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Rare-Earth Elements (REE) Market Research in the CIS

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Annotation

The report is devoted to research of current condition in the market of rare-earth elements in CIS countries and forecast for its development.

The rare earth elements or metals ("rare earths") include yttrium, lanthanum and 13 elements in the lanthanide group (cerium, praseodymium, neodymium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium and lutetium).

The report is composed of 8 Sections, contains 110 pages, including 40 Figures and 34 Tables. This work is an armchair study. Useful sources of information are data from Russian State Statistic Service, CIS countries Inter-State Statistics Committee, State Statistics Committee of Ukraine, State Customs Service of Ukraine, Kazakhstan's Statistics Agency, Federal Customs Service of Russian Federation, industrial and regional press, annual and quarterly reports of stock issuers, web-sites of REE producers and consumers, foreign media, scientific literature. There were also several interviews with experts in this field.

The First Section of the report presents brief description of REE World market, gives World reserves, production (2002-2010), consumption, as well as prices of certain kinds of REE in 2006-2010.

The Second Section of the report details REE mineral raw materials base in the CIS. It gives characteristics of the existing deposits in the territory of the CIS (Russia, Kazakhstan, Kirgizia and Ukraine); it presents potential REE reserves in the CIS.

The Third Section of the report is devoted to rare-earth raw materials processing projects in the CIS territory. It stresses most promising projects, gives their description.

The Fourth Section deals with mining and treatment of REE containing ores. It gives detailed description of the key producers of the products in the CIS countries. The key one among them is LLC "Levozersky GOK".

The Fifth Section is devoted to manufacturing of rare-earth products in the CIS. The Section presents range of rare-earth products, describes current state of REE producers in the CIS as well as shows dynamics of their output and deliveries.

The Sixth Section contains REE export and import statistics in Russia in 1997-2010 split by avenues of supply and type of goods. Here one could find different REE (compounds and metals) price dynamics. The section is supplemented with situation in REE foreign trade operations by Kazakhstan, Ukraine and other CIS countries.

The Seventh Section describes in detail consumption of rare-earth products in Russia. The Section presents dynamics of REE consumption in Russia (2000-2010), structure of individual REE consumption and key consumer enterprises. It also gives brief characteristics of rare-earth products' fields of application.

The Eighth Section is devoted to REE products output and consumption forecast in Russia/CIS until 2020. It presents different scenarios for REE market situation in Russia.

The Appendixes present quality of the main rare-earth products manufactured by AS Silmet, as well as addresses and contact information with enterprises that manufacture rare-earth products.

INTRODUCTION

The rare-earth elements or metals ("rare earths") include yttrium, lanthanum and 13 elements in the lanthanide group: cerium, praseodymium, neodymium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium and lutetium.

All of them share many common properties and in natural conditions are found together. In this case all REE are subdivided into two groups: cerium group (or light elements) from lanthanum to neodymium and yttrium group – yttrium itself and lanthanides from samarium to lutetium. Among the yttrium REE there are three more sub-groups: properly yttrium, medium REE (from samarium to erbium) and heavy REE (from thulium to lutetium).

These REE and their compounds possess complex properties that secure their wide application in various sectors of industry. The most important commercial-grade end-users of REE are petrochemical sector, electronics, glass, ceramic industry, metallurgy.

Near 30% of the rare earths being consumed in the World are used in catalysts manufacture for oil creaking, caoutchouc and polymers synthesis as well as in manufacture of catalytic filter-neutralizers of automobile motor exhausts.

At present time, the most in demand are neodymium and dysprosium; they are used in permanent magnets ($Nd_2Fe_{14}B$), which output has been increasing at high rate.

The biggest REE end-user in money terms is production of luminophors (the biggest market of yttrium, europium and terbium), which are used in TV, computer monitors, compact lamps, etc.

Cerium compounds are applied as polishing powders in manufacture of lenses, mirrors and cathode ray tubes (CRT). A new target market has become use of polishing powders for mechanical-chemical polishing of microchips.

An important REE market in developed countries is production of commercial electric and electronic ceramics – telecommunication dielectric resonators, ceramic filters and multi-layer condensers.

