

Polycarbonate/Polyalkylene Terephthalate Blends: Interphase Interactions and Impact Strength

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ABSTRACT: Blends of polycarbonate (PC) and poly(alkylene terephthalate) (PAT) such as poly(butylene terephthalate) (PBT) and poly(ethylene terephthalate) (PET) were investigated. It was learned that processes of phase separation in blends consisting of PC and PAT can cause variations in properties of both the amorphous and crystalline phases. In PC/PBT blends the DSC technique did not detect crystalline portion of PBT with its concentrations up to 20 wt %. For PBT = 40 wt %, it forms a continuous phase, and blend's crystallinity is close to the additive values. The glass transition temperature (T_g) shifts to the lower temperature region. The relaxation spectrometry revealed strong adhesion between phases in the blends over the temperature range from the completion of β -transition to T_{gPAT} . This interaction becomes weaker between T_{gPAT} and T_{gPC} . Temperature-dependent variations in the molecular mobility and interphases interactions in the blends affect their impact strength. Over the temperature range where interphases interactions occur and the two components are in the glassy state, the blend is not impact resistant. Over the temperature range between T_{gPAT} and T_{gPC} the blends become impact-resistant materials. This is because energy of crack propagation in the PAT amorphous phase—being in a high-elastic state—dissipates. It is postulated that the effect of improving the impact strength of PC/PAT blends, which was found for temperatures between the glass transition temperatures of the mixed components, is also valid for other binary blends. © 2002 Wiley Periodicals, Inc. *J Appl Polym Sci* 84: 1277–1285, 2002; DOI 10.1002/app.10472

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INTRODUCTION

Low resistance of polycarbonate (PC) to a number of organic solvents could be improved by introduction of chemically stable poly(alkylene terephthalate) (PAT).^{1–13} In addition, PAT is helpful in lowering the cost of PC materials. Therefore, PC/PAT blends find various applications. PC/PAT

blends are characterized by intensive interphase interaction, and can show partial or full miscibility at certain conditions.¹⁴ The compatibility can obviously be improved by chemical reactions of transesterification and ester–ester exchange during the operations of mixing and processing of the molten components.^{2,3} However, stronger adhesion between phases in the blend and the developments of quasi-uniform morphology result in lower impact strength of the materials prepared.

The works mentioned were mostly devoted to understanding the compatibility of PAT and PC. They analyze the dynamic-mechanical properties,

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temperatures of both phase and relaxation transitions, and discuss various aspects of compatibility of these polymers, but do not pay much attention to the properties, which are important for blend applications, for example, dependence of impact strength on temperature or fracture mechanism at impact. In view of strong dependence of the impact strength for different PC blends on test temperature, the investigation of this temperature for the simplest, i.e., binary, PC/PAT blends, is of scientific and practical interests.^{15,16} Especially important is understanding of impact strength and failure mechanism between PAT and PC glass transition temperatures. According to refs. 15 and 16, high impact strength can be achieved only at a temperature at which one of the blend components is in a high-elastic state.

The aim of this work is to analyze temperature and concentration dependencies of impact strength for PC/PAT blends with consideration of their structure, interphases interactions and relaxation behavior.

EXPERIMENTAL

Materials

The following materials were used in our experiments.

Polycarbonate (PC) under trade name Diflon with density 1.20 g/cm³; molecular weight $M_w = 35,000$; solubility parameter 20.4 (J/cm³)^{0.5}. It was prepared by chemical reaction of carbon oxychloride (phosgene) with 2,2-bis (*p*-hydroxyphenyl) propane (supplied by AO Zarya, Volgograd, Russia); Poly(alkylene terephthalate) (PAT): Poly(butylene terephthalate) (PAT) with density 1.31 g/cm³, melting point 222°C, $M_w = 65,000$; solubility parameter 20.1 (J/cm³)^{0.5}; and Polyethylene terephthalate (PBT) with density 1.33 g/cm³, melting point 250°C, $M_w = 50,000$; solubility parameter 21.2 (J/cm³)^{0.5} (supplied by Khimvolokno Co, Mogilev, Belarus). The solubility parameters for the polymers were calculated according to the well-known procedure.¹⁷

Compounding and Specimens Preparation

Polymer blends were prepared by mechanical mixing of dried PC and PAT granules with subsequent extrusion on the single-screw extruding-granulating machine based on SX-65 extruder (L : D = 32, Klockner Windsor, Germany). The tem-

perature at the outlet zone was 250°C for PC/PBT blends and 275°C for PC/PET blends. The dried PC/PAT granules were then used to make test specimens by injection molding at 250 ± 5°C for PC/PBT blends or 265 ± 5°C for PC/PET blends.

