BeST
Beryllium Science & Technology Association

Quarterly Newsletter

Winter Issue – January 2018

Dear Valued Readers

Welcome to the winter edition 2018 of the Quarterly Newsletter.

The Beryllium Science and Technology Association (BeST) is a non-profit organization based in Brussels.

BeST represents the suppliers of Beryllium in the EU market, as well as traders and industries who rely on the unique properties of beryllium to design for miniaturisation, energy conservation, greater reliability and longer product life.

It aims to promote sound policies, regulations, science and actions related to the use of beryllium and to serve as an expert resource for the international community on the benefits and criticality of beryllium applications

Our mission is to provide the best available scientific information related to Beryllium, and to ensure that its benefits to society in critical applications are realised and embraced and maintained by industry, governmental authorities and the general public. It is also the objective of BeST to promote good practices in the workplace, in order to protect workers handling beryllium containing materials. BeST has developed a specific Product Steward Program, Be Responsible, accessible at www.berylliumsafety.eu.

BeST would like to thank you all for the great support showed during the entire year.

We look forward to cooperating with all of you, once again.

Season's greetings and best wishes for 2018!

Kind regards
Dr. Andreas Köster
Chairman of BeST

Content

Be Responsible Program in five different languages

The Voluntary Product Stewardship Programme is accessible at www.berylliumsaftey.eu

BeST publishes the **Be Responsible** Product Stewardship Program documents in English, French, German, Italian and Spanish.

Be Responsible is the voluntary product stewardship programme launched in March 2017 by BeST, in an effort to advance the science of beryllium health and safety in particular on the work floor.

BeST's Beryllium Safety Bulletins briefly describe the potential health hazards associated with the exposure to beryllium on the work floor, the main sources of exposure and the control measures that should be implemented in order to minimise such exposure.

Manufacturers and distributors of beryllium products can use the product specific Safety Information Sheets that provide environmental, health and safety guidance that should be read and understood before working with alloys containing beryllium in order to identify the sources of exposure and reduce the potential risks they present for workers.

In order to raise awareness and guarantee the implementation of the Be Responsible program on behalf of employers and workers, BeST has published the Be Responsible Program in English, French, German, Italian and Spanish.

Employers and workers can now understand the potential health hazards associated with the exposure to beryllium and the adequate measures to implement to reduce such exposure in their own language and help disseminate such knowledge in their countries. Three general guides (Health & Safety, Exposure Assessment, and Personal Protective Equipment & Hygiene) but also nine specific guides by operation are now available in the main European languages.

Please find the **Be Responsible** Product Stewardship Program in your own language here

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BeST can also be found on Facebook. 'Like' the page and be notified when there is news from our association.

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

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

New Critical Raw Materials list – Beryllium confirmed as a CRM

Photo: European Commission in Brussels

On 13 September 2017, the European Commission published its new 2017 list of Critical Raw Materials (CRMs) – Beryllium is, once again, included as a critical raw material.

The Raw Materials initiative was put forward in 2008 to tackle the challenges related to the access to raw materials. The primary purpose of the list is to identify the raw materials with a high supply-risk and a high economic importance for the European Industry.

The new list features 27 critical raw materials and is the result of a third assessment conducted by the European Commission – the two previous lists were published in 2014 (20 CRMs) and in 2011 (14 CRMs).

Following the recommendations contained in the 2014 Report of the Ad hoc Working Group on defining critical raw materials, the third assessment was conducted based on a refined methodology which includes parameters such as economic importance, supply risk, trade and substitution.

The 2017 criticality assessment was carried out for 78 raw materials and the current list includes nine new raw materials (Baryte, Bismuth, Hafnium, Helium, Natural rubber, Phosphorus, Scandium, Tantalum and Vanadium) while Chromium, Coking Coal and Magnesite were not deemed critical based on the 2017 assessment. However, Coking Coal is maintained on the list as a borderline case given that it narrowly misses the economic importance threshold.

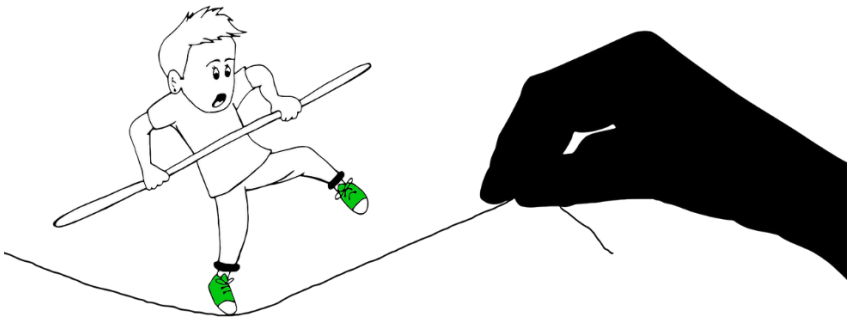
Beryllium is a critical raw material for the EU and was also included in the past lists published by the European Commission. BeST recalls that over-restrictive regulations for Beryllium would be contradictory with its status of Critical Raw Material. BeST is pleased that authorities seem to take more and more into account the criticality of raw materials in their assessments. For beryllium,

