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Use of Biochar as inexpensive lubricant filler in poly(butylene succinate-co-adipate) biocomposites

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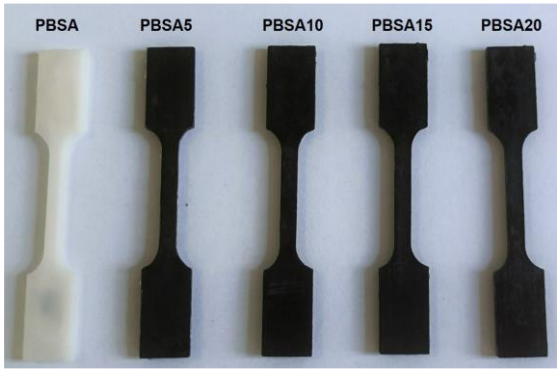
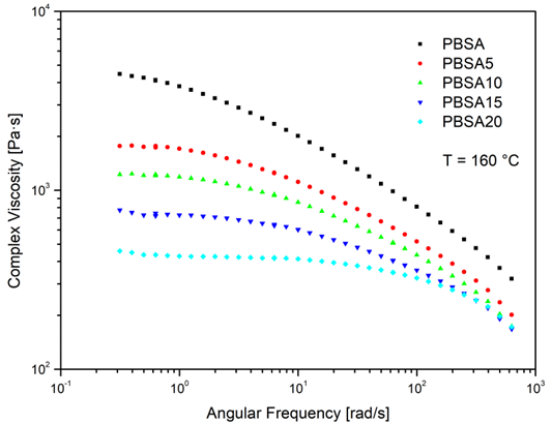
Introduction

This study focused on the development of a novel bio-composite material formed by a thermoplastic biodegradable polyester, poly(butylene succinate-co-adipate) (PBSA), and a carbonaceous filler as biochar (BC) derived by the pyrolysis of woody biomass waste. Composites with various BC contents (5, 10, 15, and 20 wt.%, PBSA5, PBSA10, PBSA15, and PBSA20, respectively) were obtained by melt extrusion and investigated in terms of their processability, thermal, rheological, and mechanical properties. BC lowered melt viscosity in all the composites, behaving as a lubricant, and enhancing composite extrudability and injection molding at high temperatures up to 20 wt.% of biochar. While the use of biochar did not significantly change composite thermal stability, it increased its stiffness (Young modulus). Differential scanning calorimeter (DSC) revealed the presence of a second crystal phase induced by the filler addition. Furthermore, results suggest that biochar may form a particle network that hinders polymer chain disentanglement, reducing polymer flexibility. A biochar content of 10 weight % was selected as the best trade-off concentration to improve the composite processability and cost competitiveness without compromising excessively the tensile properties. The findings support the use of biochar as a sustainable renewable filler and pigment for PBSA. Biochar is a suitable candidate to replace more traditional carbon black pigments for agricultural applications.



Dog-bone specimens of PBSA and PBSA/BC composites for tensile tests



Complex viscosity versus angular frequency of PBSA and PBSA/BC composites at 160 °C

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Biography
Dr. Damiano Rossi is an Assistant Professor at the University of Pisa. He graduated in Chemical Engineering at the University of Pisa and received a PhD at the University College London (UCL, UK) on micro-reactor designs and sono-crystallization phenomena. His research is focused on the development of novel polymeric particles for drug delivery systems and encapsulation of bio-active compounds, the development of novel bio-composite materials for automotive applications, and the optimization of CO2 capture strategies using silica micro-particles. He has co-authored 20+ articles in international journals/magazines, and 20+ contributions to national/international conferences, seminars, and workshops. On top of his academic research, Damiano Rossi has a large industrial experience working as Head of R&D for an international pharmaceutical company and as Project Manager for an Italian start-up leading projects in collaboration with Nestlè, GSK, Moderna, and the University of Cambridge.