Characterization

The tensile measurements were conducted on Instron 1115 tensile testing machine (Instron Ltd. Corp., England) using specimens such as a "dog bone" with the neck measuring 45 × 3 mm. The Charpy impact strength was measured using bars 60 × 10 × 4 mm in size and having a sharp-angle notch. For these investigation the pendulum-testing machine PSV 1,5 (Werkstoffprüfmaschinen, Germany) was used.

To construct temperature dependencies of impact strength, the specimens had been stored at a given temperature (maintained within ±1°C accuracy) in a cryogenic/heating chamber for 60 min to equalize thermal field before testing. The design and operation principles of the chamber are described elsewhere.¹⁵ Then they were removed and the impact strength was measured.

The melt viscosity of the test materials was evaluated in terms of the melt flow index (MFI) determined at 2.16 kg load and $T = 260^\circ\text{C}$ for PC/PBT blends and at 280°C for PC/PET. The mechanical and rheological properties of the tested materials are listed in Table I. The materials were also analyzed by the differential scanning calorimetry (DSC) technique using the DSM-3A calorimeter (Institute for Biological Instruments, Russian Academy of Sciences). The scanning rate was 16°C/min; weight of samples was 10 mg.

The heat stability at deformation of the materials was evaluated, in terms of the temperature at which the specimens would lose their shape stability, using the temperature relationship of the specimen's thermal expansion. In these measurements, the linear dilatometry technique was used (dilatometer Thermoflex, Japan). The heating rate was 2°C/min, and the specimen's height was 0.5 mm.

The failure topography at impact of the specimens was examined using the JSM-50 Å scanning electron microscopy (JOEL, Japan).

Relaxation properties were evaluated by use of home designed reverse-torsion pendulum at a frequency of 1 Hz. The specimens had a rectangular cross-section and measured 60 × 5 × 1 mm.

Similar to the previous work,¹⁶ the interphases interaction in the blends was evaluated in terms

Table I Properties of Test Materials

| Material | σ_s , MPa | ε_p , % | a , kJ/m ² | MFI, g/10min |
|------------------------------------|------------------|---------------------|-------------------------|--------------|
| PC | 57 | 22 | 18.1 | 14.7 |
| PBT | 56 | 31 | 4.5 | 23.2 |
| PC/PBT blends containing PBT, wt % | | | | |
| 10 | 65 | 33 | 14.8 | 16.9 |
| 25 | 66 | 34 | 12.8 | 22.2 |
| 40 | 65 | 44 | 10.7 | 21.5 |
| 60 | 61 | 51 | 9.2 | 23.2 |
| 75 | 59 | 55 | 7.7 | 22.8 |
| PET | 55 | 28 | 3.8 | 32.7 |
| PC/PET blends containing PET, wt % | | | | |
| 10 | 57 | 133 | 18.3 | 18.4 |
| 20 | 64 | 124 | 17.4 | 22.1 |
| 30 | 65 | 133 | 14.9 | 23.3 |
| 60 | 60 | 46 | 8.7 | 22.1 |
| 75 | 57 | 39 | 7.2 | 27.7 |

σ_s is the yield point in elongation; ε_p is the relative elongation at break; a is the Charpy impact strength measured on specimens having sharp-angle notch at 23°C; MFI is the melt flow index.

of a zG_3 parameter¹⁸ obtained from the relaxation spectrometry data by use of the following expression:

$$zG_3 = G_{bl} - \Phi_1 G_1 - \Phi_2 G_2 \quad (1)$$

where G_1 , G_2 , and G_{bl} are dynamic shear moduli of components (1), (2), and the blend, respectively; z is the function dependent on the component ratio in the blend; G_3 is the parameter accounting for the interaction between the components, Φ_1 and Φ_2 are weight shares of components in the blend. For incompatible systems with weak interactions ($zG_3 < 0$ or with its high negative values) the system would undergo separation. If $zG_3 > 0$, a strong interphases interaction of components in the blend can be expected.¹⁸

