

Using SRC Poplar to produce bark-enriched Wood Plastic Composite Profiles

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About the project

Dendromass4Europe (D4EU; 2017 – 2022) aims at establishing sustainable, Short Rotation Coppice (SRC)-based, regional cropping systems for woody biomass (dendromass) production on marginal agricultural land. The dendromass produced in SRC (lignous biomass, bark and wood) is supplied to dedicated bio-based value chains that create additional income and job opportunities in rural areas. The supply chains will be tailored for optimum efficiency of supply logistics and for reducing CO₂ emissions. Innovative bio-based materials will help to replace fossil-based materials.



Introduction

Wood plastic composite (WPC) profiles are mainly used for construction of terraces and facades, with low demand for maintenance and a natural look. These unique properties enable their use as replacement of wood boards. They are produced by extrusion process with two main components – plastics (PVC) and natural fibres (e.g. beech wood flour). Addition of a different fibre material can have an impact on both the processing parameters and more importantly the mechanical properties of the final product.

WPC profiles are divided into two major groups (independent on type of plastic used): chamber profile and full profile. Chamber profiles are widely used mainly due to the lower weight of profile. Full profiles show better physical properties.

Our Task

Our task was to develop a bark-enriched WPC profile. This task involved the development of the optimum parametrization of extrusion conditions and formula adjustment, which allows the incorporation of the poplar bark and production of WPC profiles with similar or better properties than the standard. The first objective was to find the correct, industrially suitable percentage of poplar bark in the dry mixture and to define the most suitable approach for the incorporation of the bark dendromass into the dry mixture. All processing parameters that were pre-defined by the requirements of the equipment and by the industrial process, such as particle size of the dendromass originating from poplar bark (bark flour), or the maximum moisture content, had to be thoroughly evaluated and considered during the trial. Within this task, the properties of the final composite material were defined, as they depend on the composition of the mixture (PVC and different dendromass materials like wood flour or poplar bark flour). The objective of this task was to produce a prototype, which will achieve preferable board parameters and mechanical properties (water absorption, bending strength, hardness).

Methods

New co-extrusion approach had been established for full profile to enhance the physical and visual parameters of WPC profiles compared to standard extrusion. Co-extrusion process involves two different dry blends for inner and outer side, where the inner part assures the proper physical properties (strength) and is the main target for bark incorporation. Commissioning of co-extrusion line for WPC profiles (as reference profiles) was the first condition for bark implementation. After successful development of inner part for co-extruded profiles, replacement of a certain number of natural fibres (wood flour) by milled poplar bark will follow as the second step. Critical parameters for fibre part of WPC dry blend used for extrusion were defined in formula development. The following parameters needed to be adjusted for the prototype No. 2 development to come to the modified formula and production protocol: particle size of bark flour, temperature profile of extrusion line and extrusion speed.



