

Chinese policies control rare earths industry

Sometimes it's difficult to get facts and figures on the Chinese rare earths industry; however, Contributing Writer Robert L. Wallack travelled to China and posted this revealing story.

China's new environmental policies and their enforcement are contributing to a stable global supply and pricing of rare earth elements (REE), especially necessary for magnets used in the automotive and motor industries. There are numerous factors contributing to this stable environment as explained by Dr. Chen Zhan Heng, Deputy Secretary-General of the Association of China Rare Earth Industry (ACREI) in his Beijing office. In addition, Chinese scientists are discovering cleaner processes and moving up the REE industrial value chain.

The People's Republic of China's (PRC) general strategy for the environment began in 2010. The central government is dedicating a great deal of attention to protecting the health of its citizens from factories and mines that damage the quality of the air, soil and water. Cities are issued environmental performance reports and government inspectors are visiting factories and closing illegal mines such as iron ore and coal due to emissions. The crackdown on illegal mines and their toxic processes is impacting REE mines as well.

Dr. Chen divided China's REE mining areas into those in the mountainous regions in the south and those in the north. Mines in southern China are in Jiangxi, Guangxi, Guangdong and Hunan provinces, among others, for middle and heavy elements characterized by their ion-absorption in the soils. Of the 17 REE in the periodic table, these include deposits of dysprosium (Dy), terbium (Tb), ytterbium (Yb) and yttrium (Y). Deposits in the north are dominated by Baotou, Inner Mongolia Autonomous Region (IMAR) and in Sichuan and Shandong, such as neo-

dymium (Nd) and praseodymium (Pr) used for magnets. The light, middle and heavy REEs are categorized by their atomic weight, physical and chemical properties.

The separation process of REE from ores involves the use of chemicals and toxins in the slag. In the south, miners dig holes 5 metres apart and pour in chemicals with ammonia which flows along the rocks and surface soil that collects the liquid into a pond. Then more chemicals are used to precipitate rare earths and to remove aluminum and iron. Radioactive materials such as thorium (Th) are concentrated in the slag and are dangerous to public health. In the Baotou, IMAR, Sichuan and Shandong mines, the separation process involves fluorine gas and sulfur dioxide that is released into the air.

ACREI advises the central government, scientists and their member producing companies in China and their joint ventures in techniques for REE production to reduce waste emissions. "China developed a rare earth separation technology without ammonium nitrate which is already adopted by several producers. As for the north, factories are investing in clean gas emissions and have established a waste gas processing system; solid wastes are stored safely," said Chen. ACREI also studies market trends for the REE industry.

The supply of REE to worldwide demand centres on China. China not only dominates the supply of rare earth raw materials, but also most rare earth functional materials such as rare earth permanent magnets. The United States Geological Survey (USGS) estimates that there are 110 million tonnes of proven reserves worldwide; China has 36 million

tonnes, Russia has 19 million tonnes, the US has 13 million tonnes and Australia has 5 million tonnes.

Only in the past 20 years has China become the largest supplier of REE with well over 90% of the market, but China has only 23-30% of proven worldwide reserves. The future of national economies will depend on a reliable supply of REE for new energy, new materials, defense applications and space science. Dr. Chen estimates that the worldwide demand for rare earth ore will be 210,000 tonnes per year including the supply from recycling: China with 180,000 tonnes and Japan and others 30,000 tonnes or so.

There are a number of factors contributing to the current supply and pricing of REE in China which impact demand in China and worldwide exports. The REE mines in the south of China are almost depleted. Though the producers ask for new licenses, the PRC has not issued any new licenses for about 15 years, according to Chen. The producers are asked to use their old licenses to dig in certain areas that are depleted.

Chen urges the central government to issue new licenses to producers to expand their mining areas. The expiry date for licenses is 2030 for the IMAR mines, but most southern mines are expiring. "In 2018, the PRC issued a new document on how to apply for new licenses. This signals that the government might issue licenses for new mines," he said.

The south mines have REE in very mountainous areas and the needed railways required that tunnels be drilled through them. In their construction, REE deposits are discovered during the drill-



ing and the laying of the tracks. The PRC approved the use the blasted rocks for REE mining with no need for a license, just the following of environmental protection regulations. However, there are not enough REE deposits producing REE concentrates over the past three years. Legal producers have a good track record for environmental protection, but not those involved in illegal mining.

The recent government crackdown on illegal mining curtailed REE supply since there is a production shortage in legal mines. "Last year, from January to July, because of the crackdown, prices increased. But now there is a stable price to meet demand due to imports, recycling and other sources such as railway construction in the south," said Chen.

Valparaiso, Indiana-based Alliance LLC helps customers with their magnetic designs and the procurement of product from manufacturers around the world, but predominantly those in China. They are affected by REE supply and pricing. Bob Wolf, spokesperson for Alliance, com-

mented, "Better environmental controls are a good thing for Planet Earth; however, we must all be willing to face the resulting cost impact required to be environmentally friendly."

