

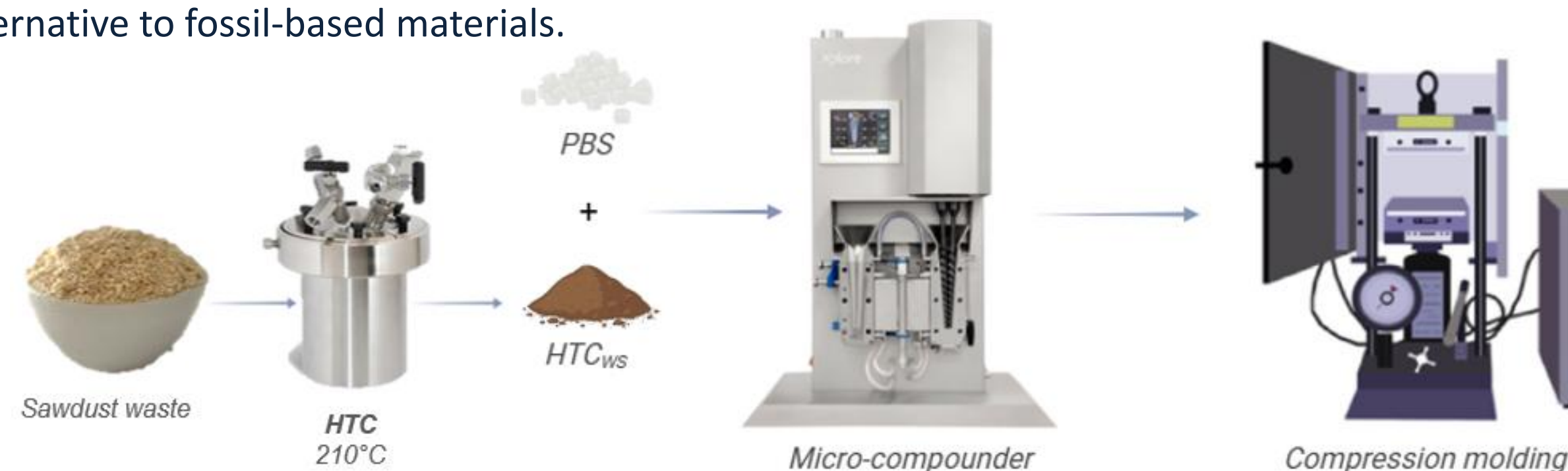
Sustainable composites based on bioplastics and hydrothermally carbonized wood waste

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INTRODUCTION & AIM

Implementing sustainability and circularity concepts involves the conscious use and treatment of various types of waste to promote the transition from a linear to a circular economy and reduce the carbon footprint. This study explores the use of wood waste that has undergone hydrothermal treatment as a sustainable filler in bioplastics, with the aim of formulating composite biomaterials as an alternative to fossil-based materials.



