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REEPRODUCE

WELCOME ADDRESS

Welcome to our newsletter.
Celebrating 1-year progress!

Words from the coordinator

Dear reader,

It has been a busy and productive first year for the REEPRODUCE project. Since its launch in May 2022, the REEPRODUCE team has been working hard on progressing to achieve the ambitious goals of the project.

Currently the EU depends mainly on imports of both permanent magnets and the rare earths found in their composition, and there are no market-ready substitutes. In this context the European Commission has published the proposal for the Critical Raw Materials Act. To increase Europe's autonomy in rare earths, the block's strategies address the entire value chain and aim to place the EU in the position of world leader in the circular economy of rare earth magnets. In the given scenario, the European Commission presented an advanced framework for the collection schemes and recycling of these materials. However, despite this opportunity, there is still no industrial recycling activity of rare earth magnets in Europe.

In this framework, the REEPRODUCE's ambition is to establish the first sustainable and complete rare earth elements recycling value chain at industrial scale able to provide rare earths from end-of-life (EoL) products at competitive cost and with environmentally friendly technologies.

Great progress has been made during this first year. This relies on the strong teamwork and close collaboration between the partners of the REEPRODUCE consortium.

Let's continue working together to secure a strategic value chain for Europe's green transition!

Dr. Ana Maria Martinez
REEPRODUCE Project coordinator
SINTEF Industry

SINTEF

After a busy period, the REEPRODUCE consortium is able to take a first look at the first results. The outcome and processes development are ongoing while more and more data are obtained.

But let's have a look at some first impressions!

How is REEPRODUCE optimising the extraction process of Nd-based permanent magnets from devices at small scale?

Friedrich-Alexander-Universität Erlangen-Nürnberg

The institute for Factory Automation and Production Systems (FAPS) of FAU is dealing with the development of electrical machines as well as process development for diverse applications. They will now bring these interdisciplinary strengths to bear on the recovery of critical raw materials.

The role of FAU is to develop processes for the separation or disassembly of magnets from e-waste and end-of-life products. "As a research institute, we focus on basic development and concept validation for dismantling and sorting technologies in preparation for industrial upscaling."

- **What are your ambitions in contributing to stimulate a more sustainable Europe raw material value chain?**

We are aware of our responsibility to contribute to a sustainable and at the same time competitive Europe. To achieve this goal, a closed loop economy for critical raw materials is essential.

- **As experts on e-motors, how significant do you think they are for the future EU rare-earth elements (REEs) supply?**

Electric motors for high-performance drives (e.g., traction drives) are one of the main applications for relevant rare earth materials such as Neodymium, Praseodymium, Terbium and Dysprosium. Therefore, e-motors are seen as one of the most important market drivers of REEs. The dependency on exports of the relevant European industries dealing with e-motors is of big concern. Facilitating a European REEs value chain is paramount to secure a reliable supply.

- **What are the challenges faced in handling the process to recover permanent magnets (PMs) from EoL e-motors and how impactful is it on the EU's e-motors market?**

Currently, there are no series processes that allow the recovery of rare earth magnets from EoL e-motors. Major challenges are the large variety of products and the missing labeling of rare earth content in the permanent magnets used in the e-motors. In addition, sorting rare earth PMs from shredded material is challenging because their concentration is low, and the physical properties are very similar to those of other ferromagnetic materials.

- **How are you going to optimise the process of dismantling Nd-based PM from e-motors?**

At the institute FAPS we are currently developing concepts that can be applied to different rotor topologies and products. In doing so, we use adaptive tools, robots and image recognition. For this purpose, we conduct test series with different process variants, optimise these processes and subsequently build demonstrator machines together with the project partner Bronneberg.

- **How are you going to optimise the process of dismantling Nd-based PM from hard disk drives (HDDs)?**

The architecture of the hard disk drives differs largely from that of rotors from e-motors. However, the design of the HDDs is quite standardised. Therefore, we will adapt the processes to dismantle Nd-based magnets from the rotors to a flow process to disassemble magnets from the HDDs.

- **How do you plan the development of the process to separate Nd-based materials from shredded components?**

Ferromagnetic fraction of shredded WEEE" (©FAU)

The processing of shredded material is the most complex part of our tasks. This is a sorting rather than dismantling task, which must be designed as a flow process. The input material is a mixture of different ferromagnetic materials, with the individual components having similar physical properties. Therefore, the individual components must be sequentially separated until only rare earth magnets remain. Sorting methods based on different physical principles are used for this purpose.