Light REEs of praseodymium (Pr) and neodymium (Nd) are mostly used for permanent magnets for end products: elevators, wind turbines, electric vehicles and speakers. Hybrid vehicles require 4,900 grams of Nd and gas vehicles require about 450 grams of which 350 grams are NdFeB magnets, according to Wolf's presentation at the Argus Specialty Metals Week conference in Las Vegas last April. A reliable supply at reasonable prices is critical to many industries.

"Considering only magnets, the main industries would be automotive, since there are over 200 magnets in your car and more if it is an electric vehicle, and the motor market which produce motors for various industries. These two cascade down to all varieties of smaller markets," said Wolf in a recent interview with *Resource World* magazine.

Resource World Contributing Writer Robert L. Wallack with Dr. Chen Zhan Heng, Deputy Secretary-General of the Association of China Rare Earth Industry (ACREI). Photo courtesy Robert Wallack.

Although magnets account for 47% of rare earth uses, others are important to many industries. These include manufacturers using lanthanum for battery-electrodes, camera lenses and fluid catalytic cracking catalyst for oil refiners. The defense industry relies on rare earths for next generation technologies such as yttrium and europium for lasers and lanthanum for radar and night-vision goggles. Personal electronics such as smart phones need europium and lanthanum for screens and circuitry. LED lights, pigments and TV screens also need rare earths among many other applications.

China is allowing imports of REE to fill the shortage caused by closing illegal mines and the crackdown due to environmental concerns. Myanmar is one source with the same type of REE as in south China, but there are security concerns;

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Malaysia is another source. **Lynas Corp.** [LYC-ASX] sells everything to the market from Malaysia.

“Lynas shipped rare earth concentrates from their Australia mines to their plant in Kuantan, Malaysia to produce rare earth oxides like lanthanum oxide, cerium oxide, Pr-Nd oxide and mixed rare earth oxides,” said Chen.

Landlocked Republic of Burundi in East Africa is another import source of REE for China. Caihong (Rainbow) Company is European invested and producing 3,000 tonnes of REE concentrates per year and is to enlarge to 5,000 tonnes in Burundi, according to Chen. In the past, there were 400 REE projects worldwide and now there are only 10 new projects because of the drop in market prices. These projects could be a new source for China from which to import rare earth raw materials. The PRC has “no policy barriers” for imports.

There is a production quota policy for the PRC to regulate the rare earth industry. The quota includes a mining quota and a separation quota issued in two batches per year. The first batch issued in the first half of the year had a mining quota of 73,500 tonnes and a separation quota of 70,000 tonnes. Producers using imported rare earth raw materials must provide import documents and their production should not exceed the allocated production quota. If the second batch quota is the same as the first, then the rare earth production might reach 147,000 tons in theory, according to Dr. Chen.

To monitor REE market price fluctuations, ACREI began a domestic REE price index (REPI) in 2013 available on the ACREI website. The average price index in 2010 was 100. In July 2011, the average REPI was 155 and in 2014 the industry was in profit, while in 2015 the whole industry was in a deficit. A reasonable REPI should be 150-160 or higher and it now is about 135-137, stated Chen.

“I am aware of the price index, but it appears (only in Chinese language) that it is only for the use by member companies. I do not know specifically how the data is collected and from what sources,”

remarked Wolf.

PRC policies for the environment and licenses are not the only ones to control the REE market. The consolidation of REE producers into six companies had limited results. “The market reacted to the integration of the six and prices did not go up until after the crackdown of illegal mining,” said Chen. They are Northern Group, CHALCO, Minmetal, Southern Group, Guangdong Rare Earth Group and Xiamen Tungsten Group. The smaller producers are the recyclers from waste of REE magnets and their costs are lower. They compete with the six in their recycling.

The small producers in the recycling collect waste REE magnets from magnet users or import from other countries such as Japan and Germany among others. These recyclers are legal entities, yet some use illegal rare earth raw materials to recycle rather than waste materials from magnets.

“Recycling has always been considered and is probably a good thing. The main problems in magnetics, however, are: 1) the difficulty in achieving a consistent chemistry so a customer does not experience variability in their product purchased and 2) generally, you get a lower grade of properties which is not desired by customers,” stated Wolf.

For the foreseeable future, China will be the center of supply of rare earths for numerous applications needed by manufacturers worldwide and for their growing domestic advancements. PRC policies regarding the environment, licenses, quotas and new sources of supply such as imports and recyclers will control the global supply and pricing as demand increases for existing and new applications.

“China will, if not already, be a large consumer of magnets for products used within China itself. This will constrict the supply of material used to produce magnets for others. However, obtaining higher magnetic grades will allow for designs with smaller magnets using less material but the higher grades will also come at higher prices,” said Wolf. ■