Multi-Stakeholder Platform for a Secure Supply of Refractory Metals in Europe

FACTSHEET

REFRACTORY METALS IN SOCIETY

WHAT ARE REFRACTORY METALS? WHAT ARE THEIR UNIQUE CHARACTERISTICS?

Refractory metals (Tungsten, Tantalum, Rhenium, Molybdenum and Niobium) are highly strategic metals that are mainly characterised by certain common physical properties: high melting points (above 2000 °C), high densities, special electrical properties, inertness and, most importantly, their ability to confer, through small additions to steel and other metals, exceptional enhancement to the metals' physical performance.

WHAT ARE THEIR MAIN APPLICATIONS?

Refractory metals are used in many applications of varying grades. Among the most important applications are:

- **The automotive industry:** mainly used as components of steel, stainless steel and high-strength low-alloy steels,
- **Aeronautics:** aerospace superalloys for aircraft engines and gas turbines
- **Structural:** machinery, bridges, railways, petrochemical and power plants, electricity generation, particle acceleratoRs, radiation shielding
- **Gas and Oil:** pipelines
- **Medical devices:** optic lenses, camera lenses, magnetic resonance imaging equipment,
- **Hard tools:** industrial high-speed cutting tools, knives, drills and circular saws
- **Jewellery**
- **Electronics:** capacitors, cellular and wireless telephones, television sets, video recorders, tire pressure controllers and keyless entry systems, fluorescent lighting, light bulbs, cathode-ray tubes, vacuum tube filaments, heating elements, rocket engine nozzles, electron microscopes
- **Chemicals:** catalysts, lubricants, petrochemicals

WHICH OF THE APPLICATIONS ARE MOST COMMON IN OUR EVERYDAY LIVES?

Society at-large is in daily contact with:

- Hard tools, such as knives and dental drills.
- Ballpoint pens.
- Energy saving lamps: in the form of wires, coils, or electrodes.
- Transport: in car window heating systems, in car lighting, in vibration damping measures, horn-blowing mechanisms, transport emissions.
- X-ray machines.
- High-tech clubs and balls (improves stability and performance).
- Watchcases.
- Electric locomotives.
- Professional darts (stabilizes trajectory).
- Vibration alerts in mobile phones.
- Filaments for lamps.
- Balancing flaps and aileron in modern airplanes.

In the case of Niobium:

- Jewellery, to which it is added because of its resistance to ambient factors.
- Magnetic Resonance Imaging, used for cancer diagnostics.
- Optical lenses.
- Bridges, railways, constructions where steel is added.

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For Rhenium:

- Planes (added to engines parts).

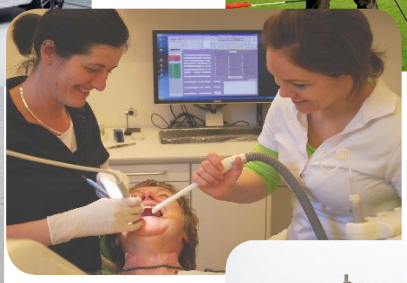
Tantalum can be found in:

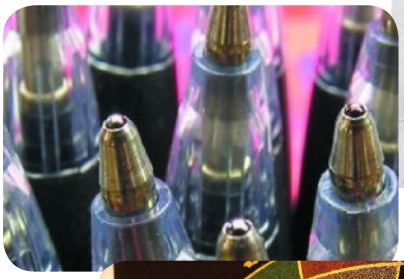
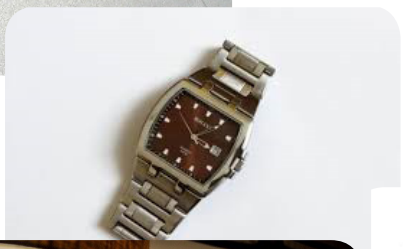
- In electronic components (the main application of Tantalum) in the form of metal powder and chiefly used in the manufacture of capacitors, which are key components of mobile phones and other communication systems, such as cameras, DVD players, GPS, desktop PCs, laptop PCs and furnaces.
- Automobiles: public transport vehicles, cars.
- Optical lenses: mainly in the form of Tantalum pentoxide, which is used in special types of glass (heat reflecting, high refractive index, low optical scattering).

