

Polycarbonate/Polybutylene Terephthalate/Impact Modifier

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Flow Characteristics, Mechanical Properties and Chemical Resistance of Polycarbonate/Polybutylene Terephthalate/Impact Modifier Blends

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: (PC)/ (PBT)/ (IM)
 PC PBT IM
 가 가 가
 0 가 0
 가 가 PC가
 PC/PBT/IM
 PC 50 wt%
 PC 가 IM
 IM 가
 가

ABSTRACT : Mechanical properties, flow characteristics and chemical resistance of polycarbonate (PC)/polybutylene terephthalate (PBT)/impact modifier (IM) blends were investigated over the various composition ranges of PC and PBT. Mechanical properties of the PC/PBT/IM blends for different IMs, butadiene based IM and butyl acrylate based IM, were studied for various compositions of the IMs. Impact strength at low temperature was also observed. For the study of chemical resistance of the PC/PBT/IM blends, the blends were dipped in organic solvent, thinner, and then variations of mechanical properties were analyzed. Tensile and flexural strengths were increased linearly and heat distortion temperature (HDT) also increased as PC content in the blends increased. Impact strength increased drastically as PC content increased up to 50 wt% and stayed stable value. Flowability decreased as PC content increased. Impact strengths of the blend were various for different IMs. Butyl acrylate based IM showed slightly higher impact strength than butadiene based IM for the temperature above 0 . However, butadiene based IM showed remarkably higher impact strength than butyl acrylate based IM for the temperature below 0 . Through the experiment of chemical resistance it was observed that tensile and flexural strengths decreased, and impact strength increased as PC content in the blends increased. PC in the blend would become mild and ductile when it contacted with organic solvent. Thus the impact strength increased while tensile and flexural strength decreased.

Keywords : polycarbonate, polybutylene terephthalate, impact modifier, chemical resistance, mechanical property.

(PBT) (PC) PBT PC/PBT/IM PC
 가 , PC IM
 , PBT SEM IM
 PC PBT IM PC/
 PC PBT/IM (thinner)
 PC/PBT (IM) PC/
 PBT/IM 1,2
 PC, PBT IM 가 PC/PBT/IM PC
 PC/PBT TRIREX[®] 3030 , PBT
 TRIBIT[®] 1700S TRIREX[®]
 3030 bisphenol A (BPA) phosgene
 PC 31000
 PC PBT miscibility 2-8 . TRIBUT[®] 1700S
 (DTA), (T_g) , 90000
 (scanning electron microscope, SEM) PBT IM Kureha Chemical Par -
 (transmission electron microscope, TEM) , Paraloid EXL2602 Paraloid EXL2313가 Par -
 miscibility PC/ (PMMA) IM
 PBT Paraloid EXL2313
 PMMA IM
 Table 1
 ,^{9,10} PC PBT PC PBT , IM 3 phr
 30 phr L/D가 40
 19 mm (APV)
 miscible IM 200
^{11,12} 가
¹³⁻²⁰ PC/PBT/IM 265 , 270
 가
 (HDT)
 가 75 ton (Battenfeld 75)
 PC/PBT/IM 가 255
 가 ^{21,22} 325 , 60
 IM Instron 4204 ASTM D638

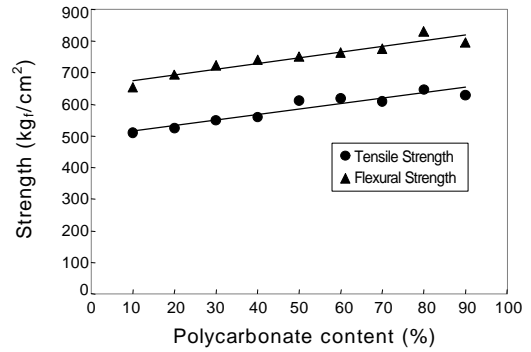
Polycarbonate/Polybutylene Terephthalate/Impact Modifier

Table 1. Materials Used in Polycarbonate (PC)/Polybutylene Terephthalate (PBT)/Impact Modifier (IM) Blends

