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Investigating the effect of Ma-grafted additives on PP and PA based compounds

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Abstract

The Mechanical performance of Polyamide6 and Polypropylene compounds in composition with maleic anhydride grafted additives has been investigated. The study allows direct comparison of the mechanical performance of different PA6 and PP based compounds and the effect of 5 different types of Ma-grafted additives. Furthermore, the comparison of these systems has been made over various content range of Ma-grafted additives. It is assumed that the efficiency of grafting maleic anhydride on polymer chains and the base polymer in these additives are two key points on improving the mechanical properties of above mentioned compounds. It was found that the Maleic Anhydride content in Ma-grafted thermoplastic copolymer additive is not playing an effective role on the performance of these additives as compatibilizer, Impact modifier and coupling agent.

Introduction

All composite materials require good bonding between the polymer and the reinforcement. This is needed for good mechanical properties. Without proper bonding any added particles/fillers act as stress raisers within the continuous polymer phase. Many polymer systems do not form chemical bonds with inorganic surfaces. The coupling agent provides the required chemical interface between the polymeric and non polymeric phases. Glass fiber reinforcement provides an attractive means of enhancing the mechanical and thermal properties of polymers required for engineering applications. Incorporation of short glass fibers in thermoplastic matrices imparts stiffness, strength, and thermal stability to these materials with some sacrifice of strain to failure.

Experimental

A) a Kolon general grade of PA6 was used as the matrix material, Lotader 4700 produced by Arkema and the PA/LT produced by Tecnofilm has been used as impact modifier in order to produce high impact PA6 compound. three samples has been prepared in this experiment, first sample (R1) and second one (R2) has been prepared with the same content of Lotader and PA/LT; the third sample (R3) contains the same content of additive as R1 and R2 with composition of Lotader and PA/LT (table No.1)

B) a Kolon general grade of PA6 was used as the matrix material, Short glass fibers (GF, E glass, Taishan, China) with an average length and diameter of 4.5 mm and 13 mm, treated with silane agents respectively, were used as reinforcement. Epimix Produced by Epsan and PA/LT produced by Tecnofilm has been used as coupling agent. Two samples has been prepared in this experiment with the same glass fiber content of 30 wt.%, first sample (R1) contains X wt.% of Epimix as coupling agent and second sample contains 0.8X X wt.% of PA/LT. (Table No.2)

C) A Homo-polymer PP with Melt Flow Rate of 25 gr/10min (230°C, 2.16 Kg) was used as the matrix material, Short glass fibers (GF, E glass, Taishan, China) with an average length and diameter of 4.5 mm and 13 mm, treated with silane agents respectively, were used as reinforcement. In order to compare the effectiveness of coupling agents Exxelor 1020 produced by Exxonmobil and PPC produced by Tecnofilm has been used as coupling agents with the same content in R1 and R2 samples containing 30% of glass fiber. (Table No.3)

Result & Discussion

A) In order to achieve the super impact properties three samples has been prepared in this experiment. As it has been shown in Fig. 1 the Impact properties has been increase to 13% comparing to R1 by using PA/LT additive instead of Lotader. This has been increased to 19% comparing to R2 by using the combination of PA/LT and Lotader.
B) To improve the dispersion and adhesion of the glass fiber reinforcement to polymeric matrix two sample has been prepared with different types of coupling agents. As shown in fig. 2 by using the decreased content of PA/Lt instead of Epimix the R2 samples resulted in increased mechanical properties.
C) To improve the dispersion and adhesion of the glass fiber reinforcement to PP matrix two sample has been prepared with different types of coupling agents. As shown in Fig. 3 by using PPC instead of Exxelor as coupling agent the R2 samples resulted in increased mechanical properties.

Conclusion

The excellent performance of *g*-MA as a coupling agent in GF reinforced composites could be attributed to the following two factors: the ability of the MA groups to react with the hydroxyls of the glass fiber and the excellent compatibility of the grafted copolymer chains with the main Polymeric phase. The use of *g*-MA additives with the functionalized fibers caused a further increase in the tensile and impact strength of the composites.
It is assumed that the efficiency of grafting maleic anhydride on polymer chains and the base polymer in these additives are two key points on improving the mechanical properties of above mentioned compounds. It was found that the Maleic Anhydride content in Ma-grafted thermoplastic copolymer additive is not playing an effective role on the performance of these additives as compatibilizer, Impact modifier and coupling agent.

References

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Table & Figures

	T(A)-R1	T(A)-R2	T(A)-R3
PA6	1-X	1-X	1-X
Lotader 4700	X	0	X/2
PA/LT	0	X	X/2

Table1: Experiment (A) contents

	T(B)-R1	T(B)-R2
PA6-30GF	1-X	1-(0.8X)
Epimix	X	0
PA/LT	0	0.8X

Table2: Experiment (B) contents

	T(C)-R1	T(C)-R2
PP-30GF	1-X	1-X
Exxelor 1020	X	0
PP/C	0	X

Table3: Experiment (C) contents

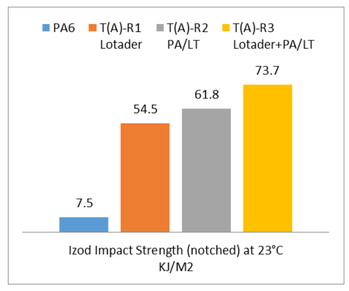

Fig.1: Experiment (A) Impact Properties

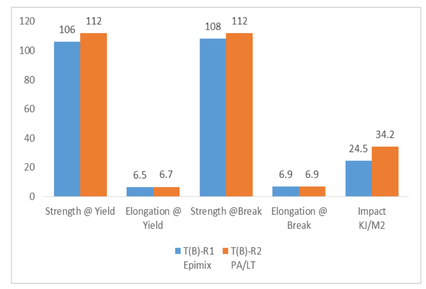

Fig.2: Experiment (B) Mechanical Properties

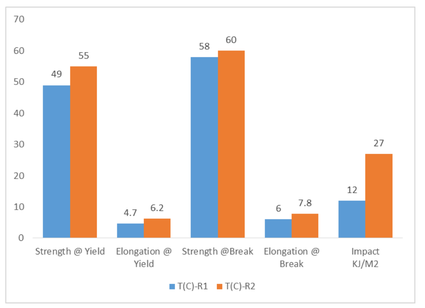

Fig.3: Experiment (C) Mechanical Properties