Rare Earths, “The War Metals?”

written by Jack Lifton | February 5, 2023

Sometime after 2007, I was invited to participate in a meeting called by the Office of Net Threat (Assessment) in the inner ring of the Pentagon in Washington, DC. The topic was the impact of the lack of critical materials on the security of the United States. I was asked to discuss the necessity of rare earths for the military. Around that same time, the US Dept of Energy put out its now well-known chart of critical materials. The current version of that chart is now given as a set of bullet points

- Rare earth elements, used in offshore wind turbine generators and electric vehicle motors;
- Lithium, cobalt, and high-purity nickel, used in energy storage technologies;
- Platinum group metals used in catalysts for automotive, chemical, fuel cell, and green hydrogen products; and
- Gallium and germanium used in semiconductors.

Note well that there is no mention of specific military demands for any of the critical materials in the DoE bullet points. This doesn’t mean that these critical materials are not important to the Department of Defense; it means that the US cabinet departments have separate agendas.

Even though the Pentagon released a report in 2013 that stated that the demand for rare earth permanent magnets by the US military was “about” 1000 tons per year, the current demand figure is “classified,”

Returning to 2007 or thereabouts I well remember that the leading market cap player at the time, sometime around 2010, started using a picture of a US jet fighter plane in its

advertising and claiming that “rare earths” were critical to its (the plane’s) flying and combat operations and implying that without rare earths the US would be defenseless. This quickly became “received wisdom.”

This was, as with so many pronouncements made by many companies in the bull market not true, but it became embedded in all rare earth related advertising from then on.

The purpose and value of rare earth permanent magnets in vehicles of any type is to reduce weight and the need for space. Their value is that they can be miniaturized. In planes, trains and automobiles this allows more payload (for the military) or more range due to less power necessary to carry the weight of the magnets and less volume allowing tiny, but powerful, magnets to be used in power accessories, such as power windows and seats or, as one example of a military use, weapons bay (formerly called bomb bay) doors.

Similar stories were that then began to say that an F35 fighter/bomber needed 935 pounds of rare earth permanent magnets in its construction and operation. This misinformation has also become, today, received wisdom.

In 2017 while working on a plan to recycle rare earth permanent magnets for the Defense Logistics Agency, I, of course, asked from where the scrap magnets were to come. The answer was that the DLA didn’t have a firm grasp on that, since compartmentalization and “need to know” and classification of end uses made it impossible for any one agency of the Pentagon to know that.

I guessed that the DoD needed 3000 tons per annum of rare earth permanent magnets. I based my estimate on data about the uses in F35s from an unclassified report published by the Pentagon in 2013, and my own guesses as to the need for rare earth permanent

magnets in main battle tanks, man-carried missiles, drones, and the Navy’s adoption of electric propulsion.

Rare earth permanent magnets are important to the military for exactly the same reason they are important to the OEM automotive industry; they save weight and volume, and thus increase range and payload.

Vehicles and weapons can be made without rare earth permanent magnets; they will just be less efficient.

The Hellfire missile, made famous by being carried and launched from drones, uses Alnico (aluminum-nickel-cobalt) magnets made in the USA by a magnet maker in business now for 120 years. It could use rare earth permanent magnets, if they were available and made from domestic raw materials processed in the United States.

The F35 could use Alnico magnets in place of its current rare earth permanent magnets, but it would require special cooling to avoid curie-point failure and the additional weight and volume would reduce range and payload. The same for automobiles and trucks except that it wouldn’t be so much the payload that is sacrificed it would be convenience accessories such as power windows, seats, and doors in all cars and range in EVs.

Rare earth permanent magnet motors are the most efficient electric motors known. They are thus the best and most robust solution to engineering issues of weight and volume for both military and consumer products.

But, they are not indispensable. And, if the US requires that any such magnets be made domestically from domestic materials then we are going to need to make between 10,000 and 15,000 tons of them per year at current usage.

Even if only the military gets to use them, we would need at least 3,000 tons per year.

Today NO rare earth permanent magnets are manufactured in the USA from domestic materials.

The time to change that is NOW.

Note from the Publisher: Jack Lifton is the co-founder and the Chairman of the Critical Minerals Institute, which maintains lists of the critical minerals as identified by the US, Canada, the UK, Australia and Europe.