Effect of CaCO3 on the Mechanical Properties of Poly(ethylene terephthalate)/ Polypropylene Blends

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1. Introduction

Plastic is a great development found by the researcher and also the manufacturer, engineer or others in terms of plastic value in the industry because of very high demands in markets. Blends with polyesters, specifically blends of poly(ethylene terephthalate) (PET) with polyolefin, are of particular interest because large amounts of these polymers are available through recycling technology and because PET is widely used as a thermoplastic for packaging, electronics, and other applications. Recently, the recycling of polymers such as PET after use is attracting the attention of many kinds of research aware of environmental problems and wishing to find ways to save earth resources [1]. However, the largest use of PET today is in containers. In this area, beverage bottles are number one. Thus, PET is the star of plastics recycling. Polypropylene (PP) is a versatile material widely used for automotive components, home appliances, and industrial applications. PP and PET, which are the most of popular, are widely used in many fields as produce the bottle, plastic box, plastic bag… to contain food and water. Although PP and PET are the most of important, the analysis of PET/PP blend is scant and don't have products produced from PET/PP blend on the market. PET/PP is expected to a chance of having better properties than PP and PET. The stiffness of PET is higher than PP because the structure of PET is less Methylene alternating between the carbon circuit. The stiffness of PET is as well as the stiffness of carbonyl and phenylene. The waterproofing of PET is better than PP...

But mixing two types of polymers together generally does not guarantee good interfacial adhesion between the two phases. The mixing of PET and PP results in clumps of one phase dispersed in the other. Two distinct incompatible phases were formed because thermodynamics does not favor the mixing of PET and PP. PET/PP blend is not compatible so we need to improve the compatibility of PET/PP blends. The incompatibility of PET and PP can be reduced by introducing an additive known as a compatibilizer [2]. The compatibilizer serves as a bridge that couples the two distinct phases. The role of the compatibilizer is to provide an interphase region where the interpenetration of the polymeric chains from both PET and PP is thermodynamically favorable. A high degree of interpenetration makes it possible for hydrogen bonds to form between functional groups.

2. Materials

Materials and chemicals were used in this study: Polyethylene (SABIC - LDPE 4024 origin Saudi Arabia) provided by Thuan Thang Plastics Co., Ltd; Ethylene vinyl acetate is supplied by Dong Nhat Phat Co., Ltd. The composition of PET and PP was mixed by using weight measuring container. PET/PP was mixed with CaCO3 according to its weight composition which is given in Table 1. CaCO3 was mixed with PET/PP in the weight composition of 0% to 10%. The mixing process was mixed by using TKC series -Vertical Injection Molding Machine. Base on the previous studies about PET/PP blends Ratio PET/PP is kept fixed 90/10. Ratio EVA is kept fixed 5%.

Table 1 Table caption must be centered

Sample	PET	PP	CaCO3	EVA
S0	85.5	9.5	0	5
S1	83.7	9.3	2	5
S2	81.9	9.1	4	5
S3	80.1	8.9	6	5

3. Results

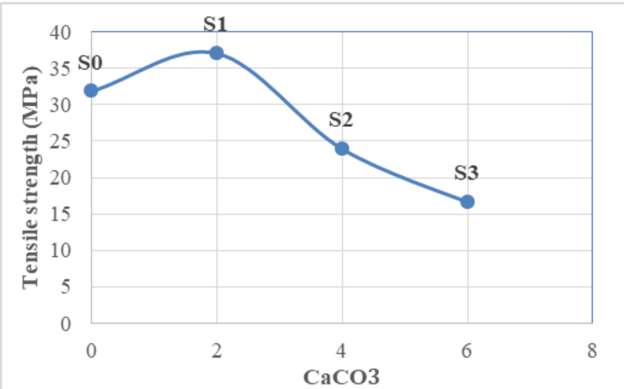

Fig. 1 Effects on tensile strength in different composition of CaCO3 filler

Graph 1 shows the tensile strength increases gradually until the composition of 2% CaCO3, but at 4 % CaCO3, tensile strengths are a drop down. For the PET/PP blends, the addition of 2% of CaCO3 gave a significant improvement in the tensile strength; the corresponding tensile strengths are 37.05 MPa. For the PET/PP blends with CaCO3 from 4 to 6%, the tensile strength became even lower with the addition of CaCO3, changing from 31.8 MPa (0% CaCO3) to 24.0 (4% CaCO3) and 16.6 MPa (6% CaCO3). This means that 2% of CaCO3 is sufficient, and larger amounts of CaCO3 are not warranted for improvement in tensile strength. It is observed that the addition of CaCO3 in PET/PP does not change significantly the PET/PP tensile strength. It's happened due to the increases in CaCO3 dramatically decreases the strength of the material and be more brittle. Tensile mechanical properties seem to be affected by the dispersion of the CaCO3 particles; small contents of CaCO3 particles led to an increase in both elastic modulus and stress, although the addition of higher contents of CaCO3 particles did not lead to a subsequent increase in these properties that remained constant.

The results of the flexural tests performed with the PET/PP and the CaCO3 are shown in Table 3 and Figure 2. From the Figure 2 can see that the addition of a CaCO3, is found to improve the strength of the blends at loadings of 2% CaCO3 until the composition of 4% CaCO3, with flexural strength 57.19 MPa and 66.05 MPa, respectively. But at 6% CaCO3 filler, CaCO3 has the opposite effect of slightly reducing the flexural properties.

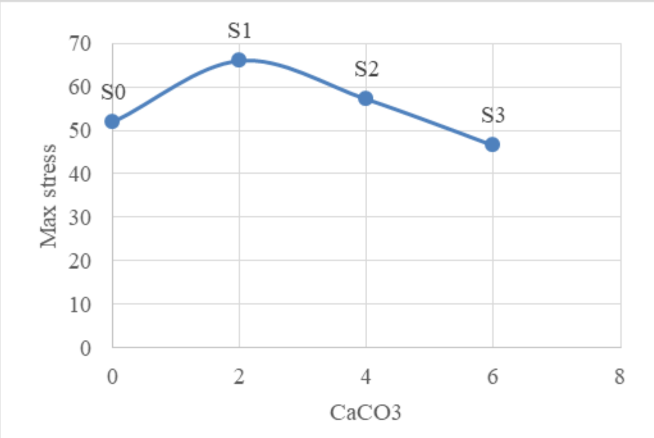

Fig. 2 Effects on flexural Strength in different composition of CaCO3 filler

4. Conclusions

The main objective of this study is to find the best ratio of PET/PP/CaCO3 based on the highest tensile strength and flexural strength of the specimen. The specimens were divided into 4 groups of weight compositions, from the experiment it was found that specimen has improved in its mechanical properties at the certain composition of CaCO3.

- Flexural mechanical properties seem to be affected by the dispersion of the CaCO3 particles; small contents of CaCO3 particles led to an increase in both elastic and stress, although the addition of higher contents of CaCO3 particles did not lead to a subsequent increase in these properties that remained constant. Great increases in elastic modulus were obtained with the addition of small content of CaCO3 particles.

- The addition of a CaCO3 is found to improve the flexural strength of the blends at loadings of 2% and 4% CaCO3 with flexural strength 57.19 MPa and 66.05 MPa, respectively. The results obtained in this work evidenced the influence of CaCO3 particles in flexural strength properties of PET/PP.

As a conclusion CaCO3 can improve the mechanical properties of PET/PP if it is present only in a small amount.

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