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PET/EPR Blends Properties in the Presence of Compatibilisers Containing Glycidyl Methacrylite

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Blends of PET with the different commercial co(ter)polymer compatibilisers were prepared and the effect of their glycidyl methacrylate *(GMA) content and viscosity on the blend properties was determined. The efficiency of compatibilisation of the commercial co(ter)polymer in the ternary blends was examined and compared. For all the ternary blends (PET/EPR/co(ter)polymer, the PET content was fixed at 70 wt% of the total weight of the blends. Higher compatibilisation effect was found in PET/EPR blends compatibilised with the commercial copolymer ethylene glycidyl methacrylate (E-GMA$_{8(5)}$) containing 8% GMA and MFI = 5 (g/10min) was achieved as reflected in the observed higher elongation at break when compared to corresponding blends compatibilised with the methyl acrylate containing terpolymer ethylene methyl acrylate glycidyl methacrylate EM-GMA$_{8(6)}$ containing 8% GMA and MFI = 6 (g/10min). The presence of methyl acrylate ester groups in the commercial terpolymer EM-GMA (containing similar amount of GMA and same MFI) resulted in low level of compatibilisation due to the possibility of a higher extent of branching and crosslinking resulting from the presence of the ester groups and this would be responsible for the observed lower elongation, and the less favourable morphology observed. Further, the more bulky structure of the terpolymer compared to the copolymer would give rise to a more difficult migration to the interface, thus lowering the efficiency of compatibilisation. However, the morphology of both blends compatibilised with either the terpolymer or the copolymer were not significantly different.*

Keywords: Reactive blending; PET; EPR; copolymer; terpolymer

Blending two polymers with different mechanical or chemical properties offers advantages over individual components as the performance of the blends is generally enhanced and economic viability of new products is increased[1–4]. Blends or alloys offer an attractive strategy for achieving specified portfolio of physical properties, without the need for synthesising specialised polymer systems. The miscibility of such polymer blends is determined by the specific interactions that occur between the two polymers. Incompatible polymer blends are likely to give a coarse and unstable morphology leading

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to poor adhesion between the two phases. Thus, the addition of a compatibiliser would improve their compatibility[5,6]. Compatibilisers act by reducing the surface tension at the interface leading to the formation of a stable morphology. Common reactive functional groups present in compatibilisers include epoxide, anhydride, amine and oxazoline. In this work, a commercial copolymer of ethylene-glycidyl methacrylate (E-GMA, I) and three commercial terpolymers of ethylene-methacrylate-glycidyl methacrylate containing different GMA content (EM-GMA, II) were used as compatibilisers for PET/EPR in ternary blends of PET/EPR/co(ter)polymer (*Table 1* and *Figure 1* give full characteristics of the different compatibilisers used in this work). Both E-GMA and EM-GMA have been used extensively as compatibilisers in different polymer blends[7–12]. Blends of PET with the different commercial co(ter)polymer compatibilisers were prepared and the effect of their GMA content and viscosity on the blend properties was determined.

The objectives of the work described in this paper were to investigate the compatibilising efficiency of these commercial co(ter) polymers when used in ternary PET/EPR blends.

EXPERIMENTAL

The compatibilisation was achieved by reactive blending of PET with copolymer ethylene-glycidyl methacrylate and terpolymer ethylene-methacrylate-glycidyl methacrylate. Both compatibilisers were supplied by Alf-Atochem. The composition of the copolymer and terpolymer used in the blend work is 70/10/20 %w/w PET/EPR/compatibiliser. The blending was carried out in a Haake batch mixer at temperature of 260ºC. The rotor speed and mixing time were fixed at 65 rpm and 10 min, respectively. The characteristics of the PET blends were investigated in terms of the processing torque behaviour, tensile properties, morphology (SEM after xylene etching of the rubber phase), dynamic mechanical properties and the extent of the interfacial reactions. The composition of the blend samples is presented in *Table 1*. The effect of structural differences in the grafted GMA (amount of GMA content and the melt flow index (MFI) of the co(ter)polymers and the composition on the compatibilisation of PET/EPR blends was also investigated.

Tensile Test

The tensile properties were measured on a Tinus Olsen Tensile Tester H25KS. Five replicates per sample were required to get an accurate confidence limit. The test specimens were cut from the 1 mm thick plaque which was prepared before by using a dumbbell shape cutter. The dimension of the cutter and specimens was 4 mm in width and 30 mm in length. A pair of grips were used to grip the ends of the dumbbell shape specimens. All the tensile tests were carried out at a crosshead speed of 10 mm/min in accordance with *ISO 527* to measure the strain at room temperature. The tensile strength, elongation at break and energy to break were recorded.

