

The Not-so Shining Path to Rare Earth Permanent Magnet Independence from China

written by Jack Lifton | June 23, 2023

On June 19, 2023, the President of Raytheon was quoted, in the Financial Times, as saying that for his company, and, in general, it is now impossible to decouple from China, but it is possible, he said, to “derisk” relying on China. He cited “rare earths” [sic] as a paradigm example of the problem. He said that since “95%” of rare earths are “processed” in China there is no way to replace Chinese rare earth enabled components.

Raytheon is known in DoD parlance as a “systems integrator,” which means that it delivers a final product to the Pentagon, such as a surface to air missile, a “SAM,” which it has manufactured from parts it has both made and sourced from others. In the case of rare earth permanent magnet motors these sources, he admits, would be 95% likely to have started with Chinese rare earths, and as a sensational story about “Chinese alloys” earlier this year admitted, the motors, even if “produced” outside of China would most likely have used Chinese manufactured rare earth permanent magnet alloys in their construction.

Raytheon is a perfect example of a military-industrial contractor caught up in the politics, or geopolitics, of the moment.

And, the president of Raytheon is correct in general in his assessment that neither we, nor anyone else can completely replace China as our source of rare earth enabled devices and components, but is he right in particular?

I think not.

The Pentagon has for a long time realized that you cannot effectively create a domestic total rare earth permanent magnet supply chain piecemeal from the existing array (jumble[?]) of small specialized companies that operate today in America's very small, highly specialized, permanent magnet manufacturing industry. No American company is today mining rare earths for direct use in the American domestic market; no American company is extracting rare earths from an American rare earth ore and selling the extracted mixture to any domestic American downstream processor; no American company is separating a rare earth mixture, extracted by cracking, leaching, and processing such a pregnant leach solution into both individual and purposely blended rare earth products; no American company is manufacturing rare earth metals or alloys; and no American company is, or, under these circumstances, can be producing rare earth permanent magnets from domestic resources.

America has an abundance of accessible mineable rare earth minerals. Canada has even more. Beneficiating (selectively concentrating) the rare earth minerals in ores was developed in the United States and Europe and is well understood. The processing of rare earth minerals into mixtures free of radionuclides and of elements that interfere with further separation and purification was pioneered in Europe and the United States, and is well known. The separation of the clean mixtures of rare earths resulting from this processing into individual rare earth salts and blends by solvent extraction was developed in France and the United States. The commercial production of rare earth metals and alloys from the separated and purposely blended individual rare earths was first developed in the United States and Japan. And, the commercial manufacturing of rare earth permanent magnets, first of the samarium-cobalt type and then of the neodymium-iron-boron type

was initiated by a joint venture between America's General Motors and Japan's Sumitomo in the late 1970s.

Beginning in the early 1980s, though, all of these steps in the supply chain for rare earth permanent magnets were moved to China by financializers who wished to take advantage of the huge resource of rare earth minerals then under development in Inner Mongolia (an "autonomous" region, they say, of the PRC). Forty years later, today, that movement has long been complete.

Now, we are told by our contemporary politicians that we must "re-shore" and/or "friend-shore" this rare earth permanent magnet supply chain. These politicians who were in diapers when this particularly short-sighted move was made, think that simply by throwing money at the "problem" they can fix it.

The Chinese government is not simply a bystander to all of this. It has severely cracked down on its companies and citizens who have been traveling the world looking for rare earth deposits and attempting, at first, to set up processing and refining operations outside of China. Chinese law today forbids the export of any technology related to rare earths mining or processing. Even the Chinese rare earth industry's unofficial "lead" company in finding materials to mine outside of China has recently been forbidden to proceed with a Thai rare earth separation plant. The same prohibitions are being enforced in Vietnam, where Chinese "interests" are very well entrenched. Like any good "capitalist roader" the Chinese State Council is protecting its monopoly control of the global rare earth permanent magnet supply chain.

So, are we doomed to be unable to de-risk, much less decouple from China's rare earth permanent magnet manufacturing monopoly with its current 40 year head start?

It depends, doesn't it always, on your perspective.

If the Chinese were to cut off the supply of rare earth permanent magnets tomorrow, the American OEM automotive industry would be immediately non-competitive in BEVs. The industry would be forced to use AC motors, which are heavier and less efficient than rare earth permanent magnet motors. Although the Washington crowd, I'm sure, would immediately impose tariffs on them, Chinese made BEVs would seriously challenge domestic American BEVs, I'm sure, on price and range. Let's not even think about batteries, please.

The American military demands for rare earth permanent magnets are much smaller than those of the civilian consumer markets, so in an "emergency" it is my belief that the DoD would "sequester" the output of MP's Mountain Pass mine and spend like drunken sailors (who, I note are employees of the DoD) on downstream processing for their needs. The resulting magnets and motors would be of the fabled \$10,000 toilet seats variety. No consumer product manufacturer could afford them.

Where does this leave the consumer market for REPMs, which is four or five times the size of the military market?

At the moment it is every man (person[?]) for him/her/it self. The domestic American OEM automotive assemblers, by far the largest market for REPMs, are basically in a fierce competition among themselves to source domestic, or friend-shored, rare earths, and to find a politically acceptable downstream path from the minerals to magnets. Even if each of them used on average just one REPPM per drive train, this would require (very conservatively) 15,000,000 (vehicles per year) x 2.5 kg of Dy modified NdFeB magnets per year. This 37,500 tons per year of REPMs. This is, today, more than 25% of all REPMs produced globally (i.e., in China). This is impossible in any foreseeable "short term," if ever.

It is possible, however, for one or more of the domestic American “assemblers,” i.e., those who produce cars/trucks in North America for the US market, to become a systems integrator for rare earth permanent magnet motors. This would require that the OEM choose or invest in every type of company in a “domestic” American rare earth permanent magnet supply chain, and manage and organize them as a coherent group that complement each other in size and technologies.

I predict that the DoD is already doing exactly that, and has chosen one or more of its existing systems’ integrators for the task. I would expect that this strategy would be kept quiet, because it is inimical to the private sector; there is only so much raw material and downstream processing skill to go around.

Oh, and don’t lose sight of the demand for rare earth permanent magnets in direct-drive wind turbines, industrial motors, home appliances, cell phones, etc. And remember that North America is not the only demand center for REPMs and the products that they enable.

The Chinese rare earth permanent magnet industry is not a weapon; it is a well planned industry and has been for a very long time now dominant in the global market.

Whether or not any of our domestic American OEM industrial companies can replace Chinese suppliers, economically and efficiently, in this category with domestic suppliers due to the pressures of geopolitics and deglobalization, not market demand, is the open question.