Meanwhile, Back in Tokyo

The Japanese have been very busy for at least the last 15 years attempting to construct, expand, and maintain a total rare earth supply chain for the Japanese domestic manufacturing industry, so that it can break free of China and Chinese involvement. Recent moves by Japanese rare earth permanent magnet (REPM) makers, such as, for example, Hitachi, to move some production to China a step that Hitachi, among others, said just 4 years ago, that they wouldn’t do – has been interpreted I think wrongly as a “surrender” to the inevitable dominance of China in the sourcing of raw materials for rare earth permanent magnets. In fact, I suspect that even though Hitachi most likely moved production of commodity (i.e., wide-spec or no spec) REPMs to China, it has, in true Japanese fashion, kept the production of specialized proprietary tight-spec REPMs as well as R&D for REPMs at home, or close to home but not in China.

Hitachi, as an example, is a Tier One supplier to the German OEM automotive transmission supplier, ZdF at its, ZdF’s,manufacturing plant in China Grove, North Carolina. REPM alloy made, I suspect, in both China and Japan is shipped from those places to Malaysia where the blocks are machined to shape. Then the shaped magnet alloy is shipped to North Carolina where it is installed and magnetized in ZdF automatic transmissions for, among others, the Ford Motor Company. I doubt that Malaysian labor rates and utilities are much cheaper than their equivalents in mainland China but I think they are no more or not much more than Chinese rates for the same overheads. Malaysia, however, offers Hitachi an added value, a venue where its trade secrets can be less likely to be stolen. Additionally, and perhaps most important of all, the Malaysian machining facility can switch suppliers without political fallout. Magnet alloy made in Japan, Vietnam, or even one day Malaysia or the USA can be substituted for

Chinese made material at any time.

The recent fuss over the operating license for Lynas LAMP facility in Malaysia was due to a previous attempt by Japan’s Mitsubishi to process local monazite bearing sands for rare earths in the late 1990s. The result of that venture was a fiasco where the Malaysian government had to pay a substantial sum along with Mitsubishi to clean up a thorium residue issue, and the project was terminated. This did not endear either rare earths or Mitsubishi to Malaysian regulators, and the residue of ill will was the main driver behind the ludicrously named Save Malaysia Stop Lynas movement that held up the license for the LAMP for at least two expensive years.

Nonetheless the Japanese REPM industry has for the last two years been looking at the viability of Malaysia for additional supply chain development due to the availability of didymium from the LAMP and of terbium and dysprosium from xenotime extracted from tin processing residues and from ionic adsorption clays in Sarawak (Malaysian Borneo).

Nearby to Malaysia in Vietnam there is already a variety of Japanese investment in a total rare earth supply chain. The REPM manufacturer, Shinetsu has a magnet alloy/magnet plant there using, among other feed stock, REPM scrap. The Japanese magnet alloy producer, Showa Denko, also has an operation in Vietnam. Toyota operates a plant in Vietnam recovering rare earths from Nickel Metal Hydride batteries as does, I believe, Honda. Toyota is also a principal investor in the development of the Dong Pao rare earth deposit in Vietnam and if and when production begins there it can be apportioned for separation to the two Chinese owned total rare earth separation facilities already operating in Vietnam as well as to the Shinetsu, Showa, and Toyota facilities with separation capabilities and/or alloy and or magnet making capacity. There are at least four solvent extraction plants in Vietnam for the separation of rare earths.

Toyota is also a principal investor in the large (8000 ton per annum capacity) monazite fed separation plant in Kerala, India that is either ready for operation or in operation today.

In Brazil Mitsubishi and/or Sumitomo is processing tin-processing tailings from Pitinga to extract some of the substantial xenotime resident in it. I believe that the separation processing of this xenotime is done in Vietnam, but it may be done in Japan or even China for the account of Mitsubishi's Japanese clients.

In North America we know that Toyota's trading company took a position in Matamec and has looked extensively at many other properties, but politics and environmental issues seem to have inhibited any further Japanese investment in North America.

The Japanese REPM industry has voted with its pocketbook and its engineers for involvement in the global rare earths trade. The purpose of all of this is to make Japanese REPM manufacturers independent of the Chinese total rare earth supply chain.

The USA is very far behind the Japanese in this. Basically this can be ascribed to two reasons:

1. The demand for REPMs in the USA as component parts of goods to be assembled in the USA is less than 1000 tons per year, and
2. No one has re-established even a minimal total domestic American rare earth supply chain here since Magnequench departed.

What the USA needs right now is a 500-1000 ton capacity total rare earth supply chain that is profitable at current pricing. Such an operation would seed a larger capacity supply chain when it becomes necessary due to Chinese internal absorption of their entire output or a real cutoff of our supply, whichever comes first.

Ecclestone on Rare Element Resources – Grasping the Holy Grail

For an industry that has talked much of technologies and science very few players have actually got to the stage of producing an end-product in either commercial or pilot mode. Those that have survived so far now generally have resource statements far behind them and mainly have PEAs also in the bag and are at various stages in the Feasibility and/or permitting continuum. They are also grappling with finding the ideal processing method that suits their own deposit's mineralogy to try and reduce some of the dizzying capex numbers that originally cast the prospects of ever getting REE production going into doubt.

Weeding Out the Cerium

We have to chuckle thinking back to the early part of the REE boom when a lot of the action was stirred by a cadaverous newsletter writer from Vancouver who came up with a thesis that the global water crisis was going to be solved by the application of Cerium to filtration processes. This set off a feeding frenzy and retrospectively underpinned the valuations of all those deposits that were massively endowed with Cerium and not much else. History has left this theory in the trashcan. Cerium has gone from being an illusory high-value product during the price spike of 2010 to being seen as akin to a deleterious element these days.