Fig.1: Poplar bark delivery



Fig.2: Rotary drum drying using green energy-heat from biogas plant



Fig.4: Dry blend mixer



Fig.3: Hammer and pin mill - two stage milling

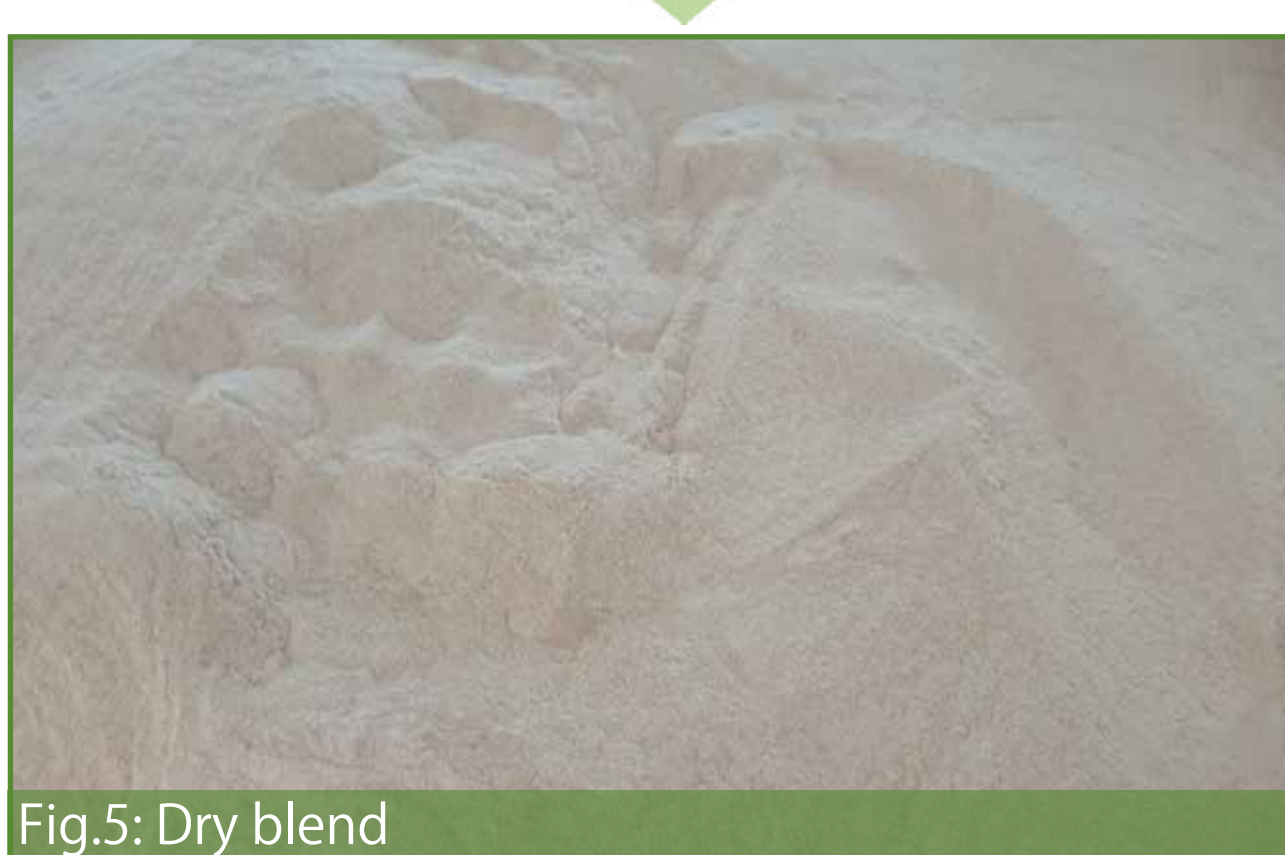


Fig.5: Dry blend

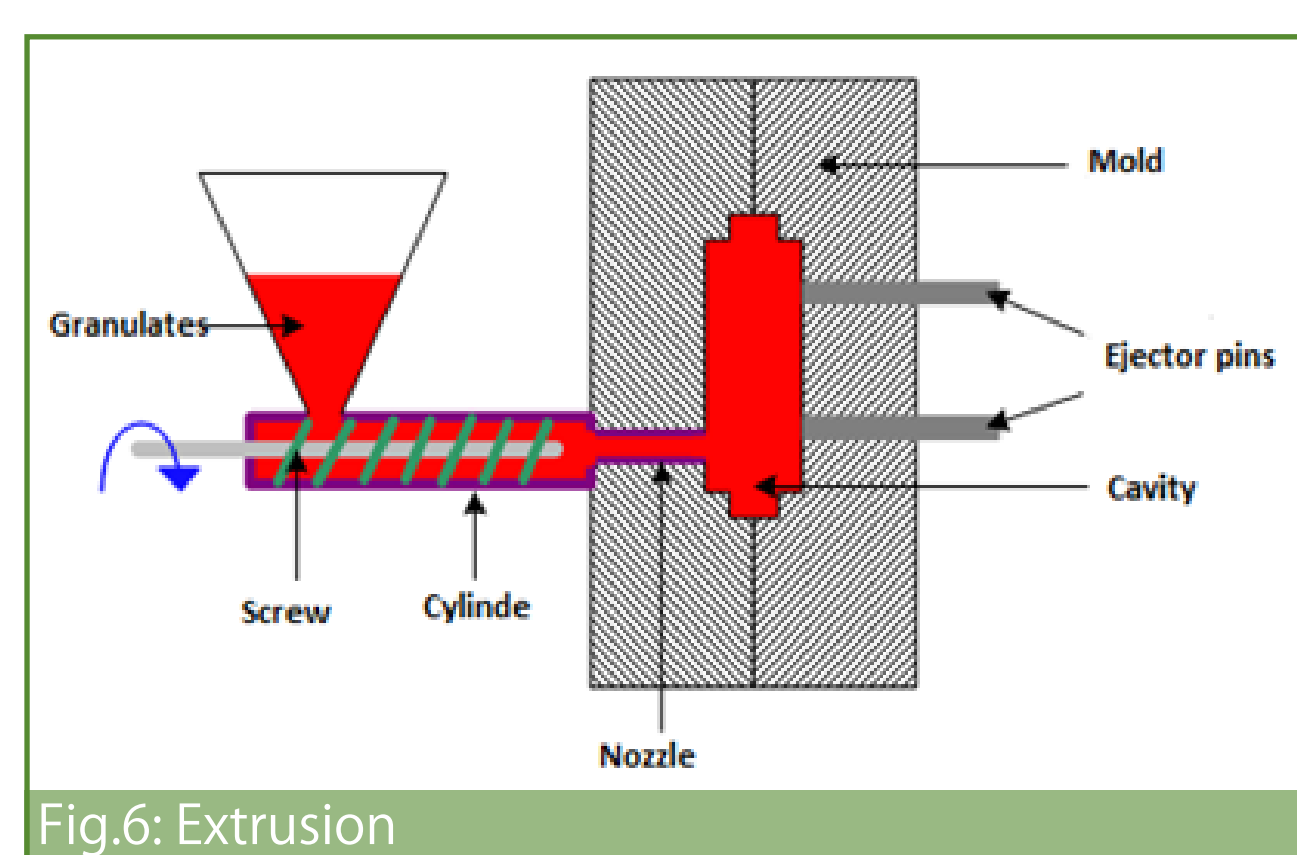


Fig.6: Extrusion

Prototype

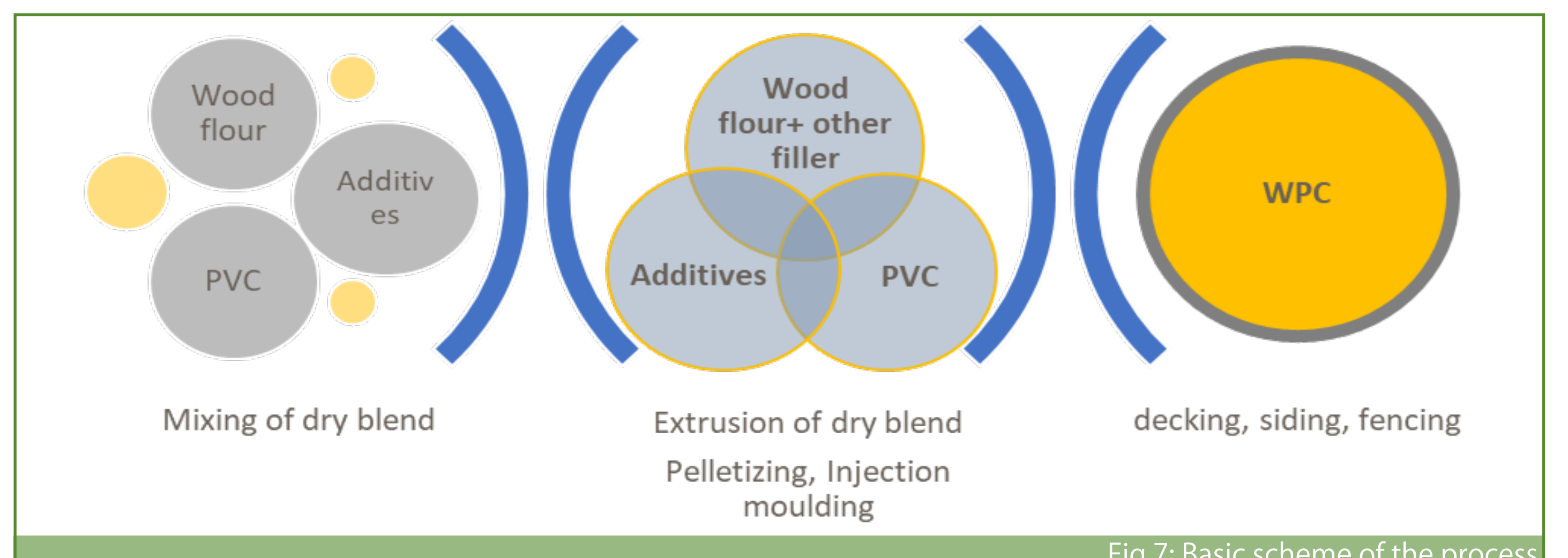


Fig.7: Basic scheme of the process

Results



Fig.8: WPC profiles used for terracing

Within Dendromass4Europe, we successfully developed and produced a prototype of bark-enriched WPC profiles, in which we replaced 5 % of beech flour using poplar bark. Further development to increase bark content in WPC profiles to achieve higher bark utilization is planned.

Our wood plastic composites can be used for high quality construction materials, such as fencing panels, siding, and decking (see Fig.8). Since WPC is made of both plastic and dendromass, it has both positive qualities: durable and posh. By using milled poplar bark, we use a material, which is normally considered to be waste.

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