https://www.osti.gov/opennet/forms?formurl=document/press/pc23.html (parts)

Lithum 6 Production in the USA and Beryllium uses

The Department of Energy has declassified information on the quantity of lithium that was enriched in the isotope lithium-6 at the Y-12 Plant in Oak Ridge, Tennessee, and the total amount of depleted lithium, stored in the form of lithium hydroxide, at the Portsmouth Gaseous Diffusion Plant in Portsmouth, Ohio.
Specifically

- The United States produced a total of 442.4 metric tons of enriched lithium from 1954 to 1963 for thermonuclear weapons, tritium production, and other purposes. The yearly production of the enriched lithium is shown on the attached chart.
- 30,909 metric tons of depleted lithium hydroxide monohydrate(process tails) are stored at the Portsmouth Gaseous Diffusion Plant, and 10,455 metric tons of natural unused lithium hydroxide mono hydrate are stored at the K-25 Site.
- 12 metric tons of natural and 8 metric tons of depleted lithium hydroxide monohydrate are stored at the Y-12 Plant.

Background

- Almost all lithium produced by the United States was enriched by the Column Exchange process. The Column Exchange facilities ran from1955 to 1961 producing lithium-6. Enrichment starts with natural lithium that contains about 7.5 percent lithium-6, with the remainderlithium-7. Lithium-6 is the desired product. It was removed from natural lithium and concentrated in the enrichment process to either95.5 percent, 60 percent, or 40 percent lithium-6, leaving depleted lithium which contains only 1 to 4 percent lithium-6.
- The Y-12 Plant produced enriched lithium-6 for thermonuclear weapons, tritium production, and other purposes. Some lithium-7 was produced to support the Department of Energy's nuclear reactor research.Lithium-7 hydroxide is a chemical base that is used to adjust the acidity of water in a reactor, since it does not absorb many neutrons or form a long lived activation product.
- Almost all lithium produced by the United States was enriched by **the mercury-based Column Exchange** process. In the process, lithium hydroxide was exchanged with lithium amalgam. Lithium-6 was concentrated in the amalgam phase.
- A small amount of lithium was enriched by the Electro-Exchange process, an electrochemical process that also used a large amount of mercury. The Electro-Exchange Plant was operated from 1953 to 1956.
- The quantity listed here is based on the evaluation of the records available. The quantity may be updated or revised in the future after evaluation of the methodology used originally.

Benefits

- As part of the Secretary of Energy's Openness Initiative, the Department of Energy is declassifying information regarding the amounts of enriched lithium produced at the Y-12 Plant in Oak Ridge and the total amount of depleted lithium at the Portsmouth Gaseous Diffusion Plant in Portsmouth, Ohio. As a result of this declassification, the American public will have information that is important to the current debate over proper management and ultimate disposition of materials. The release of this information should encourage other nations to declassify similar information.
- Declassification will facilitate the environmental restoration of the shutdown Column Exchange Plant by allowing more of its equipment to be disposed of as unclassified hardware.
- Declassification of lithium-6 production will permit explicit incorporation of significantly more data by the State of Tennessee in the environmental radiation dose reconstruction study for exposure to mercury used in lithium enrichment.

Who Are the Key Stakeholders?

- *Regulators.* The State of Tennessee has oversight of off-site releases of mercury and storage of lithium hydroxide at Oak Ridge. The State of Ohio regulates lithium hydroxide storage at the Portsmouth Gaseous Diffusion Plant. Declassification permits public discussion of related activities.
- *The Public.* The public will be able to discuss issues related to lithium production on a more knowledgeable basis, and will be provided with access to more specific information on mercury handling than was previously possible.

- *Public Interest Organizations.* Stakeholders include environmental, safety and health groups, historians, archivists, researchers, scientists and industrial workers, as well as State and Federal personnel. With this declassification, those interested in oversight of lithium-related activities will have additional information regarding the quantity of enriched lithium produced at the Y-12 Plant in Oak Ridge, Tennessee, and the total amount of depleted lithium stored at the Portsmouth Gaseous Diffusion Plant in Plymouth, Ohio. Public interest organizations which have expressed such an interest include(but are not limited to): Citizens for Better Health; Energy Research Foundation; Environmental Information Network; Foundation for Global Friends of the Earth; Greenpeace; League of Women Voters; Military Production Network; National Security Archive; Natural Resources Defense Council; Oak Ridge Education Project; Physicians for Social Responsibility; and the Sierra Club.
- ***Freedom of Information Act Requesters.*** **There have been Freedom of Information Act requests for related information in the past. Future requesters can be provided more complete answers**.

