

Comparative Study of Uniaxially Stretched Single-Layer and Multi-layer Blown Films Based on Poly(Butylene Adipate-*co*-Terephthalate) and Inorganic Fillers for Food and Agriculture Applications

Table S1: Mechanical Data of all the film samples in transverse direction

Formulation	Stretching Ratio	Thickness (mm)	Tensile Strength (MPa)	Tensile Modulus (MPa)	Elongation at Break (%)
Transverse Direction					
SL-PBAT	Unstretched	0.034	26.8 ± 5.47	17.6 ± 16.5	716.2 ± 57.47
TL-PBAT	Unstretched	0.038	25.5 ± 2.99	27.8 ± 12.38	512.2 ± 34.64
SL-PBAT/talc25%	Unstretched	0.049	19.9 ± 2.51	123.8 ± 31.08	552.7 ± 24.38
	2	0.031	12.2 ± 1.49	29.6 ± 36.2	644.8 ± 30.9
	4	0.017	8.3 ± 1.22	44.5 ± N/A	657.3 ± 43.21
	6	0.011	6.0 ± 1.77	436.2 ± 76.68	99.8 ± 30.33
TL-PBAT/talc25%	Unstretched	0.040	15.3 ± 0.9	136 ± 10.21	445.2 ± 22.53
	2	0.040	16.4 ± 2.09	167.8 ± 14.39	488.2 ± 70.1
	4	0.018	20.2 ± 2.34	154.2 ± 17.01	610 ± 61.86
SL-PBAT/CaCO ₃ 25%	Unstretched	0.04	20.7 ± 3.07	98.8 ± 7.52	559.9 ± 40.71
	2	0.048	14.1 ± 1.7	103.7 ± 10.16	600.9 ± 27.81
	4	0.046	6.32 ± 0.43	76.1 ± 5.71	510 ± 34.55
	6	0.021	4.98 ± 0.7	6.6 ± 7.73	540.8 ± 63.29
TL-PBAT/CaCO ₃ 25%	Unstretched	0.072	10.8 ± 1.41	59.7 ± 8.31	363.9 ± 20.44
	2	0.053	10.2 ± 1.3	36.4 ± 8.91	553.5 ± 48.66
	4	0.027	9.51 ± 1.45	44.9 ± 17.61	460.3 ± 38.78
	5.5	0.023	9.65 ± 2.06	37.93 ± 15.03	474.9 ± 30.53

Table S2: Glass transition temperature (T_g) of film samples

Formulation	Stretch Ratio	T_g (°C)
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TL-PBAT UNST	Unstretched	-28.5 (± 1.0)
TL-PBAT/talc25%	Unstretched	-31.5 (± 0.5)
	2	-28.8 (± 0.2)
	4	-27.0 (± 0.1)
SL-PBAT/CaCO ₃ 25%	Unstretched	-31.3 (± 0.9)
	2	-28.0 (± 1.5)
	4	-24.0 (± 1.3)
	6	-28.8 (± 4.0)
TL-PBAT/CaCO ₃ 25%	Unstretched	-30.1 (± 0.6)
	2	-29.4 (± 0)
	4	-27.1 (± 0.3)
	5.5	-28.8 (± 0.6)