RESULTS AND DISCUSSION

Blends of PC/PET

Similar to ref. 14, the compatibility of components in the blends was evaluated by comparing the calculated values for the thermodynamic interaction parameter χ_{12} with its critical values χ_{12cr} . Our calculations showed¹⁹ that for PC/PBT system $\chi_{12} = 0.02$, while $\chi_{12cr} = 0.0085$, i.e., $\chi_{12} > \chi_{12cr}$. Hence, PC and PBT are thermodynamically immiscible. Because of low χ_{12} values, however, active interphases interactions should take

place in PC/PBT blends followed by development of a pseudohomogeneous interphases region.¹⁴ These interactions can cause a strong mutual influence of the components on their structure in blends as well as physical and mechanical properties of the materials owing to the resultant structure. Below, we consider particulars of the PC/PBT structure and properties, which are important for subsequent interpretation of data on impact strength of the blends.

DSC Findings

Figure 1(a) indicates inversion of the phase structure in the blends of amorphous PC and semicrystalline PBT.²⁰ This relationship shows that the heat stability remains unchanged (close to the PBT melting point) with addition of 40 wt % PBT. It can be expected, therefore, that starting from 40 wt %, PBT creates a continuous phase in the blend, containing a PC dispersed phase. It should be noted that with 20 wt % PBT the heat stability of the blend drops to lower values than that of pure PC. This observation is quite unexpected, as PBT heat stability is much higher than that of PC. Probably, with a relatively low PBT content (up to 20 wt %) and its high dispersion within the PC matrix, developed interphases are formed. PC macromolecules get involved in them into intermolecular interactions with PBT chains (π - π exchanges and dipole-dipole interactions²¹), which results in weaker intermolecular bonds within PC

unlike that of the unmodified polymer. Thus, relatively small addition of PBT exerts "plasticating" effect upon PC.

The ability of PBT to crystallize in a blend depends on its composition (Fig. 1, curve b). At concentrations <20 wt % PBT, the DSC technique could not detect any crystallized traces at all, whereas at concentrations >40 wt % the crystallinity degree approached the additive values [Fig. 1(b), dashed line], calculated with an assumption that PC acts as solvent for PBT without influencing its crystallization. The serious retardation of PBT crystallization for its concentrations up to 20 wt % seems to be owing to display of interphases interaction in the PC/PBT system, which suppresses crystallization in interfaces.

The crystallization temperature (T_{cr}) of PBT in the blends containing its low amounts would shift to the lower temperature region (Fig. 2 and Table II), where the fact supports the conclusion that PBT crystallization in blends retards. The melting point (T_m) varied a little (Table II).

The T_m and T_{cr} temperature difference (ΔT) for PBT in the blends exceeds somewhat that for the homopolymer at 40–90 wt % concentrations and rises sharply at 30 wt % (Table II). Higher ΔT values for the blends compared with individual components are evidence to disordered structures in the blends.^{14,22} Thus, blends containing PBT in

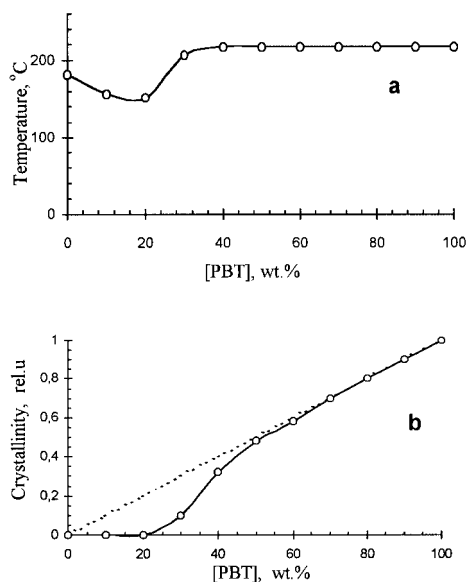


Figure 1 Effect of PBT concentration in blends with PC on heat stability expressed as temperature of beginning of deformation by using dilatometry technique (a) and relative crystallinity (b).

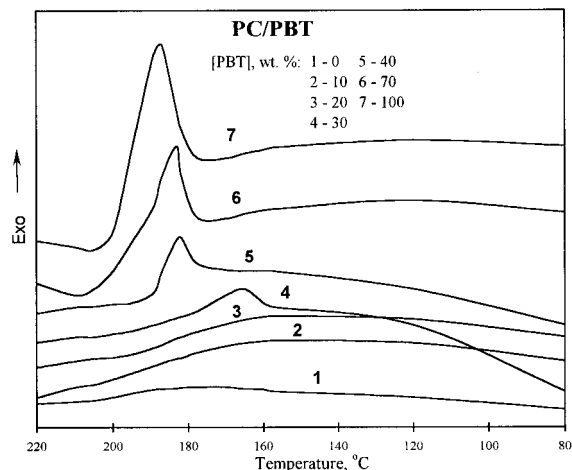


Figure 2 DSC plots of cooling: (1) PC; (7) PBT; and (2)–(6) PC/PBT blends.

a quantity at which it forms the dispersed phase have less ordered structure.