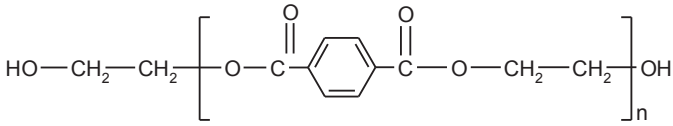
Dynamic Mechanical Properties

Perkin Elmer Pyris Diamond Dynamic Mechanical Analyser (DMA) was used to measure the dynamic mechanical properties of the PET blends. The dynamic mechanical properties include storage modulus *E'*, loss modulus *E"* and the internal friction tan δ (tan δ = *E"/E'*). Generally, for an incompatibile blend, the tan δ *vs* temperature curve shows two tan δ (or damping peaks) corresponding to the glass transition temperatures of the individual

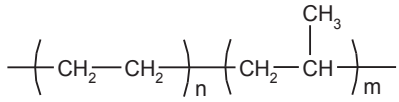
TABLE 1. CHARACTERISTICS OF THE DIFFERENT COMPATIBILISERS USED IN THE PET BLENDS

Compatibiliser Code †	Grades	GMA content (%)	MFI (g/10 min)	Methyl acrylate Content (%)	Supplier
EM-GMA$_{9(85)}$	Lotader AX8950	9	85	15	
EM-GMA$_{8(6)}$	Lotader AX8900	8	6	25	Alf-Atochem
EM-GMA$_{1(8)}$	Lotader AX8920	1	8	28	
E-GMA$_{8(5)}$	Lotader AX8840	8	5	0	

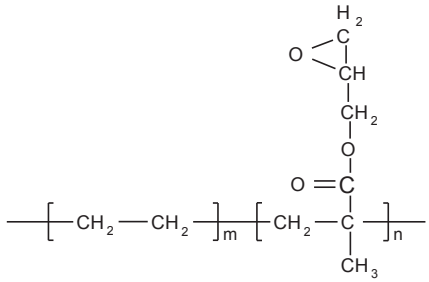
†EM-GMA$_{9(85)}$, 9 is % amount of GMA and (85) is the MFI of the co(ter)polymer



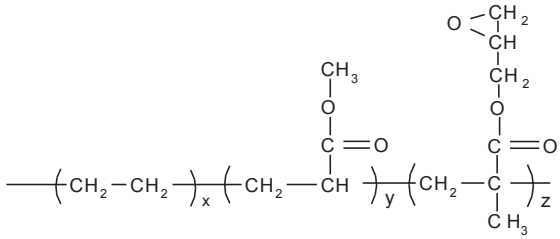
Poly (ethylene terephthalate) PET



Ethylene-propylene rubber (EPR) (E:P =8:2)



Ethylene/glycidyl methacrylate (E-GMA) (I)



Ethylene/methylacrylate/glycidyl methacrylate (EM-GMA) terpolymer (II)

Figure 1. Chemical structure of polymers used in the PET blends.

polymers. For highly miscible blends the curves show only a single peak in between the transition temperatures of the component polymers, whereas there are two separate peaks corresponding to the individual polymers in the case of partially compatible polymer blends, but the position of the peaks normally is shifted to higher or lower temperatures as a function of the composition[13]. DMA analysis of PET blends or the virgin components was carried out at a fixed frequency of 1 Hz in a bending mode over the temperature range of –80ºC to 180ºC at a 2ºC/min temperature rise, using liquid nitrogen as a cryogenic medium. The dimension of the test specimens which was cut from compression moulded plaques were 50 × 10 × 3 mm.

Scanning Electron Microscopy

Scanning electron microscopy (SEM) was used to characterise the morphology of blends including surface roughness, fracture surface, and adhesive failure[14]. In this study, the samples were characterised from a cross section of cryogenically fractured surfaces of the compression moulded plaques by using a Cambridge Instrument Stereoscan 90 Scanning Electron Microscope. Strips cut out from 1 mm compression moulded plaques were placed in liquid nitrogen for 20 min and bended (by clamping from one end) at 180ºC until fractured. For better observation of any adhesion between the phases, the cryogenically fractured surfaced were etched with boiling xylene for 5 h in order to remove the EPR. The samples were washed with acetone and then dried in a normal oven at 50ºC. The ends of samples with fractured surfaces were cut with a sharp blade and attached to a metal stub using a double sided sticky carbon pad with the fractured surface facing up. The samples were sputter coated with gold using an Emscope SM300 Coater prior to SEM examination.

