3rd International Conference On Masterbatch & Polymer Compounds 5,6 th Feb 2018

انجمن تولیـــدکنندگان مستربچ و کامپاند ایران
IRAN MASTERBATCH & COMPOUND PRODUCERS ASSOCIATION
IMPA

Analysis of optical and Thermal Resistance of Polypropylene Fibers Containing Zinc Oxide Nanoparticles

Authors: 1- Elham Alinaghizadeh , 2- Oveys Afzali Neniz

1- PhD student in Chemistry, responsible for development research department of Rangdaneh Sirjan Company

2- PhD student in Civil engineering, responsible for development research department of Sirjan Nano Yarn and Granule Company

Abstract

In this study, the effect of Zinc oxide nanoparticles in polypropylene fibers on the properties of these fibers, including its optical and thermal resistance, was investigated. So first, polypropylene chips containing Zinc oxide nanoparticles prepared using a melt mixing method. The weight percentages of nanoparticles in polypropylene 3, 7, and 10%, and the ratio of compatibilizer to nanoparticles 3 to 1 were used. In order to analysis the compatibilizer effect, the sample containing the nanoparticle and without the compatibilizer was also prepared. Then, the above-mentioned samples were produced by fibers melt spinning method. In the production phase, the fibers were prepared by mixing samples prepared with pure polypropylene granules fibers with 2% wt of nanoparticles. The fibers were exposed to ultraviolet radiation along with pure polypropylene yarn, and microscopic images, optical stability, and thermal stability were evaluated.

Introduction

Polypropylene is one of the most used polymers in various forms, including fibers. Polypropylene fibers are used for a number of reasons, such as the easy manufacturing process, high tensile strength, cheaper price, excellent chemical resistance and abrasive resistance for a wide range of applications. In spite of the considerable advantages, polypropylene fibers have disadvantages such as low polarity, low melting point, Inability to dye with conventional methods and low optical and thermal resistance. These fibers exposed to ultraviolet rays and in the presence of atmospheric oxygen are degraded, degradation of the polymer are irreversible [3]. Among the organic and inorganic particles as fillers, nanoparticles of zinc oxide have been given great attention. In addition to ultraviolet absorption, this nanoparticle has other advantages over other light stabilizers, which are not degraded by light absorbed, they do not migrate and in many cases improve the mechanical, electrical and optical properties of the polymer .

Experimental

Methodology:

Materials:

In this study, polypropylene granules with a density of 0.9 and a melt flow index of 18 g / 10 min, a zinc oxide nanoparticle with a diameter of less than 60 nm, and a polypropylene bonded with maleic anhydride with a melt flow index of 64 gr / 10min as a compatibilizer used.

Sample preparation:

First, the polypropylene chips are removed from the bags and put into the reactor, followed by a nano-oxide zinc colloid. The melting point of the pure polypropylene is 165-170 ° C and melts at a melting point at a temperature of 180 °.

The molten polypropylene will be completely homogeneously mixed with a nano-silicon colloidal mixer until all of the water entering the reactor is evaporated. Then, with the opening of the reactor lower valve, the molten nanosilver / Polypropylene nanocomposite enters a spinning beam by a gear pump. It should be noted that the melt is transmitted from the reactor to a spinning beam through double-wall tubes by outer wall of the hot oil. When the reactor and beam feeder are completed, it's time for the second reactor recharge.

After the reactor, the product is intered into parallel spinning pumps. Each pump can be equipped with two or more string instruments suitable for producing 2mm thick threads. Output threads from Spinneret enters a cold water bath. This water should be free of minerals. The strings are dried by the dryer and at the end of the bath, the strings are drawn by the Take up rollers and the guide inside the pelletizer. The resulting chips are then inserted into the slurry tank. The process of melting is started by feeding the polymeric chips and masterbatch of zinc nanooxide on PP bases inside the extruder.

The molten polymer passes through a pre-filter before entering the spinner's head, and after filtration, the molten polymer enters a gear pump and then is sent to the spinner and then enters the dye and eventually flows into a cooling chamber and it is wrapped around a bobbin.

Result & Discussion

Table 2 shows the percentage of zinc oxide in zinc oxide nano powder, which indicates a higher percentage of zinc oxide of 97.8%.

