Article

Modified Polylactic Acid with Improved Impact Resistance in the Presence of a Thermoplastic Elastomer and the Influence of Fused Filament Fabrication on Its Physical Properties

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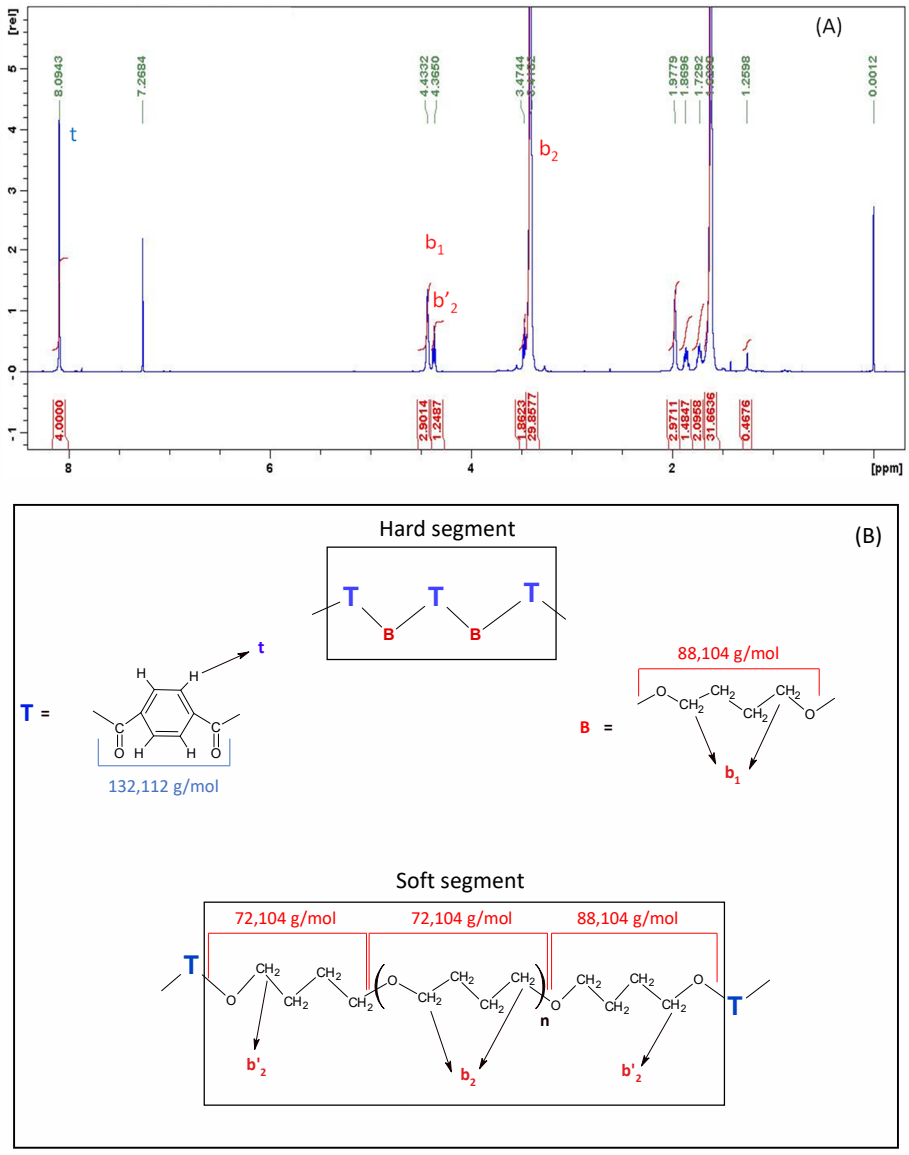
TPCE was composed of hard segments based poly(butylene terephthalate) and soft segments based poly(tetramethylene ether) glycol. In this study, this thermoplastic elastomer will be symbolized with "Hytrel" and the two kinds of segments with "PBT" and "PTMG". From ^{1}H NMR analysis on Hytrel, the mass fraction of the hard segments (F_{PBT}) and of the soft segments (F_{PTMG}) could be determined. After calculation, the values were 25 wt% and 75 wt%, respectively. Details for the calculation are provided on Figure S1.



$$F_{PBT}\ (wt\%) = 100\ x\ \frac{f_{PBT}}{f_{PBT} + f_{PTMG}} \quad (C)$$

$$F_{PTMG}\ (wt\%) = 100\ x\ \frac{f_{PTMG}}{f_{PTMG} + f_{PBT}}$$

With $f_{PBT} = \frac{I_t}{4}\ x\ 132{,}112 + \frac{I_{b_1}}{4}\ x\ 72{,}104$

$$f_{PTMG} = \frac{I_{b_2}}{4}\ x\ 72{,}104 + 0{,}5\ x\ \frac{I_{b'_2}}{2}\ x\ 72{,}104 + 0{,}5\ x\ \frac{I_{b'_2}}{2}\ x\ 88{,}104$$

Figure S1. ^{1}H NMR analysis on Hytrel [(A): ^{1}H NMR spectrum in $CDCl_3$, (B) identification of signals, (C) calculation of F_{PBT} and F_{PTMG}].

Additional DSC and DMA analyzes were performed on Hytrel. Thermograms are presented in Figure S2. DSC thermogram showed mainly two melting peaks. The first one at 4.2 °C which corresponds to the melting of the PTMG segments. The second one at 166.2 °C which corresponds to the melting of the PBT segments. DMA thermogram mainly showed two mechanical transitions. The first one, near -61 °C, corresponds to the glass transition of the PTMG segments. The second one, near 160 °C, corresponds to the melting of the PBT segments.

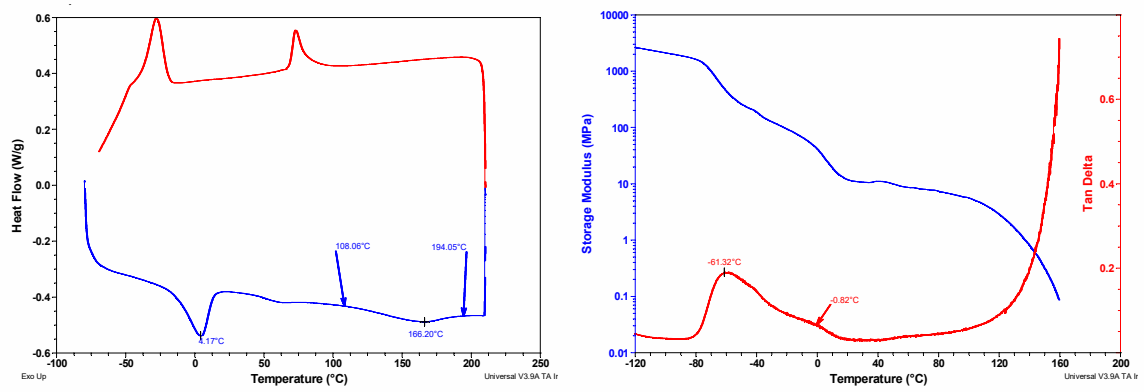


Figure S2. DSC thermogram (left) on Hytrel [heating cycle (10 °C/min) in blue then cooling cycle in red (10 °C/min)] - DMA thermogram (right) on Hytrel [tension film, 3 °C/min from -120 °C to 165 °C, 1 Hz, amplitude of 10 µm].