One more REE application is NiMH batteries. In spite of growth in demand for Li-ion batteries, NiMH batteries could match them from the point of view of volumetric energy density.

Demand in REE under high technology development grows steadily. Therefore conservation activities of China as key supplier of rare-earth raw material in the World market has lead to its deficit and need for search of alternative sources.

1. Brief appraisal of REE World market in 2002-2010

Rare-earth elements are relatively abundant in the Earth crust; meanwhile they rarely occur in concentrations enough for commercial extraction. The principal industrial mineral concentrators of REE are bastnasite ($CeCO_3F$, 75% REE) and monazite ($CePO_4$, 65% REE). Bastnasite and monazite ores are responsible for near 80% of total REE reserves.

The bulk of the World reserves of REE belongs to bastnasite deposits of China and USA, monazite deposits are found in Australia, Brazil, China, India, Malaysia, South Africa, Sri Lanka, Thailand, USA. The rest of REE raw materials are found in deposits of xenotime, ion-adsorption clays, loparite, phosphorite, apatite, secondary monazite, eudialyte, etc.

Some 50% of all the World's reserves of REE are concentrated in bastnasite ores of two deposits: Bayun-Obo (China) and Mountain-Pass (USA). In this case, reserves of proper yttrium are valuated at 0.5 to 1 million tonnes.

Estimated REE reserves (USGS data) in the World and volumes of REE production in form of concentrate (in terms of oxides) are presented in Table 1.

Table 1: REE world reserves (000 tonnes) and their output (tonnes in terms of oxides), 2002-2010

Country	Reserves, 000 tonnes	REE concentrate output (in terms of oxides), tonnes								
		2002	2003	2004	2005	2006	2007	2008	2009	2010
Brazil										
India										
China										
Malaysia										
CIS										
USA										
Thailand										
Sri Lanka										
Other countries										
Total:										

Source: USGS, IAC "Mineral", SMZ

As one can see, REE in form of concentrate World output has been assumed at level of 135 000 tonnes, and the greatest its producer is China, which share stands for 95% of the World output.

Under forecast till 2015, Chinese production of REE should reach near 175 000 tonnes or about 78% of REE World production. Output of the rest 50 000 tonnes are to generate the other countries (USA, Australia, Canada, Russia, etc.).

Besides China, Russian JSC «Solikamsk magnesium plant (SMP)» (Russia) and MolyCorp (USA) are the main sources of rare-earth raw materials in the World besides China. Until recently operational alliance SMP – Silmet (Estonia) supplied near 1 900 tonnes of REE (in terms of oxides) in 2009 and 1 500 tonnes in 2010.

As is known, in early 1980th, China discovered and developed a unique root bastnasite deposit – Bayan Obo. Its reserves have been assumed at 36 million tonnes

of REE oxides (at REE grade of 5%-6%) and probable resources - at near 100 million tonnes. At present, Bayan Obo is the major source of rare-earth raw material in the World.

China operates two major REE composition and rare-earth metals producing groups – Southern Rare Earth Group, comprising seven REE producers in Jiangxi and Guangdong provinces; as well as Northern Rare Earth Group of ten big producers (Inner Mongolia and Sichuan province). Southern group enterprises use ion-absorption ores as raw material; therefore they manufacture heavy REEs and metals of medium group. Northern sector produces just light REE on the basis of bastnasite ore.

The biggest producer of REE in China is Baotou Steel Rare-Earth (Group) High-Tech Co (Inner Mongolia) with 65 000-70 000 tpa of REE (in terms of oxides). The Company claimed significant production expansion in five years.

According to Zhang Zhong, the Company general manager, by 2015, Baotou is to increase REE output for magnet manufacture from 6 000 tpa to 10 000 tpa; for polishing materials from 5 000 tpa to 10 000 tpa; for hybrid batteries from 4 000 tpa to 6 000 tpa.

A unit of the Company in Inner Mongolia had commissioned six depots for rare-earth concentrates and oxides. According to Baotou Steel Rare-Earth, they will accommodate some 300 000 tonnes of rare-earth concentrates during five years and 80 000 tonnes of rare-earth metals during two years.