2017 List of Critical Raw Materials:

1. Antimony - Chemical symbol Sb - principle ore mineral is stibnite
2. Baryte – naturally occurring barium sulphate mineral (BaSO4)
3. Beryllium - Chemical symbol Be – very low atomic number (4) - naturally occuring element – very light grey metal with unique characteristics found in minerals such as bertrandite and beryl
4. Bismuth - Chemical symbol BI - naturally occurring element in the minerals bismuthinite (sulfide), bismutite (carbonate) and bismite (oxide)
5. Borate - Naturally-occurring mineral containing Boron (B)
6. Cobalt - Chemical symbol Co - relatively abundant metal element which is almost always found in combination with other naturally occurring minerals
7. Indium - very soft, ductile and malleable silver metal. It is very abundant in host metals such as zinc, lead, tin and cooper
8. Coking coal - is a fossil fuel
9. Fluorspar - commercial name for the naturally occurring mineral fluorite, composed of calcium and fluorine (CaF2)
10. Gallium - Elemental gallium (chemical symbol Ga) does not occur in free form in nature, but as the gallium compounds that are in trace amounts in zinc ores and in bauxite

"critical" does not mean "scarce" but overall "strategic" for the European economy, innovation, and defence.

Finding the Optimal Balance Between Protection and Feasibility



BeST publishes its "Benchmark Occupational Exposure Limits (OEL) at a glance" which features the OELs for Beryllium and Beryllium compounds currently applied in EU and Non-EU countries. The OELs are expressed in 8-hour Time-Weighted Average (TWA) – inhalable fraction – according to BeST information. This table illustrate the current very large range of OELs from the absence of OEL to extremely low OELs close to the natural occurrence of beryllium (SCOEL recommendation). For each value, brief comments are provided on the challenges concerning its implementation and on the associated risks of Chronic Beryllium disease, according to BeST survey conducted in 2015.

This benchmark confirms at a glance that the best balance between protection of workers and technical and economic feasibility is at 600 ng/m3, recommended by BeST and also by the Advisory Committee on Safety and Health at work ACSH.

Download the benchmark here

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

11. Germanium - Chemical element with symbol Ge and atomic number 32 - is a brittle, silvery-white metal

12. Hafnium - Chemical element with symbol Hf and atomic number 72 - it is a hard and ductile metal

13. Helium - Chemical element with symbol He and atomic number 2 - is a colorless, odorless, tasteless, non-toxic, inert, monatomic gas

14. Magnesium - chemical symbol Mg - is the eighth most abundant metal comprising 2.1% of the earth's surface

15. Natural graphite - chemical symbol C - is one of the purest and most crystalline forms of carbon.

16. Natural Rubber - a biotic material which is harvested from rubber trees, mainly growing in tropical forests close to the equator.

17. Niobium – Chemical symbol Nb, formerly known as Columbium (Cb), is a soft, silvery transition metal.

18. Phosphate Rock - formed in oceans in the form of calcium phosphate, called phosphorite. The phosphorus is an essential element for life and cannot be replaced

19. Phosphorus – used to produce fertilizers, animal feed, food, industrial applications and pharmaceutical product

20. Scandium - Chemical symbol Sc - is a silver-white light transitional metal

A BeST representative speaks at the CRM Day on Critical & Strategic Materials – A Global Perspective

On 26 September 2017, the second bi-annual event on Critical Raw Materials took place. The event, entitled: "Critical and Strategic Materials – A Global Perspective", gathered interested stakeholders, government representatives and EU officials to discuss the different perspectives and approaches to critical and strategic materials in the global context. The event featured two panels respectively dedicated to the European perspective and the international perspective towards critical and strategic materials.

Following a brief opening by CRM Alliance President, Martin Tauber, the newly appointed European Commission Head of Unit for Research Efficiency and Raw Materials (DG GROW), Peter Handley, outlined the latest developments on CRMs, notably the new CRM list, which Mr. Handley described as essential for a low carbon economy, for trade and for the defence industry.

EU Sector wants more investments in primary supply

The first panel session addressed the European prospective towards critical and strategic materials.

The EU is addressing the issues concerning critical and strategic materials through the umbrella of the Raw Materials Initiative, the Critical Raw Materials list, and several projects connected to CRMs: SCRREEN, CRM-InnoNet, Raw Materials Week, Raw Materials Database and other H2020 projects. The Commission's latest CRM list was published in September 2017.

