Federation of American Scientists

Special Weapons Primer

Weapons of Mass Destruction

Lithium Production

Lithium is a very low-density metal, prone to spontaneous combustion. On the periodic table of the elements it lies directly beneath hydrogen and has but three protons. It is the lightest solid element, with a density only about half that of water. Lithium is silvery in appearance, much like Na and K, other members of the alkali metal series. It reacts with water, but not as vigorously as sodium. Lithium imparts a beautiful crimson color to a flame, but when the metal burns strongly, the flame is a dazzling white. The most common stable isotope is Lithium-7, consisting of three protons and four neutrons; less common, comprising 7.4 percent of normal lithium, is Lithium-6, which has three protons and three neutrons in its nucleus.

Since World War II, the production of lithium metal and its compounds has increased greatly. Because the metal has the highest specific heat of any solid element, it has found use in heat transfer applications; however, it is corrosive and requires special handling. The metal has been used as an alloying agent, is of interest in synthesis of organic compounds, and has nuclear applications. It ranks as a leading contender as a battery anode material as it has a high electrochemical potential. Lithium is used in special glasses and ceramics. The glass for the 200-inch telescope at Mt. Palomar contains lithium as a minor ingredient. Lithium chloride is one of the most lyproscopic materials known, and it, as well as lithium bromide, is used in air conditioning and industrial drying systems. Lithium stearate is used as an all-purpose and high-temperature lubricant. Other lithium compounds are used in dry cells and storage batteries.

Lithium [Li] is a critical material for the manufacture of the secondaries of so-called dry thermonuclear devices, which do not require the use of liquid deuterium and tritium. The largest nuclear device ever detonated was a multi-stage Soviet product with a yield of nearly 60 megatons. It was exploded at only half of its design maximum yield of about 100 megatons.

Lithium enriched in the isotope Lithium-6 remains a controlled material because of its utility in the production of compact and highly efficient thermonuclear secondaries. Two-stage nuclear weapons incorporating a lithium-deuteride-fueled component can deliver greater nuclear yield from a smaller and lighter package than if a pure fission device were used. The tradeoff is that the design and construction of reliable two-stage "dry" weapons may require significant knowledge of nuclear weapons physics and technology, knowledge which is hard to acquire without a program involving full-yield testing of the fission primary to be used and measurement of its production of x-rays and their transport through a case surrounding both primary and secondary stages. Therefore, Lithium-6 is more likely to be of interest to a state with nuclear weapons experience than it is to a beginning nuclear state.

Lithium-6 is most often separated from natural lithium by the COLEX (Column exchange) electrochemical process, which exploits the fact that Lithium-6 has a greater affinity for mercury than does Lithium-7. A lithium-mercury amalgam is first prepared using the natural material. The amalgam is then agitated with a lithium hydroxide solution, also prepared from natural lithium. The desired Lithium-6 concentrates in the amalgam, and the more common Lithium-7 migrates to the hydroxide. A counter flow of amalgam and hydroxide passes through a cascade of stages until the desired enrichment in Lithium-6 is reached. The Lithium-6 product can be separated from the amalgam, and the "tails" fraction of Lithium-7 electrolyzed from the aqueous lithium hydroxide solution. The mercury is recovered and can be reused with fresh feedstock.

Russia, the UK, France, and China are all believed to be capable of making Lithium-6 in the quantities needed for the manufacture of large nuclear stockpiles. Russia exploded a device making use of Lithium-6 before the United States did; however, the Soviet device was not a "true" thermonuclear weapon capable of being scaled to any desired yield. United States production of ^{6}Li ceased in 1963.

Sources and Methods

- Adapted from - Nuclear Weapons Technology Militarily Critical Technologies List (MCTL) Part II: Weapons of Mass Destruction Technologies

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http://www.fas.org/nuke/intro/nuke/lithium.htm

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