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Journal of Advanced Research in Materials Science
ISSN (online): 2289-7992 | Vol. 7, No. 1. Pages 33-36, 2015

Ethylene Vinyl Acetate (EVA)/Natural Rubber (NR)/Potash Feldspar (PF) Composites: The Effect of PEgMAH on Tensile Properties and Spectroscopy Infrared

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Abstract – *In order to study the effect of polyethylene grafted maleic anhydride (PEgMAH) as a compatibilizer on the tensile properties and swelling behavior of ethylene vinyl acetate/Natural Rubber/ Feldspar (EVA/NR/PF) composites, the composites with and without PEgMAH were prepared using Brabender Plasticoder at 160ºC with 50rpm rotor speed. The results indicated that EVA/NR/FP/PEgMAH had higher value of tensile strength compared to EVA/NR/PF composites.*

Keywords: Potash Feldspar; Ethylene Vinyl Acetate; Natural Rubber; Polyethylene Grafted Maleic Anhydride

1.0 INTRODUCTION

Thermoplastic elastomer (TPE) received attention over the year. Thermoplastic elastomer (TPE) is based on elastomer plastic blend. TPE combine wide range of physical properties of conventional elastomers at room and service temperatures, and excellent processing characteristics of thermoplastic at high temperature. The dispersed rubber particles provide elastic properties whereas the continuous plastic matrix allows the melt processing of the blend. TPE are reprocessable, good processability and economic advantages. The blend of thermoplastic and rubber blends are immiscible. In order to improve the compatibility between the elastomer and plastic phase, compatibilizer is used [1]. Compatibilizer is a material that added to a blend of ordinarily incompatible polymers which suppresses phase separation. The compatibility of the filler with the matrix which has a great effect on the mechanical properties of the composites can be improved with the addition of polymeric compatibilizers.

During the compatibilization process, small dispersed phases are formed. Hence, the interfacial tension between the two immiscible polymers will be reduced and this leads to enhance the interfacial adhesion [2]. Filler is added into the blend to improve the mechanical properties of the blends.

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Ling Zhang et al. [3] studied aluminium hydroxide filled ethylene vinyl acetate (EVA) composites: effect of the interfacial compatibilizer and the particle size. They observed that the adhesion of EVA/Alumina trihydrate (ATH) composites was dramatically increased with the addition of interfacial modifier which results in the improvement in flammability and tensile strength.

Dong et al. [4] studied the boron nitride (BN) filled immiscible blends of polyethylene (PE) and ethylene-vinyl acetate copolymer (EVA): morphology and dielectric properties. They found that co-continuous structure was formed in the immiscible blend of PE and EVA at the mass ratio of 1/1. The addition of BN powders into the co-continuous blend give rise to the selective localization of BN in PE phase. The dielectric constant of PE/EVA/BN composites is similar with PE/BN.

In this paper, the effect of PEgMAH as a compatibilizer on tensile properties and spectroscopy infrared of ethylene vinyl acetate (EVA)/ natural rubber (NR)/ feldspar (PF) composites were investigated.

2.0 RESULT AND DISCUSSION

Figure 1 shows the effect of filler loading on tensile strength of EVA/NR/PF and EVA/NR/PF/PEgMAH composites. From Fig. 1, the tensile strength of EVA/NR/PF and EVA/NR/PF/PEgMAH composites decrease slightly with the increased of the filler loading. This was due to the incompatibility of EVA and NR which causes the fracture started from the weak interface of the composites. Poor stresses transfer at the filler-polymer interphase causes the tensile strength to be lower. Besides that, it is clearly seen that the tensile strength for the EVA/NR/PF/PEgMAH composites are slightly higher than EVA/NR/PF composites. The presence of PEgMAH as compatibilizer helps to improve the incompatibility of the EVA and NR. Hence, the formation of bridge between the EVA and NR lead to higher tensile strength. A similar observation obtained from Supri et al. [5] in which the tensile strength and elongation at break of the LDPE/ ESP decreased as the increase of the eggshell powder (ESP) content.

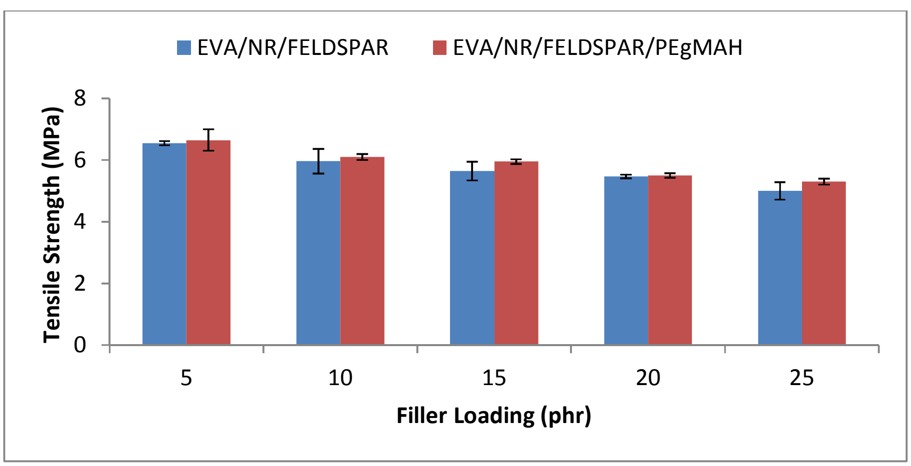

Figure 1: Tensile strength vs filler loading of EVA/NR/PF and EVA/NR/PF/PEgMAH composites