RESULTS AND DISCUSSION

Effect of Different GMA Content on Compatibility of PET/EPR/EM-GMA Blends

In order to understand the effect of different GMA content in the EM-GMA terpolymers on the compatibility of PET/EPR/EM-GMA ternary blends, two types of terpolymers were used containing GMA at 1 wt% (EM-$GMA_{1(8)}$) and 8 wt% (EM-$GMA_{8(6)}$) with similar MFI values (shown in subscript bracket). The processing torque behaviour of these blends (PET/EPR/EM-GMA 70/10/20 w/w%) are shown in *Figure 2*. It is clear that the presence of a high GMA content in the terpolymer gave rise to a tremendous increase in the torque values of the blend to values well above that of the virgin EPR, compared to the blend containing EM-$GMA_{1(8)}$ (lower GMA content). The significant increase in the torque values observed for the blend that contain a higher GMA content (PET/EPR/EM-$GMA_{8(6)}$) at 70/10/20 w/w%), may be attributed to higher melt viscosity (lower MFI) of the EM-$GMA_{8(6)}$. This resulted in higher extent of interfacial chemical reaction between the PET end groups and the higher concentration of the epoxy moiety present in the EM-$GMA_{8(6)}$, or/and due to branching and crosslinking reaction that may also take place between the epoxy group and the secondary hydroxyl group during the formation of the copolymer PET/EM-GMA[15]. Similar observation was reported[16–18] where higher GMA content (of 8 wt%) in PBT/ABS-g-GMA which was shown to give highest torque values compared to those with lower GMA content in the same blend composition. The elongation at break of the ternary blends containing different amounts of the two terpolymers is shown in *Figure 3*. At low EM-GMA content (<10 wt%), the blends compatibilised with both terpolymers showing similar and low elongation at break. However, at EM-$GMA_{8(6)}$ content above

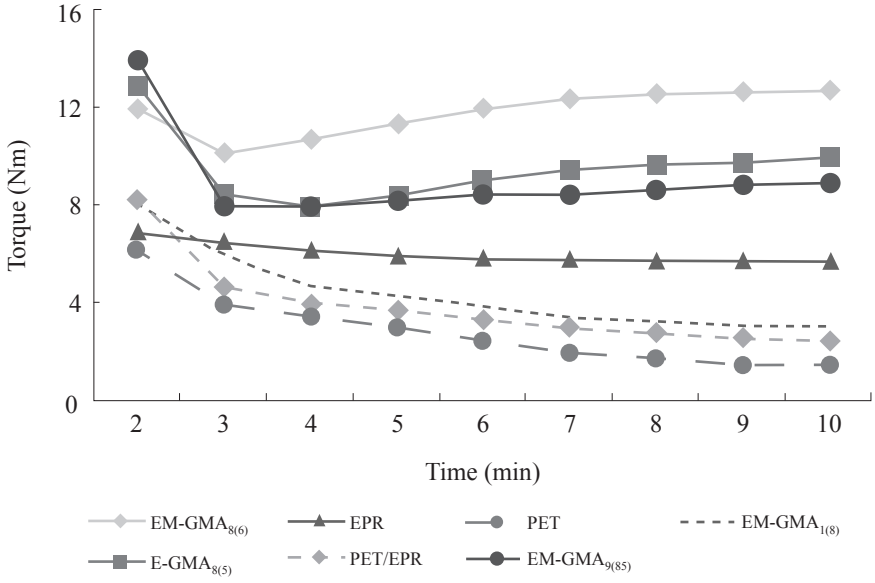


Figure 2. Effect of GMA content on PET/EPR/compatibiliser ternary blend on torque. EM-GMA$_{1(8)}$, GMA = 1%, MFI = 8 g/10 min, EM-GMA$_{8(6)}$, GMA = 8%, MFI = 6 g/min, EM-GMA$_{9(85)}$, GMA = 9%, MFI = 85 g/min, E-GMA$_{8(5)}$, GMA = 8%, MFI = 5 g/10 min.

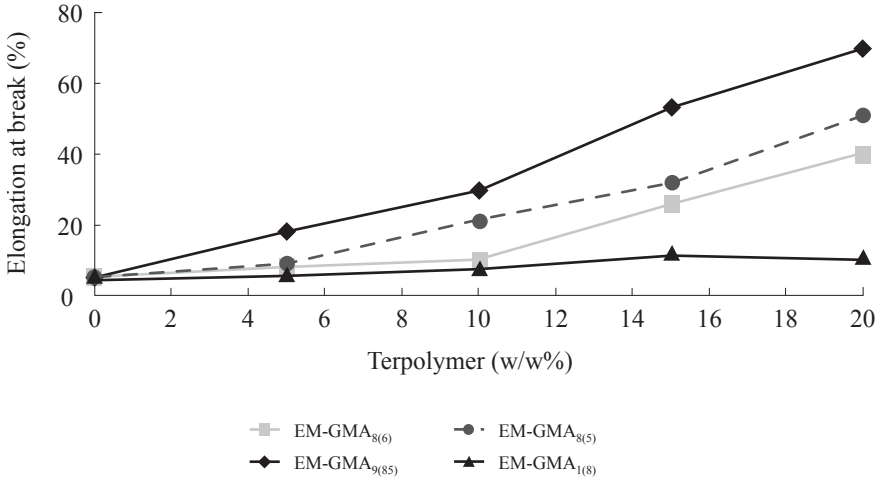


Figure 3. Effect of GMA content on PET/EPR/Compatibiliser ternary blends properties. EM-GMA$_{1(8)}$, GMA=1%, MFI = 8 g/10 min, EM-GMA$_{8(6)}$, GMA = 8%, MFI = 6 g/min, EM-GMA$_{9(85)}$, GMA = 9%, MFI = 85 g/min, E-GMA$_{8(5)}$, GMA=8%, MFI = 5 g/min.

