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The Progressive Technologies and Materials

edited by
Grzegorz Samołyk

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Contents

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The influence of nanofillers on LDPE mechanical properties

Keywords: Low-Density Polyethylene, nanofillers, injection molding, mechanical properties.

Abstract

Polymer nanocomposite has been known as one of the early success stories of realizing the potential of nanomaterial as reinforcement filler to improve the properties of neat polymers. By adding the nano sized organic compounds, the properties of polymers are improved. Properties of the produced nanocomposites depend on the inorganic materials present in the polymers matrix.

The polymer Low-Density Polyethylene (LDPE) marketed under the trade name Malen E, produced by Basell Orlen Polyolefins Company, was used in the experimental tests. This material was modified by Halloysite nanotubes (HNT). Halloysite is a naturally occurring member of the kaolin family of aluminosilicate clays. Halloysite nanotubes, produced by Sigma-Aldrich Company, in the form of powder of the grain diameter from 30 to 70 nm and length 1-3 μm was used as filler. Polyethylene grafted with maleic anhydride (PE-*graft*-MA), produced by Sigma-Aldrich Company, as a compatibilizer was used in the tests.

The article aims to investigate the influence of filler mass content HNT on the selected mechanical properties of polymer nanocomposites with LDPE matrix. The material LDPE was modified by HNT with a mass content of 2, 4, 6 wt%. Nanocomposites were filled with 5 wt% PE-graft-MA as a compatibilizer.

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The specimens were prepared by injection molding on injection molding machine type Arburg Allrounder 320 C 500 – 170. Mechanical properties of specimens were tested by static tensile test (Young's modulus, tensile strength, tensile strain at strength), Charpy impact test and Shore hardness test according to standards. The surface of pure polyethylene without additives is shown on Fig.1. Figure 2 shows the structure of polyethylene with 2% addition of HNT and 5% of compatibilizer. The relationship between Charpy impact strength and the filler content of the HNT without the addition of compatibilizer and with the addition of a compatibilizer is shown on Fig.3.

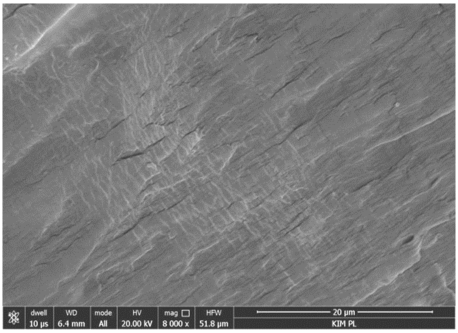


Fig.1 The surface of pure LDPE without additives

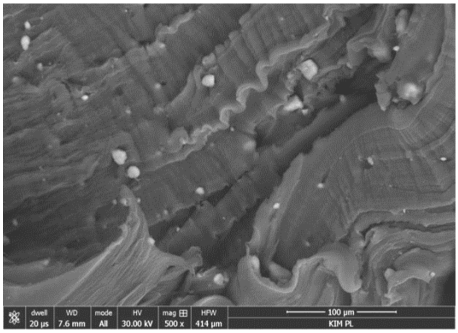
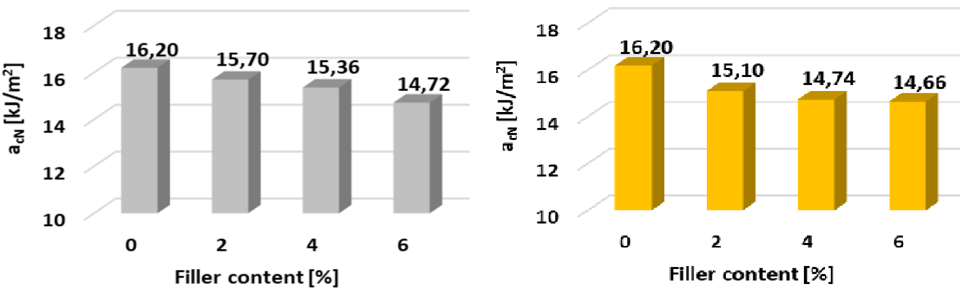


Fig.2 Structure LDPE with 2% addition of HNT and 5% of compatibilizer



a) b)

Fig.3 Charpy impact strength in dependence on nanofiller mass content without the addition of compatibilizer (a) and with the addition of 5% of compatibilizer (b)

Based on the research it can be concluded that the tensile strength was increased by adding the filler and PE-graft-MA and strain at strength was decreased by adding the fillers and PE-graft-MA. The hardness of the tested materials remained almost constant over the test but showed a tendency to decrease. The largest deterioration of the investigated properties was observed for the tested materials by the Charpy impact test.

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 734205 – H2020-MSCA-RISE-2017.