Evaluation of the parameters of poly(butylene succinate) enzymatic polymerization

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Introduction

Poly(butylene succinate) (PBS) is a **bio-based** and **biodegradable** polyester, that can be used in numerous applications, especially in the biomedical sector [1,2]. Even though green polymerization routes such as **biocatalysis** are being developed [3,4], there is a very limited literature on the enzymatic synthesis of PBS and in most of the works where high-molecular-weight PBS is produced, several drawbacks may impede the process scaling up. On that basis, an **eco-friendly**, **solvent-free**, **enzyme-based process for the production of PBS** was applied and the most important process parameters were evaluated.

Experimental part

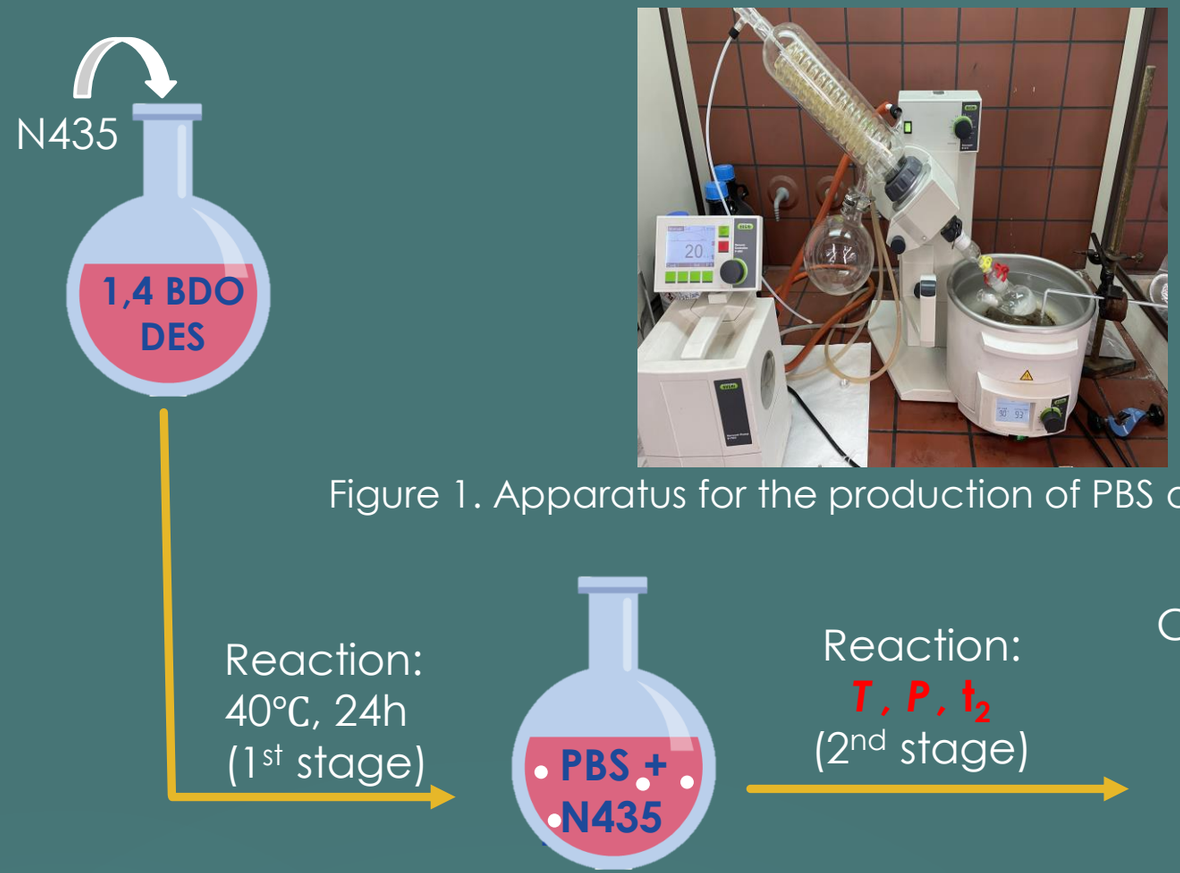

Figure 1. Apparatus for the production of PBS oligomers

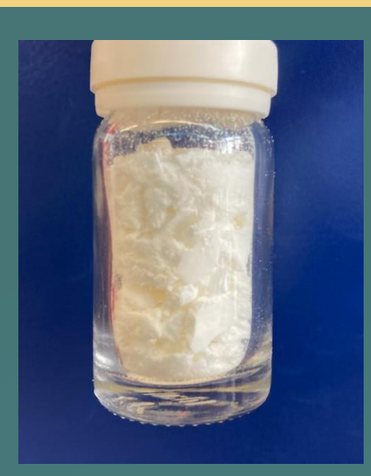

Figure 2. Enzymatically synthesized PBS oligomer (scaled up,10 g)

Results and Discussion

- Evaluated process parameters:

Reaction temperature	90 and 95°C
Pressure	↑ $\overline{M_w}$ at 90°C, ↓ $\overline{M_w}$ at 95°C
Reaction time	↓ $\overline{M_w}$ at 90°C and 95°C