Therefore, the processes of phase separation in blends containing PC and PBT miscible in the amorphous region lead to variations in the properties of both the amorphous (PC) and crystalline (mostly PBT) phases. At PBT concentrations ≥ 40 wt % in the blend, it forms a dispersed medium; its crystallinity is similar to that of the homopolymer; this fact should be considered when working out commercial mix formulations.

Relaxation Measurements

We have learned earlier^{15,16} that the mechanical behavior and, consequently, the temperature dependence of impact strength for the PC blend are much affected by the relaxation processes. The relaxation spectra (temperature dependencies of the mechanical loss tangent ($\tan \delta$) and dynamic shear modulus (G') of PC, PBT, and PC/40 wt % PBT blends are shown in Figures 3 and 4. The spectra of the individual components (PC and PBT) had been described earlier,^{15,16,23} so it is not needed a detailed their analysis. The $\tan \delta$ vs. temperature plots of the initial components have two major peaks describing the β -transition process (at -95°C for PC and -70°C for PBT) and α -transition process ($T_{gPC} = 150^\circ\text{C}$ and $T_{gPBT} = 55^\circ\text{C}$). On the G vs. temperature plots, two plateaus appear for the initial PC and PBT (following after α and β -transitions) (Fig. 3).

Similar relaxation processes are typical of PC/PBT binary blends. The $\tan \delta$ vs. temperature plots for the blend have two strong peaks refer-

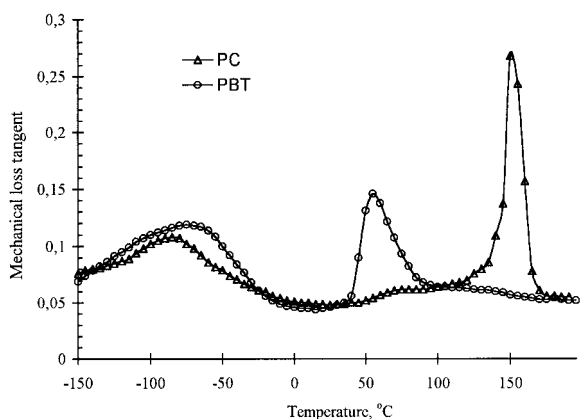
Table II Effect of PBT Concentration on Phase Transition Temperatures in PC/PBT Blends Determined by DSC

| Temperature, °C | PBT Concentrations in the Blend, wt % | | | | | | | |
|---------------------------|---------------------------------------|-----|-----|-----|-----|-----|-----|-----|
| | 10 | 20 | 30 | 40 | 50 | 70 | 90 | 100 |
| T_m | — | 221 | 221 | 221 | 220 | 220 | 222 | 222 |
| T_{cr} | — | — | 165 | 183 | 183 | 184 | 185 | 187 |
| $\Delta T = T_m - T_{cr}$ | — | — | 56 | 38 | 37 | 36 | 37 | 35 |

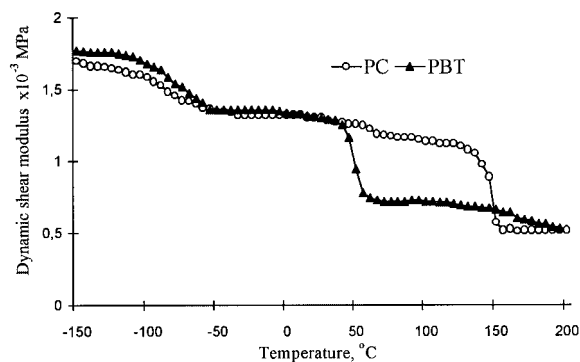
ring to the glass transition temperatures of the two components and a single peak typical of the β -transition (Fig. 4). For the blend, T_g of each component varies unlike that of the homopolymers, namely, T_{gPBT} increases up to 60°C, while T_{gPC} decreases up to 125°C. The glass transition temperatures of the components in a blend tend to approach. Similar behavior is typical for the blends with different ratios of PC and PBT.²³ The

approach of T_g of the components in a blend along with rather high $\tan \delta$ values observed over the region between the glass transition temperatures of the components are indicators of active interphases interactions and refs. 14 and 22.