10 w/w%, a substantial increase in elongation at break was up to 40 % (at 20 w%). In contrast, the EM-$GMA_{1(8)}$ was found to be less effective in improving the elongation at break of the blends even when 20 w% was added. *Figure 4* compared the phase morphology of physical blend of PET/EPR 70/30 w/w%, PET/EPR/EM-$GMA_{8(6)}$ and PET/EPR/EM-$GMA_{1(8)}$ 70/10/20 w/w% blends, respectively. It can be seen clearly that PET/EPR/EM-$GMA_{8(6)}$ blend showed finer dispersed particles which are well distributed in the continuous phase compared to the larger dispersed particle size with irregular shapes observed in the ternary blend containing EM-$GMA_{1(8)}$. However, the larger dispersed particle size observed in the physical blend explained the incompatibility of the PET/EPR blend.

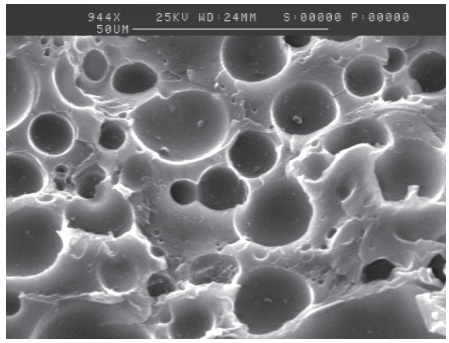
The SEM results support a higher level of compatibilisation in blends containing terpolymer with higher GMA content as demonstrated by finer and more uniform distribution of the dispersed rubber particle (*Figure 4*). Unfavourable morphology obtained in EM-$GMA_{1(8)}$ blend having low GMA content is most likely due to the presence of smaller amount of GMA for reaction with –COOH or –OH end groups in the PET resulting in reduced extent of interfacial reaction, thus lower compatibilisation efficiency[15]. The significant improvement observed in the phase morphology is responsible for the higher elongation at break observed in these blends (*Figure 3*). Examination of PBT/EM-GMA blends[19], has also shown a low extent of interfacial reaction in EM-GMA with low GMA content that could not prevent coalescence compared to EM-GMA with high GMA level which would in turn prevent the dispersed phase from being distributed evenly in the PET matrix.

The effect of GMA content in the terpolymer on the dynamic mechanical properties of the blends can be seen in *Table 2* and *Figure 5*. This figure gives an overview of the tan δ–temperature curves as a function of temperature for PET/EPR/EM-GMA at 70/10/20 w/w % blends ratio. The blend containing EM-$GMA_{8(6)}$ shows three tan δ peaks which correspond to the glass transition temperatures (*T*g) of the rubber phases (including EPR and EM-GMA) as well as the PET phase. The *T*g of PET shifted away from the *T*g of PET in the physical blend (about –3.9ºC) to lower temperature, (*Table 2*). Only two tan δ peaks were observed in blends containing EM-$GMA_{1(8)}$ and these can be linked to the *T*g of PET and EM-$GMA_{1(8)}$.

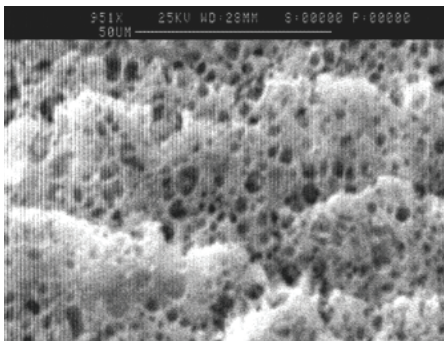
On the other hand, the peak corresponding to the *T*g of EPR was not clear, appearing as a shoulder. In this blend, the *T*g of PET phase has shifted away from the *T*g of PET in the physical blend by –2.3ºC to lower temperature. The storage modulus values for both compatibilised PET blends showed similar values at room temperature (*e.g* 25ºC) and they were lower than that of the physical blend (*Table 2* and *Figure 6*). The suggested higher extent of compatibilisation achieved in the PET/EPR/EM-$GMA_{8(6)}$ blend is further supported by a larger shift in its matrix *T*g (compared to the physical blend) which is due to interaction between the two phases with stronger interface giving rise to higher extent of reduction in the *T*g values of the matrix[20]. A lower storage modulus of the PET/EPR/EM-$GMA_{8(6)}$ blend at all temperatures examined (*Figure 6*) was observed compared to PET/EPR/EM-$GMA_{1(8)}$ blend suggesting more elastomeric behaviour in the latter blend.

