Rare Earth Elements: Building a Best Practices Roadmap to Sustainable Mining

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Outline

• Introduction
• Stream Mapping of the Production Process
• Identification of Stakeholders
• Hazards and Vulnerabilities
• Summary and Conclusions
Introduction

Relevant importance of REEs in terms of: trade, number of initiatives, number of geopolitical events/reports, and level of REEs mitigation

- China is considered a dominant player in REEs world production
- The US, EU and Japan are the major importers of Chinese REEs
- The main end uses of REEs include the energy and defense sectors.
- Applications of REEs may provide low cost / energy efficiency.
- A significant number of initiatives & critical geopolitical events/reports related to REEs have been identified since 2010.
- The mitigation techniques of REEs are rare and/or impossible and/or in preliminary status and/or suffers by a number of constraints.
Mining of REEs: two attributes

- Presence of Thorium and/or Uranium: Unwanted radioactivity
- 15 different elements: Uncommon to find identical REEs ores
Stream Mapping of the Production Process

Limited info due to:

- China dominant player: lack of data for production process
- Illegal mines – smuggling (1/3 of total Chinese exports)
- Mining sector of REEs in other industrialized countries did not exist until recently
Stream Mapping of the Production Process

Figure 1: Main process steps in REEs mining processing. Figure was obtained from (EPA, 2011).

Figure 2: Flowchart depicting the REEs refining process. Figure was obtained from (Oko-Institut, 2011).
Stream Mapping of the Production Process

- The scope of stream mapping is to only provide the big picture and is not focusing in detailed pieces of the processes.

- The mining processes of REE ores does not differ from any other hard rock mining processes.

- Deposits are mined by surface “open pit” mines and/or underground mines.
Identification of stakeholders

Main stakeholders in REEs production

Fishbone diagram representing the “effect” of each stakeholder to REEs production
Identification of stakeholders: Environment

- Mining of REEs is expected to be similar to any other hard rock mining procedures.

- "...except for the radio-activity of uranium and thorium the potential waste emissions would be comparable to a typical hard rock mine" (EPA, 2012)

- Special attention should be given to the radiation risk management.

- Other possible contaminants: barium, beryllium, copper, lead, manganese, zinc, sulfide minerals, carbonate minerals, fluorine and asbestos minerals.
Identification of stakeholders: Public (Society)

- Social License to Operate: an important asset
- It creates the necessary social agreement/“contract” between the mining company and the local-national-global society
- Public - two faces:
  1. a user/consumer of the final REE products (i.e., electrical cars)
  2. has the right to vote.
- June 2012: the issue of a new REEs processing plant in Malaysia became the main issue of the national Malaysian elections
Identification of stakeholders:

Employees

- Contribution of employees to the production of REEs: similar to any other hard rock mining operation

- Special consideration: Radiation
  - occupational safety and health,
  - training,
  - qualifications and responsibilities
Identification of stakeholders: Media

- Role of the media: negative and/or positive

- The positive effect: necessity, importance and linkage of REEs to green economy and to the stop-page of climate change

- The negative effect: distribution of “bad news” due to a probable mishap and/or environmental impacts.
Identification of stakeholders: Markets

Main factors:
- Dominance of China
- Demand, Supply, Price mix
- Export restrictions by Chinese government
  - Export quotas
  - Export taxes
  - Value Added Tax (VAT)
  - Production quotas
- Smuggling/Illegal mining
- Reluctant and/or lack of ESH regulations in China
- Strict ESH regulations in west countries
- Status of global economy/growth
- REEs are not traded through Market or Metal Exchanges
- (Geo)political aspects
- Substitution or REEs is rare and/or impossible and/or in preliminary status
- Limited recycling potential
Identification of stakeholders:
Governments/NGOs

• **Role of the government:**
  same importance as in any other hard rock mining process.

• Since 2010, a large number of REEs-related governmental initiatives - critical geopolitical events/reports

• Many commercial intergovernmental transactions related to REEs the last three years

• Politicians: are elected

• Governmental decisions are sensitive to public opinion, media and NGOs.

• Conflict of interests: governments - environmental NGOs - politicians

A challenging political environment
Identification of stakeholders: Mining Companies

- A challenged cost sensitive and competitive environment
- Strict regulatory frame
- Rule of thumb: Lean, environmental and sustainable management, ethical policies and transparent business rules
- Past experience (Molycorp ’90s):
  - combination of strict ESH regulations
  - low prices market environment
  - bad decision making
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- CO2 emissions  
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Public  
Mining company  
Media  
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Markets |
Summary & Conclusions

• The Stream Mapping of REE Production process includes:
  - the ore mining,
  - crushing grinding,
  - flotation,
  - chemical processing,
  - purification, and
  - manufacture

• The main stakeholders are:
  - the mining companies,
  - the environment,
  - the markets,
  - the public,
  - the governments/NGOs,
  - the employees, and
  - the media.
Summary & Conclusions (cont.)

• From the environmental perspective, mining of REEs is expected to be similar to any other hard rock mining procedures.

• Except for the radioactivity of uranium/thorium the potential waste emissions would be comparable to a typical hard rock mine.

• Media plays a major role as a stakeholder in REE production. The role of media would be negative and/or positive.

• Many factors affect the market of REE such as the dominance of China in REE production, the demand/supply/prices mix, the export restrictions, etc.
Summary & Conclusions (cont.)

- Several hazards exist at each process of REE production
  - air dust,
  - radiation,
  - CO2 emissions,
  - heavy metals/acids/fluorides to surface/groundwater/soil,
  - occupational safety & health hazards

- The effect of these hazards/vulnerabilities is expected to incorporate all stakeholders.
Thank you