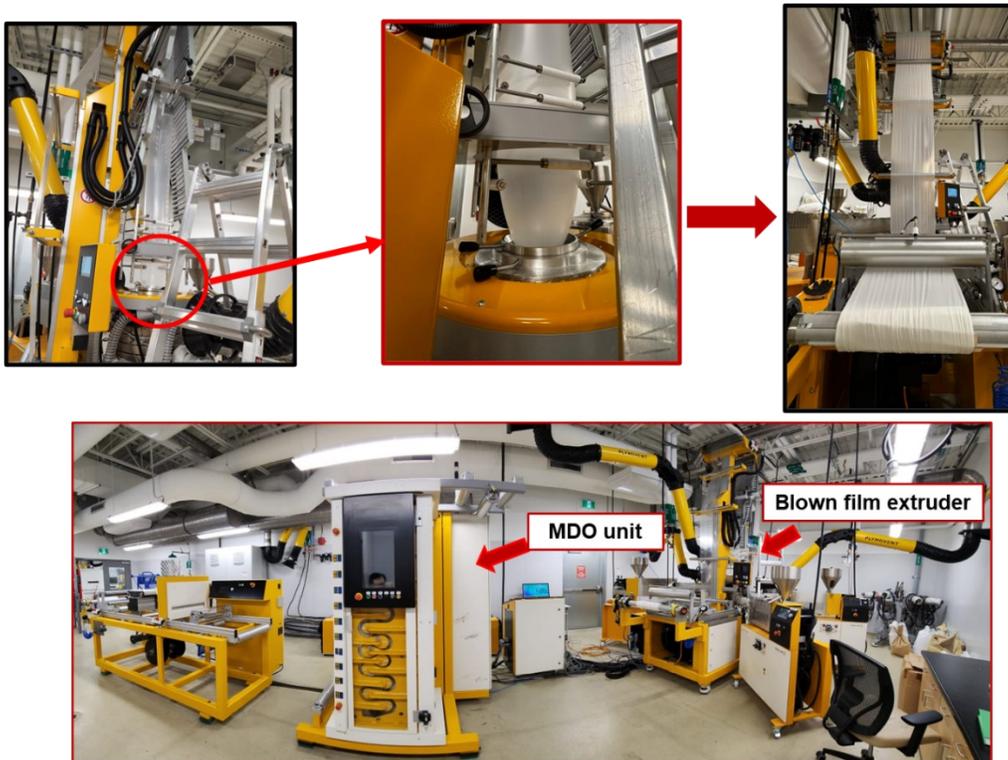


Figure S1: Blown film processing and uniaxial orientation of the PBAT/talc and PBAT/CaCO₃ films; MDO: Machine Direction Orientation