Beryllium continues to be included in the list of critical raw materials.

In addition to the EU approach, Member States also implement national approaches towards critical raw materials. In particular, France has adopted a innovative approach towards critical and strategic materials with aim of (i) creating tools to help companies be more efficient in their use of raw materials, (ii) identifying where there is a risk of supply of a critical raw material and cooperate with the relevant administration to solve the issue; and (iii) fostering dialogue between upstream and downstream users.

21. Silicon metal - Chemical symbol Si - in its pure form, is a grey metallically lustrous metalloid element

22. Tantalum - Chemical symbol TA - is a silver-grey hard transitional metal

23. Tungsten - Chemical symbol W - also known as wolfram, is a shiny, silvery-white metal

24. Vanadium - Chemical symbol V - is a steel-grey, shimmering and ductile metallic element

25. Platinum Group Metals – comprises six (6) PGMs: palladium (Pd), platinum (PT), rhodium (Rh), iridium (Ir), osmium (Os), ruthenium (Ru)

26. Heavy Rare Earth Elements – describes 17 different elements which have a unique set of properties that makes them very difficult to substitute

27. Light Rare Earth Elements - describes 17 different elements which have a unique set of properties that makes them very difficult to substitute

"There is still a lack of social acceptance of mining operations" Kay Lax, Head of Department of the Geological Survey of Sweden.

In Sweden, the former government had actively developed a minerals strategy and the current government is building upon the work of the previous administration

In the EU, there are no mining activities concerning Beryllium.

Less structural approach in non-EU countries

The second panel session focused on the approach towards critical and strategic materials adopted by non-EU countries. In particular, the approaches of Greenland, USA and Japan were discussed.

In Greenland, the 2008 recession had a strong impact on the mining activity. However, mining activity is starting to resume and redevelop.

Photo: Mr. Maurits Bruggink, Secretary General of the Critical Raw Materials Alliance

In the US, the first CRM policy request was presented in the 1950s, and the last request in 2016, without any outcome yet. In 2010 and 2011, the Department of Energy issued two Critical Materials strategy reports focused on the risk of supply disruption for materials necessary for renewable energy, with the OSTP (Office of Science and Technology Policy) publishing a report on natural resources and critical raw materials prepared in March 2016 which contains a screening method for potential supply constraints of individual critical materials. Whilst both the Obama administration and the Trump administration remain concerned about potential supply disruption, no formal policy or legislation has been adopted.

"From a US industrial perspective, policies that restrict access or the use of CRMs are not in the interest of the US and it can be expected that minerals mined and processed in the US and which fall on a list of CRMs could become eligible for most-favoured status in the Trump Administration" Dr. Stephen Freeman of the Beryllium Science and Technology Association.

CRMs, in Japan, are defined as rare metals. Japan is heavily reliant upon imports of rare metals from third countries, especially as the Japanese economy is dependent upon electronics, where many rare metals are used, and the competitiveness of Japanese industry is founded on the production of high-tech technologies. Japan's strategy for securing mineral resources consists of four pillars: (i) securing mineral interests; (ii) recycling; (iii) substitute development; and (iv) stockpiling. Moreover, Japan also participates in the EU-Japan-US trilateral conference on critical materials, the last of which took place in November 2016.

The next generation of power electronics featuring Gallium Nitride doped with Beryllium

Photo by Hanna Koikkalainen - Sample chamber of the positron accelerator

Physicists at Aalto University have made a breakthrough in revising methods largely discarded 15 years ago. Scientists discovered a microscopic mechanism that will allow gallium nitride semiconductors to be used in electronic devices that distribute large amounts of electric power by using beryllium atoms in gallium nitride.

Gallium nitride is a compound widely used in semiconductors in consumer electronics from LED lights to game consoles. To be useful in devices that need to process considerably more energy than in your everyday home entertainment, gallium nitride needs to be manipulated in new ways on the atomic level.

"*There is growing demand for semiconducting gallium nitride in the power electronics industry*" said Professor Filip Tuomisto from Aalto University

To make electronic devices that can process the amounts of power required in, for example, electric cars, structures based on large-area semi-insulating semiconductors with properties that allow minimising power loss and can dissipate heat efficiently are needed. To achieve this, adding beryllium into gallium nitride – or 'doping' it – shows great promise.

Experiments with beryllium doping were conducted in the late 1990s in the hope that beryllium would prove more efficient as a doping agent than the prevailing magnesium used in LED lights. The work proved unsuccessful, however, and research on beryllium was largely discarded.

Researchers at Aalto University have now managed to show – thanks to advances in computer modelling and experimental techniques – that beryllium can actually perform useful functions in gallium nitride. Depending on whether the material is heated or cooled, beryllium atoms will switch positions, changing their nature of either donating or accepting electrons.