The above was also supported by results of analyzes of the dependencies zG_3 vs. temperature (Fig. 5). It is clear that coincidence of PC and PBT molecular dynamics significantly affects the component interaction. For the temperature range between T_{gPC} and T_{gPBT} molecular mobility becomes more active in the two polymers. The molecular mobility of PC in the form of rotating diffusion and diffusive rotation of PBT segments^{23,24} do not coincide; it means that energy of segmental motions in the amorphous phase of PBT is substantially higher than that for PC segments, which are in the glassy state. Consequently, the zG_3 value drops over this interval of temperatures. After crossing the PC glass transition temperature, the coincidence in molecular dynamics of the chains (PC and amorphous phase of PBT are in a high elastic state) leads to higher zG_3 values; hence, the interactions in the blends' components, which become somewhat weaker



(a)



(b)

Figure 3 Temperature dependencies of $\tan \delta$ (a) and dynamic shear modulus (b) for PC and PBT.

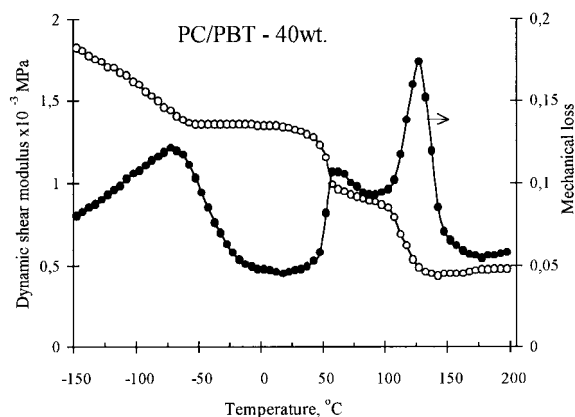


Figure 4 Temperature dependencies of $\tan \delta$ and dynamic shear modulus for PC/PBT-40 wt % blends.

with further increase in temperature, stabilizes them. It is resulted from reducing a distance between functional groups determining intermolecular interactions.

Thus, the relaxation measurements by use of an inverse pendulum tester help to obtain a clear picture on the level of interphases interactions in the blends over a wide temperature range. These data are indicative of material microheterogeneity. In combination with findings about phase structural changes, they can participate in true interpretation of the relationships related to the temperature course of the impact strength, one of the most important engineering properties of PC blends.

Temperature Dependence of Impact Strength for PC/PBT Blends

Figure 6 shows that the temperature course of the impact strength for homopolycarbonate and PC/40 wt % PBT blend differs essentially between the T_{gPC} and T_{gPBT} . In the low-temperature region (from -150°C to -60°C) the variations in the impact strength behavior and its values for PC are close to those of the PC/PBT blend, i.e., the blended system behaves like quasi-homogeneous homopolycarbonate. The causes of variations in PC impact strength with the test temperature are described elsewhere.¹⁵ Therefore, the molecular mobility in PC increases owing to defrosting rotations of isopropyl fragments in the macromolecules. For neat PC above 50°C impact strength decreased, which is explained by lower elastic modulus of the material and, as a result, lowering energy of initiation of crack at impact loading.¹⁵ The PC/PBT blend is characterized by intensive intermolecular interactions [$zG_3 > 0$, Fig. 5] up to

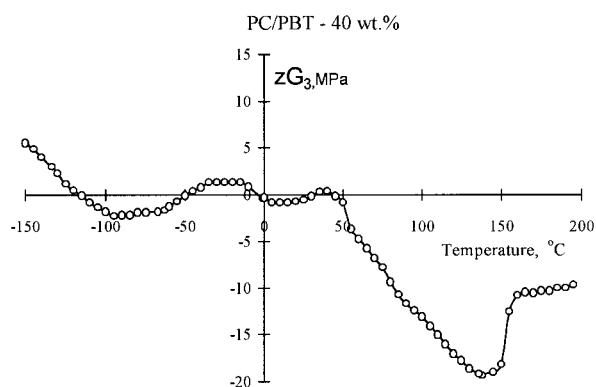


Figure 5 Temperature dependence of zG_3 for PC/PBT-40 wt % blends.

