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DOMESTIC CAPABILITY FOR MAGNET PRODUCTION

Urban Mining Company: How A U.S. Company Uses Unconventional Resources To Meet A Strategic Defense Need

With support from the Defense Logistics Agency Small Business Innovation Research Program, Texas-based Urban Mining Company further developed their Magnet-to-Magnet (M2M®) technology for using recycled materials to manufacture high performance magnets.

Rare-earth elements (REEs) are key materials used in thousands of high-tech devices. Neodymium-iron-boron (NdFeB) magnets contain REEs and are **essential** components for missiles, smart bombs, UAVs, and aircraft. NdFeB magnets enable the miniaturization of guidance, propulsion and power systems due to their weight to magnetic power ratio. Design of many current and future defense systems are based around motors and generators whose reduced size and weight and increased efficiency and performance can only be achieved using NdFeB magnets.

It was the mission of DLA in the context of strategic materials to support the development of a technological solution for NdFeB magnets that offered a high performance, low-cost alternative and immediate impact.

M2M[®] uses waste magnetic materials recovered from “end-of-life” applications to manufacture new high performance magnets. First, the company uses processes it has developed for extracting magnets from recycled hard disk drives, air conditioners, wind turbines, MRI machines, hybrid electric vehicles (HEV) and more. Then, magnetic materials are reduced and milled down into powders before re-processing into new magnets without melting the magnetic alloy phase. M2M[®] works by engineering the grain boundaries of NdFeB magnets. All sintered magnets are made up of tiny grains of magnetic Nd₂Fe₁₄B embedded in a matrix of rare-earth rich ‘grain boundary’ material. During the milling process employed during M2M[®], the magnetic grains are removed from the grain boundary phase and the ‘GBM alloy’ replaces it with a new boundary during the heating (sintering) process. This new grain boundary has a carefully tailored composition that grants recycled magnets their superior magnetic and physical properties.

Urban Mining Company uses a sustainable, domestic source to address critical demand for NdFeB magnets. M2M[®] requires a small amount of ‘virgin’ rare-earth inputs (~3%) to produce high performance magnets. This innovation places UMC largely outside of the traditional ‘mining-refining’ supply chain, as M2M[®] obtains ~97% of the material it uses to make magnets from domestic source NdFeB present in end-of-life appliances already located on US soil. M2M[®] recycling insulates UMC and its customers from REE price fluctuations and supply restrictions, and grants the company a decisive cost advantage and its customers a more stable low-cost solution.

“Collaboration with DLA and defense partners has been key and must continue to address this issue. Our technology is truly a paradigm shifting breakthrough in terms of how we all view resources,” said CEO Scott Dunn. Our final product is superior in performance where it counts – high temperature. And because there is no “performance tradeoff”, our technology opens the way for truly closed-loop systems. This potential introduces the concept that customers are not merely ‘purchasing’ magnets; they are ‘investing’ in the long-term stability and availability of their own REEs/NdFeB supply chain made possible by magnet-to-magnet recycling.”

Despite their importance to industry and defense, REEs mining, refining and magnet manufacture are largely controlled by China. Past supply crises (2010-2012), where China restricted REEs production and exports, raised the prices of REEs and NdFeB magnets by up to 3000%. Price volatility and supply restriction of NdFeB magnets would require significant R&D expenditure as the subcomponents of many defense systems would have to be redesigned or phased out. And such alternative designs would also result in reduced performance. The ‘booms and busts’ in REEs prices are directly caused by market-interventions, such as export tariffs enacted by the Chinese Government and may be deliberately contrived to maintain dominance in this sector. For the US, future reductions in REE/NdFeB magnet supply for geopolitical or other reasons are likely. Chinese high-tech industries are increasingly given preferential access to REEs per *Made In China 2025* with the aim of 70% of all materials containing REEs exported from China to be in the form of finished goods. In fact, many analysts predict that China will become the world’s largest importer of REEs by 2025. This sets the stage for future, long-term REE/NdFeB magnet supply crises. However, investing in and creating the capacity to produce REEs and NdFeB magnets in the west to neutralize geopolitical vulnerability will take at least a decade and hundreds of billions of dollars according to GAO.

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Urban Mining Company (UMC) offers a solution that does NOT require re-trenching of the entire REE supply chain in the US as the technology is ‘standalone’. M2M[®] works by recovering domestic source NdFeB alloy from end-of-life devices already located in the US. The resulting recycled magnets have superior magnetic and physical properties to the starting NdFeB materials. Using end-of-life materials allows UMC significant cost advantages while making use of an abundant domestic source. Thanks in part of DLA support, M2MTM process currently functions at a manufacturing readiness level of ~7-8. The design, construction, and installation of UMC’s fully commercial manufacturing plant for establishing strategic domestic capacity is underway in San Marcos, TX.

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