Effect of Viscosity of the Compatibiliser on Blends Properties

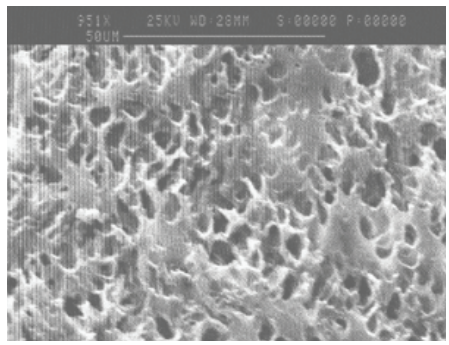
To understand the effect of viscosity of the compatibilisers, two terpolymers with different rheological properties were chosen, EM-$GMA_{8(6)}$ and EM-$GMA_{9(85)}$, having MFI



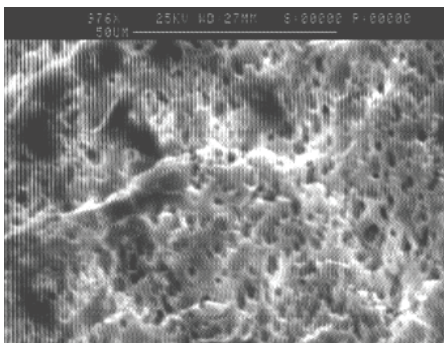
PET/EPRphysical blend 70/30 w/w%



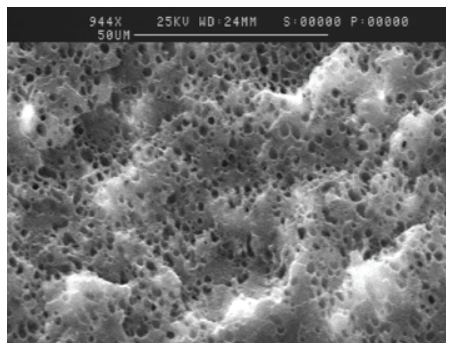
PET/EPR/EM-GMA$_{8(6)}$ 70/10/20 w/w% blend



PET/EPR/EM-GMA$_{1(8)}$ 70/10/20 w/w% blend



PET/EPR/EM-GMA$_{9(85)}$ 70/10/20 w/w% blend



PET/EPR/EM-GMA$_{8(5)}$ 70/10/20 w/w% blend

Figure 4. Effect of GMA content on PET/EPR/compatibiliser ternary blends morphology.

TABLE 2. TG AND STORAGE MODULUS OF PET AND EPR PHASE OF PET/EPR COMPATIBILISED WITH EM-$GMA_{1(8)}$, EM-$GMA_{8(6)}$, EM-$GMA_{9(85)}$ AND E-$GMA_{8(5)}$ 70/10/20 W/W %. THE SHIFT IS WITH RESPECT TO VALUES OF THE CORRESPONDING PHYSICAL BLEND

Blend ratio PET/EPR (or PETEPR-g-GMA) 70/10/20 w/w%	Compatibiliser	Blend Ratio PET/EPR/EM-GMAx PET phase Tg (ºC)	Shift (ºC)	EPR phase Tg (ºC)	Shift (ºC)	Compatibiliser Tg (ºC)	E' (MPa) at 25ºC
PET/EPR	-	93.8		-43.2	-	-	171
PET/EPR/ EM-$GMA_{8(6)}$	EM-$GMA_{8(6)}$	89.9	-3.9	-42.5	+0.7	-15.0	114
PET/EPR/ EM-$GMA_{1(8)}$	EM-$GMA_{1(8)}$	91.5	-2.3	-	-	-27.2	127
PET/EPR/ EM-$GMA_{9(85)}$	EM-$GMA_{9(85)}$	89.2	-4.6	-43.3	-0.1	-14.3	92
PET/EPR/ E-$GMA_{8(5)}$	E-$GMA_{8(5)}$	89.4	-4.4	-41.4	+1.8	-	110

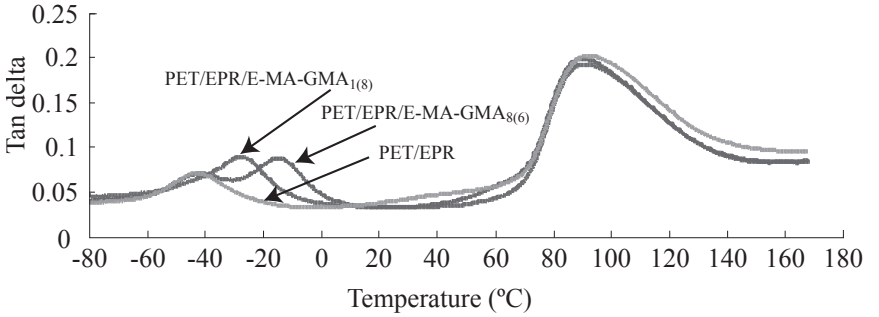


Figure 5. Effect of GMA content on thermal properties of PET/EPR/EM-GMA_X 70/10/20 w/w%. (EM-$GMA_{8(6)}$: GMA = 8 %, MFI = 6 g/10 min, EM-$GMA_{1(8)}$: GMA = 1 %, MFI = 8 g/10 min).

