BeST
Beryllium Science & Technology Association

Quarterly Newsletter

Autumn Issue – October 2017 BeST – Beryllium Science and Technology Association

Launch of the Be Responsible Program

BeST has announced the roll-out of the **Be Responsible** Product Stewardship Program.

BeST has been actively working to advance the scientific information regarding beryllium health and safety to better protect beryllium workers and the general public.

With this objective in mind, BeST has created **Be Responsible** to help educate and guide industries to improve worker safety during the production and processing of beryllium-containing materials.

Be Responsible includes easy access web based information and features several tools for assessing and controlling workplace exposure for the most common work activities used to process beryllium-containing products.

The program addresses the key components necessary to achieve a high degree of safety for workers at both manufacturing and end-user facilities through existing engineering controls, work practices and personal protective equipment.

This program is recognised by the German Federal Institute for Occupational Health and Safety (BAuA) and is available at www.berylliumsafety.eu or via a web link on the BAuA web site.

BeST members, as beryllium containing products suppliers in EU, are committed to informing and encouraging their customers to implement the **Be Responsible** Product Stewardship Program.

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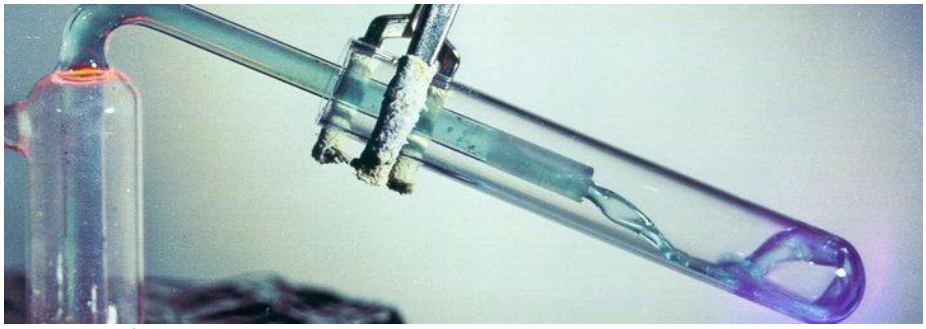
Beryllium used in the second phase of the thorium reactor research



Molten FLiBe flowing

The Nuclear Research and Consultancy Group in Petten (a nuclear research facility in the Netherlands) has begun the first phase of a Salt Irradiation Experiment (SALIENT) - the latest research into Molten-Salt thorium reactors following the pioneering work lead by Alvin Weinberg that was carried out in the 1950's at the Oak Ridge National Laboratory (ORNL) in the United States.

The experiment is being carried out with the cooperation of the European Commission Laboratory Joint Research Centre - ITU (JRC) in Karlsruhe, Germany, with the initial aim of producing cleaner reactor fuel and, subsequently, addressing materials for reactor construction.

In the first stage of the experiment, scientists will use the high-flux reactor and will be melting a sample of thorium salt fuel - a mixture of lithium fluoride and thorium fluoride - inside an insulated graphite crucible where the neutron bombardment will trigger a nuclear reaction and change the thorium salts into uranium isotopes.

To find the most efficient fuel production, two processes will be used: the scientists will place nickel foil in one crucible and a cube of highly porous nickel in another crucible, in both cases, hoping the noble metals will preferentially precipitate out onto the nickel.

During the second phase of the experiment, scientists will be using a different fuel mixture containing beryllium (FLiBe), which is a molten salt made from a mixture of lithium fluoride (LiF) and beryllium fluoride (BeF_2) and is believed to be the optimum fuel for use in a working thorium nuclear reactor. A key feature of the FLiBe fuel is that in the case of a power failure, the reactor "fails safe", with the liquid fuel safely solidifying in a containment vessel under the reactor, ready for restarting. This feature was proven every week throughout the operation of the test reactor. All of the fuel for the original Oak Ridge reactor was supplied by a member of BeST and the material functioned perfectly for the 2-year operation of that test reactor.

Also of note is that compared to a Uranium reactor, the reduced volume of radioactive waste produced (1/1,000), and the radioactivity (1/10,000), are considerably lower. These features make the storage and disposal of the waste a manageable issue within proven engineering capabilities. The half-life of FLiBe waste decays to less than that of natural rock within a few hundred years, compared to over 10 million years for Uranium reactor waste.

This experiment will help in testing the resistance to corrosion at the high operating temperatures of materials to be used in the construction of molten salt thorium

A handful of Countries Control the Earth's most precious metals

The raw materials - metals and minerals - that comprise a cell phone or a computer are sourced from a handful of countries:

1. U.S: Beryllium - the bulk of the world's beryllium is mined in Utah.

2. Canada: Cobalt - Lithium batteries account for roughly 20% of the cobalt used today but portable battery usage is expected to rise.

3. Mexico: Fluorspar - commonly used in refrigerants for domestic and commercial use, aluminium, iron and steelmaking, paints and high-performance optics

4. Democratic Republic of Congo: Cobalt together with tantalum, tin, tungsten and gold.

5. Brazil: Niobium - used in structural steel, in medical tech and in electronics.

6. Russia: Platinum and Palladium - used by vehicle manufacturers in catalytic convertors.

7. Turkey: Magnesium - Until 1995, nearly half of the world's magnesium came from the U.S. but new production from Turkey and China has lowered prices.