METHOD

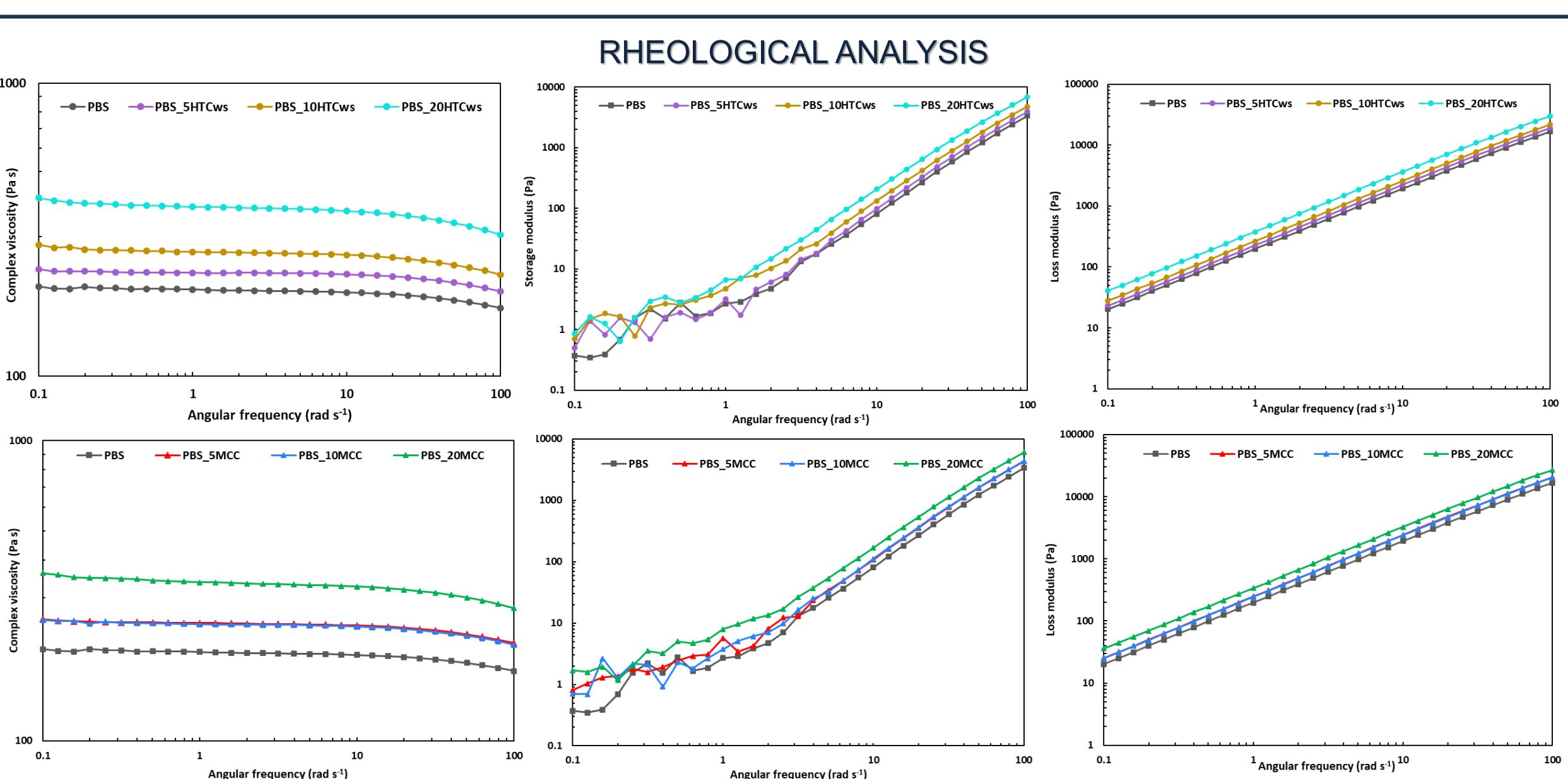
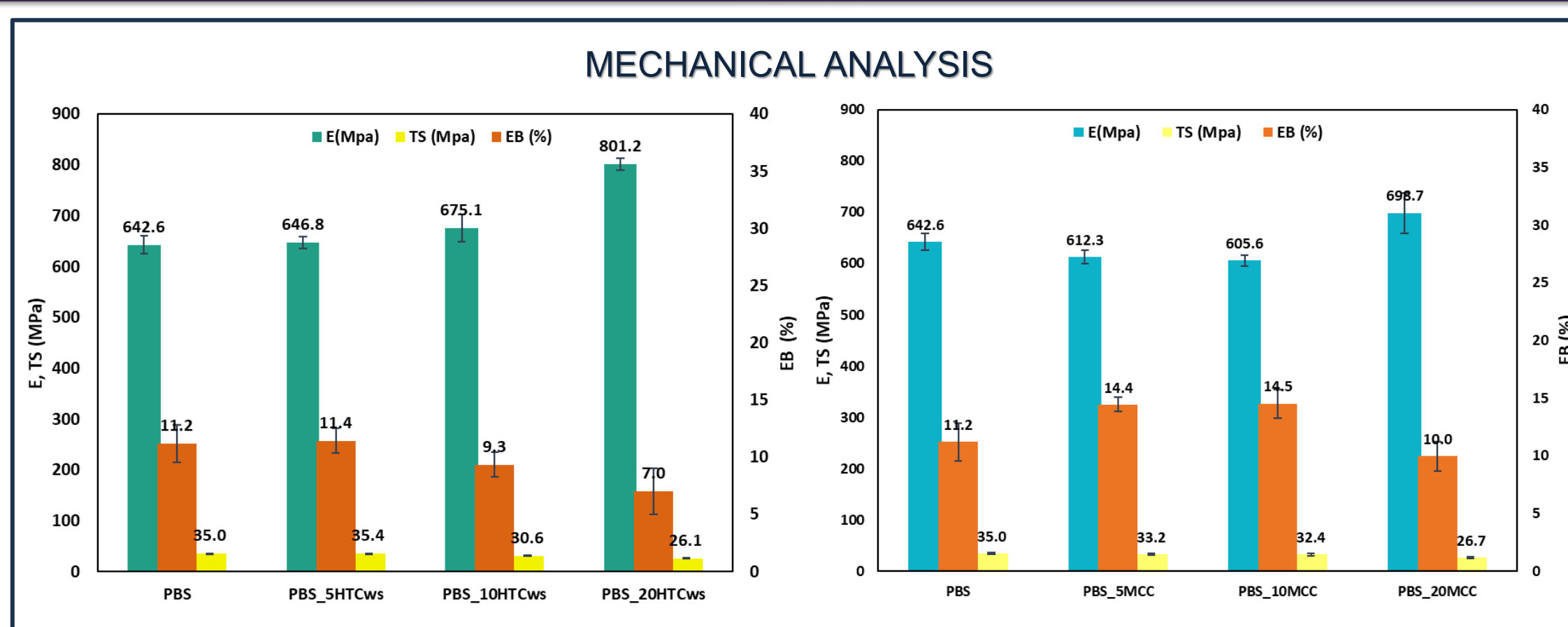
Sawdust wood waste was subjected to a sustainable hydrothermal carbonization treatment, and the produced particles were introduced into the poly(butylene succinate) (PBS) matrix using a micro compounder at different weight ratios. For comparison, biocomposites based on PBS and micro-crystalline cellulose (MCC) have been produced following the same processing protocols.