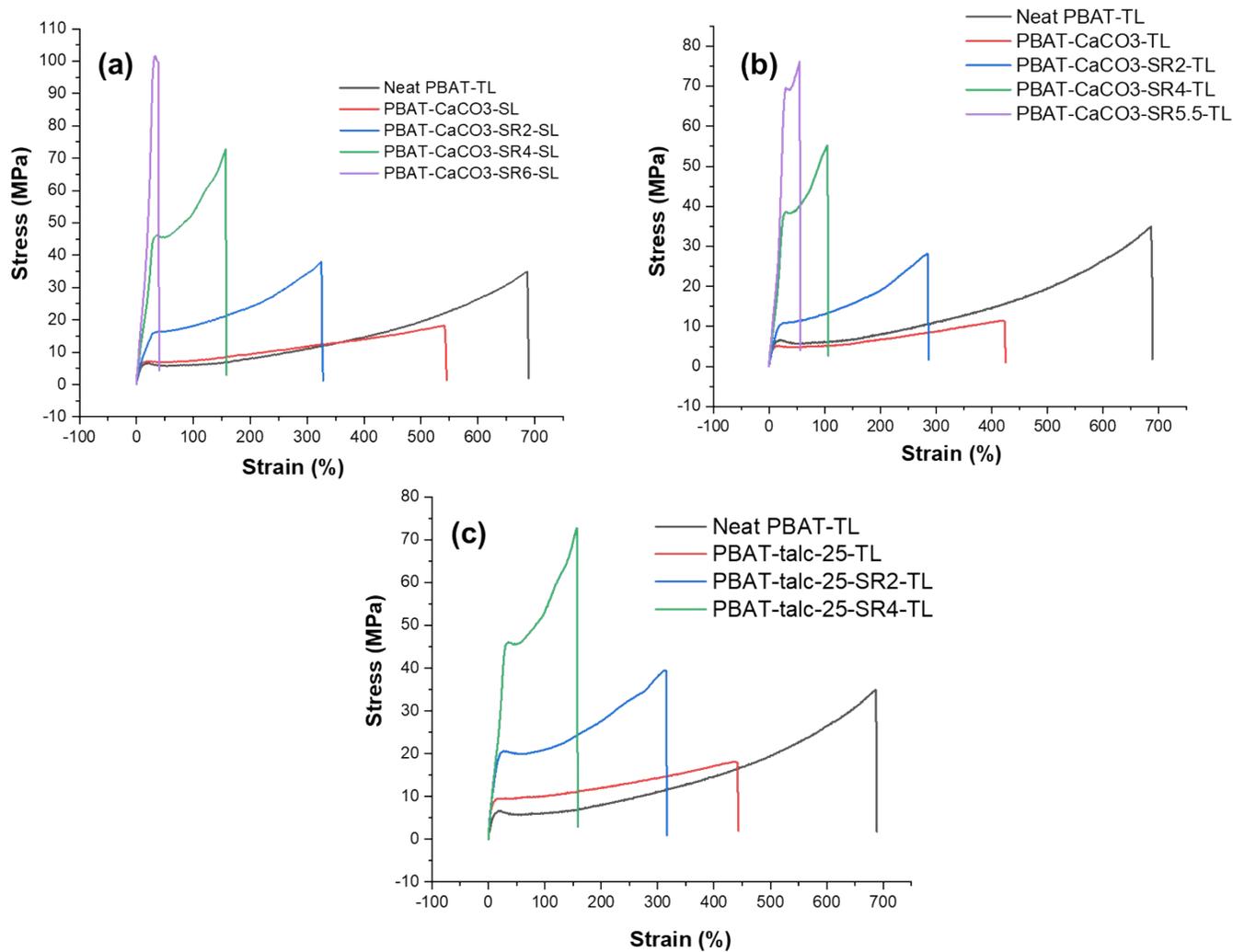


Figure S2: Stress-strain Curve of all film samples; (a) SL-PBAT/CaCO₃25% film at different stretch ratios (b) TL-PBAT/CaCO₃25% film at different stretch ratios (c) TL-PBAT/talc25% film at different stretch ratios

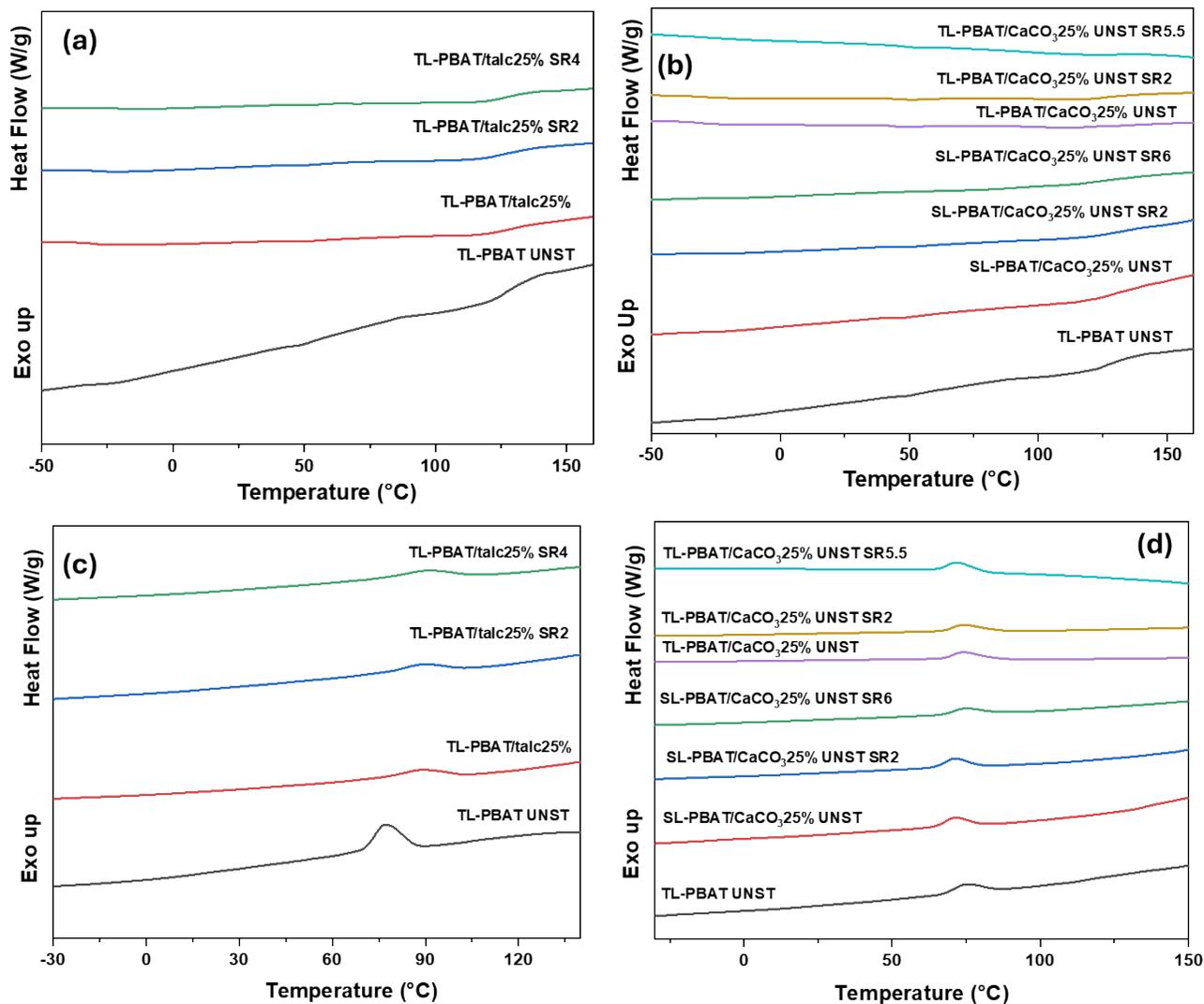


Figure S3: DSC curves of (a) melting peaks of PBAT/talc films (b) melting peaks of PBAT/CaCO₃ films (c) cooling peak of PBAT/talc films (d) cooling peak of PBAT/ CaCO₃ films