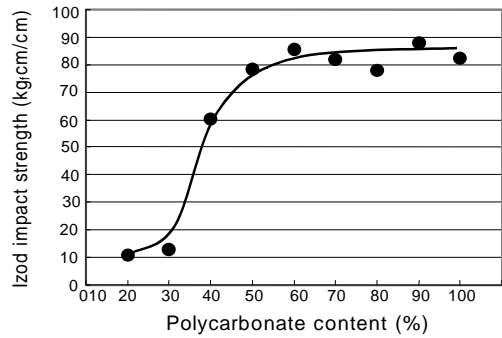
material	grade	supplier	remarks
PC	SYC TRIREX [®] 3030	Samyang Co.	M _w : 31000
PBT	SYC TRIBIT [®] 1700S	Samyang Co.	M _w : 90000
impact modifier	Paraloid EXL2602	Kureha Chemical	butadiene based
	Paraloid EXL2313	Kureha Chemical	butyl acrylate based

D790 CEAST
 -40 (25)
 ASTM D256
 Rosand
 ASTM D648 HDT
 Rosand capillary rheometer
 PC/PBT/IM IM
 SEM
 SEM Stereoscan 360 (Cam-
 bridge Instruments)
 30
 PC/PBT (painting)
 acrylic/urethane T -
 725 (())
 10~20%,
 20~30%, 5~10%
 15~20% PC/PBT/IM
 24
 가
 1, 24, 72 168 (1)
 PC/PBT/IM
 IM 6 phr PC/PBT/IM
 PC

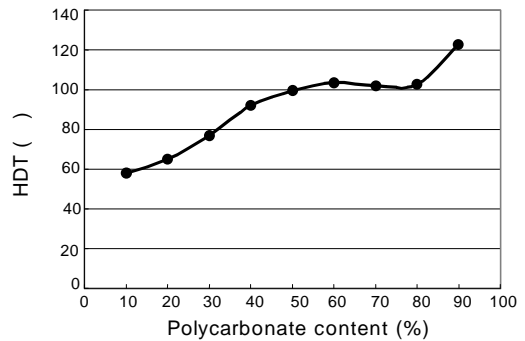
Figure 1(a) PC



(a)



(b)



(c)

Figure 1. Variations of physical properties of polycarbonate (PC)/polybutylene terephthalate (PBT)/ impact modifier (IM) blends with PC content for 6 phr of butadiene based IM. (a) Tensile and flexural strengths, (b) Izod impact strength, and (c) Heat distortion temperature (HDT).

PC 가 가
 500 640 kgf/cm² 680 820 kgf/cm²

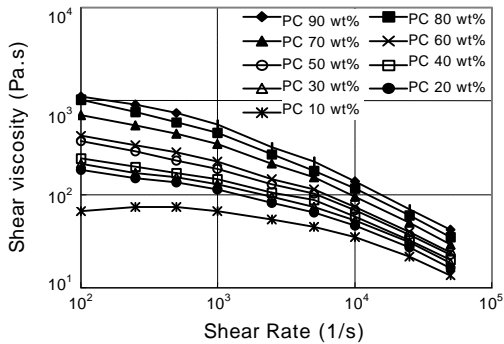


Figure 2 Shear viscosity of polycarbonate(PC)/polybutylene terephthalate (PBT)/impact modifier (IM) blends for 6 phr of butadiene based IM.

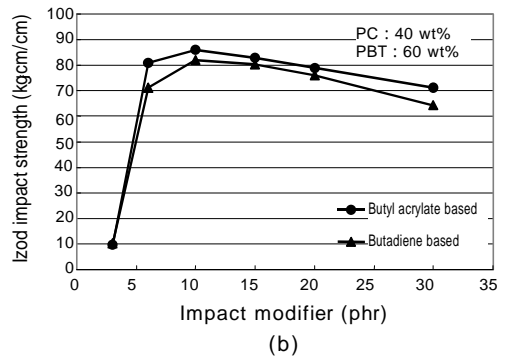
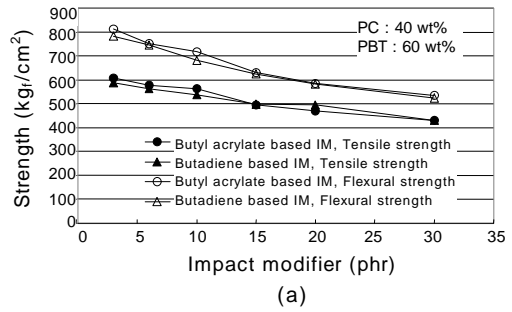


Figure 3. Mechanical properties of polycarbonate (PC)/polybutylene terephthalate (PBT)/impact modifier (IM) blends with various IM contents for different IMs. (a) Tensile and flexural strengths and (b) Izod impact strength.