In Sichuan province, Sichuan Rare Earths Group uses bastnasite ores to produce near 10 000 tpa – 15 000 tpa of RRE (in terms of oxides); from ion-absorption ores of Jiangxi and Guangdong provinces they produce 45 000 tpa – 55 000 tpa of REE (in terms of oxides). According to some experts, just here illegal and unrestrained extraction of rare-earth ores takes place.

We should note that in early 2011, China introduced state control over 11 rare-earth producing mines under State program of the sector consolidation. Chinese Ministry of land and resources said that the Government is seeking reinforcement of “protection and security of reasonable development” of the sector. Therefore it will control mines in Jiangxi province. In addition, there is significant decrease in issuance of rare-earth ores mining licenses (from 1 000 down to 100 licenses).

Concurrently there has been consolidation of enterprises going on. In this case, China Minmetals Nonferrous Metals Co, daughter-company of China Minmetals Corp., and two Jiangxi based private firms, Hongjin Rare Earth and Dingnan Dahua New Material Resources, formed China Minmetals Rare Earth in November 2009. Its 40% belongs to China Minmetals Nonferrous Metals Co.

The new Company plans to take one of the leading positions in REE production in China. In five years, it will invest 2 bn yuan (290 $m) into restructuring of enterprises in Jiangsu province. It will allow expanding of processing capacities from 8 500 tpa to 13 000 tpa of REE (in terms of oxides).

In 2009, Chinese aluminium producer, Aluminum Corp. of China (Chinalco), established affiliate enterprise, China Rare Metals Rare Earth Company, which also supposed to become one of the leaders in the sector of rare-earth metals of China.

Chinalco also is planning acquisition of a controlling share in Jiangxi Rare Earth and Rare Metals Tungsten Group. It was stated that investments into development of rare-earth resources of Jiangxi Company would exceed 10 billion yuan (1.5 $bn) in 3-5 years.

It was stated that in May 2011 China was likely to establish association for rare-earth elements price and export quotas setting. Currently, 93 big companies in this sphere displayed their desire to become members of this future semi-official industrial group.

China exports significant volume of rare-earths, most of all it comes in form of REE compounds and of metals, to lesser extent (see Figure 1). In 2010, China exported 39 800 tonnes of rare-earths, 9.3% below 2009 year level.

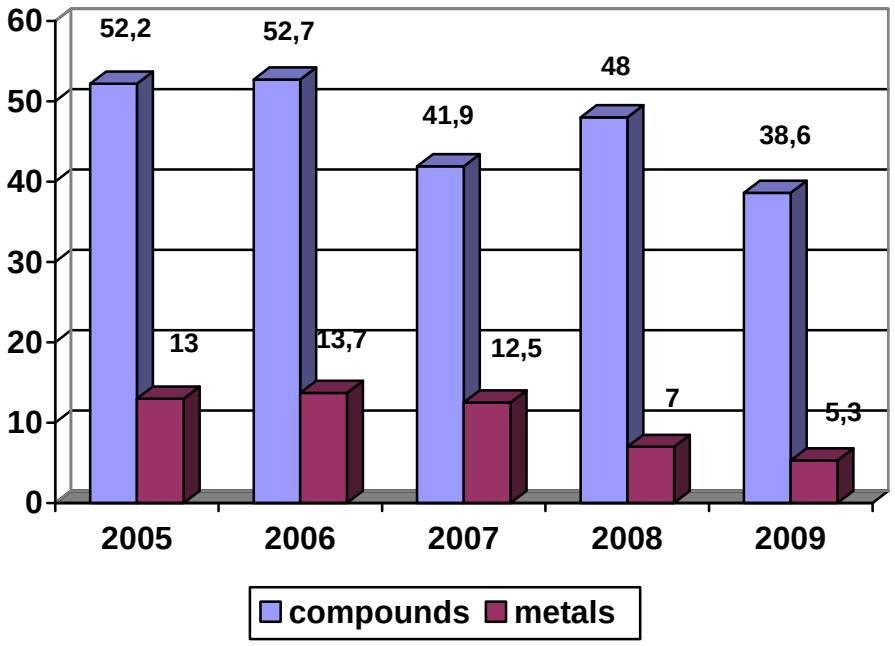
The volume of supplies is regulated by means of PRC Government quotas with general trend to annual decrease of quota level. Export quotas decreased from 65 500 tonnes in 2005 down to 30 300 tonnes in 2010 (Figure 2).