As shown in Fig. 1, the size distribution of nanoparticles is between 40-60 nm.

Thermal resistance:

The oxidation stability time is the determination of the resistance of a substance to oxidation by the thermal analysis, the time interval between the initiation of thermal oxidation in one substance at a specific temperature in the atmospheric oxygen up to the beginning of the material degradation reaction. Indeed, the higher the thermal stabilizer additive, the higher the index, the greater the time it takes to start the thermal degradation of the substance.

Thermal resistance was evaluated with DSC. As shown in Fig. 1, increasing the amount of nanoparticles of zinc oxide in the samples improves this parameter and delay polymer degradation and prevents the oxidation of the polymer. As well as in compatibilizer samples, due to the enhancement of the nanoparticle bond with the polymer, increasing the compatibilizer material content lead to Increased thermal stability.

Conclusion

Microscopic images show the distribution size of the compatibilizer particles and the presence of a fiber-compatibilizer ingredient. Increasing the amount of nanoparticles of zinc oxide in the samples improves this parameter and delays polymer degradation and prevents oxidation of the polymer. The optical resistance of the samples improved with increasing nano-particle size (up to 2% by weight of the compatibilizer), but by increasing the percentage of compatibilizer (from 2% up), it changes the color shade.

References

1. Tests and results in production lines and masterbatch and competate labs, and modulus yarns and high resistance of the Rangdaneh complex and Sirjan Nano Yarn
2. Huanhua Wang,Robert L.Wick,Baoshan Xing,"Toxocity of nanoparticulat and bulk ZnO, Al2O3 and tiO2 to the nematode caonorhabditis elegans","Enviromental Pollution.",Vol157,pp 1171-1177,2009
3. I.Perelshtein,G.Applerot,N.Perkas,E.Wehrschuetz-Singl,A.Hasmann,G.Guebitz,A.Guebitz,A.Guebitz,A.Gedanken,"CuO-Cotton nanocompositon,morphology,and antibacterial activity","Surface and Coatings Technology", Vol 204,pp 54-57,2009
4. Sang Yeo,sung Hoon Jeong,"Preparation and characterization of polypropylene/silver nanocomposite fibers", Vol 52,pp1053-1057,2003
5. Sang Young Yeo,Hoon Joo Lee Jeong,"preparation of nanocomposite fibers for permanent antibacterial effect","Journal of Material Science",Vol 38,pp2143,2003

Table & Figures

Sample	Percent of nano-oxide zinc	Percent of Compatibilizer
PP	0	0
P03	3	0
P07	7	0
P10	10	0
P03M	3	1
P07M	7	2
P10M	10	3

Table1: Abbreviations of production samples

sample code Test subject (W/W%)	Sample 1	sample 2
Alumina	0.32	0.73
Silicon Dioxide	3.20	0.46
Sulfur Trioxide	0.70	0.82
Titanium Dioxide	13.28	-
Zinc Oxide	3.47	97.8
sil er Oxide	-	0.19