8. Afghanistan: Cobalt, niobium, rare earth metals, copper, gold and iron have been found in Afghanistan.

9. China: Considered the world's no. 1 metals consumer and holds more than half of the known global reserves of 9 of the 14 most critical raw materials. China is the top producer of tungsten used in weights that make cell phones vibrate and for the cutting tools used to shape metals.

reactors, and will be a critical step to the realisation of this exciting and potentially carbon free method of generating electricity.

Beryllium safety discussed in three-day workshop

Iter Organization – last manufacturing activity – photo taken in January 2017

In the ITER project , twelve (12) tonnes of Beryllium will be used as armour for the plasma-facing first wall panels fitted inside the Tokamak - a surface of approximately 610 m^2, in addition to a beryllium bead blanket layer behind the first wall.

Beryllium has been chosen for its good thermal properties - as it can accommodate the high heat fluxes on the first wall (up to 5 MW/m2) - and for its low atomic number, which in the case of loss of magnetic control of the plasma, would minimize radiation heat loss which otherwise might lead to unacceptable cooling of the hot fusion plasma, and so prevent uncontrolled reactions.

Even though the beryllium used in the manufacture of ITER component is non-radioactive, the ITER Organization is currently planning a management program that will provide for the safe handling of beryllium during its manufacture and operational use and so provide for a healthy environment.

To this end, on 28-30 June at ITER headquarters, a workshop was organised with the aim of sharing the Organization's plan on dealing with beryllium issues, receive feedback from international actors in the field and receive advice from those who have experience in the fields of beryllium facility design, on-site operation, monitoring and training.

The information from the workshop will be used to improve the ITER beryllium training program and develop an ITER beryllium 'code of practice'.

A BeST delegation participated actively to the workshop in the session dedicated

10. Japan: Indium - used in the past in high-performance aircraft engines, it is now used for flat-screen displays.

11. India: Graphite - the recession has cut graphite demand, however large-scale deployment of fuel-cell technology currently in development could transform the global graphite market.

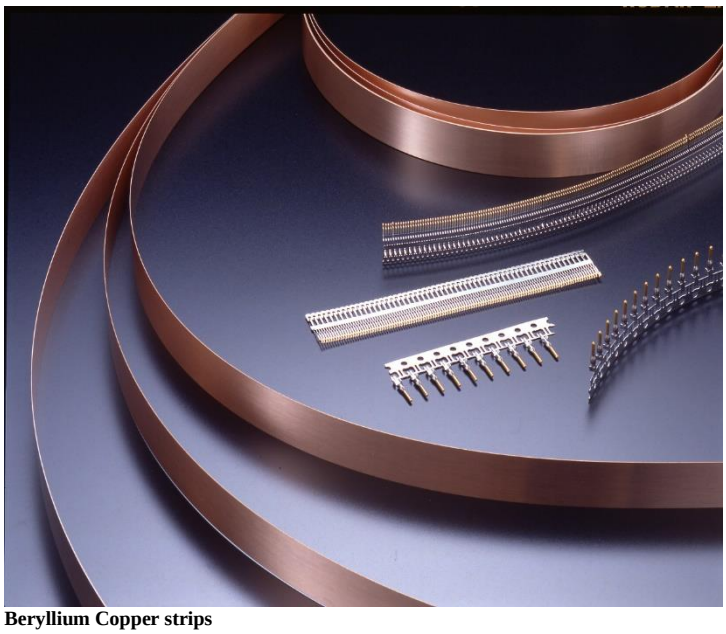
12. Australia: Tantalum - used in gaming consoles, computer and cameras. Australia has however suspended production in 2008 due to cheaper prices being offered by miners in Africa. It may restart its mine next year.

13. South Africa: Platinum - used in catalytic converters and many high-tech lab applications. The largest reserves are located in the Bushveld Complex even though reserves may also be found in China.

to “Working with Beryllium” and discussed the following: (i) National OEL benchmarks; (ii) OEL decision process at the EU level (SCOEL, ASCH, etc); (iii) Beryllium working practices implemented in France.

The BeST members were pleased to note a consistent regulatory environment, especially regarding the best safety practices and the Occupational Exposure Limit for beryllium metal, between the different stakeholders coming from the main regions of the world (EU, USA, china, India, Russia, South Korea, Japan).

Beryllium-Copper and Aluminium alloys continue to rise in Aerospace



Beryllium Copper strips

The ever increasing requirement by aerospace operators for extreme performance in the harshest of environments from aircraft, UAVs and satellites continues to challenge the limits of materials in terms of lighter weight and greater strength to provide the superior fuel efficiency, operational range and minimum vibration of the platforms.

Expanding aerospace system capabilities has driven the development of new advanced materials and high-performance alloys, which is also the case of beryllium alloys. Beryllium alloys are exceptional in aerospace applications due to the metal's light weight, stiffness, very high melting point, low density and resistance to oxidation and corrosion.