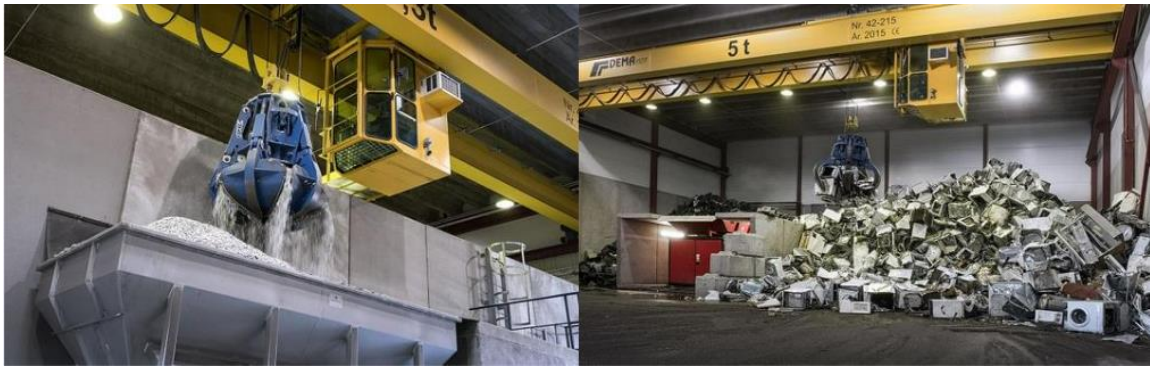
How is REEPRODUCE going to demonstrate the sorting of EoL e-motors containing Nd-based PMs?

REVAC is one of the Scandinavians biggest recyclers of WEEE (Waste of Electrical and Electronic Equipment) having recycling plants in Norway and Sweden. The Norwegian plant i recycles 70% of the total post-consumer waste electronics placed on the Norwegian market. The plant is top modern and meets all Best Available Techniques Reference Documents (BAT and BREFs) regulations for now and the near future.

Within REEPRODUCE, REVAC will identify Nd-based magnets in HVAC compressors, bringing samples further in the project and register waste products reaching our recycling plant that contains Neodymium. Moreover, the sorting machine developed by partner Sens2Sort will be validated in their plant.

- **What are your ambitions in contributing to stimulate a more sustainable raw material value chain in Europe?**

We aim to ensure EU access to a secure and sustainable supply of critical raw materials, contributing to stimulate this value chain to be recycled in the future.



Recycling WEEE in REVAC facilities (©REVAC)

- **As one of the largest companies in the treatment of WEEE in Norway, what are the main challenges you are facing today to recover critical raw materials from the WEEE?**

The main challenge is to make the recovery economically sustainable compared to the value we bring out today.

- **Apart from WEEE recycling, you are also experts on recycling cooling appliances. Which raw materials can be recovered from these devices?**

Cooling appliances gives us valuable secondary raw materials such as iron, aluminum, copper, and plastics that continue onwards into the circular economy as post-consumer secondary raw materials within the industries.

- **In REEPRODUCE, how are you going to demonstrate the sorting of EoL e-motors containing Nd-based PMs on the sorting pilot developed by Sense2Sort?**

We will test the pilot and demonstrate the possibilities to register, sort and hopefully recycle Nd-based products in the future.

Give us your HDDs, DISKUS will give them a second life!

For many years ,issues related to environmental preservation have been close to DISKUS Polska, a manufacturer of innovative devices for data removal and media destruction. DISKUS also provides services implying non-destruction of the devices, which are then sent for disposal. By participating in the process of developing technologies for the recovery of rare earth elements from electronic data carriers, they have a unique opportunity to support the idea of a circular economy in which all waste material is reused.

- **What are your ambitions in contributing to stimulate a more sustainable raw material value chain in Europe?**

It is an honor for our company to participate in the REEPRODUCE project. We are a very ambitious company that wants to have a real impact not only on the development of modern IT solutions, but also on technologies related to environmental protection. Developing the first European rare earth recovery system is a challenge for Europe. We believe that industry and science (of which we represent) will be able to achieve this goal while maintaining environmental protection through environmentally and socially sustainable technologies.

- **What are the main challenges you are facing today when dismantling (HDDs)?**

Shredded HDDs (©FAU)

The biggest problem with the services and further sorting of fractions of HDDs is due to the shredding of the complete device. Although we develop and offer media shredders, this way of destruction reduces drastically the chance to regain most of the materials from HDDs. Of course, there are professional sorting lines that can be used but it is not convenient to regain the rare earth elements. That means our challenge is to rebuild the customer's approach and the way of thinking about data security to achieve the best possible level of "green data destruction".

- **What is the state-of-the-art process of DISKUS?**

Years of experience in data media destruction (hardware and services) lead us directly to the conclusion stated above – physical media destruction (shredding) is not necessary for magnetic media, and in direct way it's the result of old standards for paper that is easy to recycle. Data destruction performed by state-of-the-art degaussers is fully covering the market needs and security demands. Our mission now is to promote degaussing (magnetic media types) and deflashing (flash media) as the ultimate secured solution to sanitise the data. That means carriers themselves are ready to be fully dismantle so up to 98% of the materials can be recycled. The idea is in line with the goal of the project.