Optimum conditions: **90°C**, **20 mbar**, **2h**

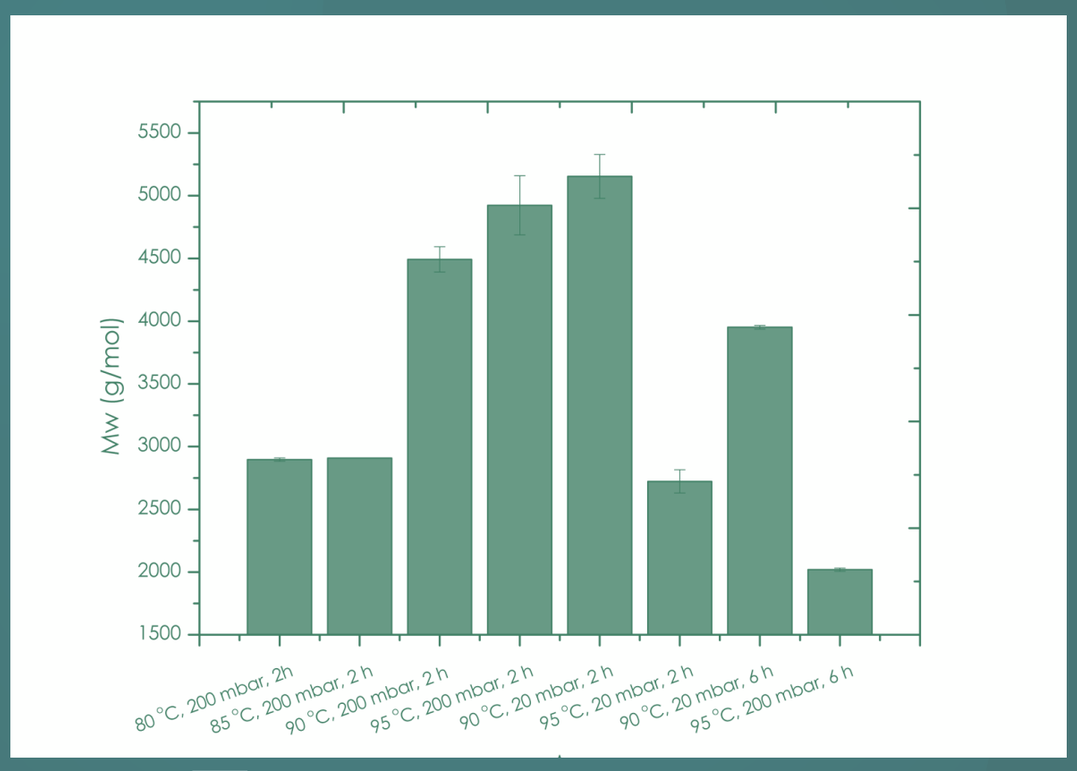

Figure 3. $\overline{M_w}$ of the enzymatically synthesized oligomers

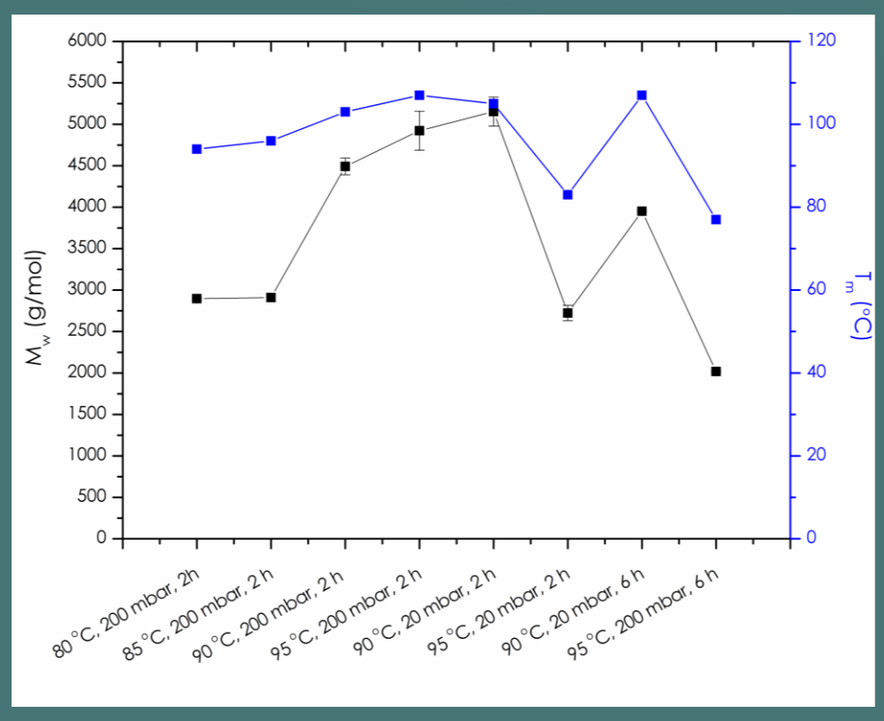

Figure 4. $\overline{M_w}$ and T_m of the enzymatically synthesized oligomers

- The synthesized at 90 °C, 20 mbar, 2h product was successfully **scaled up** (ca. 10 g of product).

Table 1. Scaled-up PBS oligomer's properties

$\overline{M_n}$ (g/mol)	$\overline{M_w}$ (g/mol)	T_{m1} (°C)	T_c (°C)	T_{m2} (°C)	$T_{d,5\%}$ (°C)	T_d (°C)	Residue (%)
1000	4700	104	57	103	258	387	1,44

Conclusions

The bulk enzymatic polymerization route resulted in a PBS grade of $\overline{M_w}$ 4700 g/mol, crystallinity ca. 61% and melting points at ca. 104°C. This free of thermal degradation and metal catalyst residues grade is appropriate to be used in biomedicine applications where low controlled molecular weight is usually needed.

References

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