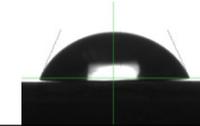
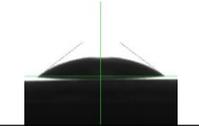
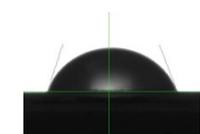
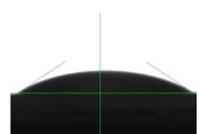
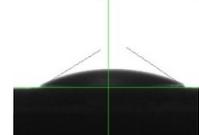
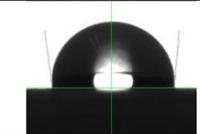
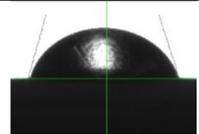
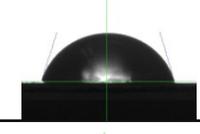
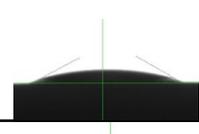
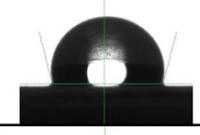
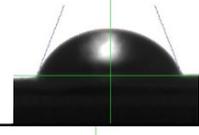
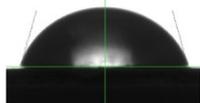
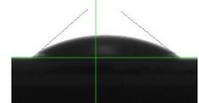
Sample	Water contact angle	Diidomethane contact angle
TL-PBAT UNST		
TL-PBAT/talc25% UNST		
TL-PBAT/talc25% SR4		
SL-PBAT/CaCO ₃ 25% UNST		
SL-PBAT/CaCO ₃ 25% SR6		
TL-PBAT/CaCO ₃ 25% UNST		
TL-PBAT/CaCO ₃ 25% SR5.5		

Figure S4. Contact angles of single-layer and tri-layer composite films for the UNST and highest SR samples, along with the neat TL-PBAT UNST sample.

Thermogravimetric Analysis

A Thermogravimetric analyzer (Q500, TA Instruments, USA) was used to assess the thermal stability of the PHBV/PBAT blend samples. Approximately 8 mg of each sample was heated from room temperature to 600 °C at a rate of 10 °C/min in a nitrogen atmosphere with a flow rate of 50 mL/min.

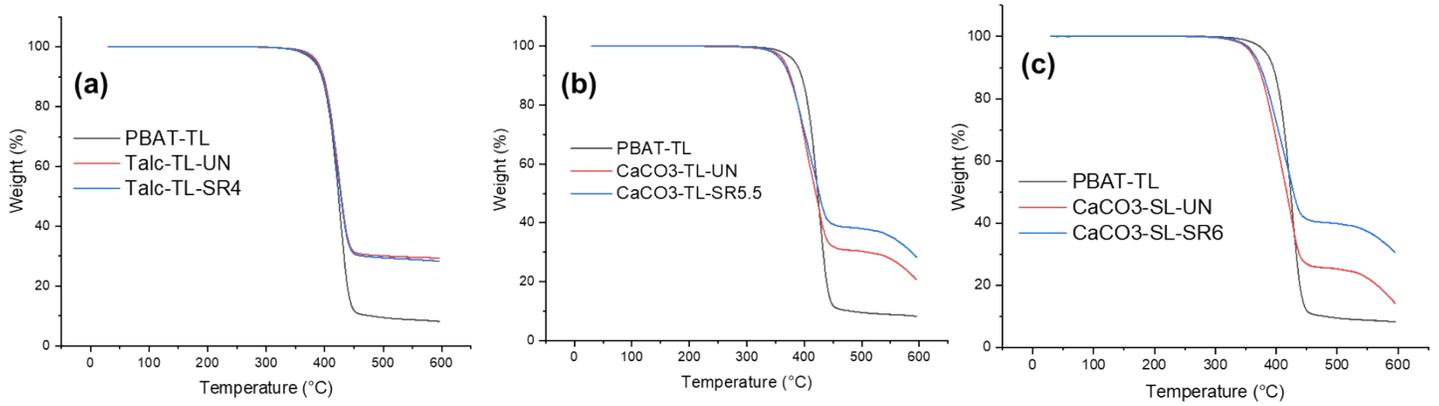


Figure S5: TGA curves of (a) talc filled TL films (b) CaCO₃ filled TL films (c) CaCO₃ filled SL films