing alloys. Beryllium is not radioactive and presents no radiation hazard. There is no known hazard connected with the ingestion of beryllium. The hazard associated with CBD is due exclusively with inhalation.

CANCER

The question of whether occupational exposure to beryllium causes cancer has been examined extensively for the past three decades without producing any study that would demonstrate that beryllium exposure causes human cancer.

The most recent and most extensive human study involved over 9,000 workers employed in the beryllium industry between 1940 and 1969 at seven different plants. The two oldest plants, which operated in the 1940’s, had no engineering controls in that period and workers were exposed to massive levels of airborne beryllium. The remaining five plants had varying degrees of engineering controls over the years and, therefore, a lower level of airborne beryllium. Workers in these five plants showed fewer lung cancers than would be expected in a comparable population, whereas workers in the two oldest plants showed a slightly larger number than would be expected. When the authors of the study adjusted for smoking, this excess was reduced to a level only slightly above expected, a level of excess comparable to that seen in passive smokers.

There are three plausible explanations for these results, but none is more than an educated guess. The first explanation would be pure chance. Having five points falling just below the mean and two falling just above would fit a random probability pattern, with the age and condition of the plants being pure coincidence. A second explanation would be that beryllium is weak carcinogen at the massive doses level seen in the two oldest plants (a thousand-fold higher than current occupational exposure levels), but at today’s exposure levels, it is not an effective carcinogen. The third explanation is smoking. Critics of the study contend that the smoking adjustment made by the authors of the study was inadequate and that when the dates are properly adjusted for factors unrelated to beryllium, such as smoking, all excess disappears, even in the two oldest plants.

Regardless of the explanation selected, the plain fact is that there is no evidence that the thousands of beryllium workers in the industry today have any excess risk of cancer when compared to the general population.

REFERENCE


This information applies to a specific manufacturing operation. If you need additional information on safe handling practices or technical data on beryllium products, contact the Laird Technologies Engineering at 570-424-8510.

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