Evaluating recyclability and creating an optimized remanufacturing cycle for NdFeB

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MaXycle

To secure a future of green energy in Europe, we need to establish stable sourcing and efficient recycling of NdFeB

Neodymium-Iron-Boron (NdFeB) magnets are key materials for electromobility and green energy. While the sustainability strategies depend on NdFeB, the rare-earth elements used have been classified as EU Critical Raw Materials and 90% are produced outside the EU under critically harmful conditions and sourced from a volatile market. MaXycle aims towards estabilishing circular economy for NdFeB within the EU along with other linked-to projects. In MaXycle, the recyclability of magnets with regard to their coating and fixation in the product was researched and documented, criteria for quantifying recyclability were established and a labelling system using a recycling code represented by a data matrix code.

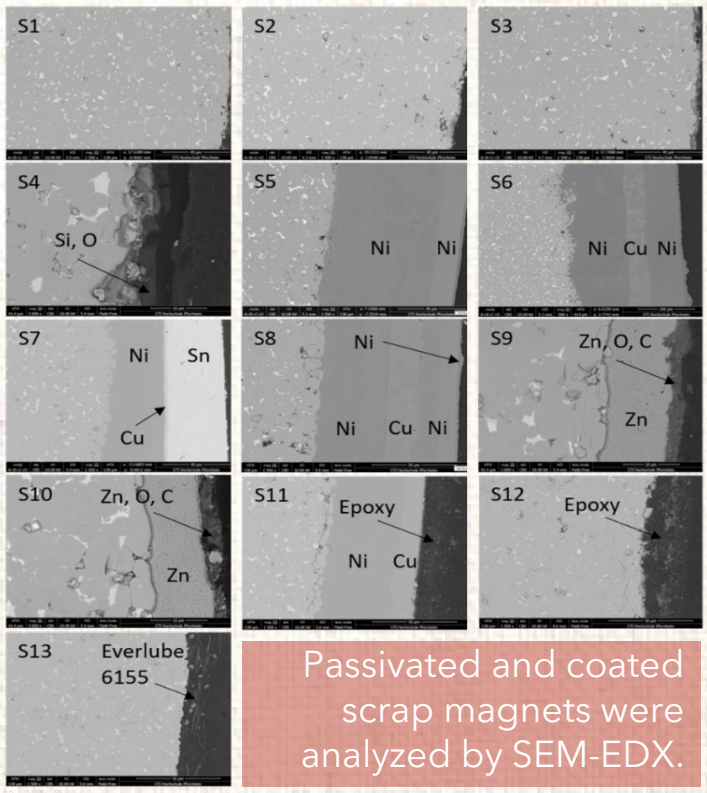
1	A	0050	X	NH52 SH	AAAABBBBYYYY
				Magnet Grade	12-digit indiv. producer code

X: Coating Type (f.e. X for polymeric)
0050: Heavy Rare earth content (f.e. 0050 for 0,5%)
A: Production method (f.e. A for sintered)
1: Magnet Type (f.e. 1 for NdFeB)

MaXycle developed a deep understanding of recycling relevant factors such as accesssibility and fixation methods, coatings and chemical compositions.

As result, a comprehensive data base system allows to grade EOL magnets for their recyclability and generates a labelling for easy identification, sorting and processing. The recycling code as shown above is suitable for damage-free laser-marking on the magnet coating itself. However, more effective for automatic processing is a labelling of the magnet containing component to pave the way to industrial scale high quality recycling of NdFeB magnets.

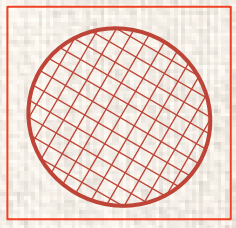
All important criteria for hydrogen assisted magnet recycling (HPMS), as e.g. the magnet's coating type were analysed in detail. Methods to improve the recycling yield were tested, implemented on lab scale and evaluated for industrial scale applications. In the case of coating evaluation, a wide range of commercially available coatings were compared with respect to functionality and removability, using standardised and bespoke testing methods, e.g. corrosion testing, electrochemical etching and various blasting technologies. The role of coatings in various states of removal as a source for potential contamination of the recycled material was investigated with a range of analytical methods, such as in-situ video monitoring of the recycling process, SEM -EDX, ICP-OES, ONH- and CS-analysis. The results were fed into the data base and provided valuable input for the grading of the recyclability.

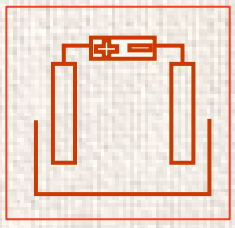


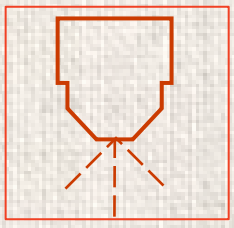
Passivated and coated scrap magnets were analyzed by SEM-EDX.

The hydrogen permeability and disintegration of coatings was monitored.

Methods for coating removal were tested.







Sieving: mixed results.

Electrolysis: mixed results.

Sandblasting: good results.

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