Table2: XRF test results

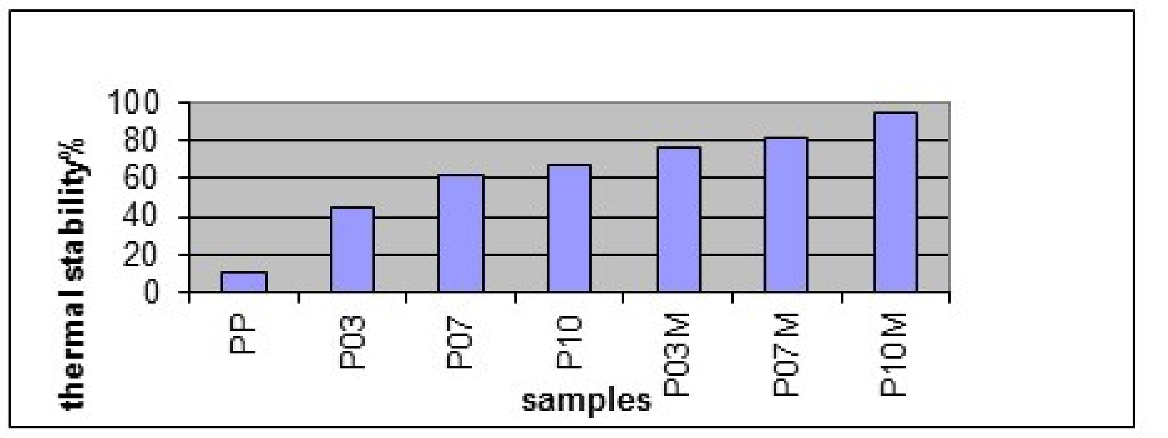

Chart 1 : analyzing the Thermal Stability of Samples

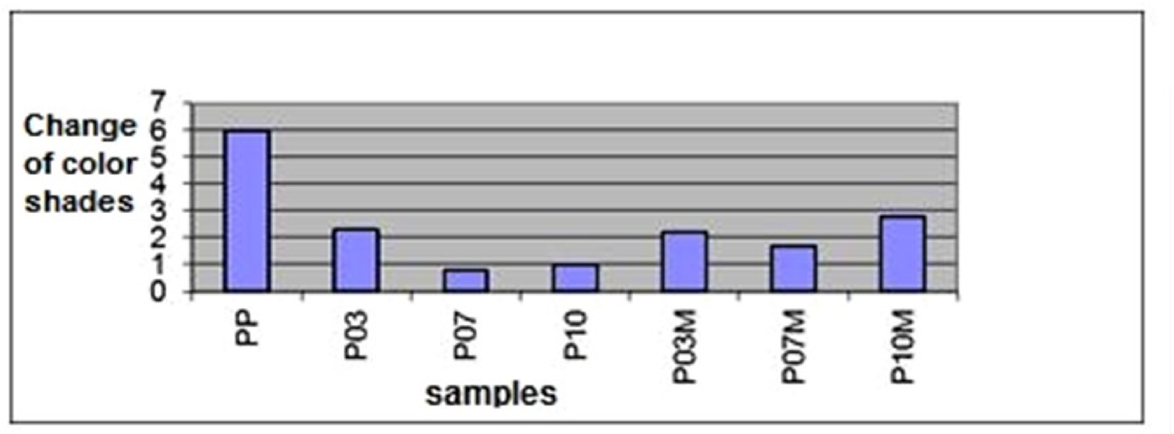

Chart 2 : analyzing the color shade against sunlight (250 hours)

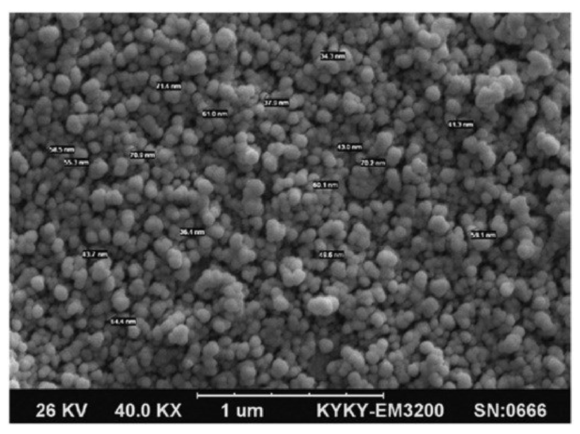

Figure 1: SEM test results

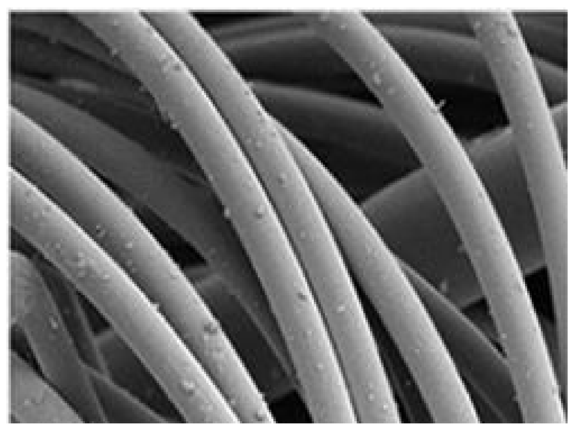

Figure 2 : Zinc Oxide Nanoparticles Fibers