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Recycling of textile fibres from end-of-life tires for the production of plastic compounds.

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Abstract

In Europe, about 320,000 tons of textile fibres from ELTs (end-of-life tires) are produced every year.
Currently the fibres is disposed of in landfills or sent to incineration. In order to give a second life to this material, TECNOFILM has developed plastic compounds with the use of textile fibres. Tecnofilm studied, developed and tested several compounds with different percentages of fibres (up to 25% by weight) and with the use of different plastic matrices. A PP based compound with 10% - 15% of fibre guarantees the best performances and workability. Tecnofilm developed the know-how for the compounding technology of this material. With regards to the technical properties, our innovative compound guarantees the improvement of the impact resistance (up to 50%) compared to virgin polymers and recycled polyolefinic compounds.
Regarding the environmental impact, according to the LCA analysis, there is a saving of 4 Ton co2eq for each Ton of fibre.

Keywords: Fibers – Polypropylene – Recycling – Compounds - Impact

Introduction

Textile fibres represent about 10% by weight of the end-of-life tires (ELT) and every year, in Europe, about 320,000 tons of fibres material must be disposed as a special waste. This management system has a negative impact on the environment, in terms of GHG emissions and pollution, economic losses and public costs. In order to give a second life to this material, TECNOFILM - in partnership with a team of Universities and companies - has developed plastic compounds with the use of textile fibres. This innovation has been also financed by the European Union through the project REFIBRE LIFE (LIFE14ENV/IT/000160).
REFIBRE action aims to overcome the main existing barriers limiting ELT fibre recycling, like the absence of useful and economically affordable applications for fibre reuse that makes it worthy of recycling.
The ultimate goal of this project is a full valorisation of textile fibres from ELTs and their transformation into a useful secondary raw material according to a "circular economy" thinking.

Experimental/Theoretical

Due to the nature of the fibres (post consumption), it was initially chosen to develop a compound blending fibres and polyolefins using post-consumer material that contains mainly PP. Blends were designed with a fibre percentage in the range 0% - 45%. For the production of the samples, a co-rotating screw micro-extruder has been used.
Subsequently, a series of molding tests were carried out by a pilot customer for the production of pallets made by compounds containing 0%, 12% and 24% of fibres.

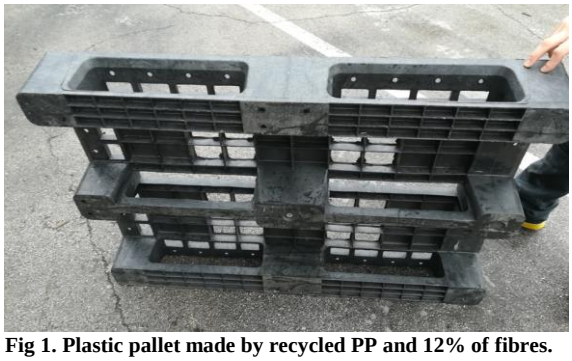

Fig 1. Plastic pallet made by recycled PP and 12% of fibres.

This step was necessary to understand the feasibility of the injection and the molding problems, caused by the addition of fibres, in the filling of the mold and in the mechanical properties of the pallet.
In order to test the materials, pallets were ground and then, using the hot-plate press and an aluminum mold, two plates having thickness of 4.2mm and a

dimension of 300x300 mm were made. The hot plate press was used since the material contained metal contaminations that prevented the possibility of using the injection press (nozzle clogging).
Then, specimens for impact tests were obtained.

Results and Discussion

With regards to the technical properties, our innovative compound guarantees the improvement of the impact resistance (up to 50%) compared to virgin polymers and recycled polyolefinic compounds.

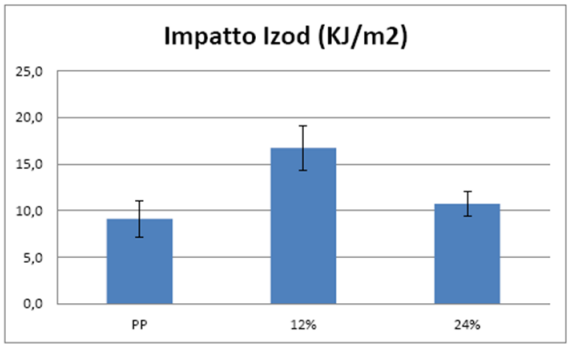

Fig 1. Impact resistance of the samples from plastic pallets made by recycled PP and blends of recycled PP and fibres.

In particular way, the results of the tests demonstrate that the best performance and workability can be reached with a compound having a content of 12% of fibres.
Moreover, testing the impact properties of the compounds designed with different percentage of fibres, from 0% to 45%, as the amount of fiber increases, the surface fractured by the impact is always smaller. This last feature implies that the actual energy needed to generate the same fracture surfaces increases as the amount of fiber increases.

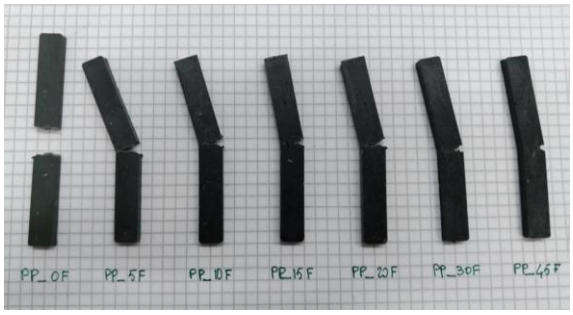

Fig 2. Fracture surfaces decreases when the amount of fibres in the compound increases from 0% up to 45%.

Regarding the environmental impact, according to the LCA analysis, there is a saving of 4 Ton co2eq for each Ton of fibre. Moreover, products made by this innovative compound can be recycled with no relevant loss of mechanical properties.

Conclusion

REFIBRE project demonstrates that the fibres of end-of-life tires are a valuable resource and Tecnofilm developed the know-how for the compounding technology of this material. Considering the results, especially for the impact resistance, it is possible to test the compound in several applications such as agricultural boxes, domestic appliances, bumpers etc.

Fig 3. Angle brackets and fittings made by recycled PP and 12% of fibres.

Since most of the activity has been already done, Tecnofilm has already submitted an international patent application for this technology. Anyway, R&D is still working on the potential developments and applications, including the use of different raw materials and additives, functional polymers and production processes in order to improve the technology.

References

1. Siavosh Moghaddamzadeh, *Thermoplastic Elastomers based on Polyester. Recycled Tire Fibers and Ground Tire Rubber*, 2018
2. Siavosh Moghaddamzadeh, Denis Rodrigue, *The effect of polyester recycled tire fibers mixed with ground tire rubber on polyethylene composites. Part I. Morphological analysis*, 2018.
3. B.Acevedo, A.M. Fernández, C. Barriocanal, *Identification of polymers in waste tyre reinforcing fibre by thermal analysis and pyrolysis.*
4. California Department of Resources Recycling and Recovery, *Markets for Wire and Fiber from Waste Tires*, 2013.