MSP REFRAM

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

FACTSHEET

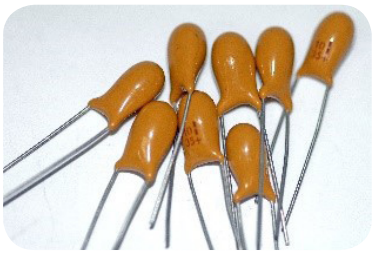
REFRACTORY METALS IN EU

WHAT ARE THE REFRACTORY METALS? WHAT ARE THEIR SINGULAR CHARACTERISTICS?

Refractory metals (Tungsten, Tantalum, Rhenium, Molybdenum and Niobium) are highly strategic metals. They are mainly characterised by certain common physical properties: a high melting point (above 2000 °C), high density, special electrical properties, and inertness, especially as regards their ability to improve, even with small additions, the physical performance of steel and other metals.

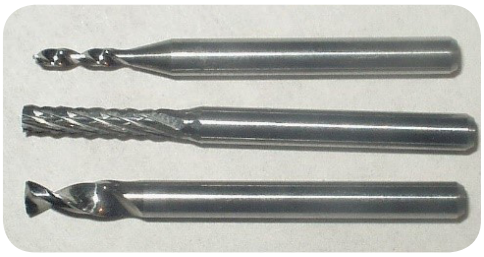
MAIN USES AND FUTURE USES

These metals are highly strategic in the aircraft industry as well as in the energy industry, as they are critical components of the very sophisticated super-alloys used to design and manufacture the components of the hot parts of aircraft and gas turbines. They are also important in corrosion resistant steel for extreme environments, tools, lubricants, and catalysts. The main applications are:



Tantalum
Capacitors

Rhenium
Aerospace super-alloys



Tungsten
Tungsten carbide for hard materials

Molybdenum & Niobium
Steels: Automotive, Gas Pipeline and Structural applications

EU DEMAND AND MARKET (2015)

EU demand on refractory metals is high mainly due to the steel production and aeronautic industry. The EU has many steel producers, two of which are at the top list of worldwide steel producers: ArcelorMittal (Luxembourg) and

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ThyssenKrupp (Germany). Steel production is the main application of refractory metals such as Niobium (Ferro-Niobium) and Molybdenum. For example, the total FeNb import figure for Europe in 2015 was 25219 tons, 32% of total production. The aeronautic industry is a final end-user of all refractory metals, mainly Re, which is added to aerospace industry super-alloys. Airbus France is the second-biggest aerospace manufacturer in the world, with BAE Systems (UK), Safran group (France) and Rolls-Royce Holdings also among the top aerospace manufacturers.

The extraordinary properties of refractory metals, the unlikeliness of their being replaced in the near future by other materials, the improving EU economy, electronics development and the use of refractory metals in this industry, among other factors, will all contribute to a continued high demand for refractory metals in the EU.

Metal	Form	Trade Flow		Production (tons)
		Import (tons) Value (US m$)	**Exports (tons)** Value (US m$)	
Mo	Ores &concentrates	119,824 ~1035	54,932 ~441.6	~0
Re*	-	-	-	7.6 (Poland,2014)
Nb	FeNb	25,771 ~513	5,658 ~100	~0
Ta	Unwrought Ta	225.7 ~80	222 ~369	
	Ta waste&scrap	250.7 ~40,3	167 ~15	
W	Ores &concentrates	4,214.8 ~65	3,720.6 ~36.7	2,830
	FeW – FeSiW	3,647.7 ~97	1,897 ~42	
	Waste and Scrap	6,627.3 ~103.3	6,662.5 ~120.6	

EU market (2015, data from UN Comtrade | International Trade Statistics Database)

*Rhenium products and wastes are reported in the same categories along with other metals such as niobium, so it is not possible to estimate rhenium content for these flows.

Main EU importer countries of Refractory Metals:
Germany, France, Italy, Sweden, Belgium, UK, Netherlands, Spain, Austria

Main EU exporter countries of Refractory Metals:
Germany, France, Italy, Sweden, Belgium, UK, Netherlands, Spain

WHERE DO THEY COME FROM?

