COMPOSITION-DRIVEN RHEOLOGICAL BEHAVIOUR AND PROCESSABILITY OF PBAT/PHBV BLENDS FOR BIODEGRADABLE FOOD PACKAGING

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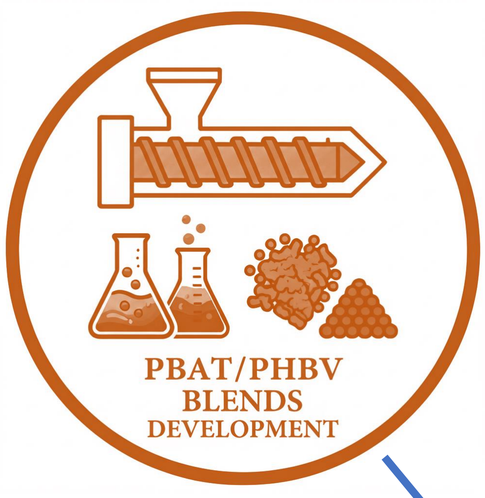
INTRODUCTION

Widely used food packaging materials are predominantly based on fossil-derived synthetic plastics. Although they provide suitable performance, their limited biodegradability and recyclability contribute to increasing environmental concerns. Biodegradable polymer blends therefore represent a promising alternative for more sustainable food packaging. Poly(butylene adipate-co-terephthalate) (PBAT) and poly(3-hydroxybutyrate-*co*-3-hydroxyvalerate) (PHBV) are biodegradable polyesters with complementary properties. This study investigates the effect of PBAT/PHBV blend composition on melt flow behaviour, rheological properties, and temperature-dependent dynamic-mechanical response using melt flow index (MFI), oscillatory rheometry, and dynamic mechanical analysis (DMA).

MATERIALS & METHODS



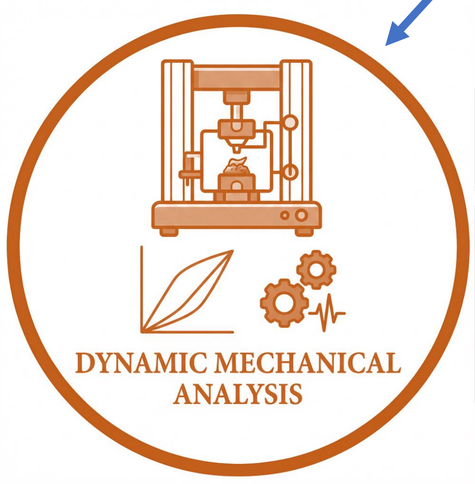
PHBV, ENMAT™ Y1000P, Tianan Biologic Materials Co., Ltd., China

PBAT, DAWNECO 0101, Shandong Dawn degradable Materials Co.,Ltd., Kina

Brabender kneader
- 180 °C
- 60 rpm
- 10 min
- PBAT/PHBV blends: 0–100 wt.% PBAT in 10 wt.% increments

Discovery HR30 Hybrid Rheometer, TA Instruments, USA

Rheological test
- Frequency sweep
- 0.1 rad s^{-1} – 600 rad s^{-1}
- Sample diameter: 20 mm
- Sample thickness: 1.5 mm
- Temperature: 180 °C
- Strain: 2%



Discovery HR30 Hybrid Rheometer, TA Instruments, USA

Dynamic mechanical test (DMA)
- Temperature sweep
- T= -60 °C - 120 °C
- Sample size: 10 mm×20 mm×1 mm
- Frequency: 1 Hz
- Amplitude: 25 µm

Davenport, AMETEK Test and Calibration Instruments, UK

Melt flow index (MFI)
- ASTM D1238, ISO 1133
- 190 °C
- Mass of the polymer granules: 5 g
- Mass of the weight: 2,16 kg
- Preheating time: 6 min