CHARACTERIZATIONS

Thermal analysis (DSC, TGA)
Mechanical analysis
Rheological analysis
Morphological analysis
Degradation study
FTIR
Weight loss

RESULTS

	T_{cc} (°C)	ΔH_{cc} (J/g)	T_m (°C)	ΔH_m (J/g)	T_c (°C)	ΔH_c (J/g)	χ (%)	T_{max} (°C)	Residue ₇₀₀ (%)
PBS	95.8	-12.31	115.6	76.11	63.6	-73.87	57.85	389.8	2.81
PBS_5MCC	98.2	-11.74	115.9	74.01	69.5	-73.87	59.43	398.4	2.04
PBS_10MCC	98.9	-8.85	116.6	69.62	68.6	-57.15	61.23	402.0	2.52
PBS_20MCC	99.0	-9.26	115.8	66.38	71.4	-62.98	64.74	399.1	2.73
PBS_5HTC	101.1	-12.24	115.8	79.15	74.9	-90.15	63.86	400.2	2.72
PBS_10HTC	101.2	-11.20	115.5	75.96	75.7	-87.36	64.25	398.3	3.40
PBS_20HTC	101.6	-10.40	115.5	72.00	76.5	-82.23	69.82	396.4	4.91

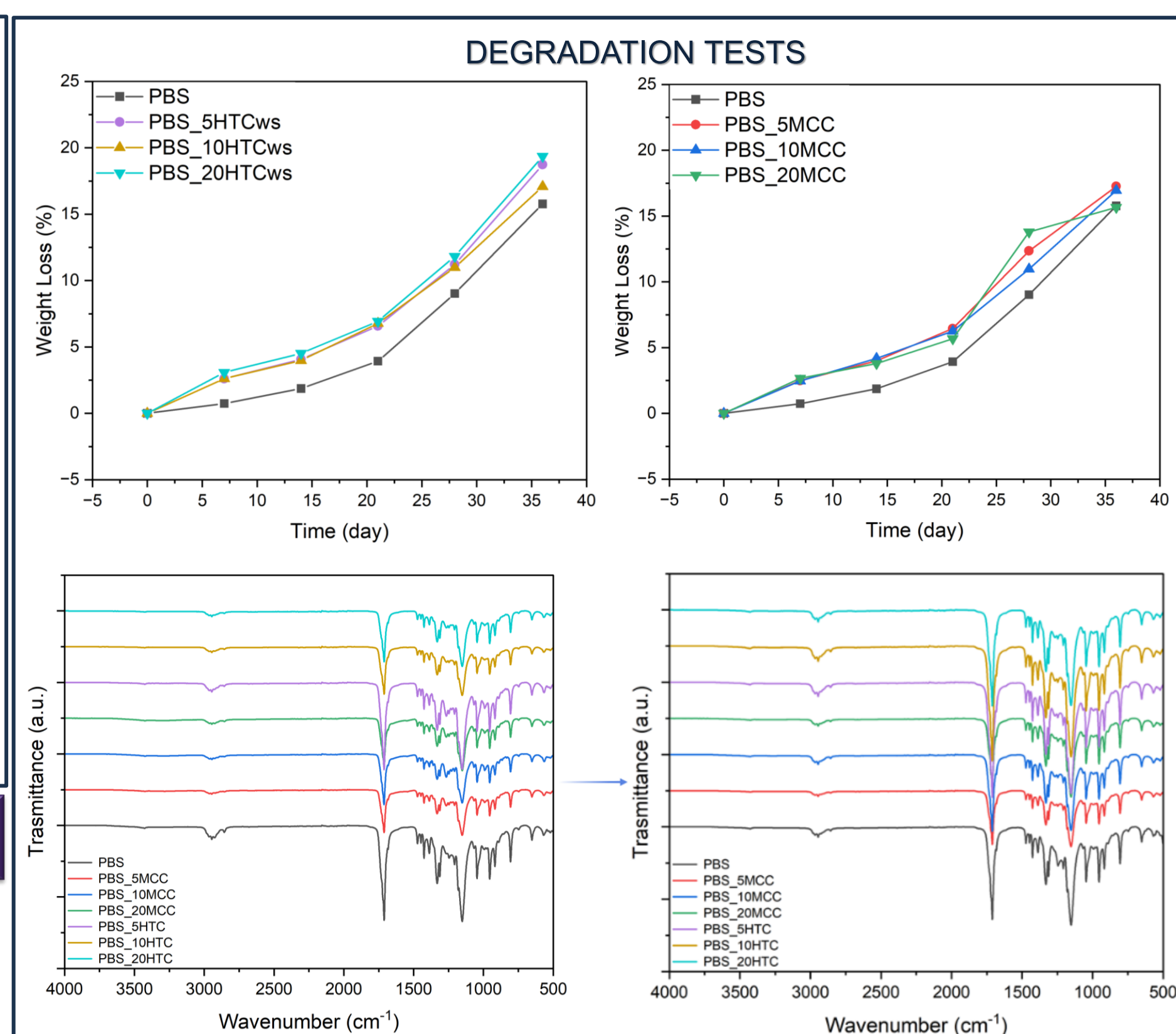


DISCUSSION & CONCLUSIONS

The calorimetric analysis suggests a clear nucleating effect of both fillers, leading to a significant increase in the crystalline degree of the PBS matrix. The elastic modulus values of the biocomposites are significantly higher than the value of the neat matrix, and this increase is more pronounced for the materials containing hydrothermally treated particles. In conclusion, hydrothermally treated wood particles can be considered as a valuable alternative to high-cost conventional micro-crystalline cellulose.

REFERENCES

Cárdenas-Zapata, R.; et al. Valorization of Sawdust Biomass for Biopolymer Extraction via Green Method: Comparison with Conventional Process. *Int J of Energy Research* **2022**, *46*, 20279–20302, doi:10.1002/er.8112.
Ye, C.; Yu, F.; Huang, Y.; Hua, M.; Zhang, S.; Feng, J. Hydrochar as an Environment-Friendly Additive to Improve the Performance of Biodegradable Plastics. *Science of The Total Environment* **2022**, *832*, 155124, doi:10.1016/j.scitotenv.2022.155124.



MORPHOLOGICAL ANALYSIS