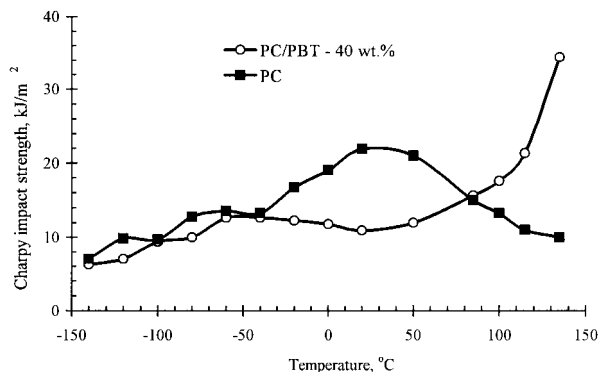


Figure 6 Charpy impact strength for PC and PC/PBT-40 wt % blends.

60°C , which equals T_{gPBT} (Fig. 4). Lower impact strength for the PC/PBT blends in comparison with that for PC in the temperature interval between -50 and 60°C resulted from the glassy state of the amorphous phase of PBT. In the blends, the molecular mobility of PC is limited as a result of intermolecular interactions there. Maximum impact strength found for the virgin PC at 30°C is not observed on the temperature dependence of this property for the blend studied.

Subsequent increase in the impact strength with further temperature rise could be associated with devitrification of the PBT amorphous phase. As was mentioned above, transition PBT amorphous phase to the high-elastic state results in lower zG_3 values (Fig. 5). Here, weaker interphases interactions are followed by higher “molecular heterogeneity” of the blend caused by inconsistency in the molecular dynamics of PC and PBT chain segments. The PBT amorphous high-elastic phase dispersed in the PC glassy matrix is supposed to act as a modifier for the impact strength, which is able to initiate crazing.

The high-elastic state of the modifier and structural microheterogeneity is one of the important factors that ensure high impact resistance of the blends.^{14–16} Hence, we expect that the PBT devitrified amorphous phase along with heat-caused higher mobility of its segments can increase “molecular heterogeneity” in the blends. The toughness of a blend system is also important in providing high impact strength, and depends on the toughness of the PBT crystalline phase. It seems possible that PC/PBT-40 wt % impact strength above T_{gPBT} could be explained^{15,25} by facts that higher segmental mobility of PBT and the blend’s microheterogeneity increase the energy required to propagate microcracks at impact failure. The

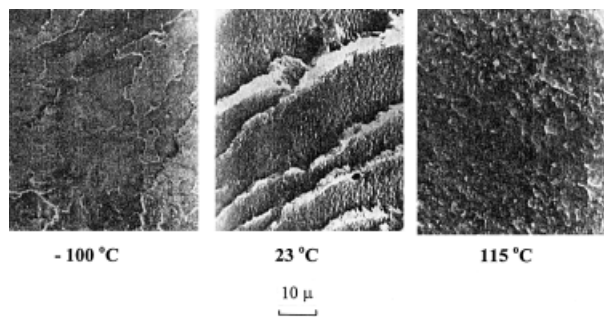


Figure 7 SEM micrographs of PC/PBT-40 wt % blend at different test temperatures.

energy required for initiating a failure at impact remains high, however, because of the reinforcing action of PBT crystalline phase.

It is most probable that mechanical energy dissipated within the specimen during impact deformation makes the main contribution in the impact strength improvement. Changing topography of the specimen's failure surface when the test temperature was varied supports this conclusion (Fig. 7). At low temperature (−100°C) the failure surface is relatively smooth and the appearance resembles elongated folds formed, probably by shear routes. At 23°C, the failure surface looks like a set of waves, which is typical of the materials, which follow the shear flow mechanism.^{14,16} At 115°C the impact strength is rather high and the failure surface contains numerous fine folds and micropores resulting, as a rule, from crazing.¹⁴

According to work,²⁵ the crazing and shear flow processes proceed simultaneously at impact failure of polymer blends. The crazing region in a polymer blend can be transformed into the shear flow region as the crack propagates. In the initial crazing region, crazes can collapse and close by shear flow.²⁵ Figure 8 suggests that for PC/PBT blends, crazing can be observed clearly at 115°C; this means over the T_{gPBT} .

The ingredients ratios (Table III) has some influence on the impact strength of PC/PBT blends. At low concentrations of PBT (up to 10 wt %) no changes were observed, but for the blends with PBT continuous phase the ingredients ratio is most significant. The maximum impact strength for the blends 2.5-fold exceeds that for the homopolycarbonate.

