Polylactic acid bonded magnets – impact of loading fraction on viscoelastic and magnetic properties

Tilen Švarc, Mihael Brunčko

University of Maribor, Faculty of mechanical engineering, Smetanova ulica 17, 2000 Maribor, Slovenia
E-mail: tilen.svarc1@um.si

Injection moulded polymer bonded magnets are a composite material consisting of thermoplastic polymer binders and magnetic fillers, where the most common ones are rare-earth based – Nd-Fe-B and Sm-Co[1].

With the transition to a green and circular economy demand for recycling of end-of-life products is at an all-time high, as is the use of biobased materials. Currently the most widely used biobased polymer is polylactic acid[2]. Polylactic acid presents a promising alternative to polyamide and polyphenylene sulphide in applications where high temperatures are not present – sensors and small electric motors.

Understanding of viscoelastic behaviour of polymer melts with solid fillers is crucial for the planning of the manufacturing process of highly filled polymer materials. To fully understand the viscoelastic behaviour of such materials chemical and mechanical interactions between the polymer melt and the filler material must be studied[3]. Here we will present the preparation of a composite consisting of polylactic acid and isotropic spherical Nd-Fe-B magnetitic particles, its temperature dependent behaviour, viscoelastic behaviour at elevated temperatures and microstructure. With appropriate material composition and process parameters PLA based bonded magnets show promise to be applicable in additive manufacturing based on filament extrusion[4,5].

1. J.M.D. Coey, Perspective and Prospects for Rare Earth Permanent Magnets, Engineering, **2020**, *6*, 199–131
2. Jan-Georg Rosenboom, Robert Langer, Giovanni Traverso, Bioplastics for a circular economy, *Nature Reviews Materials*, **2022**, *7,* 117–137.
3. Martha Margarita Rueda, Marie-Camille Auscher, René Fulchiron, Thomas Périé, Grégory Martin, Philippe Sonntag, Philippe Cassagnau, Rheology and applications of highly filled polymers: A review of current understanding, *Progress in Polymer Science*, **2017**, *66*, 22–53
4. Eda Hazal Tümer, Husnu Yildirim Erbil, Extrusion-Based 3D Printing Applications of PLA Composites: A Review, Coatings, **2021**, *11*, 390
5. Janez Slapnik, Irena Pulko, Rebeka Rudolf, Ivan Anžel, Mihael Brunčko, Fused filament fabrication of Nd-Fe-B bonded magnets: Comparison of PA12 and TPU matrices, Additive Manufacturing, **2021**, *38*, 101745