With the exception of Rhenium, these metals are mainly imported from China (W, Mo, Ta), Brazil (Nb, Ta), Chile (Mo, Re) but also from the USA, Canada, etc. European primary production is only a small percentage of the global production of these metals, with only Rhenium being produced in significant amounts in the EU (Poland accounted for 15% of total world production of it in 2013), as well as Tungsten, which is produced in Austria, Spain and Portugal (total EU production represents about 2.7% of total world production).

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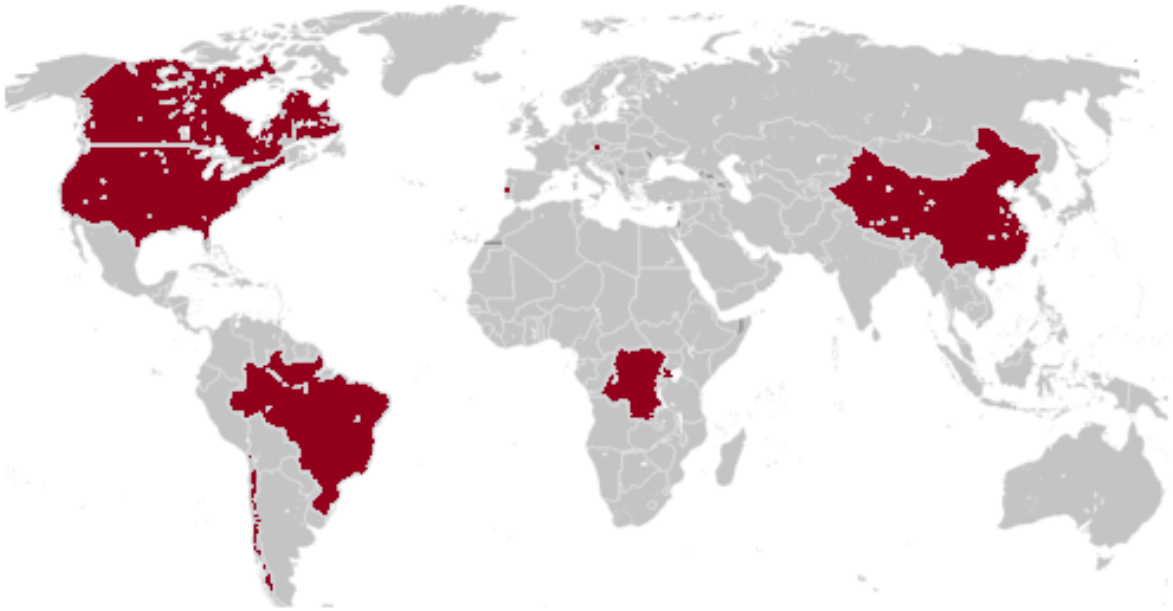