values of 6 and 85 g/10 min and a close GMA content of 8 and 9 wt%. The torque values of these ternary blends, PET/EPR/EM-GMA 70/10/20 w/w% as in *Figure 2* show that the blend containing a terpolymer with lower MFI value gives lower torque values. Although two of the terpolymers used in this work contained similar GMA content (8 and 9 wt%), they had very different viscosity (different in MFI value) and their ternary blends (70/10/20 w/w%) showed very different torque behaviour. Different extent of interfacial reaction may occur in blends compatibilised with these two terpolymers due to the difference in their MFI values. The higher torque values shown by a blend containing EM-$GMA_{8(6)}$ (*Figure 2*), must be due to its much higher viscosity, compared to blend containing EM-$GMA_{9(85)}$, and is most unlikely due to a better extent of compatibilisation. This is supported by both

the lower elongation at break at all ratios of blends containing the higher viscosity (MFI = 6 g/10 min) terpolymer (*Figure 3*) and by the slightly larger dispersed particle size observed from its SEM micrograph (*Figure 4*) compared to a similar blend but with a lower viscosity terpolymer, EM-$GMA_{9(85)}$. The viscosity ratio of the blend components has been shown[21] to have a major effect on the mobility of the interface and the interfacial tension making it difficult for the interfacial copolymer in the blend containing EM-$GMA_{8(6)}$ to diffuse to the interface, hence, the observed coarse morphology of this blend. The effect of MFI values of the modified rubber on blend compatibilisation was also discussed by Al-Malaika *et al*.[22] It was also demonstrated that for blends of PET with EPR-g-GMA_{TRIS} (in the presence of the comonomer trimethylol propane triacrylate, TRIS) having higher MFI values (lower viscosity) a finer morphology and better performance was observed.

The elongation at break of these blends (with different amount of terpolymer), (*Figure 3*) increased steadily with increasing terpolymer content in the blends. The blends compatibilised with terpolymer having higher MFI gave a higher overall elongation at break. The SEM micrographs of blends containing 20 w% of the compatibiliser showed no significant difference in morphology in the presence of EM-$GMA_{9(85)}$ or EM-$GMA_{8(6)}$, where both showed stable morphology with rough surfaces and no large holes (*Figure 4*).

Figure 7 shows the dynamic mechanical analysis of the blends where the *T*g of the PET phase of a blend compatibilised with EM-$GMA_{9(85)}$ had shifted to lower temperature by –3.9ºC compared to that of the physical blend whereas a blend compatibilised with EM-$GMA_{8(6)}$ showed a larger shift of –4.6ºC (moving closer to *T*g of EPR) (*Table 2*).

On the other hand, the *T*g of the EPR phase of the PET/EPR/EM-$GMA_{9(85)}$ blend showed only a slight shift (-0.1ºC) towards lower temperature while the *T*g of the EPR phase of a PET/EPR blend compatibilised with EM-$GMA_{8(6)}$ showed a larger shift of -0.7ºC to lower temperature. Close examination of the storage modulus showed that the PET/EPR/EM-$GMA_{9(85)}$ blend gave a lower value compared to PET/EPR/EM-$GMA_{8(6)}$ blend, (*Table 2* and *Figure 8*). In fact, the storage modulus values

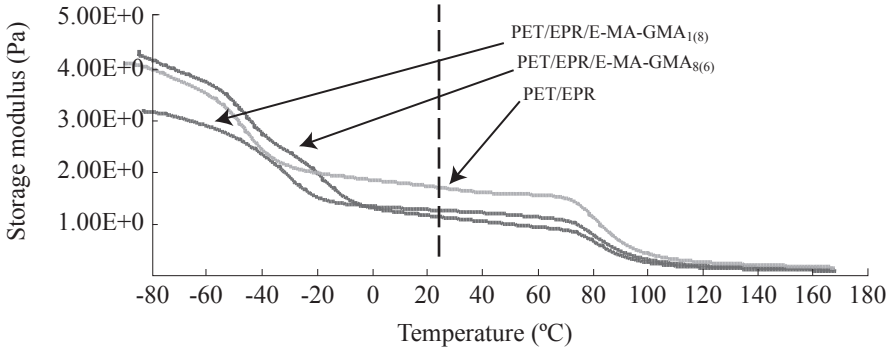


Figure 6. Effect of GMA content on thermal properties of PET/EPR/EM-GMA_X 70/10/20 w/w%, (EM-$GMA_{8(6)}$: GMA=8%, MFI = 6 g/10 min, EM-$GMA_{1(8)}$: GMA=1%, MFI = 8 g/10 min).

of all compatibilised blends are shown to be lower than that of the corresponding physical blend.