In view of this, a conclusion can be made that PC/PBT binary blends, having been regarded as nonimpact resistant, are in fact such, but only within a certain temperature range. At tempera-

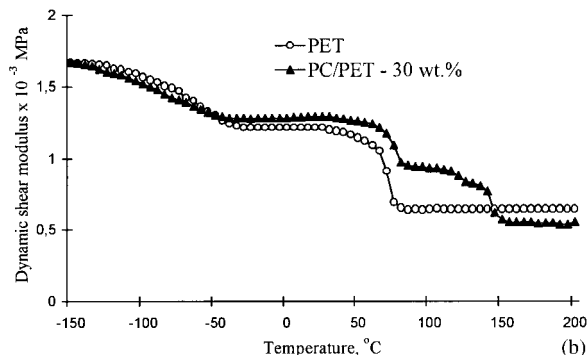
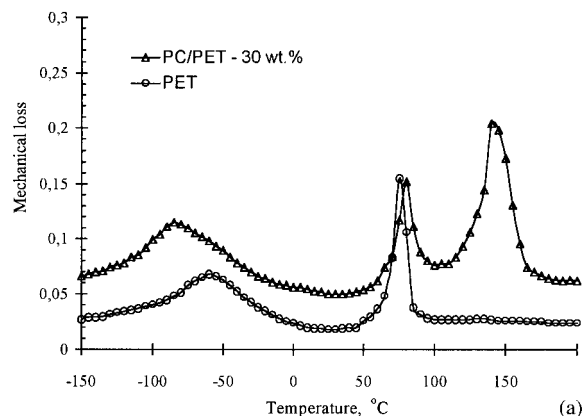


Figure 8 Temperature dependence of $\tan \delta$ (a) and dynamic shear modulus (b) for PC/PET-30 wt % blend.

tures between T_{gPBT} and T_{gPC} , the impact strength of the blend can reach rather high values.

PC/PET Blends

For PC/PET blends, $\chi_{12} = 0.3$, while $\chi_{12cr} = 0.008$, i.e., $\chi_{12} > \chi_{12cr}$, which indicates component incompatibility. Because of χ_{12} low values, intensive

Table III Effect of PBT Concentration and Test Temperature on Charpy Impact Strength of PC/PBT Blends, kJ/m²

| PBT Concentration, wt % | Test Temperature, °C | | | |
|-------------------------|----------------------|------|------|------|
| | 60 | 80 | 100 | 120 |
| 10 | 9.6 | 9.6 | 9.7 | 9.7 |
| 25 | 9.5 | 9.7 | 17.4 | 22.1 |
| 40 | 11.8 | 12.6 | 18.7 | 23.5 |
| 60 | 11.9 | 12.0 | 30.3 | 27.9 |
| 75 | 13.6 | 14.5 | 24.5 | 27.4 |

interphases interactions are to be expected, like that for the PC/PBT blends.

Relaxation Spectroscopy Findings

The temperature dependencies of $\tan \delta$, G and zG_3 for PET and PC/PET blends are close to that for PBT and PC/PBT (Figs. 8 and 9). The β -transition temperatures for PET and PC/PET-30 wt % are -55 and -85°C , respectively; $T_{g\text{PET}} = 76$ and 80°C . The PC/PET blend has one T_β . For PC/PET-30 wt %, $T_{g\text{PC}} = 136^\circ\text{C}$ [Fig. 8(a)]. Thus, a common feature for PC/PAT blends is the approach of α -transition temperatures.

Effect of temperature on interphases interactions in PC/PET blends is illustrated in Figure 9. Parameter $zG_3 > 0$ over the temperature range from -65 until 76°C , i.e., between completion of the β -transition temperature and $T_{g\text{PET}}$. Parameter zG_3 decreases sharply between $T_{g\text{PET}}$ and $T_{g\text{PC}}$, then it begins to rise fast with subsequent stabilization of the values, which remain positive up to $T = 200^\circ\text{C}$. Hence, the intensity of interphases interaction in PC/PAT blends, the quantitative estimation of which was based on calculated values of zG_3 parameter, strongly depends on the temperature. This is a result of changes in the molecular mobility of the components. For temperatures between the glass transition of the two components in the blend, interactions between them become much weaker. Within this range of T_g a microheterogeneity might be increased for the blended material, which should be followed by changes in the impact strength.