If the beryllium-doped gallium nitride structures and their electronic properties can be fully controlled, power electronics could move to a whole new realm of energy efficiency.

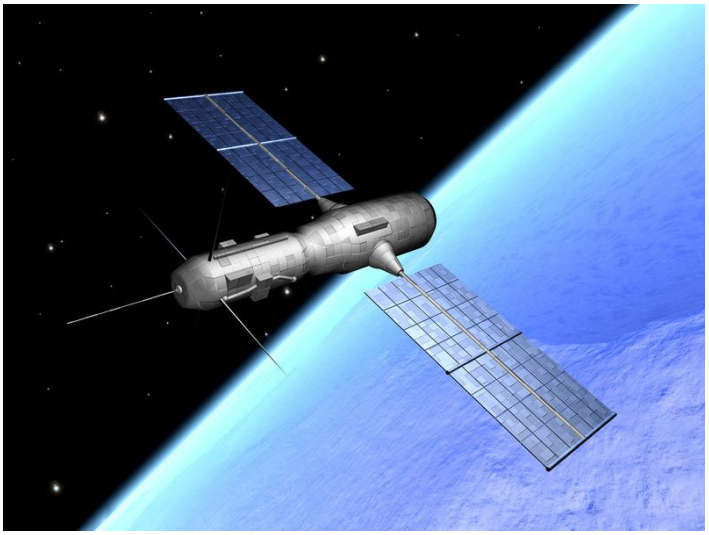


Photo: Satellite

Beryllium is the ideal material for manufacturing gyroscopes

Beryllium is a material with special properties, many of which irreplaceable.

Three major excellent qualities of beryllium make it quickly replace steel, titanium, aluminum and other metals, becoming the ideal material for manufacturing gyroscopes

First, the thermal conductivity of beryllium is 3 times that of steel, and 5 times that of copper, and its thermal expansion coefficient is less than half of that of magnesium. The high-speed rotating rotors in the gyroscope will produce a lot of heat and good thermal conductivity allows the heat to be evenly distributed on the gyro to reduce the internal stress of the gyroscope.

Second, the density of beryllium is one-third that of titanium, two-thirds that of aluminum alloy, while the elastic modulus is 3 times, 5 times and 7 times that of titanium, aluminum and magnesium, respectively. Its specific strength is 1.7 times that of aluminum alloy, 2.1 times that of magnesium alloy, and 1.5 times that of steel. By using Beryllium, the gyroscope's skeleton can become stronger while being lighter. Changing the structure of a three-level missile's inertial navigation system to beryllium metal can reduce the weight of the system by a few kilograms, thereby significantly reducing the burden on the overall missile system from the missile control system.

Third, beryllium has great stability. If there is a deviation of 1% micron in the center of mass of gyro rotor, it will cause hundreds of meters of deviations for long-range missiles. The shape of beryllium metal can be stably maintained as it can quickly restore to its original shape even after the effect of very large stress. The antioxidant capacity and corrosion resistance of the beryllium shell without any surface treatment even surpass those of stainless steel materials that have been through multiple anti-corrosion treatments.

The application of beryllium is mainly concentrated in nuclear industry, weapons systems, aerospace industry, X-ray instrumentation, electronic information systems, automotive industry, household appliances and other fields. However, with the deepening of research, its range of application has a tendency to expand.

Earphones with Beryllium Technology Offering the Highest Sound Quality for Music Lovers achieve a higher success than predicted

More than 200 singers and producers invest more than $25,000 to bring their music to life, supporting a new, straight-from-the-studio sound technology that provides superior acoustic sound and enhanced hi-fi qualities for audiophiles.

Earphones with beryllium technology deliver high-fidelity audio by harnessing the technology of Beryllium (represented as Be4 on periodic table), which is the fourth-lightest metal element and four times stronger than steel.

The results obtained by these earphones have been higher than those expected. According to the CEO of the company producing these earphones, the Beryllium-based earphone design produces a more coherent, powerful sound. The earphones allow the users to listen to the pure quality of the music, as it was mastered in the recording studio, with no software effects that enhance or interfere with the audio sound. The result is crisp, hi-fi sound quality that puts the listener directly in the studio or in the front row of the concert.

These earphones are built by hand using the highest quality materials like CNC Aluminum Casing and natural dark wood casing, with each pair going through frequency and distortion testing to ensure all pass quality control before shipping it out. They are very different from many other earphones on the market today that are constructed with plastic parts, cheap diaphragms and other cheap material – resulting in muddy sound and distorted music at higher volumes.

The earphone Beryllium Dynamic Driver is capable of reproducing sounds with details as well as providing a balance between bass, mid-range and high notes on the scale. With lively and vivid sounds, users will surely enjoy their musical experience.