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PRACA DOKTORSKA

Biokompozyty wybranych poliestrów biodegradowalnych

Praca zrealizowana w Instytucie Inżynierii Materiałów Polimerowych i Barwników oraz w Centrum Materiałów Polimerowych i Węglowych Polskiej Akademii Nauk

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Gliwice 2018

Załącznik nr 2

Abstract

Polymer biocomposites containing biodegradable polymer matrix and vegetable filler are materials of continually increasing significance. The evaluation of the interaction between biodegradable matrix and natural filler and their impact on properties of obtained composites is important for polymer processing and applications of composites.

The influences of unmodified filler such as cork, jute and wood flour on the mechanical, rheological and thermal properties of composites were studied. Polymer matrices based on selected polyhydroxyalkanoates (PHA) were: PHB homopolyester, PHBV and P3HB4HB copolyesters. It was found that the tested compositions exhibited a character of pseudoplastic fluids. The influence of unmodified fillers on physical and mechanical properties of obtained biocomposites was also demonstrated. PHB and PHBV biocomposites with jute fibres and wood flour presented improved tensile strength, Young's modulus and impact strength in comparison with unfilled matrices. Tensile strength of composites increased with increasing of filler content. Cork filler caused the increase of the elasticity (decrease of Young's modulus value) of composites based on polyester matrix: PHB and PHBV which moreover showed the highest degree of crystallinity among the used matrices. The described properties were not improved in the case of the P3HB4HB matrix. The effect of addition of cross-linked PHB (clPHB) obtained by reactive extrusion was also examined. The addition of clPHB reduced the susceptibility of the PHB matrix to secondary crystallization, that was proved by DSC investigation. The decrease of Young's modulus and the increase of tensile strength for composites PHB/clPHB were also observed.

PHAs are low thermal stability materials. However it was found that a cork as a filler in PHA biocomposites showed the increase of T_{max} value of obtained biocomposites, regardless of the used matrix. During the studies the substances contained in cork, which may be responsible for increased thermal stability of PHA were selected. The tests of PHBV mixtures with ellagic or gallic acid showed the effect of these acids on increasing of thermal stability of PHBV. The studies proved a significant effect of the addition of the other compounds containing acid hydrogens (e.g. p-toluenesulfonic acid) on thermal stability of tested PHAs. The obtained results have not given an unequivocal answer confirming the mechanism of thermal stability process (both PHA degradation process i.e.: *cis*-elimination and elimination catalyzed by base, lead to obtaining the same products).

(Bio)degradation studies of P3HB4HB/cork composites do not affect their ability to (bio)degradation in industrial composting conditions.