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Improving the recycling of rare earths in electric motors

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Feasible recycling concepts must be developed in the years ahead for the recycling of rare earths used in permanent magnets in modern and highly efficient electric motors. The motors used in industry are not being collected and disposed of at the end of their life cycle; the potential for recovery of rare earths is thus not being exploited. This is the finding of a survey of several hundred industrial companies in Baden-Wuerttemberg and of a study conducted on its basis by Oeko-Institut on behalf of the Baden-Wuerttemberg Ministry of the Environment, Climate Protection and the Energy Sector.

The survey carried out by Oeko-Institut established a considerable potential for the recycling of rare earths among the important and rapidly expanding segments of industry in which permanent magnets are used: In 2012 European companies produced up to two million electric motors with permanent magnets for use in industry; approx. half of these motors were produced in Germany. Around half of the magnets, which contain approx. 30 per cent rare earths, are used in Germany in industrial equipment; the other half is exported abroad, either as magnets or as part of machines and equipment.

Increasing demand for rare earths for high performance magnets

Around a fifth of rare earths produced overall is currently used in the production of high performance magnets, particularly in small motors in, for example, hard drives and the optical drives of consumer electronics. The use of electric motors is – and above all will be in the future – rapidly expanding in vehicles, in gearless wind turbines and, to a substantial extent, in electric motors and generators for industry. Almost the total production of the rare earth element dysprosium, for example, is used in the production of magnets. This is also reflected in the high price increases: the price of dysprosium rose from 150 US dollars per kilogram in 2009 to 660 US dollars in 2013.

Recycling potentials need to be fully tapped

Currently there is insufficient collection and recycling of the valuable materials (rare earths) in the increasing stock of electric motors with permanent magnets that are used in industry. As a result, the permanent magnets either land – at the latest after 30 years – on the steel or copper scrap heap or are even discarded in the household waste. Consequently, industry in Germany is not able to make use of approx. 35 to 40 tons of neodymium iron bore magnets today – a trend that is set to strongly increase up to 2025/2030.

This potential urgently needs to be tapped: “Electric motors with rare earth permanent magnets are an important part of industry in Baden-Wuerttemberg. As a result, skilled recovery of the rare earths in the electric motors used in industry is urgently necessary,” says Franz Untersteller, Minister for the Environment, Climate Protection and the Energy Sector in Baden-Wuerttemberg.

Dr. Matthias Buchert, the project leader and Head of the Infrastructure & Enterprises Division at Oeko-Institut, adds: “The infrastructure for the collection, separation and recycling of scrap magnets needs to be place in 2030 at the latest, when the amount of neodymium magnets will have risen to approx. 100 tons.”

Last but not least, recycling plays an important role in environmental protection: “The mining of rare earths, especially in China, often leads to negative impacts on the environment at the moment,” says Matthias Buchert. “Without relevant counter measures, mining in rare earth deposits, for example – almost all of which contain radioactive substances – seriously damages the environment and results in illness in the case of workers and local residents.”

Background: data collection in Baden-Wuerttemberg

Within the scope of an extensive survey of companies in Baden-Wuerttemberg, Oeko-Institut collected the data to estimate the recycling potentials with the support of the Baden-Wuerttemberg State Association of Industry (LVI), the German Electrical and Electronic Manufacturers' Association (ZVEI) and the German Association of Steel Recycling & Waste Management Companies (BDSV).

Please find here Oeko-Institut´s study “Analysis of rare earths: permanent magnets used in industry in Baden-Wuerttemberg” (in German language) as well as the presentation (in German language).