RESULTS

RHEOLOGY

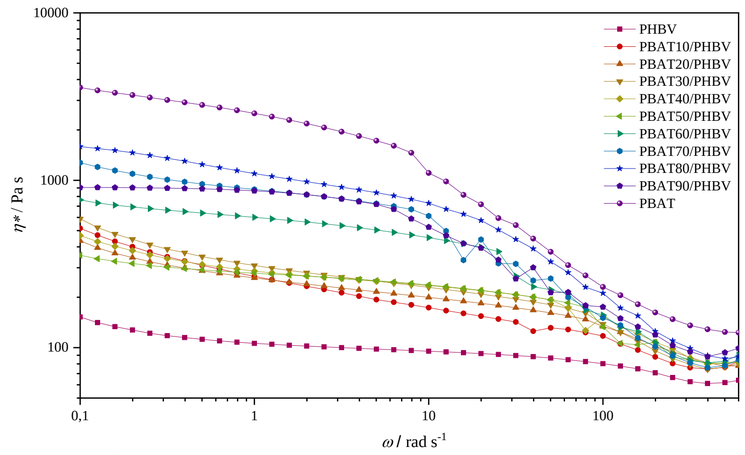


Fig 1. Complex viscosity, η^*, of PBAT/PHBV blends.

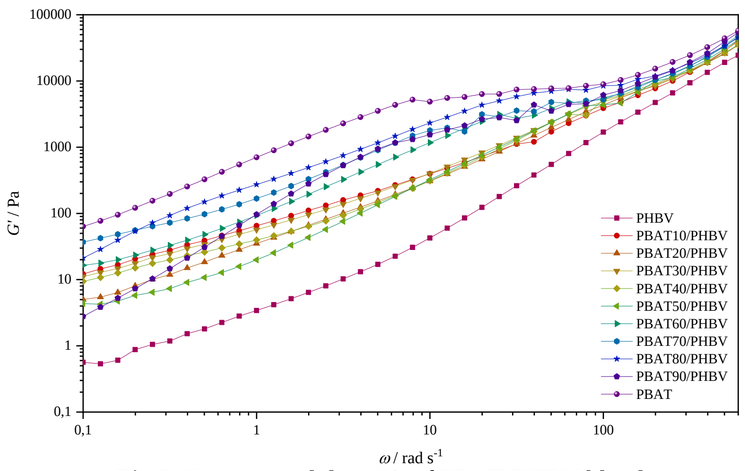


Fig 2. Storage modulus, *G*', of PBAT/PHBV blends.

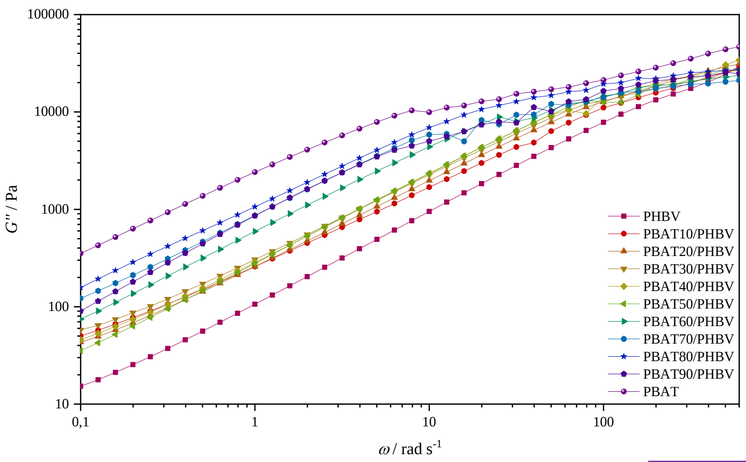


Fig 3. Loss modulus, *G*'', of PBAT/PHBV blends.

