A novel types of compound for surface treatment of carbon nanotubes for more effective application in polymers

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Abstract

Nowadays, beneficial management of plastic and rubber waste from different sources and environmentally friendly ways of recycling is becoming an increasing challenge. A possible solution for that problem could be to produce plastic composites usually consisting of heterogeneous phases. That fact and the interface between phases, and characteristics of components all play important roles in development of properties of end-product. By using a compatibilizing additive a chemical bridge can be created between the plastic composite components requiring reactive functional groups. In case of carbon nanotube containing composites particular attention must be paid to the formation of suitable interactions between the dispersed material and the matrix that can be carried out by impregnating the surface of carbon nanotubes with dispersed additive in hydrocarbon solution or in aqueous surfactant containing composition. We have applied O/W typed emulsion techniques for carbon nanotube impregnation, bearing in mind the importance of environmental regulations for the conditions of treatment. Compatibilizing additives have been classified by various analytical measurements (total acid number, saponification value measurement, size exclusion chromatography, FT-IR measurements, adhesive strength, conditions of emulsification) to identify the possible structure of the additive and to study interactions with the reinforcing material.

Keywords: rubber waste, compatibilizing additives, emulsification, carbon nanotube

1. Introduction

Plastics are integral part of society and have varied applications. Plastics are composed of a network of molecular monomers bound together to form macromolecules. As of 2017, the worldwide annual production of plastic reached 348 million tonnes, however, worldwide plastic recycling contributed to only 10% of this production. [1]

The polymer composites are one of the most promising materials for researching purpose. The composites are consisting of two main phases: the bulk matrix and the disparaged phase. If the matrix and the disparaged phase have very different chemical properties (e.g.: one of them has apolar surface and the other has polar one) then a compatibilizing additive a has be used.

During our work we produced olefin-maleic-anhydride copolymer based compatibilizer additives. The purpose of the study has been to identify the structure of the produced compatibilizers in a more exact way. Based on more information about the molecule structure of the additives more advanced composites can be produced.

2. Experiments and Results

Structure of the molecules was examined with titration methods such as measurement of acid number value, furthermore FT-IR spectroscopy and size exclusion chromatography measurements were carried out. As the acid number value corresponds to the amount of carboxylic acid groups in the additive information about maleic-anhydride functional groups was collected. The FT-IR spectroscopy is capable of recognizing the ratio of the different functional groups (ester-amide, imide, half-ester and unreacted anhydride) in the additive (Fig.1). Size exclusion chromatography was used to measure molecular weight of the additives and its distribution.

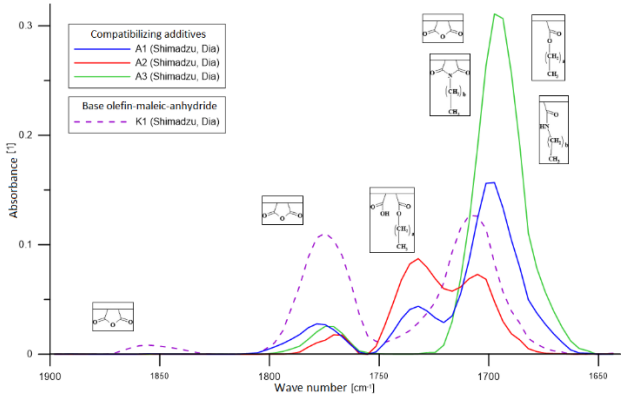

Figure 1. The molecular structure of the base olefin-maleic-anhydride copolymer and its derivatives used as compatibilizing additives

References

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