Impact Strength of PC/PET Blends

Both PC/PET and PC/PBT blends generally have low impact strength at negative temperatures

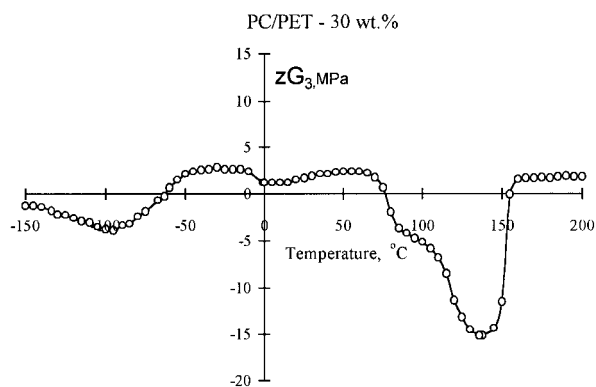


Figure 9 Temperature dependence of zG_3 for PC/PET-30 wt % blend.

Table IV Effect of Concentration and Test Temperature on Charpy Impact Strength of PC/PET Blends, kJ/m^2

| PBT Concentration, wt % | Test Temperature, $^\circ\text{C}$ | | | | |
|-------------------------------|------------------------------------|------|------|------|------|
| | 23 | 60 | 80 | 100 | 120 |
| 10 | 18.3 | 14.2 | 9.2 | 9.4 | 9.7 |
| 25 | 13.4 | 5.8 | 18.5 | 20.1 | 19.3 |
| 40 | 12.3 | 5.8 | 9.0 | 12.0 | 34.5 |
| 60 | 8.7 | 1.6 | 7.7 | 12.2 | 35.0 |
| 75 | 7.2 | 3.2 | 20.6 | 17.7 | 29.0 |

(between 5 and 11 kJ/m^2 at -40°C) as well as at room temperature (Table IV). Between $T_{g\text{PET}}$ and $T_{g\text{PC}}$ the impact strength was improved and depends on PET concentration in the blend. The effect is most pronounced for blends with a PET continuous phase (PET concentration over 40 wt %) (Table IV).

These common relationships observed for binary blends (PC/PBT and PC/PET) suggest the importance of interphases interactions and molecular mobility of components for impact strength investigations. Intensive interphases interactions together with suppressed segmental mobility promote formation of quasi-homogeneous structure and make the blends nonimpact resistant over a wide temperature range from -100°C up to $T_{g\text{PAT}}$. Their mechanism of impact failure resembles that of homopolycarbonate.^{15,16} Between $T_{g\text{PAT}}$ and $T_{g\text{PC}}$, however, the blends show higher resistance to impact failure (unlike virgin PC), and at certain ratios of both components and temperatures they become impact-resistant materials. We explain this fact by more intensive dissipation of energy in the PC amorphous phase being in high-elastic state. From the impact strength viewpoint, transition of the PAT amorphous phase to a high-elastic state and the failure mechanism for PC blends resemble addition of an impact strength modifier with low T_g into PC (e.g., siloxane-containing block copolymers, the siloxane having low T_g ^{15,16}).

Based on the obtained experimental data on the influence of temperature on impact strength of the PC/PAT blends it is postulated that this dependence is also valid for other binary systems containing polymers differing in the glass transition temperatures. Transition of one of the components, or its part, to a high elastic state is the necessary condition for obtaining high impact

strength material, and could be equivalent of the introduction of well-known modifiers^{14,16,25} of impact strength. According to our opinion, from both scientific and practical viewpoints, it is important to perform further investigations concerning mechanism of impact failure of polymer blends in this temperature interval. It especially concerns blends with polymers differing in structure, intermolecular interactions, compatibility, and the width of the interval between their glass transition temperatures.

CONCLUSIONS

Processes of phase separations in blends of PC and PAT cause changes in both the amorphous (PC) and crystalline (PAT) phases. The DSC technique did not detect traces of crystallized PBT in PC/PBT blends up to PBT-20 wt %. At PBT \geq 40 wt %, a continuous phase is created in the blend and its crystallinity approaches the additive values. Owing to intensive interphases interactions, the PC glass transition temperature shifts to the lower temperature region (for PC/PBT-40 wt % by 25°C).

The relaxation spectrometry revealed intensive interphases interactions in these blends within the temperature range from the β -transition to T_{gPAT} . These interactions become weaker between T_{gPAT} and T_{gPC} .

It is postulated that the effect of improving the impact strength of the PC/PAT blend, which was found for temperatures between glass transition temperatures of the mixed components, is valid also for other binary blends.

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