Tailored Metal Injection Moulding Of Isotropic NdFeB Hard Magnets Based On Recycled Powders With And Without Nd-Additions

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Abstract
As the raw materials used for permanent magnets production is a critical factor in the development of a low carbon future as envisioned by the European Union, the Horizon 2020 project Resource Efficient Production of Magnets (REProMag http://www.repromag-project.eu/) aims to address the issue of the sustainability of RE permanent magnets by developing an innovative automated manufacturing route called the SDS (Shaping, Debinding and Sintering) process. This process will allow the economically efficient production of net shape or near net shape magnetic parts possibly with complex structures and geometries, whilst being waste-free through the use of fully recycled raw material and a 100% material efficiency in the subsequent processing steps of shaping, debinding and sintering. The REProMag SDS processing route is based on the use of powder obtained from the end of life rare earth magnets by means of the hydrogen processing for magnetic scrap (HPMS) process [1,2]. A proprietary binder system has been developed for producing a mouldable SDS feedstock, having a chemical composition optimised for the processing of the highly reactive magnetic powder. NdFeB-based magnets were processed in a modified injection moulding unit and were subsequently debinded and sintered under carefully tailored conditions. An overview of the project, including the processing steps and their associated challenges, the influence of the debinding and sintering conditions on the microstructure and the magnetic properties of isotropic sintered SDS parts (with and without Nd-additions) are presented and discussed. Special attention is given to temperature control, gas pressure conditions and atmospheres during the thermal debinding and sintering.