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Figure 2 compare the FTIR spectra of the EVA/NR/PF with and without the presence of PEgMAH. The characteristic absorption at 724 cm^{-1} in Fig. 2 (b) shows the cis R-CH=CHR from natural rubber. The functional group of C-N shows the peak at 1012 cm^{-1} while C-O at peak 1238 cm^{-1}, 1010 cm^{-1} and 1237 cm^{-1}. The spectrum shows α- CH_2 bending at the absorption of 1447 cm^{-1}. The absorption peak of 1726 cm^{-1} shows the C=O (carbonyl) group from the saturated ester. The characteristic peak at 1719 cm^{-1} was attributed to the stretching of the carbonyl (C=O) groups of the maleic anhydride in the blends. The peak at 1465 cm^{-1} shows the CH_2 & CH_3 deformation whereas the peaks at 2912 $cm^{-1}$and 2913 cm^{-1} are due to the presence of EVA/NR matrix. The silica (SiO_2) from the potash feldspar shows the absorption at 2338 cm^{-1} and 2360 cm^{-1}. The presence of the O-H shows the spectrum at the peak of 3288 cm^{-1}, 3502 cm^{-1}, 3148 cm^{-1}, 3402 cm^{-1} and 3497 cm^{-1}. The illustration mechanism of the interaction of PEgMAH with EVA and NR are shown in Fig. 3.

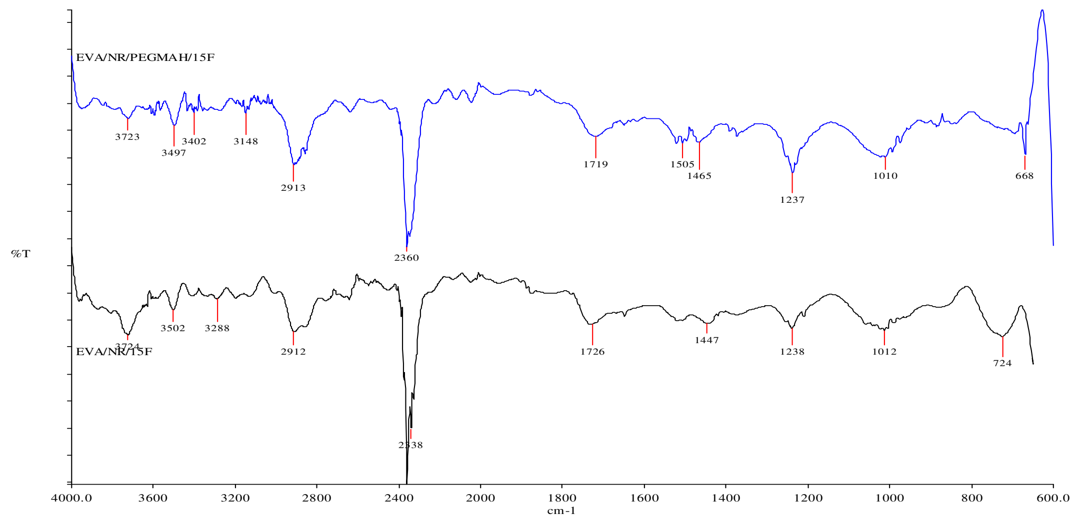

Figure 2: Infrared spectroscopy of (a) EVA/NR/PF-5 composites with PEgMAH (b) EVA/NR/PF-5 Composites

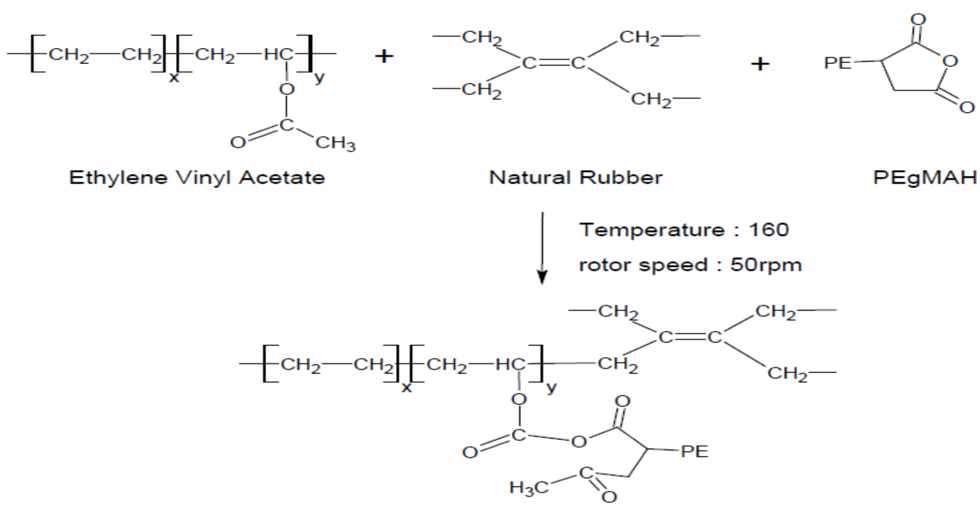

Figure 3: Illustration mechanism of the interaction of the PEgMAH with EVA/NR phases

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3.0 CONCLUSION

The addition of PEgMAH as compatibilizer for EVA/NR/PF composites slightly increased the tensile strength, modulus at 100% elongation but reduced the elongation at break and percentage mass swell of EVA/NR/PF composites. The FTIR spectra of EVA/NR/PF composites showed the carbonyl groups at peak of 1726 cm^{-1} from the saturated ester and peak at 1719 cm^{-1} was attributed to stretching of the carbonyl groups from acetic anhydride (PEgMAH).

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