ABSTRACT

Thesis title:

Optimisation of performance properties of EPDM terpolymer-based composites filled with biocomponents and functionalized with nanostructured mineral additives

Abstract:

This dissertation presents the preparation and test results of newly developed composite materials based on EPDM (ethylene-propylene-diene monomer) using selected additives, fillers of natural source and by-products of forest biomass combustion and artificial sports surfaces.

The theoretical part characterises the rubber industry, the opportunities but also the challenges of managing post-consumer materials.

The experimental section consists of the results of own research. Two forms of halloysite, hemp fibres, antimicrobial additives and two types of combustion by-products (from forest biomass and artificial sports surfaces) are characterised. Laboratory- and industrial-scale fabrication and test methods, of polymer composites, are described. The newly formulated composite materials were characterised in terms of the possibility to search for a correlation between the type of filler, its rate of dispersion and the change in physical, mechanical and physicochemical properties. It has been shown that composites containing fillers up to a specific concentration, exhibit stable and often more positive properties compared to the reference compound. Often, however, performance is affected once the critical amount is exceeded. In the case of antimicrobial additives and by-products of sport surface combustion, stable rheological properties of the rubber compounds, acceptable kinematic viscosities, mechanical parameters both before and after ageing, and comparable tribological properties to the reference material, such as hardness and the abrasion resistance of the vulcanized compounds, were observed. Analyses were carried out for selected samples: SEM, GC, FT-IR, TGA and DSC.

In the final part of the study, general and specific conclusions were formulated. The direction of further research and development work is also indicated.

Keywords: EPDM, halloysite, calcium carbonate, antibacterial additives, circular economy, combustion by-products