- **As leader in manufacturing HDDs shredders, what is your main interest in the REEPRODUCE project and how it will impact your business?**

As the world's leading manufacturer of devices for removing data (degaussers, deflasher) and destroying data carriers (shredders), we want to effectively disseminate knowledge about the need to remove redundant data in an environmentally friendly manner. The developed technology will be used in the development of new devices used in combination with our degaussers for destroying hard drives, which DISKUS Polska may sell all over the world.

ProDevice ASM240+degausser (©Diskus/Polska)

Our first year progress is coming up and with that in mind, we are proud to reveal the External Advisory Board of the project!

The external advisory board (EAB) of REEPRODUCE is composed of experienced experts in the project's scope. The role, as an independent body, is to give oversight, validate the project direction and results, and provide feedback.

The REEPRODUCE's EAB members are:

David O'Brock, Commercial Director at REEtec, Norway

"The ability to effectively process end-of-life permanent magnet materials into high quality new magnets is one of the processes that REEtec has considered important for the continued development of the rare earth magnet industry in Europe. I am very happy to participate in the REEPRODUCE External Advisory Board, and contribute with expertise, point of view, test material, provide input on market requirements and required chemical specifications for use in the production of high-performance magnets."

Toru H. Okabe, Director General, Professor Institute of Industrial Science, The University of Tokyo, Japan

"For over 35 years now, I have consistently pursued research on smelting/recycling "rare metals" or "specialty metals" or "less-common metals". In addition to research on innovative production technologies, I have been working on developing innovative environmentally friendly recycling technologies for rare metals such as niobium, tantalum, tungsten, rhenium, rare-earth metals, and precious metals. I am very interested in the REEPRODUCE project, and I would be happy to

participate in the REEPRODUCE External Advisory Board, providing input on metal recycling technologies developed in Japan, and rare earth magnets' value chain."

Mario Champagne, p.eng., Chemical Process Engineer, European Recycling Platform, Landbell Group

"From the OEM's standpoint, ERP as a producer responsibility organisation feels an increasing interest from the Electric and Electronic Equipment (EEE)industry in developing their circular economy strategy namely by incorporating post-consumer materials, as secondary raw materials, like RE containing magnets, in their new products.

We are very excited about the plans proposed that will allow recovery of valuable material from end-of-life equipment, that will provide Europe with the possibility of having a secondary rare earth value chain. We are convinced of the impact that the results of the project can bring, and fully support this proposal and the consortium behind it. I am happy to participate in the REEPRODUCE External Advisory Board, to contribute by bringing our Group expertise in WEEE collection and recycling, to facilitate support from our supply chain in obtaining test material, and to provide input on the study development and results."

Jula Lanzer, Development Engineer, Materials & Components for Future Powertrain, Mercedes-Benz AG, Germany

"At Mercedes-Benz, our ambition is to make our entire fleet of new vehicles net carbon-neutral along the entire value chain and over the vehicles' entire life cycle by 2039 – from technical development to the extraction of raw materials, to production, service life and recycling. We work intensively to close material loops and increase the proportion of recycled materials to conserve primary resources.

Our goal is to build the world's most desirable cars and therefore we need high performance materials and magnets in our electrical drive systems. Securing a stable and environmentally friendly rare earth magnets value chain in a closed loop in Europe is essential and we are convinced of the impact that the results of the REEPRODUCE project can bring in this respect. We are happy to participate in the external advisory board bringing expertise in the field, point of view from an automobile manufacturer as well as providing test material to bring the project forward."

REEPRODUCE HIGHLIGHTS

The REEPRODUCE project has been included as “Good Practice” on the European Circular Economy Stakeholder Platform. This platform includes relevant innovative processes and “learning from experience” examples. The REEPRODUCE project has been acknowledged to demonstrate circularity by maintaining the value of resources throughout the cycle of production, consumption and disposal in Europe. Moreover, it has been proved to provide added value for implementation of the circular economy via an innovative process, and the achievement of a circular economy through new financing models and opportunities.

Now the REEPRODUCE project’s objectives and results are available to a community with a clear engagement to facilitate exchange among stakeholders that build a true European circular economy. Find it here.

Find further information on the REEPRODUCE website.

Recycling inside

REEPRODUCE’s on Recycling inside Magazine!

The REEPRODUCE’S Intelligent Sorting Pilot is the first step in the establishment of a resilient permanent magnet value chain in Europe.

REEPRODUCE’s and FAU at EDPC 2022 !

Insitute FAPS/FAU were at the International Electric Drives Production conference (**EDPC**) representing the REEPRODUCE project.

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