Figure 1(b) PC Izod
 wt% PC 가 10 kg/cm/cm 80
 kg/cm/cm 가 가 PC

PC
 .14 PC 50 wt% PC가
 가 가
 85 kg/cm/cm . Figure
 1(c) PC HDT . HDT
 PC 가 58 123 가

PC 50 80 wt%
 . Figure 2 PC 가 가
 . PC 가 가
 PBT/IM IM 가 가 IM
 . PC/
 IM 10 phr
 compatibility가

PC PBT 40 wt%
 60 wt% IM 3 phr 30 phr
 IM

EXL2602 EXL2313
 IM
 Figure 3 IM
 (Figure 3(a)) IM
 가 , IM

Figure 3(b) IM
 IM IM
 10 phr
 compatibility가
 IM PC/PBT IM 10 phr
 IM

Figure 4 IM
 Figure 4(a) (b) IM
 (EXL2602) 가 IM
 (EXL2313) -
 (ductile - brittle transition temperature)가

IM
 (Figure 3(b)) (-20)
 IM 가

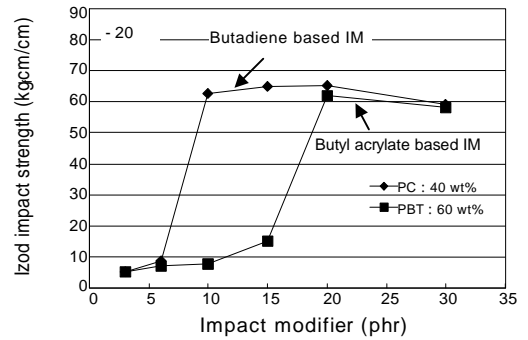
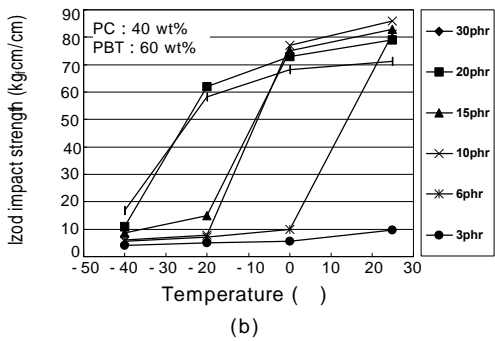
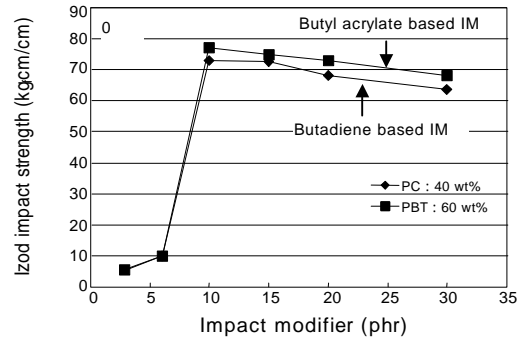
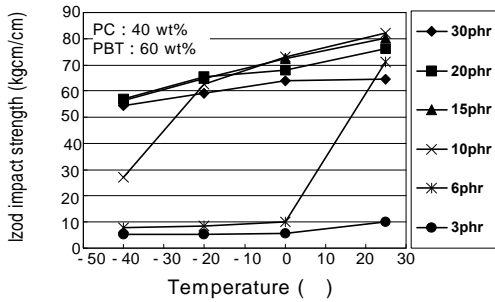


Figure 4. Izod impact strength of polycarbonate (PC)/polybutylene terephthalate (PBT)/impact modifier (IM) blends with various test temperatures for different IMs and their contents. (a) Butadiene based IM and (b) Butyl acrylate based IM.

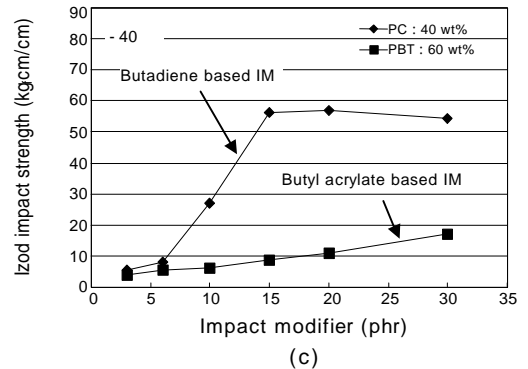


Figure 5. Characteristics of impact strength for different IMs and their contents at low temperatures. (a) Izod impact strength at 0°C, (b) Izod impact strength at -20°C, and (c) Izod impact strength at -40°C.