In December 2010, Chinese Ministry of commerce released export quotas for the first half of 2011. They totaled 14 500 tonnes, 35% below the same period of 2010. The quota was granted to 31 companies, including Sinosteel Group, China Minmetals Non-ferrous Metals and Inner Mongolia Baotou Steel Rare-Earth (Group) Hi-Tech.

China sharply decreased deliveries of rare-earth metals to Japan, USA and European countries. Given the trend of recent years, we could assume that increase in REE exports from China is unlikely. According to experts, China will sell “as much REEs as it wants to at as high price as they desires to, while demand is practically secured”.

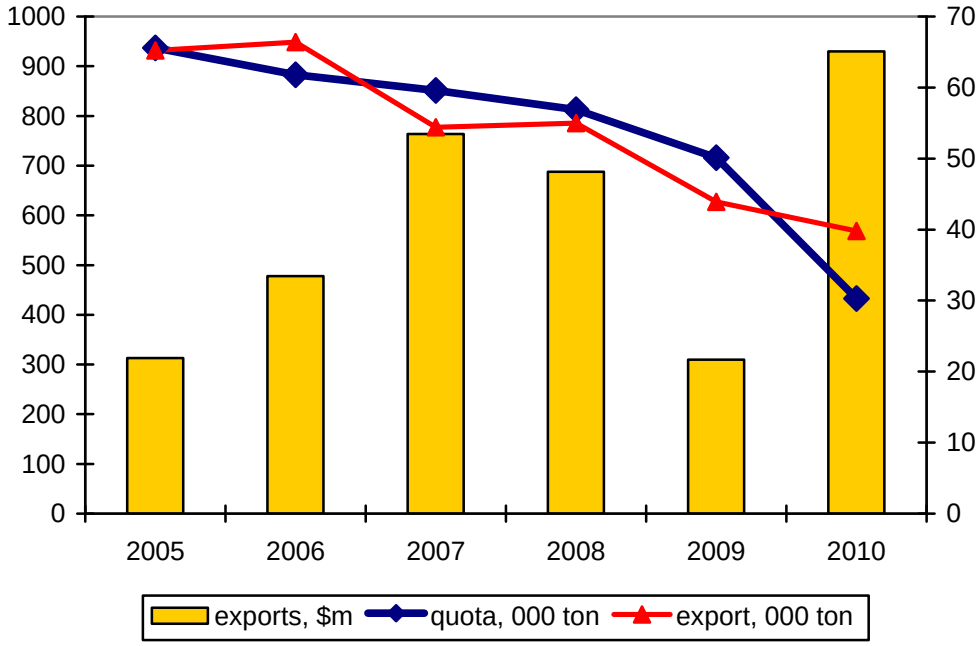
Shortage in rare-earth raw materials’ supply from China prompted activization in search for new REE sources in the World. At the moment, modernization of mothballed mines is under way at Molycorp (USA), Lynas (Australia), Great Western Minerals Group (South Africa), Avalon Rare Metals (Canada), etc. (Table 2), but their commissioning will take certain time.

Figure 1: Chinese import of REE compounds and metals (2005-2009), 000 tonnes



Source: UN data base analysis

Figure 2: Chinese export of rare-earth products (000 tonnes and $m) and quotas level (2005-2010), 000 tonnes



Source: UN data base analysis

In nearest future, realization of two REE projects is being supposed – at Mount Weld deposit of Lynas Company in Western Australia and Mountain Pass deposit of Molycorp Company in the South of California state (USA).

Commissioning of Lynas' mine at Mount Weld is expected at very short time. According to latest data, resources of the deposit (probable, explored and evaluated) total 17 490 000 tonnes with REE oxides rate of 19.4%. Mount Weld deposit is considered to be one of the richest in the World by REE content.

Plant for treatment of rare-earth raw material is being built in Malaysia (Kuantan) to be launched in September 2011. Its preliminary capacity will amount for 11 000 tpa of REE oxides.