Contact

U.S. Department of Energy Office of Public Affairs Contact: Sam Grizzle (202) 586-5806

Q and A -- Attachment below

U.S. Department of Energy, Office of the Press Secretary, Washington, DC20585

QUESTIONS AND ANSWERS

Q. Why is lithium production being declassified if it is used in thermonuclear weapons?

A. Our review indicates that lithium production can be declassified since it is produced in excess. Therefore, the information does not provide correlation with the number of weapons using this material. Quantities of lithium used in nuclear weapons are still classified.

Q. Does the storage and use of chemicals, such as lithium, and the release of radioactive materials, such as uranium, at the Y-12 Plant represent a health hazard to the workers or the public?

A. The Department of Energy is addressing the question of health hazards from exposures to chemicals and radioactive materials by sponsoring a comprehensive package of health studies of Oak Ridge workers and community residents.

The medical surveillance program examines workers exposed to chemicals and radioactive materials to identify signs of organ damage known to be associated with metals, such as beryllium, mercury and uranium. The National Institute for Occupational Safety and Health is managing special study of mercury workers.

The Department of Energy has established **a special medical monitoring program for beryllium workers** at the Oak Ridge Y-12 Plant. In 1991, two beryllium workers who had been diagnosed with other lung diseases were determined to have chronic beryllium disease. Be sintering of powder is no longer used due to berylliousis in the lungs. In 1993, 146 current beryllium workers were provided a the blood lymphocyte proliferation test for immunologic sensitivity to beryllium. Six cases of chronic beryllium disease were diagnosed among those with abnormal blood test results. In 1994, 383 former beryllium workers have been provided the blood test, 12 have been found to be abnormal, and 1 case of chronic beryllium disease has been diagnosed. One individual with an abnormal blood test was found not to have chronic beryllium disease and 10 others are scheduled for or in the process of receiving diagnostic medical examinations.

A special insert below on beryllium.

The element beryllium is a grey metal that is stronger than steel and lighter than aluminum. Its physical properties of great strength-to-weight, high melting point, excellent thermal stability and conductivity, reflectivity, and transparency to X-rays make it an essential material in the aerospace, telecommunications, information technology, defense, medical, and nuclear industries. Beryllium is classified as a strategic and critical material by the U.S. Department of Defense. In 2014, the U.S. produced 270 metric tons of beryllium domestically and imported 68 metric tons, increases from 2013 of 15% and 19% respectively. Government stockpile release is another source of beryllium. Bertrandite (<1% beryllium) is the principal mineral mined for beryllium in the U.S. while beryl (4% beryllium) is the principal mineral mined for beryllium in the rest of the world.

Beryllium is used industrially in **three forms**: as a pure metal, as beryllium oxide, and most commonly, as an alloy with copper, aluminum, magnesium, or nickel. Beryllium oxide (called beryllia) is known for its high heat capacity and is an important component of certain sensitive electronic equipment. Beryllium alloys are classified into two types: high beryllium content (up to 30% beryllium) and low beryllium content (2 - 3% beryllium). Copper-beryllium alloy is commonly used to make bushings, bearings, and springs. Beryllium is also found as a trace metal in slags and fly ash.

Why is beryllium a hazard to workers?

Workers in industries where beryllium is present may be exposed to beryllium by inhaling or contacting beryllium in the air or on surfaces. Inhaling or contacting beryllium can cause an immune response that results in an individual becoming sensitized to beryllium. Individuals with beryllium sensitization are at risk for developing a debilitating disease of the lungs called chronic beryllium disease (CBD) if they inhale airborne beryllium after becoming sensitized. Beryllium-exposed workers may also develop other adverse health effects such as acute beryllium disease, and lung cancer. See the Health Effects section in the preamble of the Beryllium Final Rule for more information.

What is OSHA doing to protect workers from exposure to beryllium?

OSHA's final rule for beryllium requires employers in general industry, construction, and shipyards to implement protective measures for workers who are exposed to beryllium. For more information on the compliance dates and requirements of the beryllium standards for general industry, construction, and shipyards see OSHA's final rulemaking webpage.

Who is exposed to beryllium in the workplace?

OSHA estimates that approximately 62,000 workers are potentially exposed to beryllium in approximately 7,300 establishments in the United States. While the highest exposures occur in the workplace, family members of workers who work with beryllium also have potential exposure from contaminated work clothing and vehicles. Based on OSHA Integrated Management Information System and industry exposure data, beryllium workers in primary beryllium manufacturing and alloy production, and recycling have the highest average exposures to beryllium. Occupations with potential exposure to beryllium include:

- Primary Beryllium Production Workers
- Workers Processing Beryllium Metal/Alloys/Composites
  - Foundry Workers - Furnace Tenders - Machine Operators
  - Machinists - Metal Fabricators - Welders - Dental Technicians
- Secondary smelting and refining (recycling electronic and computer parts, metals)
- Abrasive Blasters (slags)

Certain types of slags (coal, copper) used in abrasive blasting operations may contain trace amounts of beryllium (<0.1 % by weight). Due to the high dust conditions inherent in abrasive blasting operations, workers involved in these activities may be exposed to dangerous levels of beryllium.

