Niobium as a strategic metal for Brazil

Carlos C. Peiter
Centro de Tecnologia Mineral-CETEM
Brazil
Recent report to EU Brazil Sectoral Dialogues Program

Study on critical materials production chains: opportunities and threats of the circular economy

Partnerships:

- Brazilian research institutions CETEM, IBICT, EESC-USP
- European research/academic institutions: JRC/EC (Ispra, IT) and INAB/ Aachen University (GER)
- Brazilian Company CBMM (cooperation agreement) and Ministry for S, T &I Brazil (additional funds)

Critical raw materials origin or market leadership
EU’s critical raw materials list 2020

Source: Study on EU’s list of critical raw materials 2020, JRC/EC
Brazilian share in some ores/metals world production

Brazilian share in world 10 important ores or metals production

- Nióbio (contido): 93.4%
- Minério de Ferro: 16.4%
- Tântalo: 12.9%
- Vermiculita: 12.0%
- Talc e Pirofilita: 9.8%
- Grafita Natural: 8.7%
- Bauxita: 7.7%
- Manganês (contido): 7.6%
- Alumina: 6.8%
- Magnesita: 6.1%
- Estanho (contido): 4.8%

Source: Boletim do setor mineral 2020, MME, Brazil
Why is Niobium important?
Steels for pipelines, structural steels, superalloys, superconductors

- Steel for pipelines
- Superconductors (e.g., CERN Particle accelerator Large Hadron Collider, 27 Km long)
- Photos available at internet sites
Why is Niobium important?

Under development Nb/Ti oxides anodes for lithium ion batteries
Is Niobium a rare metal?

48 Nb minerals mines/deposits/occurrences in all continents but strategic for Brazil that operates the higher Nb content mines
Main niobium producing companies

<table>
<thead>
<tr>
<th>Company</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBMM</td>
<td>Ferroniobium, Vacuum Grade FeNb and NiNb, Oxides: high purity, optical grade, niobic acid (HY-340) and ammonium niobium oxalate (ANO), Niobium metal: reactor-grade, commercial-grade, RRR superconductor grade, and niobium zirconium</td>
</tr>
<tr>
<td>NIOBRAS</td>
<td>Ferroniobium</td>
</tr>
<tr>
<td>Niobec</td>
<td>Ferroniobium</td>
</tr>
<tr>
<td>TRBOCA</td>
<td>Ferrotantalum &amp; Ferroniobium</td>
</tr>
</tbody>
</table>

Source: Study of critical materials' production chains: opportunities and threats of the circular economy
Niobium a strategic metal for Brazil

MFA for FeNb

Source: Study of critical materials’ production chains: opportunities and threats of the circular economy

UNECE
Ferroniobium MFA
Flow details for FeNb (steels) for transportation

Source: Study of critical materials’ production chains: opportunities and threats of the circular economy

UNECE 

RESOURCE MANAGEMENT WEEK 2021 | ENABLING SUSTAINABILITY PRINCIPLES IN RESOURCE MANAGEMENT | 26-30 April 2021 | Geneva
Niobium circularity is low

0.14 for generic Nb and 0.11 for Nb in steels for transportation based on EU mass flow analysis (Deloitte, 2015)
Science and Innovations

Results from 4,953 papers sample and from 3,092 patents sample collected 2013-19
Steel making and metallurgical use higher shares and energy applications growing

Percentage of scientific papers by application (2013 – 2019)
- Anode: 29%
- Cathode: 23%
- Stainless: 8%
- Alloy: 13%
- Steel: 6%
- Sensor: 4%
- Capacitor: 3%
- Superconductors: 3%
- Electrode: 2%
- Catalyst: 1%

Percentage of Patents per application (2013 – 2018)
- Anode: 42%
- Cathode: 5%
- Stainless: 3%
- Alloy: 7%
- Steel: 3%
- Sensor: 3%
- Capacitor: 0.10%
- Superconductors: 8%
- Electrode: 1%
- Catalyst: 2%

Source: Study of critical materials’ production chains: opportunities and threats of the circular economy
Niobium Science and Innovations

Patent applicants by countries’ origin

Percentage of Patents by country (2013 - 2018)

Brazilian R&D on Niobium is raising and more related to extractive metallurgy. Federal Gov will establish a new Research Lab. For Niobium and Graphene materials.

Source: Study of critical materials’ production chains: opportunities and threats of the circular economy.
Niobium sustainability indicators
FeNb LCA and S LCA results

Source: Study of critical materials’ production chains: opportunities and threats of the circular economy
Why is Niobium strategic for Brazil?

Some very good reasons

1. Very large amount of available minerals resources with high niobium content

2. National and international companies operating mines and metallurgical units in Brazil at high level production standards

3. A promising future due to innovations developed and under development in many countries (many with Brazilian companies partnership)

4. Important contribution to sustainability improving energy and materials conservation (while planning on how to improve circularity)

Source: Study of critical materials’ production chains: opportunities and threats of the circular economy
Thank you!

cpeiter@cetem.gov.br