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Biocomposites based on PHBs and natural fibers for commodity applications in different environments: processing, performance in soil, compost and sea water

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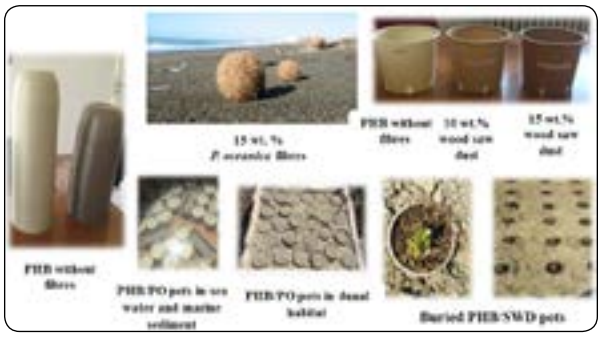
Composites based on poly(3-hydroxybutyrate) (PHB) and natural fibres such as fibres of *Posidonia oceanica* (PO), wood saw dust (WSD) and bran were produced by extrusion in presence of appropriate amounts of plasticizer (Acetyl Tri-n-Butyl Citrate, ATBC) and filler (calcium carbonate). Thermal, rheological, mechanical and morphological characterizations of the developed composites were conducted in order to optimize formulations in terms of processability and mechanical performance. The biodegradability of the optimized composites was investigated under controlled composting conditions in accordance with standard methods (ASTM D5338-98, ISO 20200-2004) and in soil for the PHB/WSD composites, because their expected fate is to be treated in composting plants or used for applications in agriculture; in simulated and natural marine sediments in mesocosms and dune habitat for the PHB/PO composites, because their potential applications are in marine environment, such as natural engineering interventions (restoration of seagrass habitats). The optimized PHB/WSD compounds were used for the production of pots for terrestrial plants, PHB/PO compounds for pots and other items usable in the sea and sand dunes, such as transplanting tools and structures for restoration or protection of coastal habitats, and the PHB/bran fibres for the production of food contact containers. The results showed that the industrial processing by extrusion of the composites did not show any difficulty up to 20 wt. % fibres and the presence of the fibres (PO or WSD) facilitated the disintegration of the PHB matrix and, consequently, accelerated its biodegradation both in compost, soil, sea water and dune. The PHB/WSD composites resulted no-phytotoxic by using cress (*Lepidium sativum* L.) germination test, compostable in accordance with EN 13427:2000, biodegradable in soil at controlled degradation rate. The PHB/PO composites showed a good controlled biodegradation rate in marine sediments and were suitable to manufacture items usable, for example, in natural engineering interventions and represent an interesting valorisation of the PO fibrous wastes accumulated in large amounts on coastal beaches.



Recent Publications

1. Seggiani M, Cinelli P, Balestri E, Mallegni N, Stefanelli E, Rossi A, Lardicci C, Lazzeri A (2018) Novel sustainable composites based on Poly(hydroxybutyrate-co-hydroxyvalerate) and seagrass beach-cast fibers: performance and degradability in marine environments. Submitted to Materials and requested minor revisions.
2. Seggiani M, Altieri R, Puccini M, Stefanelli E, Esposito A, Castellani F, Stanzione V, Vitolo S (2018) Polycaprolactone-collagen Hydrolysate thermoplastic blends: processability and biodegradability/compostability. Polymer Degradation and Stability 150:13–24.
3. Seggiani M, Cinelli P, Mallegni N, Balestri E, Puccini M, Vitolo S, Lardicci C, Lazzeri A (2017) New Bio-Composites based on Polyhydroxyalkanoates and *Posidonia oceanica* fibres for applications in a marine environment. Materials 10(4): 326.

4. Seggiani M, Cinelli P, Geicu M, Popa ME, Puccini M, Lazzeri A (2016) Microbiological Valorisation of Bio-composites Based on Polylactic Acid and Wood Fibres. Chemical Engineering Transactions 49:127-132.
5. Seggiani M, Cinelli P, Verstichel S, Puccini M, Vitolo S, Anguillesi I, Lazzeri A (2015) Development of fibres-reinforced biodegradable composites. Chemical Engineering Transactions 43:1813-1818.

Biography

Maurizia Seggiani is an Associate Professor of Industrial and Technological Chemistry. Her research activities are focused on analysis/optimization of chemical processes regarding the waste management (treatment/recovery/valorisation of industrial solid/liquid/gaseous effluents), biomass gasification, green waste hydrocarbonization, and on the development and application of innovative materials such as solid adsorbents for carbon capture at high temperature and biodegradable/compostable composites for applications in agriculture and marine environments. In the last years, she has been coordinator of research projects concerning the development, processing and validation of bio-composites based on PCL and PHA and industrial byproducts (collagen hydrolysate) and natural waste fibers for different applications.

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