Where is beryllium used?

End products[1] containing beryllium and beryllium compounds are used in many industries including:

- Aerospace (**aircraft braking systems, engines, satellites, space telescope**)
- Automotive (**anti- lock brake systems**, ignitions)
- Ceramic manufacturing (**rocket covers, semiconductor chips**)
- Defense (components for **nuclear weapons, missile parts, guidance systems, optical systems**)
- Dental labs **(alloys in crowns**, bridges, and dental plates)
- Electronics (**x- rays**, computer parts, telecommunication parts, automotive parts)
- Energy (microwave devices, relays)
- Medicine (laser devices, electro-medical devices, **X-ray windows**)
- **Nuclear energy (heat shields, reactors)**
- Sporting goods (**golf clubs, bicycles**)
- Telecommunications (**optical systems, wireless base stations**)

The Department of Energy conducted mortality studies of workers at various facilities on the Oak Ridge reservation. The studies included industrial exposures to nonradioactive chemicals such as elemental mercury, and to ionizing radiation primarily through exposure to uranium. A mortality study of 2,133 white male workers exposed to elemental mercury at Y-12 and an unexposed group was published in 1984. The mercury exposed workers did not have any statistically significant causes of death, whereas the control group exhibited two cancer categories with more deaths than expected. In a related study, a group of 247 workers heavily exposed to elemental mercury and a control group were studied for clinical evidence of mercury toxicity. The results of this study, published in 1988, determined that the mercury workers had few clinically significant abnormalities except for the increased prevalence of tremor. The Oak Ridge Institute for Science and Education and Emory University are updating this study under a contract with the National Institute for Occupational Safety and Health.

A Y-12 mortality study, published in 1981, included 18,869 white males employed for more than 2 days between June 1943 and May 1947. No personnel dosimetry data was available, although radiation exposure was primarily due to uranium dust. The vital status of the workers was followed through 1973. The elevated risk of lung cancer was statistically significant among men hired at age 45 or older and exposed to uranium dust. Employees in this cohort who were exposed to phosgene

were also the subjects of two separate mortality studies published in1980 and 1985. Exposure to phosgene is associated with increased deaths due to lung diseases, including lung cancer, but there was no observed excess of lung cancer and only a slight increase in respiratory disease mortality through 1985. A special study of 27 cases of central nervous system cancers among Y-12 workers was published in 1987. No association between the risk of these tumors and internal exposure (using the lung dose from uranium as the surrogate for brain dose) or external radiation was found.

A mortality study of 6,781 white males employed at Y-12 for at least 30days between 1947 and 1974 was published in 1988. This study examined the mortality of workers exposed to ionizing radiation from uranium compounds. The death rate for lung cancer was statistically significantly elevated when compared with U.S. death rates. There was evidence that the risk of lung cancer increased with increasing exposure to ionizing radiation. There was no excess rate of death among workers when compared with Tennessee death rates. This study has been updated through 1990 and the report is expected in 1994 after review by the National Institute for Occupational Safety and Health who currently manage Department of Energy analytic epidemiology studies.

Y-12 workers are also part of other Oak Ridge studies in progress that focus on statistical methodology rather than risk of disease.

A mortality study of the Oak Ridge workers was published in 1985. The vital status of 8375 white males who worked at least 1 month between1943 and 1972 at Oak Ridge National Laboratory was followed. This study included mortality through 1977. Statistically significant decreases of cancer deaths were noted for 6 of the 23 categories of cause of death and none had statistically significant increases. Deaths due to leukemia, Hodgkin's disease, and prostate cancer were slightly elevated. Leukemia death rates were highest among men employed 10 or more years or involved in engineering activities.

A second study of the Oak Ridge National Laboratory cohort was published in 1991. The study found a statistically significant excess death rate from all leukemia combined although there was no correlation with the amount of ionizing radiation encountered in the workplace. The overall cancer death rate increased with increasing exposure to ionizing radiation. The statistical tables in the 1991 publication were in error, but the conclusions remained unchanged. In 1992 a second publication analyzed associations between cancer mortality and occupation. The author concluded that isotope production, chemical operations and exposures to mercury, beryllium and lead may be associated with higher cancer risks. The vital status of the workers included in the Oak Ridge National Laboratory study is expected to be updated through 1990. The results of these studies were published and the information was provided to workers.