DMA

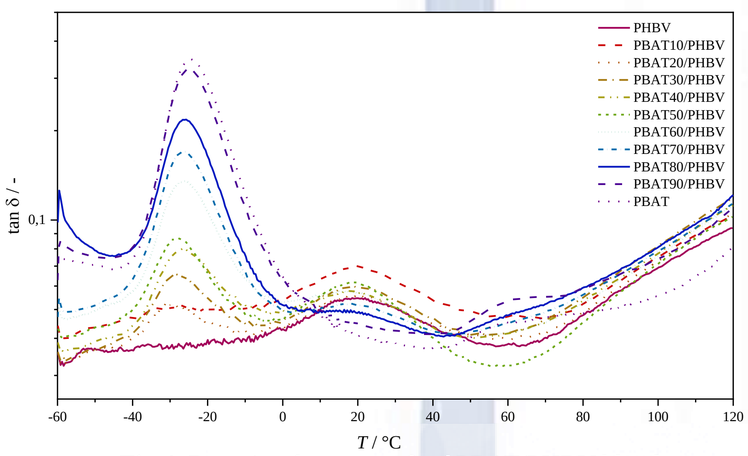


Fig 4. Damping factor, *tan δ*, of PBAT/PHBV blends.

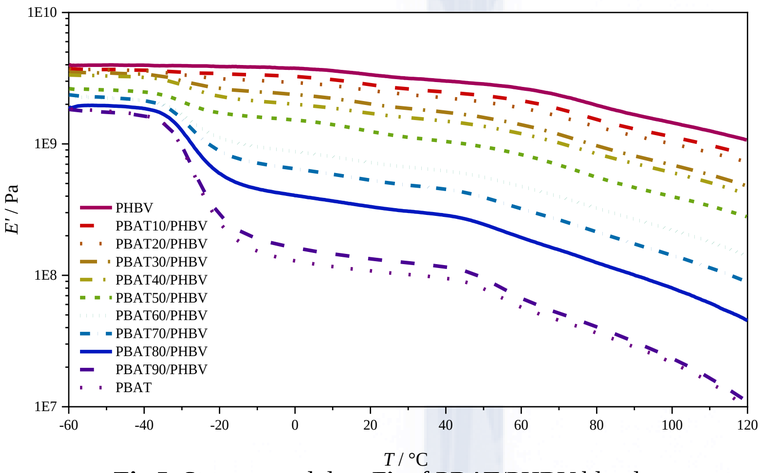


Fig 5. Storage modulus, *E*', of PBAT/PHBV blends.

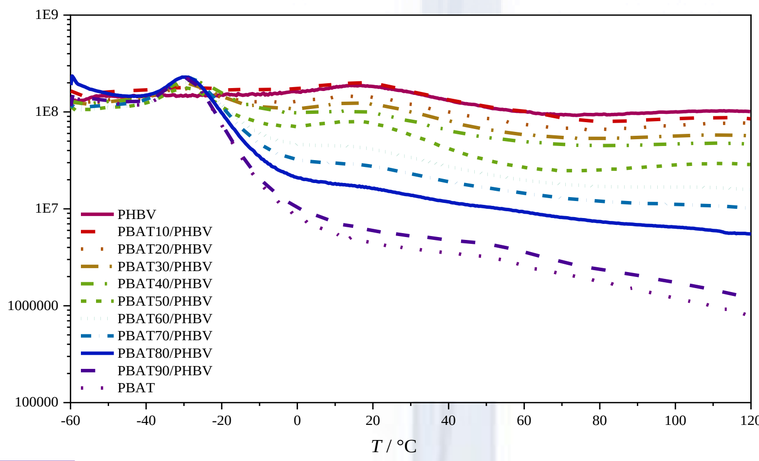


Fig 6. Loss modulus, *E*'', of PBAT/PHBV blends.

MFI

Fig 7. Melt flow index, MFI, of PBAT/PHBV blends.

CONCLUSIONS

- Increasing PBAT content generally increased the complex viscosity, storage modulus (*G'*), and loss modulus (*G''*), indicating a more pronounced viscoelastic response of the melt.
- DMA revealed distinct relaxation regions associated with PBAT and PHBV, indicating limited miscibility of the two polymers.
- MFI decreased with increasing PBAT content, showing reduced melt flowability and confirming the strong composition dependence of PBAT/PHBV processability.
- Overall, the PBAT/PHBV ratio enables effective tailoring of the rheological, processing, and dynamic-mechanical behaviour of the blends.

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