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Rare Earth Elements and Permanent Magnets

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Rare earth (RE) magnets have become virtually indispensible in a wide variety of industries such as aerospace, automotive, electronics, medical, and military. RE elements are essential ingredients in these high performance magnets based on inter metallic compounds RECo5, RE2TM17 (TM: transition metal), and RE2TM14B. Rare earth magnets are known for their superior magnetic properties-high induction, and coercive force. These properties arise due to the extremely high magneto crystalline anisotropy made possible by unique 3d-4f interactions between transition metals and rare earths. For more than 40 years, these magnets remain the number one choice in applications that require high magnetic fields in extreme operating conditions-high demagnetization forces and high temperature. EEC produces and specializes in RECo5 and RE2TM17 type sintered magnets. Samarium and gadolinium are keys RE ingredients in the powder metallurgical magnet production processes which include melting, crushing, jet milling, pressing, sintering, and heat treating. The magnetic properties and applications of these magnets will be discussed. We will also briefly discuss the past, current, and future of the permanent magnet business. Currently, over 95% of all pure rare earth oxides are sourced from China, which currently controls the market. We will provide insights regarding current and potential new magnet technologies and designer choices, which may mitigate rare earth supply chain issues now and into the future.

In Japan, it has been said that oil is the "blood," steel is the "body," and rare earths are the "vitamins" of a modern economy. Rare earth elements are ubiquitous in many civilian, green energy, and military technologies. They have become imbedded in applications such as face-centered catalysts for efficient oil production, florescent light bulbs, hybrid electric vehicles, nickel metal hydride batteries, computer hard drives, glass additives, polishing powders, direct-drive high power wind generators, speakers, nuclear fuels, radar, most weapons systems, and over a thousand other uses. Several rare earth elements are essential ingredients in production of the highest performance magnets available in the world today, which has enabled vast miniaturization and the significant increase in power density in hundreds of applications.

Although a broad variety of issues have been covered here in response to the current situation with China's dominance of rare earth elements, there are tremendous opportunities for technology development and commercial success. Rare earths in the short to long term will continue to be the materials of choice for many growing applications for which replacements will be very challenging if not impractical. Fortunately, the news headlines have infused much cash into non-Chinese rare earth mining and downstream supply chain development and production interests, which are moving forward with vigor in the United States, Canada, Australia, Asia, and South Africa. In addition, the U.S. government is engaged in collaborating with industry and academia in reinvigorating the international rare earth supply chain. This is a great area of business and technology to participate in through the balance of this decade.