Especially, beryllium provides aluminium alloys with a low coefficient of thermal expansion (CTE) which results in significantly less expansion and temperature induced stresses, and so minimises distortions in optical devices across the wide range of environments encountered in space and aerial applications.

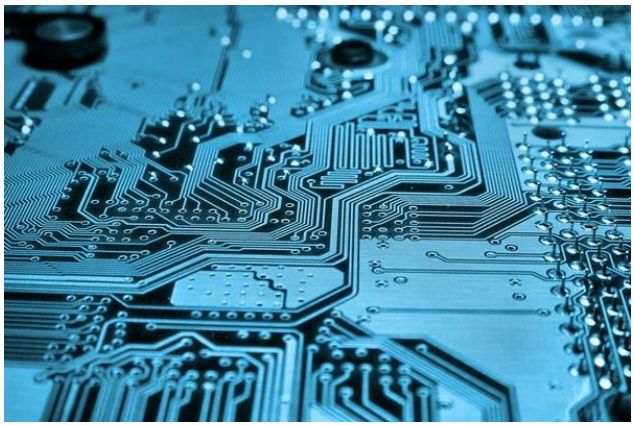
These are critical characteristics for many aerospace uses and justify Beryllium's fundamental importance in aerospace.

4 beryllium facts…

1. Of all alkaline earth metals known, Beryllium is the lightest of all.
2. Beryllium sits on the 4th place on the period table but when it comes to abundance on Earth, it takes the 44th.
3. Beryllium was discovered in 1798 by Louis-Nicholas Vauquelin.
4. Beryllium has an atomic number of 4, which means it has 4 protons.

Beryllium Applications - Future demand for Beryllium

Get the BeST Leaflet on EU Occupational Exposure Limit for Beryllium Metal and Alloys here



Circuit board

Beryllium is a critical and strategic metal with applications in four fundamental areas: (1) Consumer electronics and telecommunications; (2) Industrial components and Commercial Aerospace; (3) Defence / Military and (4) Medical.

(1) Consumer electronics and telecommunications applications account for nearly half of all beryllium consumption. Copper-beryllium alloys (2% maximum beryllium in copper) can be found in electrical contacts, connectors in cell phones and computers. The metal can also be found in automobile electronic connector terminals used in braking, suspension and power steering systems as well as in electrical components such as air bag sensors and engine control systems, where they are valued for the high reliability and consequent user safety that they provide.

Beryllia ceramics are used in high-power electronic circuit boards such as those used in air traffic control radar, that generate heat which must be removed to prevent damage to the delicate electronics, and accounts for approximately 5-10% of annual consumption.

(2) Industrial applications that incorporate beryllium alloys are concentrated in the oil & gas drilling and production, heavy equipment bearings, plastic and metal forming moulds and electric resistance welding sectors as a result of the alloys' high strength, conductivity, corrosion resistance and ease of machining.

(3) Beryllium's classification as a strategic and critical metal by agencies in the US and in Europe is due to its range of military and defence applications.

Beryllium is used in the aerospace sector as an alloying agent in aluminium based structural metals because of its high thermal stability, thermal conductivity and low density. The majority of aerospace electronic connector terminals such as those used in electrical components for navigation, flight and engine control systems are copper beryllium alloys, used to provide the high reliability and user safety that is essential for commercial and military flight operations.

The metal's commercial aerospace applications often overlap with many of the military applications, such as those found in satellite structural, observation and

launching systems, as well as aircraft landing gear, brake and flight control bearings.

(4) Due to its low density and atomic mass, beryllium metal foil is relatively transparent to x-rays and ionizing radiation, making it a key component in the construction of x-ray source windows for X-Ray, CT-Scan and other medical uses.

(5) A potential demand for beryllium lies in commercial nuclear power generation. Research has shown that adding beryllium oxide to uranium oxide works to cool the fuel pellet, which allows it to operate at lower temperatures, expanding its lifetime.

High-tech loudspeakers and beryllium

Professional-grade speakers made with beryllium metal diaphragms

Beryllium outperforms aluminium and titanium

Thanks to its high stiffness-to-mass ratio, beryllium outperforms both aluminium and titanium by reducing mechanical deformation and shifting resonant frequencies outside the audible range.

The audio frequency at which the first distorting waveform break-down occurs in any metal is analogous to the speed of sound through that metal. The speed of sound through beryllium is nearly 2.5 times faster than that of aluminium and titanium which means that the first break-down will occur at a much higher frequency - often outside the human audible range.

Consequently, beryllium diaphragms offers the potential to advance loudspeaker performance beyond today's conventional solutions, and they are the premium choice for both pop concerts and concert hall classical performances.

The BeST website keeps you informed with a 'Latest news' section, where readers can follow the latest news and features on beryllium.

The new section complements the wealth of information already on the site, on issues such as environment, health and safety.

Get the latest news on BeST online

http://www.beryllium.eu

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https://www.facebook.com/beryllium.science

Photos of events organised by BeST can also be found on our Facebook page.