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Graphene-Graphene Oxide Dopping Effect on the Mechanical Properties of Polyamide Composites

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Abstract : Graphene and graphene oxide have been intensively studied due to the very good properties, which are intrinsic to the material or come from the easy doping of those with other functional groups. Graphene and graphene oxide have known a broad band of useful applications, in electronic devices, drug delivery systems, medical devices, sensors and opto-electronics, coating materials, sorbents of different agents for environmental applications, etc. The board range of applications does not come only from the use of graphene or graphene oxide alone, or by its prior functionalization with different moieties, but also it is a building block and an important component in many composite devices, its addition coming with new functionalities on the final composite or strengthening the ones that are already existent on the parent product. An attempt to improve the mechanical properties of polyamide elastomers by compounding with graphene oxide in the parent polymer composition was attempted. The addition of the graphene oxide contributes to the properties of the final product, improving the hardness and aging resistance. Graphene oxide has a lower hardness and textile strength, and if the amount of graphene oxide in the final product is not correctly estimated, it can lead to mechanical properties which are comparable to the starting material or even worse, the graphene oxide agglomerates becoming a tearing point in the final material if the amount added is too high (in a value greater than 3% towards the parent material measured in mass percentages). Two different types of tests were done on the obtained materials, the hardness standard test and the tensile strength standard test, and they were made on the obtained materials before and after the aging process. For the aging process, an accelerated aging was used in order to simulate the effect of natural aging over a long period of time. The accelerated aging was made in extreme heat. For all materials, FT-IR spectra were recorded using FT-IR spectroscopy. From the FT-IR spectra only the bands corresponding to the polyamide were intense, while the characteristic bands for graphene oxide were very small in comparison due to the very small amounts introduced in the final composite along with the low absorptivity of the graphene backbone and limited number of functional groups. In conclusion, some compositions showed very promising results, both in tensile strength test and in hardness tests. The best ratio of graphene to elastomer was between 0.6 and 0.8%, this addition extending the life of the product. Acknowledgements: The present work was possible due to the EU-funding grant POSCCE-A2O2.2.1-2013-1, Project No. 638/12.03.2014, code SMIS-CSNR 48652. The financial contribution received from the national project 'New nanostructured polymeric composites for centre pivot liners, centre plate and other components for the railway industry (RONERANANOSTRUCT)', No: 18 PTE (PN-III-P2-2.1-PTE-2016-0146) is also acknowledged.
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