Towards sustainable wood fillers from agroforestry for Wood-Plastic Composites (WPC): Key roles of wood species and filler characteristics

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Résumé

Current environmental concerns push towards more sustainable and local practices for biomass production. In this regard, agroforestry has been highlighted by researchers and policies as a highly efficient approach for carbon sequestration (between 1.5 and 4 t C/ha/year), and a sustainable alternative to deforestation with many agricultural benefits: deeper rooting of trees in soil, enhanced biomass productivity, crop fertilization... Agroforestry implies regular branch cuts that are processed into wood chips and mostly used as energy wood or soil mulching. New higher added-value chains could be considered such as reinforcements or specific molecules for bio-based materials and chemistry.
Besides, since 90's, Wood-Plastic Composites (WPCs) have experienced significant growth, particularly in building (decking & siding), and constitute the largest share of bio-based composites developed at an industrial scale. Nevertheless, the quality of WPCs and variability in their performance are major technological issues for their implementation in industrial applications. This is due to difficulties in tracing the origin of wood fillers and the different processing steps, from drying and defibration process to composite manufacturing, that are not well controlled. Indeed, numerous interdependent parameters govern the final properties of WPCs, such as biochemical composition, presence of contaminants (binders, wood treatment residues, varnishes...), (micro)structure, thermal stability, mechanical properties of wood fillers, and the control of their milling/sieving and further processing into composite materials.
In this context, the development of quality-controlled agroforestry wood fillers in terms of granulometry, chemical composition and physical (microstructure, mechanical) properties is therefore strategic for their implementation in wood-based products. This work investigates the influence of wood species (poplar, oak, walnut, chestnut)) and filler size and shape on the microstructure and mechanical properties of polypropylene (PP) / wood composites manufactured by extrusion/injection moulded. Moreover, woods from three recovery platforms in

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Brittany (mix of several species) were also investigated to evaluate the potential of existing agroforestry feedstocks.