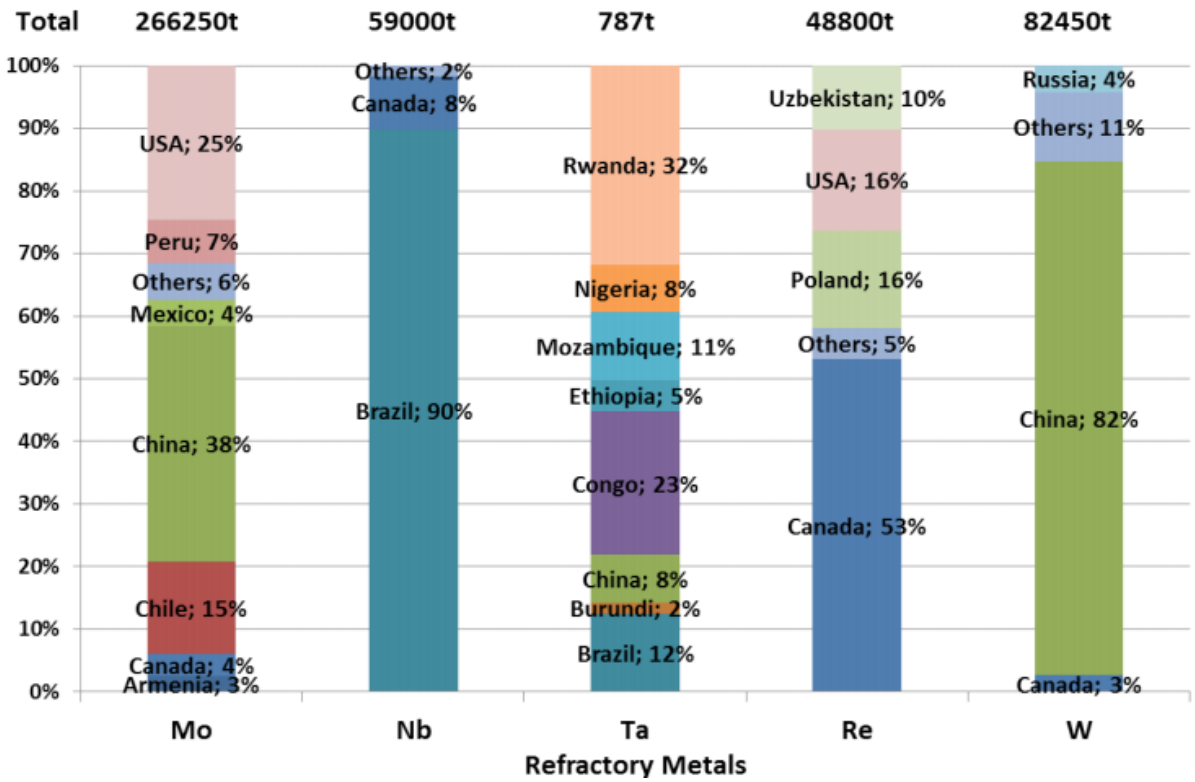

Although refractory metal resources exist in Europe, they are too insufficient to be considered primary resources. There are, however, many secondary resources available: mine tailings, sludges, dusts, scraps, end-of-life vehicles, spent electronic devices, steels, etc.

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SUBSTITUTION POSSIBILITIES

A secure and sustainable supply of raw materials has been identified as an important issue for the European economy and substitution is seen as one possibility for improving the raw materials supply chain in Europe. To address the problem of reduced functionality resulting from certain applications, refractory metals in general can be substituted by:

- Tantalum: Glass, Nb, Pt, Ti, and Zr could be used to replace Ta in corrosion-resistant equipment and Hf, Ir, Mo, Nb, Re, and W in high-temperature applications. Aluminium and ceramic capacitors offer substitutes for Tantalum.
- Niobium: Ti and Va in HSLA steels; Mo, Ta and Ti in stainless steel; Mo, Ti, Ta or Ceramic Matrix Composites (CMCs) in Va-Ga super-alloys, as superconductors.
- Rhenium: CMCs as superalloys for high-pressure turbines
- Molybdenum: B, Cr, Nb, V, W, Ta, Ni-Co alloys. Mo2NiB2 are possible alternatives for wear-resistant hard materials such as WC.
- Tungsten: Can be substituted with tool steel, ceramics, MoC, NbC, TiC in cemented carbides, Mo alloyed with Cr, Va and Ni in tool/high-speed steels, Mo, CMCs in super-alloys, or Carbon Nanotube filaments as mill products.

SOCIAL AND ENVIRONMENTAL IMPACTS

As with any other resource-extraction activity, the extraction of refractory metals may raise public concerns about its environmental and social impacts. These metals are not toxic, so the two main concerns in terms of how they may affect the environment are:

- The extraction source in the case of primary sources: environmental impact to soil, fauna, vegetation, noise and dust.
- The manner in which the metals are handled and disposed of after their use.

As there is very little production of refractory metals in Europe (Tungsten and Rhenium), the environmental impact related to primary resources extraction is quite limited in the EU. Moreover, all mining activities must fulfil the requirements set forth in the European Directive 85/337/CEE concerning environmental impact assessment. By harnessing the potential of refractory metal production in Europe, more jobs would be created from metal mining to new markets related to refractory metal products. Moreover, the Directive 2006/21/EC provides several references for measures, procedures and guidance to reduce any adverse effects on the environment (water, soil, air, fauna, flora and landscape) stemming from extractive industry waste management issues. One of the objectives of this directive is that Member States 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. Moreover, the uncontrolled depositing of extractive waste must be avoided. The reference document entitled “The Best Available Techniques for Management of Tailings and Waste-Rock in Mining Activities “is based on ores that have a potentially significant environmental impact. In this document, only Tungsten is included among the refractory metals. Another publication, “The 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.

[1] *European Commission – Reference Document on BAT for Management of Tailings and Waste-Rock in Mining Activities – January 2009*

[2] *European Commission – BAT for the Non-Ferrous Metals Industries – October 2014*

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