We should note that Sojitz and Jogmec, Japanese corporations, had signed an agreement with Lynas over investments of $250 000 000 into extraction and treatment of rare-earth ores under this project. In exchange, Sojitz and Jogmec should off-take over 8 500 tpa of rare-earth product for delivery in Japanese market. In addition, Sojitz had signed an agreement with Lynas to appoint Sojitz as its sole distributor in Japan.

In near-term outlook, it is possible to expect commissioning of Mountain Pass mine that belongs to Molycorp Minerals LLC in the South of California. In 1965-1985, the enterprise was generating significant share in total REE global output. But in the end the mine was forced to close due to Chinese market behavior and price collapse. Molycorp announced plans to organize totally integrated production (starting with ore extraction down to magnets manufacture) at volume of 20 000 tpa of REE (in terms of oxides) by 2012.

Table 2: Rare-earth elements mining projects in the World (excluding China)

Mine, plant/Country	Company	Capacity, 000 tpa	Likely term of realization
Mine and plant Mount Weld/Australia plant Kuantan/Malaysia	Lunas		
Mountain Pass/USA	Molycorp		
Dubbo/ Australia	Alkane Resources		
Steenkampskraal/South Africa	Great Western Minerals Group		
Hoidas Lake/Canada	Great Western Minerals Group		
Dong Pao/Vietnam	Vietnam Government, Toyota, Sojitz		
Nolans/ Australia	Arafura Resources		
Nechalacho/Canada	Avalon Rare Metals		
Uranium deposits in Kazakhstan	Kazatomprom, Sumitomo		
Kutessai-2/Kirgizia	Stans Energy		
Kvanefjeld/Greenland	Greenland's Minerals and Energy		

Source: Industrial Minerals

Application of rare-earth metals in a number of fields means use of undivided REE (metallurgy, production of catalysts for oil refining industry, manufacture of rechargeable storage batteries, glass).

They use compounds of individual REE in many sectors: production of catalytic filter-neutralizers of automobile exhausts (cerium); manufacture of magnets and alloys (samarium, neodymium, dysprosium); luminophors (yttrium, europium, terbium); capacitors (lanthanum); optic glass (lanthanum, cerium); ceramics (yttrium); hi-tech abrasive materials (cerium), etc. (Table 3).

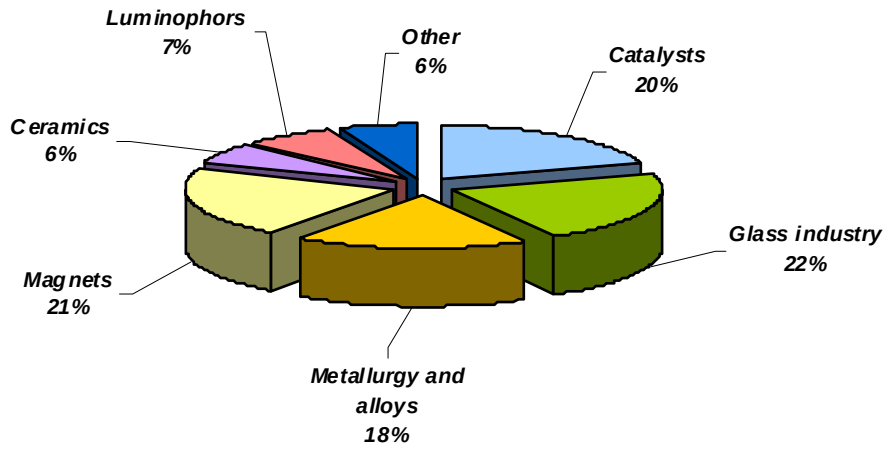
Table 3: Consumption of different REEs in final product manufacturing, %

Products	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Y	Other
Magnets											
Alloys for batteries											
Metallurgy											
Automobile catalysts											
cracking catalysts											
Polishing powders											
Glass											
Luminophors											
Ceramics											
Other											

Source: Lynas

Rare earths global consumption totals 120 000 tpa – 125 000 tpa of REE (in terms of oxides). Most of REE global consumption in kind (Figure 3) is due to glass industry (glass manufacture and polishing) – 22%, magnets (21%) and catalysts (20%). In value terms, most volume of consumption falls on magnets (37%) and luminophors – 32% (Figure 4).

Figure 3: REE world consumption structure (in terms of oxides, in kind), %



Source: Linas