Rare Earth Materials

A Q&A on the Rare Earth Material Situation in China and its Impact on US Manufacturing

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Q  What are “rare earth” materials and why are they important?

A  Rare earth metals are 15 rather obscure elements in the periodic table (called the lanthanides) plus two others with similar properties (scandium and yttrium). These metals and their oxides have very special and useful optical and magnetic properties. Rare earths are analogous to “vitamins” in food. While they tend to be used in small concentrations, their importance is quite significant. They are not that “rare”, but locations are relatively few where they are concentrated enough to be mined economically.

![Figure 1. Periodic table showing rare earth elements from Geology.com.](image)

Q  What are the uses for rare earth materials?

A  Rare earth materials are used in many more products than is generally understood. Their uses are almost too numerous to list, but the major uses include ultra strong magnets for electric motors, advanced batteries, and phosphors for fluorescent lighting and display panels (See Figure 2). Solid state laser systems, phosphors used in fluorescent lighting and plasma flat panel displays, optical fiber communications, and satellite communications all rely on rare earth materials.
Ultra strong (neodymium-iron-boron) magnets were discovered in the 1980s. More than twice as strong as previously known magnets, this touched off a revolution in miniaturizing electronic devices. Rare earth magnets lie at the heart of many of the consumer electronic products that have become so familiar in recent years, including: cell phones, laptop computers, small hard drives, and many personal electronic devices. Rare earth magnets are quite important to efforts to produce clean energy, especially wind turbines where large amounts of rare earth metals are used in the electric generator.

**Q** Are there important military defense uses too?

**A** Rare earths are essential for many military uses, including: missile guidance systems, lasers, and smart bombs; sonar and underwater mine detection; radar and antimissile defense; jet engines; laser range finders and targeting; electronic countermeasures; and satellite communication systems.
Q: Where do rare earth materials come from?

A: More than 97% of rare earths supplied to the world today are mined in China. Until about 10 years ago, the United States produced most of the world’s rare earths from Molycorp’s mine in Mountain Pass, Ca. However, price pressure from China and EPA compliance problems caused operations to close. Molycorp, now a much smaller company, is restarting operations, but will not be able to meet global demand, particularly for “heavy rare earths”, such as dysprosium and terbium, for the near-to-mid term.

Q: What’s the situation in China?

A: Control of rare earth supplies is a major part of China’s industrialization strategy and emergence as a world power. China has announced intentions to restrict the supply of rare earths (~11% in 2011). They have also cited concerns about exhausting their resources, supplying to the world, instead of using to support China’s rapid industrialization. Additionally, they stated they saw a need to slow production to address environmental concerns and to prevent “illegal” mining, which supplies up to 25% of Japan’s rare earths for the production of magnets -- raising concerns and tensions with Japan.

Environmental problems caused by rare earth mining in China need very serious attention. At the same time, China is pursuing policies of forcing manufacturers to locate operations in China to access rare earth supplies, and is actively growing their internal magnet production capability to compete with Japan. So, China is still shipping rare earths today, but increasingly those will be in the form of higher value products instead of raw materials. This situation has touched off a scramble among industrialized nations, particularly Japan, and global manufacturers to find alternative sources for rare earths.

Q: But aren’t there plenty of rare earth reserves around the world?

A: Well, yes and no. A number of rare earth reserves have been identified (see Figure 3) but not all rare earth ores are the same. Some lack useful concentrations of heavy rare earth elements, especially dysprosium and terbium, which are needed for critical applications such as wind turbines, hybrid vehicles and efficient lighting. Most reserves would require 7-10 years to
develop and $500M – $2.3 billion to develop because of the infrastructure required: roads, power, water, labor, chemicals, and permits – all in remote locations.

Molycorp, LLC’s Mountain Pass, CA mine (#2 above) is resuming some operations in 2011 and hopes to supply up to 40,000 tons (of the estimated 180,000 tons global demand) by the end of 2013. Primary ore body does not contain high concentrations of heavy rare earths most critical, such as dysprosium and terbium. Australia’s Lynas Corp. (#1) and Arafura (#7) projects are next closest to producing rare earths. Very significant Canadian reserves exist (#4 and #8), including heavy rare earths, but will take major development efforts. Even with these added sources, rare earth production may not meet global demand in the near to mid term (5-15 years). Concern exists that China’s export restrictions and strategic pricing may delay or prevent economical development of other sources.

So what is being done about this problem in the U.S.?

The Department of Energy (DOE) completed its Critical Materials 2010 report in December 2010, and outlined proposed plans and policies as follows:

1. Develop first integrated research plan with respect to critical materials, building on 2010 workshops
2. Strengthen DOE capacity for information gathering on this topic
3. Work closely with international partners, including Japan and Europe, to reduce vulnerability to supply disruptions and address critical material needs
4. Develop an updated Critical Materials Strategy, based upon additional events and information, by the end of 2011
5. Enable diversified global supply chains and multiple sources of materials
6. Develop environmentally sound substitutes/alternatives
7. Develop economical recycling, reuse and more efficient uses

DOE’s proposed response focuses on eight major elements, including research and development, information gathering, permitting for domestic production, financial assistance for domestic production and processing, stockpiling needs, recycling technologies, education, and diplomacy. Priority research areas should include finding: rare earth substitutes in magnets, batteries, photovoltaic films, and phosphors; environmentally sound mining, and materials processing practices; and rare earth recycling and refinement.

Q So how can interested companies get involved in this issue?

A EWI is providing a collaborative forum for public/private stakeholders on the rare earth issue. The goal of this effort is to help move this national issue closer to resolution. As this initiative develops, EWI will work closely with industry, academia, and the federal government to find innovative solutions that improve US competitiveness and national security. Please join the conversation at www.ewi.org/rareearth.