

Enhancing Rheological and Mechanical Properties of BioSourced Poly(butylene succinate-co-butylene adipate) through Green Reactive Extrusion

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PBSA copolymer is becoming increasingly popular in the market due to its sustainability and biodegradability, as well as its mechanical properties which are similar to low-density polyethylene but with higher deformability than PHAs and PLA. However, prolonged and/or repeated melt processing at elevated temperatures during the manufacturing and mechanical recycling of biodegradable polyesters such as PBSA is challenging due to their thermo-mechanical sensitivity, which leads to a rapid loss of properties caused by degradation. This work investigates the possibility of controlling the thermomechanical degradation of poly(butylene succinate-co-butylene adipate) (PBSA) for designing a green reactive extrusion approach which would improve PBSA rheological and mechanical properties and not require any additional additives. Different mixing protocols (temperature profile and screw rotation speed) were employed to evaluate the influence on thermomechanical degradation of the material. The effect on the online PBSA rheological assessment of varying three different mixing speeds (30, 60, 120 rpm) and four different processing temperatures (150, 180, 200, 220 °C) were studied (Figure). The torque curves recorded during the different PBSA melt mixing for process temperatures above 150 °C and 30 rpm showed consecutive minimum and maximum points which suggest degradative reactions such as depolymerization followed by branching/recombination. These hypotheses allowed for a reactive extrusion design based on the control of the thermomechanical degradative paths of PBSA by the suitable selection of processing conditions. The reactive extrusion resulted in improved PBSA mechanical, rheological and viscoelastic properties.

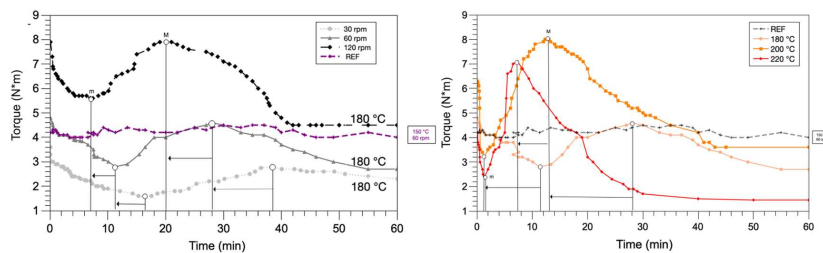


Figure: Time-dependent evolution of the torque recorded during the PBSA melt processing in an internal mixer under different processing conditions. In particular: A) at $T=180\text{ }^{\circ}\text{C}$ and different screw speeds, and B) at 60 rpm at different processing temperatures (Ref purple dot line and Ref black dot line is the torque profile recorded at $150\text{ }^{\circ}\text{C}$ and 60 rpm).

Commentato [GLR1]: Inizia motivando perché è importante migliorare le performance del PBSA!

Commentato [MG1R2]: Deve essere Massimo di una pagina non posso scrivere più di questi caratteri

Commentato [GLR2]: ???? Che significa?

Commentato [GLR3]: Definisci che cosa intendi per REF nelle leggende, oppure cambia il nome nelle figure. Spero che questa non sia una figura che userai tal quale nel paper in scrittura.

Commentato [MG3R2]: Si è la prima figura del Lavoro 1 (ma tanto sarà già pubblicato no ???)

Abstract for Nordic Polymer Days 2023

Commentato [GLR4]: Non lo citi