Dealing with the "nasties" has become the challenge for REE companies. Rare Element Resources with its Bear Lodge project has been grappling with this issue. In recent days it announced that it had completed bench-scale testing on enhancements to its existing patent-pending Thorium extraction technology that allows for the selective precipitation of 100% of the Thorium, while also removing 85% of the Cerium. This technology significantly reduces the concentrate mass of material subject to further separation, thereby reducing costs, and results in an upgraded product that is nearly 40% by weight in what the company calls critical rare earths (CREE) and 99.999% pure rare earth oxide (REO). CREE is a parsing of the REE mix that I have only seen this company use but it is based on comments by the U.S. Department of Energy (Critical Materials Strategy Report, 2011) defining CREE as those rare earths most essential to the "clean energy" economy and at highest risk of supply disruption, including neodymium, dysprosium, europium, terbium and yttrium. Rare Element includes praseodymium because of its use with neodymium in didymium, a raw material in high-strength permanent magnets.

In the second stage, a two-contact solvent extraction (SX) process is used to separate the contained rare earths into heavy rare earths (HREE) and light rare earths (LREE) to simplify the separation process and further reduce costs.

Testing was undertaken using concentrates generated from the large-scale pilot plant work conducted by SGS Lakefield, Canada, and Hazen Research, Colorado.

Process, Process, Process

In the real estate industry they have the Three Ps (Position, Position, Position). In Rare Earths it's all to do with process. If it can't be separated (economically) it remains little more than a chemistry experiment. Some REE mineralisations are more complex than others but none of them are easy. The accepted wisdom is that one cannot "pick and choose" one's REEs you have to essentially process them all out through a great many phases and that you have to focus first on the separation of Cerium and Lanthanum before one can get at the “good stuff”, those Rare Earths with the highest demand and pricing.

In the case of Rare Earth Elements, it has focused its attentions of firstly dealing with Thorium, a common passenger in many REE deposits. Then its attention has been directed towards sidelining the Cerium component so it can be dealt with efficiently and in a cost-effective manner. The technology combines selective precipitation and SX process technology to extract cerium and thorium from the rare earth oxide mix concentrate and thereby doubling the grade of CREE to about 40% by weight. Subsequently, the upgraded rare earth product is separated into HREE and LREE groups.

The total rare earth (TREO) concentrate product is initially dissolved in nitric acid and then complexed with an alkaline solution to make the cerium and thorium amenable to selective precipitation. Over 85% by weight of the Cerium and 100% of the Thorium is removed in this process, resulting in a product rich in Didymium (37% by weight). As well as saving on processing costs, this also has a capex saving as it reduces the feedstock to SX and hence requires a smaller processing facility.

The company feels this represents a significant achievement in the SX flowsheet potentially reducing the number of steps in subsequent separation processing and improve management of radioactive materials.

Anyone who has seen Molycorp’s Silmet plant (pictured left) in Estonia knows that the number of steps in REE separation can be mind-boggling. With Rare Element Resource’s new process they claim that, after Cerium removal, the CREE-enriched product is treated in a single-contact SX step, in which the LREE are separated from the HREE. It is possible to produce an almost cerium-free LREE fraction containing 93% to 98% Lanthanum, Praseodymium and Neodymium, allowing the production of pure Lanthanum and Didymium products. The HREE fraction includes 97% of all elements from Dysprosium to Lutetium, including 88% Terbium. Bench-scale tests are ongoing to use either the HREE or LREE feedstocks to separate individual rare earth elements.

Earlier this month Rare Elements Resources filed an application for a Provisional U.S. Patent on the technology for the selective precipitation and SX process technology to extract cerium and thorium.

Band of Brothers

It's interesting that while the ranks of Canadian Rare Earth companies have been decimated those operating or intending to operate in the US have "soldiered on" and we use that word with consideration. Maybe there is some greater force working to ensure that the US economy is not exposed on the REE front to Chinese pressure and that the greater force clearly has no interest in projects in Canada. And why should the Pentagon get interested in Canadian REE projects when the US has, even though just a handful, enough to supply the foreseeable needs for many decades?

Molycorp has clearly been the favoured child but the other US plays, UCore, Rare Element Resources, Texas Rare Earths and US Rare Earths, all have different things in their favour. Texas Rare Earths has the added juice of being multi-element, with the potential for Beryllium, Lithium, Fluorspar or even Uranium potentially justifying its development.

While all of these plays are standalone at the moment, some sort of combination between one or more would make sense. Molycorp could definitely do with having a source of upstream Heavy Rare Earths. The poignant question is which one of these not-so-blushing beauties might be the chosen one.

Conclusion

Kicking Cerium and Thorium to the curb seems to be the goal of most REE technologies these days. Up and comers in the space do not want to operate under the self-delusion that has caused Lynas and Molycorp such grief that Cerium (in the short term) might be worth extracting and selling. That is a fallacy now totally dismissed.

Rare Element Resources (NYSE MKT: REE | TSX: RES) have forged ahead with a process that suits their special conditions at Bear Lodge and the effort is bearing fruit. Depending on the price of Cerium, the Cerium/Thorium stream can be stockpiled or further treated through a separate SX circuit to remove cerium for potential sale. This opens up the potential to further wind back capex and opex, which is crucial to gaining ground in the race to be the next US-based deposit to make it across the finish line of viable production of Rare Earths.