RECYCLING OF VEGETAL FIBERS REINFORCED POLYMERS

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The manufacturing of plant fiber-reinforced composites is a growing sector for many environmental reasons. The production of vegetal fibers needs lower energy than synthetic fibers: they have a low density allowing to reduce the transport costs [1], they reject lower quantities of green house gas [2] and they offer several end of life ways (combustion, recycling or composting with a biodegradable matrix [3]). These environmental advantages are combined to interesting mechanical properties showing that vegetal fibers are good candidates for the substitution of glass fibers in thermoplastic reinforcement.

In the first part of this work, we have been focusing on the recycling of thermoplastic-matrix composite materials made of polypropylene (PP) and polylactic acid (PLA) resins reinforced with plant fibers such as flax, sisal and hemp [3-5]. These materials were processed by extrusion and injection moulding then crushed and grounded using an industrial cutting mill. Despite a degradation of fiber wall properties evidenced by in-situ nanoindentation measurements [6], we highlighted a good stability of the composites mechanical properties. This phenomenon could be explained by the stabilization of the fiber aspect ratio with the recycling, due to the division of bundles during the process and to the decrease of the fiber length. The aspect ratio plays a key role in the reinforcement mechanisms of a composite. In the same time, we could notice a decrease of the composites viscosity due to the conjugated effect of the process shear rate and of the PP chains drop.

The second part of this study is dedicated to the evolution of the main characteristics of a PP/hemp composite elaborated with a PP coming from automotive wastes after multiple injection mouldings. We have investigated, after each cycle, the mechanical, viscoelastic, impact and rheological properties. As evidenced in the figure 1, these results show, despite some differences induced by the first life of the PP, a good stabilization of these properties after several injection cycles.

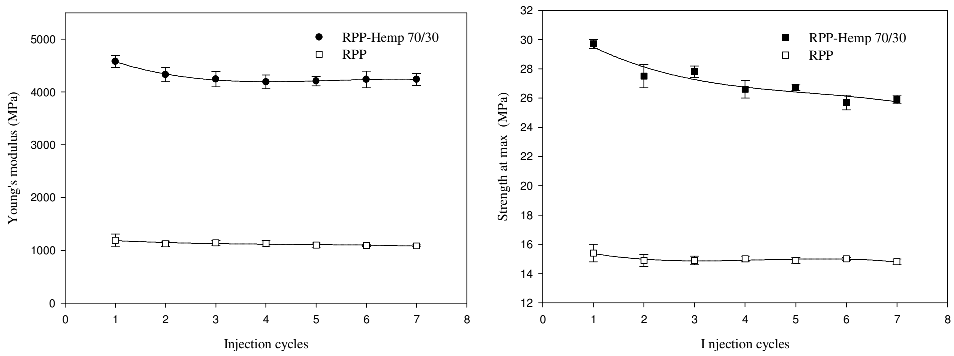

Figure 1: Evolution of the Young's modulus and strength at max for recycled PP and RPP-Hemp 70-30 with injection cycles

To conclude this work, we have carried out a simplified life cycle analysis to estimate the environmental interest to use a recycled matrix and hemp fibers to reinforce composites.

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