

Common Misconceptions of Rare Earth Elements

Written by Cindy Hurst

Tuesday, 15 March 2011 00:00

On September 22, 2010 word began circulating among rare earth traders that China was 'unofficially' suspending rare earth exports to Japan. The suspension occurred as a result of an ongoing territorial dispute between China and Japan, which escalated after Japan detained the captain of a Chinese trawler near the disputed Senkaku/Diaoyu islands in the East China Sea. China demanded that Japan release the captain while Japan insisted on holding him until they completed a full investigation over the incident. By September 23, news that China had suspended rare earth deliveries to Japan captured the attention of the global media. Within hours, China denied all reports of withholding rare earths, and Japanese prosecutors announced that the captain would soon be released.

As of late November, there has been conflicting information on the status of rare earth exports to Japan. Some claim that exports have recommenced. Others say China continues to withhold exports. Still others claim that exports have recommenced but they are not clearing customs. No matter what the status, there is a lesson that can be drawn about over-dependence on one country for a vital resource.

The news that China withheld rare earth exports to Japan has renewed urgency in revitalizing the rare earth industry. Rare earth elements are vital in the production of hundreds of modern technologies. They can be found in cell phones, i-Pods, computer hard drives, green technologies, and critical military weapons systems to name a few. China produces over 95% of the world's rare earth elements, and the country has been steadily cutting back its export allocations since 2006, causing the Western world to begin scrambling for alternatives.

While governments and private companies seek out alternative sources, there is often confusion from misinformation spread through the media and other sources. With all the fuss over rare earth elements by government officials and investors, it is important that decision makers have a basic understanding of the industry in order to promote good decision-making.

Four Experts

The following article is derived from interviews with four of the world's leading rare earth experts. Dudley Kingsnorth is one of the foremost authorities in the rare earths industry. He is the Executive Director of the rare earth consulting company Industrial Minerals Company of Australia (IMCOA). Gareth Hatch has a background in materials science and metallurgy and is the co-founder of Technology Metals Research, LLC. Mark Smith, with over 25 years experience in the energy and mining industries, is the chief executive officer of Molycorp, which

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owns and operates Mountain Pass, the only rare earth mine and processing facility in the United States. Finally, Karl Gschneidner is a distinguished professor in the Department of Materials Science and Engineering and senior metallurgist at the US Department of Energy's Ames Laboratory.

Misconception #1: If China cuts off all exports of rare earth elements, we will no longer be able to manufacture modern day technology

Reports exaggerate what might happen if China stops all exports of rare earth elements. For example, in an article titled "Global Supply of Rare Earth Elements Could be Wiped out by 2012," it assumed that if China stopped exporting rare earth elements to the rest of the world, "the Western world will be crippled by the collapse of available rare earth elements. Manufacturing of everything from computers and electronics to farm machinery will grind to a halt. Electronics will disappear from the shelves and prices for manufactured goods that depend on these rare elements will skyrocket."

This is a fallacy. Since the late 1990s, China has been enticing manufacturing sectors to move their facilities to China with the promise that they will have access to rare earth elements as long as their manufacturing operations remain in China. Mark Smith describes a three-tiered priority system within China's rare earth industry. At the top of the list as priority one are Chinese consumers. Not only do Chinese consumers get first dibs at rare earth elements, but costs are maintained at the lowest level. The second priority-consumers are international companies that move their manufacturing facilities to China. These consumers pay more than domestic consumers, but less than the rest of the world. The balance of the world's rare earth consumers fall under priority three. Obviously, the real danger is for countries that are heavily dependent on China for their rare earth metals if demand at the two tier priority levels is high which may crimp supply for the remainder of world consumers.

Because of this system, more and more Western companies have been progressively moving their manufacturing to China. Control over rare earths acts as an incentive in providing more job opportunities to Chinese citizens. Clearly, manufacturing will not grind to a halt if China cuts off its exports.

Also noteworthy is that alternatives to rare earth elements do exist. However, these alternatives are not generally as effective as the rare earths themselves. For example, prior to the discovery of rare earth magnets, many applications relied on alnico and ferrite magnets, neither of which contain rare earths. Both the alnico and ferrite magnets are considerably weaker than their rare earth counterpart. In order to match the same magnetic power as a rare earth magnet, these

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traditional magnets would have to be made larger. This poses a great problem for many applications. According to Smith, “If you were to use ferrite magnets, as opposed to Neodymium-Iron-Boron (Nd-Fe-B) magnets (Note: The Nd-Fe-B rare earth magnets are the strongest magnets available), in hybrid and electric cars, the vehicles would never meet the definitions of hybrids for electric vehicles, or the zero emissions vehicles. The size of each unit would become so big. As the size gets bigger, of course, the battery can only operate for so long.”

Misconception #2: A rare earth is a rare earth is a rare earth

This misconception is truly in the eye of the beholder. According to Gareth Hatch, there is a tendency to talk uniformly about rare earth elements as if they were one. This is misleading because they are all different, with different levels of demand-consumption patterns and different levels of abundance.

From an electronics point of view, there are heavy rare earth elements, medium rare earth elements, and light rare earth elements. For our purposes they will be broken down into light and heavy rare earth elements. The light rare earth elements as generally defined by industry—lanthanum, cerium, praseodymium, neodymium, and samarium—are more abundant in the earth’s crust than the heavy rare earth elements. Scientifically, according to Karl Gschneidner, while rare earth elements are similar in their chemical properties, when it comes to what is known as the 4f-electrons each element is unique.

Global RE Consumption 2010

Estimated Global Rare Earths Demand in 2010 (t REO $\pm 15\%$) (Source: IMCOA and Rare Earths Industry Stakeholders)					
Application	China	Japan & NE Asia	USA	Others	Total
Catalysts	9,000	3,000	9,000	3,500	24,500
Glass	7,000	1,500	1,000	1,500	11,000
Polishing	10,500	6,000	1,000	1,500	19,000
Metal Alloys	15,500	4,500	1,000	1,000	22,000
Magnets	21,000	3,500	500	1,000	26,000
Phosphors	5,500	2,000	500	500	8,500
Ceramics	2,500	2,500	1,500	500	7,000
Other	4,000	2,000	500	500	7,000
Total	75,000	25,000	15,000	10,000	125,000

Source: IMCOA