Valorization of a post-consumer poly(lactic acid) residue by mechanical recycling

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Bioplastics and poly(lactic acid)

Massive use of fossil-oil based plastics leads to environmental issues.

Bioplastics emerge as an alternative to conventional plastics in some applications.

**Poly(lactic acid) (PLA)** is amidst the most established bioplastics.
Bioplastics and poly(lactic acid)

Poly(lactic acid) (PLA) is an aliphatic polyester.

PLA is relatively cheap, safe in food contact and has acceptable optical and mechanical properties.

Poly(lactic acid) (PLA) is used in biomedical, textile and packaging applications.
Valorization of PLA wastes

PLA is biodegradable, but degradation rate depends on environmental conditions.

A circular economy approach implies the valorization of plastic waste.

Among the alternatives mechanical recycling poses several advantages.
Challenges of recycling

Recycling leads to a decrease of the performance of plastics.

Mechanical recycling is a complex and expensive process.

A centralized recycling approach is not feasible for PLA.

Distributed recycling could be an interesting alternative.
Main objective

**Study a case of distributed mechanical recycling: PLA cutlery coming from a local shop.**

With special focus on the structure and properties of the materials
Methodology

Collection of used spoons

Cold washing

Demanding washing

Grinding

Extrusion and compression molding
Results: Intrinsic viscosity

Mechanical recycling led to the degradation of the polymer.

Service life
Washing and grinding
Reprocessing

Could negatively affect the properties of recycled materials

Fig. 1. Intrinsic viscosity of the samples
Results: Differential Scanning Calorimetry

The recycled material crystallizes more easily than the virgin plastic.

Melting temperature shifts toward lower values in the recycled polymer.

Both changes are a sign of the degradation of PLA during recycling.
Results: Thermogravimetric Analysis

Thermal stability plays a very important role on the processing of plastics

Mechanical recycling led to an important decrease of the thermal stability

Fig. 4. TGA curves of the samples
Results: Vickers Hardness

Recycled spoons show lower hardness values than new spoons.

This result is in good agreement with the degradation of the polymer during recycling.

Fig. 5. Vickers hardness of the samples
Conclusions

Recycling led to the degradation of PLA, along with the reduction of the properties of the recycled material. This decrease could negatively affect the distributed recycling approach for PLA. It is important to develop accessible and cost-friendly upgrading methods to improve the recyclability.
Thank you for your attention

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