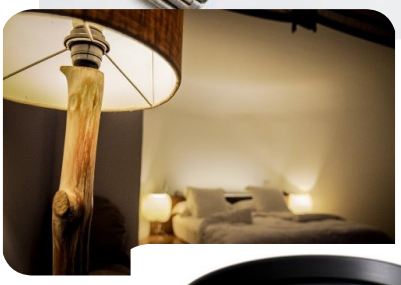
And, lastly, Molybdenum in:

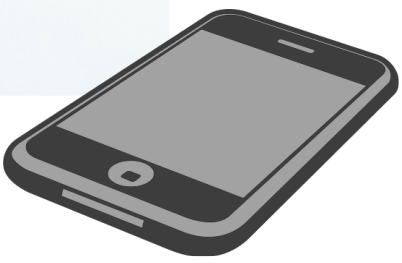
- Structures and other manufactured items made of steel (bridges, cars,...).
- Stoves and refrigerators.
- Pipelines.
- TV screens, computers and chemical sensors.



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ENVIRONMENTAL AND SOCIAL IMPACTS OF REFRACTORY METALS USE

As stated in the table below, Rhenium and Tantalum are the most environmentally unfriendly of the refractory metals, with higher potential for contributing to global warming, higher cumulative energy demand, and higher levels of terrestrial acidification. However, potential danger in terms of freshwater eutrophication and human toxicity are relatively low, as these metals are considered to be non-toxic.

Impact category	Ta	Re	W	Nb	Mo
Global warming potential (kg CO_2 eq / kg)	260	450	12.6	12.5	5.7
Cumulative energy demand (MJ eq / kg)	4,360	9,040	133	172	117
Terrestrial acidification (kg SO_2 eq / kg)	1.7	11	0.29	0.053	0.16
Freshwater eutrophication (kg P eq / kg)	1.5E-01	3.5E+01	9.3E-6	3.7E-03	0.54
Human toxicity (CTUh/kg)	1.2E-04	5.9E-02	3.4E-05	6.4E-06	9 E-04

Table 1. Comparison of Refractory Metals in Terms of Environmental Impact (Life Cycle Assesment of Metals : A Scientific Synthesys paper, Nuss P& Eckelman MJ 2014)

As with any other resource-extraction activity, the extraction of refractory metals may raise environmental and social concerns among the population at-large. Although these metals are not considered to be toxic, the following two activities could have potentially harmful effects on the environment:

1) Extraction activities of the ores from the mines, which may have an environmental impact on the local soil, fauna and vegetation. Dusts generated from extraction activities are also potential effects that should be taken into account.
2) Treatment and disposal after their use.

As there is very little production of refractory metals in Europe (Tungsten and Rhenium), the environmental impact of primary resources extraction is very limited in the the EU. Moreover, all mining activities be conducted in accordance with the regulations set forth in the European Directive 85/337/CEE on environmental impact assessment. By unlocking the potential of refractory metal production in Europe, more jobs would be created from metal mining to new refractory metal product markets. In addition, Directive 2006/21/EC provides several references for measures, procedures and guidance aimed at mitigating and reducing any adverse effects on the environment (water, soil, air, fauna, flora and landscapes) related to the management of extractive industry waste. One of the objectives of this directive is for member states to take the necessary measures to ensure that extractive waste is managed without endangering human health and without using processes or methods which could harm the environment. The uncontrolled disposal of extractive waste must also be avoided.

The reference document entitled Best Available Techniques for Management of Tailings and Waste-Rock in Mining Activities is based on ores that have the potential for significant environmental impacts. In this document, only Tungsten is included among the refractory metals. Alternatively, the document known as Best Available Techniques Reference Document for the Non-Ferrous Metals Industries is focused on secondary metal sources. Among the identified metals, only FeMo is included among the refractory metals. In case of treatment and disposal of refractory metal end-of-life products, recycling is the best way to ensure no environmental impact, paving the way for the circular economy approach and the zero-waste concept.

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