POLYOXYMETHYLENE/NANOSILICA NANOCOMPOSITES

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Introduction

During the last years a big increase in interest in the study of nanoscale materials has been noticed. One of the important areas of nanotechnology are polymer nanocomposites [1,2,3]. POM is an engineering polymer showing very good mechanical and chemical properties. The advantages like hardness, toughness, good dimensional stability of the polymer moulder and ease of processing make polyacetals very useful materials for the automotive, electronics and electrotechnical industries.

The results described in this paper concern the use of silica nanoparticles and its modified form. It was found that all the nanocomposites (with different quantity of fumed silica) showed better mechanical properties, higher thermal stability and resistance in use in comparison with non-modified polyoxymethylene.

Materials and Preparation

Polyoxymethylene (POM) in powder (grade Tarnoform) was supplied by Nitrogen Works in Tarnow-Moscice S.A., Poland and had a melt flow rate MFR = 10 g/10 min.

Fumed silica (14 nm) was provided by Aldrich and modified according to the process elaborated in Industrial Chemistry Research Institute [4].

Polyoxymethylene and fumed silica [5] were melt mixed using a Berstorff ZE-25x33D co-rotating twin-screw extruder (D = 25 mm, L/D = 33). Compouding was carried out using screw speed of 100 rpm and at the temperature profile 209-219^{o}C for the sequential heating zones. Than the product was dried and injection moulded.

Methods and Characterisation

A thermobalance (TGA/SDTA 851e Mettler - Toledo) was used to investigate the thermooxidative stability. The weight loss of a polymer annealed at 222 ^{o}C, after 10, 30 and 60 min (K_{222}) was measured. The content of the unstable fraction (UF) was calculated as weight loss of a

polymer annealed for 1 h at 222^{o}C under pressure 50 Pa. Melt flow rate (MFR) was examined according to ISO 1133: 2002. The mechanical properties were obtained according to ISO 527 and ISO 179. The microstructures of nanocomposites were examined using a ZEISS-SUPRA scanning electron microscope.

Results

Table 1. Melt flow rate (MFR) and thermal properties of POM and POM nanocomposites.

	MFR *[g/10 min.]*	*UF* *[wt. %]*	K_{222} *[wt. %]*
Polyoxymethylene	**9**	**0.64**	**0.13__0.38__0.62**
Nanocomposites with modified nanosilica [wt. %] 0.25	10	0,60	0.07__0.17__0.28
0.50	10	0.65	0.06__0.14__0.22
1.0	9	0.67	0.07__0.15__0.25
2.0	9	0.72	0.11__0.25__0.40
4.0	8	0.89	0.26__0.52__0.78

The research in the field of thermal analysis (Table 1.,K_{222}) showed the influence of nanosilica on the polymer structure (the content of the crystalline phase) and on its thermal stability is very high. The results indicate the possibility of obtaining a material with high resistance in use.

References

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