

A Green Enzyme-based Process For The Production Of Poly(butylene succinate)



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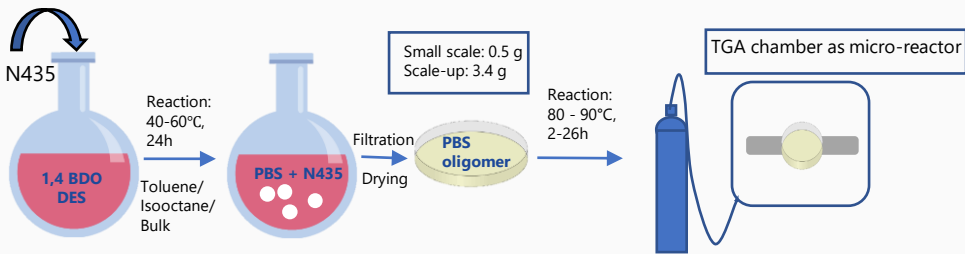
Introduction

Enzymatic polymerization is a green route, especially when bio-based and biodegradable polymers, such as PBS, are produced. PBS prepolymers are herein enzymatically synthesized and post-polymerized in the vicinity of T_m to upgrade thermal properties and molecular weight [1-3].

Experimental part

Enzymatic Prepolymerization

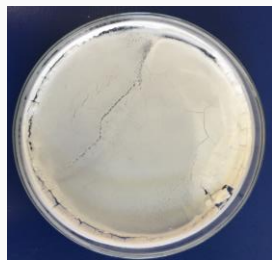
Post-polymerization



Conditions of PBS post polymerization (PBS_{YS}Z_h, where Y: Number of steps, Z: Reaction time in the 2nd step).

Sample	1 st step		2 nd step	
	T_r (°C)	t (h)	T_r (°C)	t (h)
PBS _{1S}	80	1,2,16	-	-
PBS _{2S} _{8h}	80	2	90	8
PBS _{2S} _{16h}	80	2	90	16
PBS _{2S} _{24h}	80	2	90	24

Scaled-up PBS prepolymer enzymatically synthesized in solvent-free system at 50 °C.

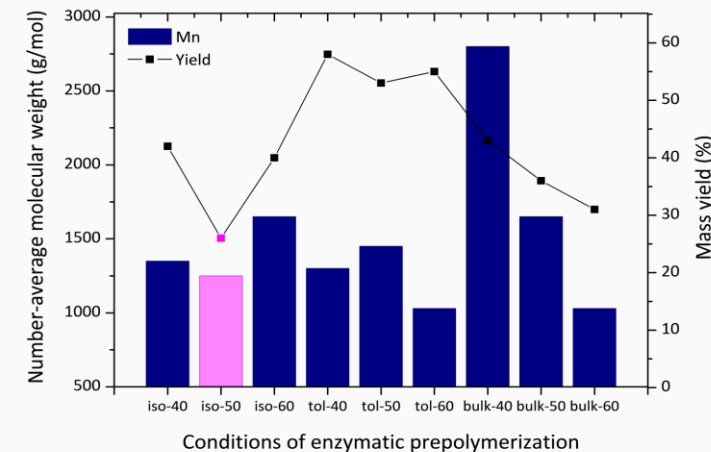
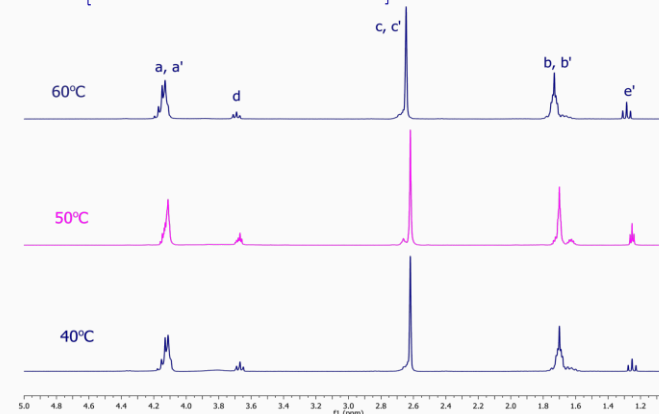
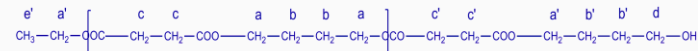


References

- [1] Vouyiouka S.N, Topakas E, Katsini A, Papispyrides C.D, Christakopoulos P. Macromol. Mater. Eng. 2013; 298: 679-689.
- [2] Kanelli M, Douka A, Vouyiouka S, Papispyrides C.D, Topakas E, Papispyridi L.M, Christakopoulos P. J. of Appl. Polym. Sci. 2014; 131: 2-9.
- [3] Gkountela C, Rigopoulou M, Barampouti E.M, Vouyiouka S. Eur. Polym. J. 2021; 143: 110197

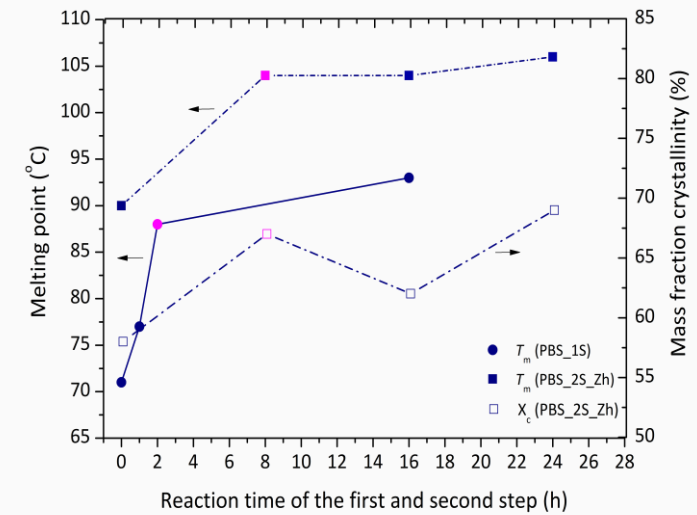
Results and discussion

Enzymatic Prepolymerization



Post-polymerization

- Scaled up iso-50 : $\overline{M}_w \rightarrow 2000$ g/mol, $T_m \rightarrow 78^\circ\text{C}$



- PBS oligomers, free of thermal degradation and metal catalyst residues
- Promising molecular weight and thermal properties:

$\overline{M}_w \rightarrow 4500$ g/mol
 $T_m \rightarrow 104^\circ\text{C}$
 $X_c \rightarrow 65\%$

Conclusions

A sustainable process, conducted under mild reaction conditions is suggested for the production of free of thermal degradation and metal catalyst residues PBS grades, appropriate to be used in biomedicine applications.