A community dose reconstruction study to estimate chemical and radiation doses to community residents is being initiated this year by the State of Tennessee under a State Health Agreement. It will assess releases of materials to the environment and the pathways leading to human exposure.

The State Health Agreement also supports quality assurance activities to enhance the operations of the Tennessee cancer registration program. The registration of cancer cases in a surveillance system will help detect unusual patterns or clusters of cancer in workers or residents living near the site. The clusters can then be examined for potential associations with Site operations or releases.

The State Health Agreement supports a birth defects registry in Tennessee. The registry provides information about any reproductive outcomes so that those can be analyzed to determine if they are associated with the Department of Energy operations in Tennessee.

The following information is a summary of bioassay (medical surveillance) programs at the Oak Ridge National Laboratory facilities:

Workers at the Oak Ridge Y-12 Plant

During calendar year 1993, 1978 workers at Y-12 were monitored for potential exposure to uranium. The number of positive doses in that group was 687. Five hundred and seventy-two of these represented doses between 1-10 m -rem committed effective dose equivalent. Committed effective dose equivalent is the dose that the individual will receive from the uptake that is delivered to body tissue over the next 50 years. Ninety-three doses fell within the range of 10-30 mrem committed effective dose equivalent. Eighteen doses fell within the range of31-100 mrem committed effective dose equivalent. One dose fell within the range of 101-150 mrem committed effective dose equivalent and thehighest was in the range of 201-250 mrem committed effective dose equivalent. There was no reported exposure to either plutonium ortritium. The majority of the doses at Y-12 are chronic exposures. Thus, there is little distincThe Department of Energy has declassified information on the quantity oflithium that was enriched in the isotope lithium-6 at the Y-12 Plant inOak Ridge, Tennessee, and the total amount of depleted lithium, storedin the form of lithium hydroxide, at the Portsmouth Gaseous DiffusionPlant in Portsmouth, Ohio.

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Benefits

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Contact; **U.S. Department of Energy Office of Public Affairs Contact: Sam Grizzle (202) 586-5806**

------Attachment -- *U.S. Department of Energy, Office of the Press Secretary, Washington, DC20585*

QUESTIONS AND ANSWERS ON Lithium

Q. Why is lithium production being declassified if it is used in thermonuclear weapons?

A. Our review indicates that lithium production can be declassified since it is produced in excess. Therefore, the information does not provide correlation with the number of weapons using this material. Quantities of lithium used in nuclear weapons are still classified.
Q. Does the storage and use of chemicals, such as lithium, and the release of radioactive materials, such as uranium, at the Y-12 Plant represent a health hazard to the workers or the public?
A. The Department of Energy is addressing the question of health hazards from exposures to chemicals and radioactive materials by sponsoring a comprehensive package of health studies of Oak Ridge workers and community residents.
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Workers at Oak Ridge National Laboratory (X-10)

During calendar year 1993 1245 personnel were monitored at the Oak Ridge National Laboratory (X-10) for potential internal dose. Of these about95 percent were monitored for plutonium, Tritium or uranium. There were no positive plutonium doses. Two positive Tritium doses ranged from 1-2mrem committed effective dose equivalent. Seven positive uranium doses ranged from 2-66 mrem committed effective dose equivalent.

Historical burdens are being followed for 3 individuals for plutonium, 2for uranium and none for tritium.

Workers at the Oak Ridge K-25 Plant

During calendar year 1993, 1339 individuals were monitored (all for uranium). The number of individuals with positive uranium doses was 64. The range of the uranium uptakes was 1-16 mrem committed effective dose equivalent. This range could change as 14 of these dose assignments are under current analyses update.

Q. What kind of data will you be able to supply for environmental dose reconstructions that you were unable to supply in the past?

A. The State and its contractors already have access to relevant classified data. The declassification process that was initiated will permit more information to be provided to the public. Plant capacities have been declassified so that quantities of mercury in some parts ofthe plant or equipment would be declassified.

Q. What is depleted lithium hydroxide, and why is it stored at Portsmouth?

A. The material at Portsmouth is depleted in lithium-6. Depleted materials contain less lithium-6 than naturally occurring lithium, which contains 7.5 percent lithium-6. The depleted materials contain between1 and 4 percent lithium-6. The material was stored at Portsmouth because warehouse capacity was available.

Q. Why did you only run the Column Exchange Plant for 8 years?

A. The plant produced all the lithium-6 that we needed in that timeframe. It was later used to make lithium-7 of high isotopic purity from depleted lithium.

Q. What are plans for disposition of the lithium hydroxide at Portsmouth and Oak Ridge? Is it waste?

A. The lithium hydroxide at both Portsmouth and Oak Ridge will be disposed of by a negotiated sale to major lithium producers. Lithium hydroxide is not considered a waste by the Department. between historical and current exposures.

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