(Figure 5).
 IM T_g가
 IM 0 IM
 10 phr (Figure
 3(b), 5(a)) (-20, -40)
 가 가 IM 가
 (Figure 5(b), 5(c)). T_g가 IM

IM -20 -40
 15~20 phr IM
 가 IM
 IM -20 20 phr
 -40 30 phr
 wt% IM (,
) PC/PBT/IM

Figure 6. SEM PC 40 wt%, PBT 60

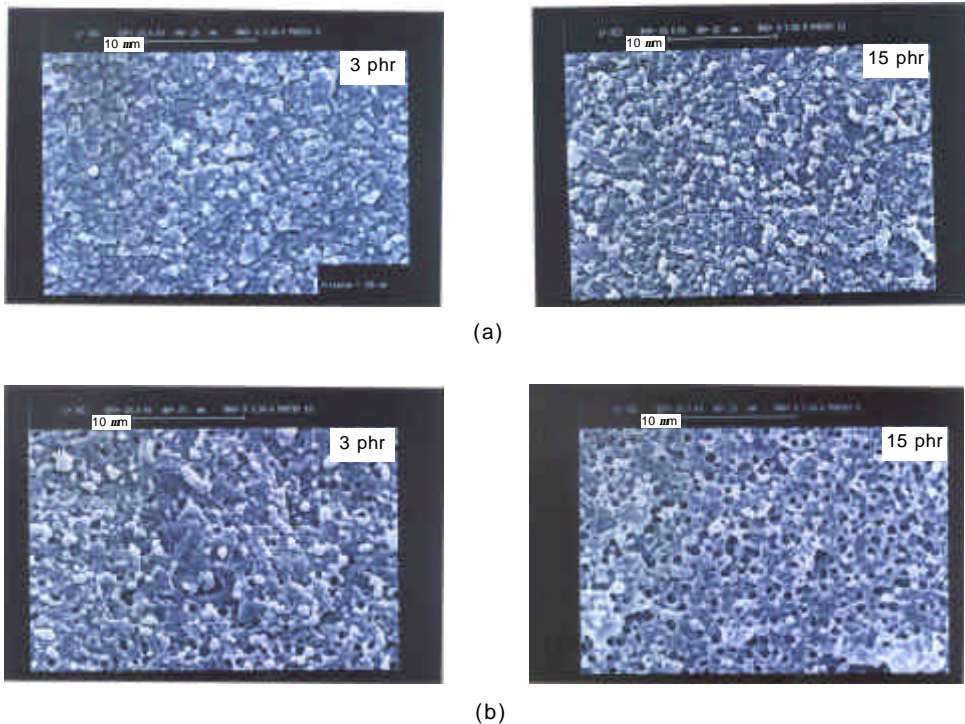


Figure 6. Scanning electron microscopy (SEM) of cross-sectioned polycarbonate (PC)/polybutylene terephthalate (PBT)/impact modifier (IM) blends. (a) Butadiene based IM, PC: 40 wt%, PBT: 60 wt% and (b) Butyl acrylate based IM, PC: 40 wt%, PBT: 60 wt%.

Figure 7 shows the morphology of PC/PBT/IM blends with different impact modifier (IM) concentrations. The figure is divided into two parts, (a) and (b), corresponding to the SEM images in Figure 6. Part (a) shows the morphology for Butadiene based IM, and part (b) shows the morphology for Butyl acrylate based IM. The images are arranged in a grid, with labels for the impact modifier (IM) concentration (3 phr or 15 phr) and the polymer composition (PC/PBT/IM). The labels are as follows:

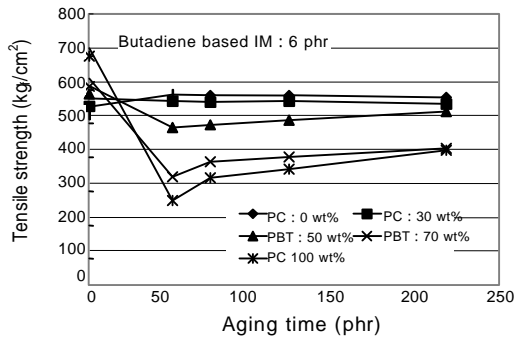
- Top row: IM, IM, IM, IM, PC
- Second row: IM, IM, IM, IM, PC
- Third row: PC/PBT/IM, IM, IM, IM, PC
- Fourth row: PC, PC, PC, PC, PC
- Fifth row: IM, IM, IM, IM, PC
- Sixth row: IM, IM, IM, IM, PC
- Seventh row: IM, IM, IM, IM, PC
- Eighth row: IM, IM, IM, IM, PC
- Ninth row: IM, IM, IM, IM, PC
- Tenth row: IM, IM, IM, IM, PC

The labels are arranged in a grid, with labels for the impact modifier (IM) concentration (3 phr or 15 phr) and the polymer composition (PC/PBT/IM). The labels are as follows:

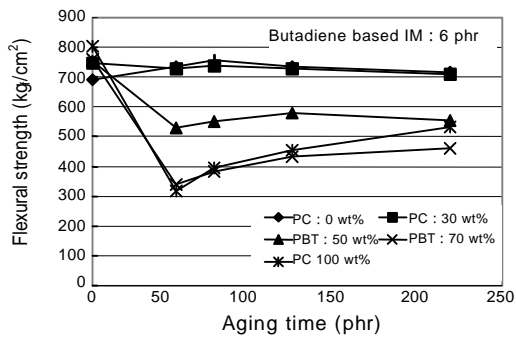
- Top row: IM, IM, IM, IM, PC
- Second row: IM, IM, IM, IM, PC
- Third row: PC/PBT/IM, IM, IM, IM, PC
- Fourth row: PC, PC, PC, PC, PC
- Fifth row: IM, IM, IM, IM, PC
- Sixth row: IM, IM, IM, IM, PC
- Seventh row: IM, IM, IM, IM, PC
- Eighth row: IM, IM, IM, IM, PC
- Ninth row: IM, IM, IM, IM, PC
- Tenth row: IM, IM, IM, IM, PC

The labels are arranged in a grid, with labels for the impact modifier (IM) concentration (3 phr or 15 phr) and the polymer composition (PC/PBT/IM). The labels are as follows:

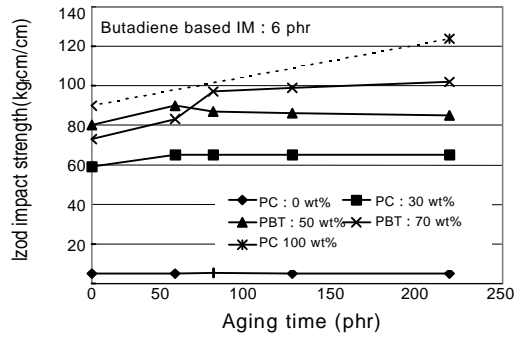
- Top row: IM, IM, IM, IM, PC
- Second row: IM, IM, IM, IM, PC
- Third row: PC/PBT/IM, IM, IM, IM, PC
- Fourth row: PC, PC, PC, PC, PC
- Fifth row: IM, IM, IM, IM, PC
- Sixth row: IM, IM, IM, IM, PC
- Seventh row: IM, IM, IM, IM, PC
- Eighth row: IM, IM, IM, IM, PC
- Ninth row: IM, IM, IM, IM, PC
- Tenth row: IM, IM, IM, IM, PC



(a)



(b)



(c)

Figure 7. Variations of mechanical properties of polycarbonate (PC)/polybutylene terephthalate (PBT)/ impact modifier (IM) blends for various aging times after dipping in the thinner for 24 hours. (a) Tensile strength, (b) Flexural strength, and (c) Izod impact strength.

가
 PC , PC
 PBT, IM
 PC/PBT/IM
 PC/PBT/IM
 가
 PC/PBT/IM
 PC
 가
 HDT PC 가
 가 . 20~40 wt% PC
 가 50 wt% PC
 . PC 가
 가
 IM . PC/
 IM
 가 IM
 가 IM
 IM 10 phr
 IM가 IM
 가 IM
 가 가 IM
 PC/PBT/IM
 가
 PC
 가 . PC
 0~43%
 0~34%
 가 , PC 가
 가
 PC/PBT/IM

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