Thermal Oxidative Aging of Biodegradable Poly(propylene carbonate) / Organophilic Montmorillonite Nanocomposites

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Abstract: Poly(propylene carbonate) (PPC) / organophilic montmorillonite (OMMT) nanocomposites were prepared by direct melt intercalation. Effect of OMMT on thermal oxidative aging of PPC/OMMT nanocomposites was investigated. The results showed that the reserved values of tensile strength and elongation at break of PPC/OMMT nanocomposites were higher than that of pure PPC after thermal oxidative aging. The heat aging properties of PPC were obviously improved by adding OMMT.

Key words: poly(propylene carbonate); organophilic montmorillonite; nanocomposite; thermal oxidative aging
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Some studies indicated that the influence of layered silicate on the degradation and stability of the nanocomposites are controversial. It is reported that PP/layered silicate nanocomposites have a faster degradation rate in photo oxidation and thermal oxidation[1—3]. But Tidjani[4] found that stability of PP/clay nanocomposites is improved. Investigation based on thermal oxidative aging of PPC/layered silicate nanocomposites hasn't been reported.

In this paper, thermal oxidative aging of PPC/OMMT nanocomposites was investigated.

1 Experiments

1.1 Materials

PPC was provided by Mengxi High-tech Group Company, Neimenggu. OMMT was purchased from Zhejiang Fenghong clay chemicals Co., Ltd.

1.2 Preparation of PPC/OMMT composites

PPC/OMMT composites were prepared by melt compounding at 110 ℃ using a Hake rheometer with a screw speed of 40 r/min for 10 min. Pure PPC and the composites were then pressed at 10 MPa for further use.

1.3 Thermal oxidative aging

The samples were exposed in a circulating oven set at 75 ℃ for 30 days. After exposure, tensile properties tests of the samples were carried out.

1.4 X-ray measurement

X-ray measurements were performed on a X-ray diffraction meter (D8-advance, Bruker) using the CuK_α radiation at room temperature in the range of $2\theta = 1.7^\circ$ to 30° with a scanning rate of 2°/min.

2 Results and discussion

2.1 X-ray measurements

Fig. 1 showed the XRD patterns of OMMT and PPC/OMMT composite. The interlayer distances of OMMT enlarged from the original 3.65 nm ($2\theta = 2.42^\circ$) to 4.30 nm ($2\theta = 2.05^\circ$) for PPC/OMMT composite. The change of the (001) diffraction peak of OMMT in the XRD pattern suggests that the clay has an intercalated dispersion in PPC.

2.2 Change of retention of tensile properties

Reserved values of the tensile properties, determined by the ratio of the tensile properties after aging to that before aging, were used to evaluate the retention of the properties (Fig. 2).

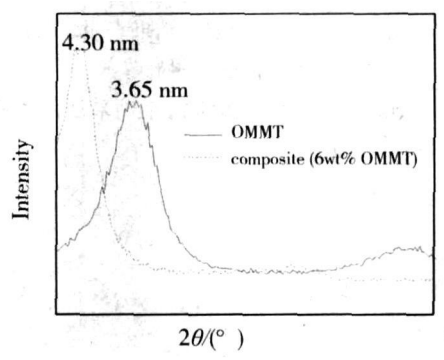

Fig. 1 XRD patterns of OMMT and PPC/OMMT composite

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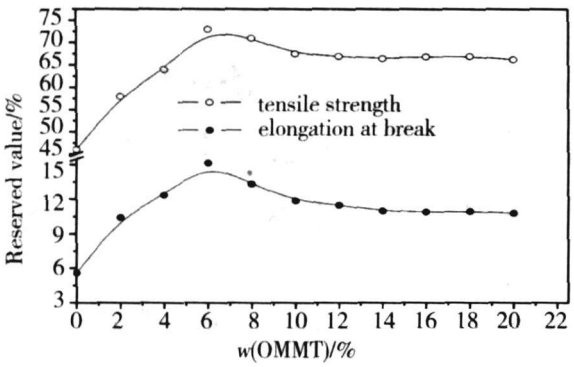

Fig. 2 Reserved values of tensile properties after 30 days aging

Interestingly, the two curves show the same trend. The retention of tensile properties of the composites is higher than that of the pure PPC. The optimum retention occurs while the content of OMMT is 6%. When the OMMT content is lower than 6%, the retention of the composites is improved with the increase of OMMT. Moreover, the retention tends to decrease when the OMMT content is higher than 6% and becomes almost invariable when the OMMT content is higher than 10%. The improvement can be attributed to the intercalated structure of the nanocomposites which acts as barriers, reducing oxygen diffusion through the samples.

3 Conclusions

The retention of both the tensile strength and the elongation at break of PPC/OMMT nanocomposites was increased obviously compared to the pure PPC. Noticeably, the nanocomposite with 6% OMMT had an optimum retention of the tensile properties.

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生物可降解性聚碳酸亚丙酯/有机蒙脱土纳米复合材料的热氧老化

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摘 要: 通过熔融插层法制备了聚碳酸亚丙酯 (PPC)/有机蒙脱土 (OMMT) 纳米复合材料。研究了 OMMT对 PPC/OMMT纳米复合材料热氧老化的影响。结果表明, 老化以后复合材料的拉伸强度以及断裂伸长率的保留率均高于纯 PPC。加入 OMMT后, 复合材料的热老化性能明显改善。

关键词: 聚碳酸亚丙酯; 有机蒙脱土; 纳米复合材料; 热氧老化
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