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Polymer-bonded magnets recycling via a hydrothermal treatment.

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Rare Earth resources become a critical topic at an era where $Nd_2Fe_{14}B$ permanent magnets are at the base of the technologies of today and tomorrow. The depletion of the geological deposits and the geographical concentration of the resources in China lead to an uncertain supplying of rare earths, intimately dependent on political situations. On the other side, we are seated on a large rare earth mine constituted by the disposals. The reclaiming and reuse of rare-earth metals from the disposals become then a favorable alternative for the future, emancipating from the international market.

These last years, processes to recycle end of life $Nd_2Fe_{14}B$ magnets are emerging, offering the possibility to use powdered $Nd_2Fe_{14}B$ disposals to produce new sintered magnets, requiring addition of fresh rare-earth material, or to create polymer bonded magnets (PBM). If recycling of sintered magnets is already carried out, recycling of PBM by recovering $Nd_2Fe_{14}B$ magnetic powder from a polymeric matrix represents a new challenge. Processes consisting in the dissolution [1-3] as well as the thermal decomposition [4] of the polymer were already proposed to recover rare-earth compounds. However, the use of aggressive solvents, such as acetone, dimethyl formamide, tetralin, naphthalene or toluene [1-3], and of temperatures up to 1200°C [4] are not ecologically viable.

The challenge of PBM recycling is taken up by the project SupplyPBM (Securing the Supply Chain for Rare Earth Polymer-Bonded Magnets by Recycling), proposing the recovery of the $Nd_2Fe_{14}B$ particles via a hydrothermal treatment. Indeed, the efficiency of supercritical water on resin removal has already been proven, for example on fiber reinforced polymers for which a total solvolysis of the polymer matrix has been obtained [5-7]. The use of water as only solvent and the heating at moderate temperatures (up to 450°C) lead to relatively low environmental impacts [8], in agreement with the ecological deontology of SupplyPBM project. In addition, the project is also driven by the will to conserve the magnetic properties of $Nd_2Fe_{14}B$ particles during the treatment in order to be able to directly substitute the primary magnetic material in the PBM production chain and demonstrate a circular economy route for rare earth polymer-bonded magnets.

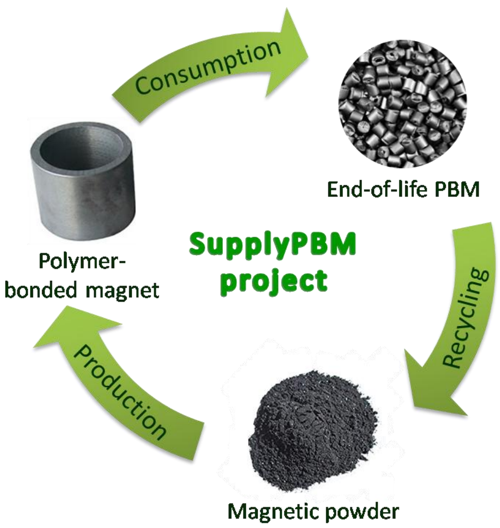

Figure 1: Circular economy route for rare earth polymer-bonded magnets in the frame of SupplyPBM project

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