The suggestion of a better compatibilisation in the PET/EPR/EM-GMA$_{9(85)}$ blends is further supported from results of their dynamic mechanical analysis (*Figure 7*) which show a sharp increase in tan δ of the PET phase possibly due to the high mobility of PET chain segments[23] (*Table 2*). A greater shift of *T*g towards the *T*g of the second component in blends is attributed to higher extent of compatibilisation[22]. The lower storage modulus observed for the PET/EPR/EM-GMA$_{9(85)}$ blend at all temperatures examined indicates also a more elastomeric behaviour for this low viscosity terpolymer containing blend.

The Effect of Terpolymers Compared to a Copolymer on the Extent of Compatibilisation of PET/EPR Ternary Blends

The effect of the commercial copolymer and terpolymer on the blend properties was examined. Two compatibilisers with GMA content (8 wt%) and MFI values of 5 and 6 g/10 min (copolymer E-GMA$_{8(5)}$ and terpolymer EM-GMA$_{8(6)}$) were compared. *Figure 2* showed that the copolymer (E-GMA$_{8(5)}$) containing blend gives lower torque values compared to that containing the terpolymer. However, the torque values of both reactive ternary blends seem to be much higher than those of the virgin EPR, virgin PET and the physical blends.

The mechanical properties of these compatibilised ternary blends are presented in *Figure 3*. The elongation of PET/EPR/E-GMA$_{8(5)}$ blends increased with increasing content of the copolymer E-GMA$_{8(5)}$. Addition of 10 w% of the copolymer E-GMA$_8$ was found to be sufficient to promote the compatibilisation in the blends observed through the clear increase in elongation at break, while the blends compatibilised with the corresponding terpolymer EM-GMA$_{8(6)}$ required more than 10 w%. The morphology of the PET/EPR/E-GMA$_{8(5)}$ and PET/EPR/EM-GMA$_{8(6)}$ blends showed no significant difference as shown in *Figure 4*.

The only difference between the copolymer and terpolymer is the presence of the methyl acrylate ester unit in terpolymer. *Figure 3* shows that even at only 10% composition, the copolymer containing blend gives a higher elongation at break and finer morphology compared to the terpolymer. The higher torque curve observed for the terpolymer containing blend (EM-GMA$_{8(6)}$) therefore suggests the possibility of higher extent of branching and crosslinking in the presence of ester groups which would be responsible for the observed lower elongation and the less favourable morphology observed in *Figure 4*. Further support for good compatibilisation and performance in the case of the copolymer E-GMA$_{8(5)}$, is the larger shift in the *T*g of its EPR phase towards the *T*g of PET (by +1.8ºC) compared to the terpolymer (+0.7ºC) and the lower (than the physical blends) storage modulus values (*Table 2* and *Figure 9*).

Comparisons of the copolymer and terpolymer in terms of their influence on the dynamic mechanical properties of the PET/EPR blends are shown in *Table 2* and *Figure 9*. For both compatibilised blends, besides the peak of EPR phase, an additional peak was observed around –15ºC which is attributed to the *T*g of the terpolymer or the copolymer respectively (*Figure 9*). However the additional peak for PET/EPR compatibilised with the copolymer E-GMA$_{8(5)}$ was found to be broad, thus the exact temperature of the peak could not be measured. The storage modulus (at temperature of 25ºC), revealed that the

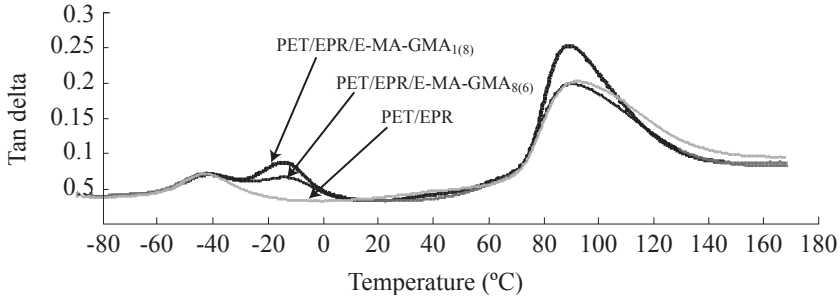


Figure 7. Effect of GMA content on thermal properties of PET/EPR/EM-GMA$_X$ 70/10/20 w/w%. EM-GMA$_{8(6)}$, GMA=8%, MFI = 6 g/10 min, EM-GMA$_{9(85)}$, GMA = 9 %, MFI = 85 g/min.

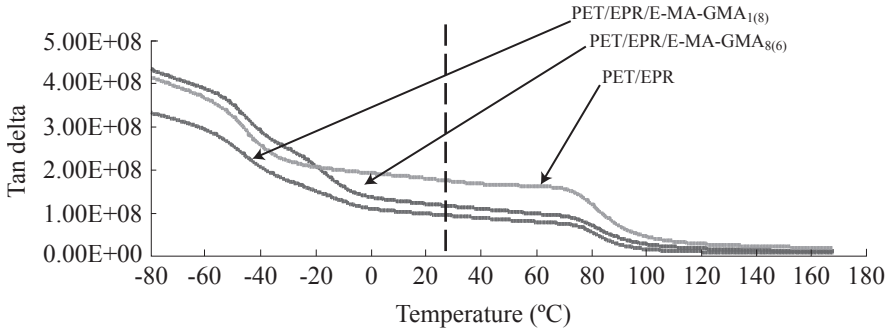


Figure 8. Effect of GMA content on thermal properties (storage modulus) of PET/EPR/EM-GMA$_X$ 70/10/20 w/w%: EM-GMA$_{8(6)}$, GMA = 8%, MFI = 6 g/10 min, EM-GMA$_{9(85)}$, GMA = 9%, MFI = 85 g/min.

compatibilised blends have lower values compared to the physical blends (*Figure 10*).

CONCLUSIONS

The GMA content in the commercial terpolymers (ethylene methacrylate glycidyl methacrylate, EM-GMA) as compatibilisers for PET/EPR blends plays an important role on the level of compatibilisation. At higher GMA content (*e.g.* 8 wt%), elongation at break and the morphology of the PET/EPR/EM-GMA$_{8(6)}$ 70/10/20 w/w% blends was found to be more stable with fine dispersed particles size compared to that of blends containing lower GMA concentration (*e.g.* 1 wt%). Low terpolymer viscosity (MFI = 85 g/10 min) was also shown to give rise to a finer morphology and improved elongation at break.

Higher compatibilisation effect was found in PET/EPR blends compatibilised with the commercial copolymer E-GMA$_{8(5)}$ as reflected in higher elongation at break when compared to corresponding blends compatibilised with

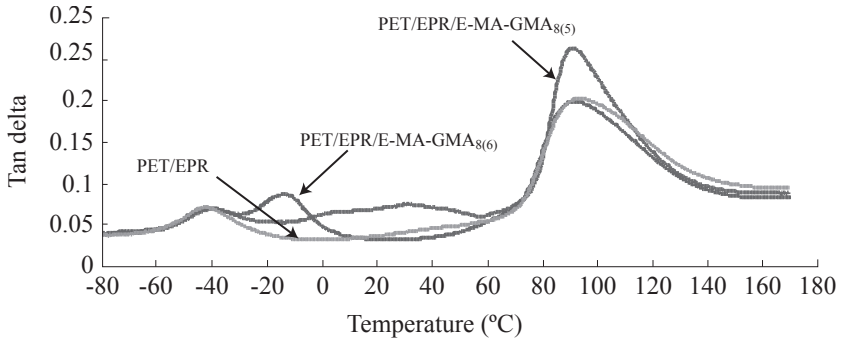


Figure 9. Effect of copolymer and terpolymer on thermal properties of PET/EPR/ compatibiliser 70/10/20 w/w% ternary blends. E-GMA$_{8(5)}$, GMA = 8%, MFI = 5 g/10 min, 0% ester content, EM-GMA$_{8(6)}$, GMA = 9%, MFI = 85 g/min, 25% methyl acrylate content.

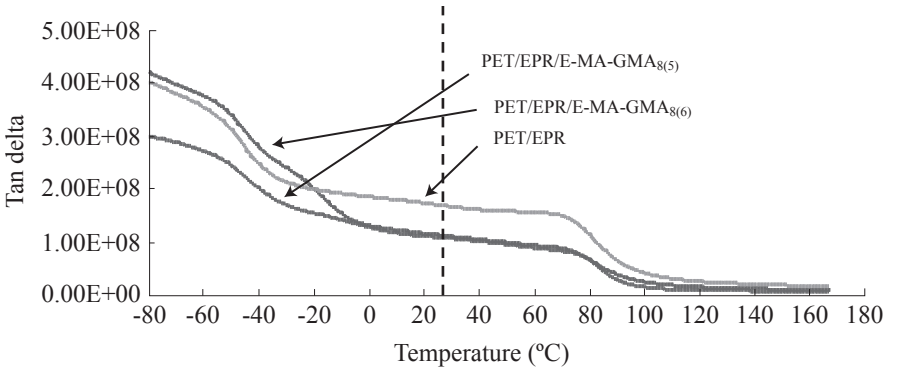


Figure 10. Effect of copolymer and terpolymer on thermal properties of PET/EPR/ compatibiliser 70/10/20 w/w% ternary blends. E-GMA$_{8(5)}$, GMA = 8%, MFI = 5 g/10 min, 0% ester content, EM-GMA$_{8(6)}$, GMA= 9%, MFI = 85 g/min, 25% methyl acrylate content.

the terpolymer EM-GMA$_{8(6)}$. The presence of methyl acrylate ester groups in the commercial terpolymer EM-GMA (containing similar amount of GMA and same MFI) resulted in low level of compatibilisation due to the possibility of higher extent of branching and crosslinking. This would be responsible for the lower elongation and the less favourable morphology. The bulkier the structure of the terpolymer than the copolymer, the higher the difficulty of migration to the interface would be, thus, lowering the efficiency of compatibilisation. However, the morphology of both blends compatibilised with either the terpolymer or the copolymer was not significantly different.

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