Use of SRC Poplar as a novel material stream for the Production of a new bio-based material: the Functionally Adapted Lightweight Board

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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 (ligneous 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 CO_2 emissions. Innovative bio-based materials will help to replace fossil-based materials.

Fig.1: Seperately stored and tested batches of boards with different densities

Introduction

Our task was to develop a New Bio Based Material (NBBM) – the Functionally Adapted Light Weight Board (FA LWB) – by substituting conventional wood species such as pine with logs from local, close-to-factory fast growing poplar. This board – made from wood with up to 30 % lower bulk density – can balance the volatility of the wood market prices and decrease the pressure on natural forests. Furthermore, we aimed to produce a board that is at least on par with its mechanical properties with the conventional boards and has a positive customer evaluation during use in furniture manufacturing.


Fig.2: SRC poplar machinability test marked three densities; stacked FA LWB - visible core and surface layer of the final FA LWB

Materials and Methods

The impacts of the novel material stream based on the SRC poplar had to be monitored throughout the whole production process, to assess the net impact on production. The material flow and the main steps of board production as well as furniture manufacturing are shown in Figure 4. The board batches, which have been produced with different densities had to be stored separately and marked clearly enabling the evaluation of each density category separately (see Fig.1). The combination of the internal monitoring system of the production line and manual measurements (sieve analysis, testing of mechanical properties) were used during the data gathering. To test whether the produced furniture panels fulfill all quality requirements, "BILLY" bookshelves produced from boards of each density category were sent to CATAS laboratory, an expert organization that is verifying suitability, safety and reliability of new raw materials for the furniture production of IKEA Industry.

Results

- IKEA Industry Slovakia in cooperation with CNR-IBE managed to reduce the breakage and soil contamination of the logs
- IKEA Industry Slovakia developed an efficient way to feed the poplar logs from short rotation coppices into the process for manufacturing our NBBM that allowed the successful production of FA LWB with the required mix of pine and SRC poplar
- Undebarked SRC logs didn't have any negative effects on strander knife service life
- Once stranded, SRC logs produced a larger proportion of large strands (see Fig.3) (and a proportionately lower proportion of small strands) compared with standard pine logs
- The FA LWB looks appealing with smoother edges and lighter brown color in comparison with the boards containing 100 % pine
- The use of SRC logs and chips for production of FA LWB in the factory is positive
- IKEA Industry Trnava (IIT) Flatline successfully processed the strand boards with 30 % poplar content with 3 different densities (see Fig.1)
- Separate machinability test of each density was conducted, the results suggest that the density decrease of FA LWB has no negative impact on the properties of the produced furniture
- The out-sorting that is connected to the board quality slightly decreased in comparison with the out-sorting levels of the last 2 months of standard operation
- The tops and side panels produced from all 3 density categories of FA LWB containing 30% SRC poplar passed the test conducted by CATAS laboratory, thus fulfill suitability, safety and reliability of new raw materials for the furniture production of IKEA Industry


Fig.3: Large poplar strand fraction present in the strand sample taken from the wet bin (directly after the strander)

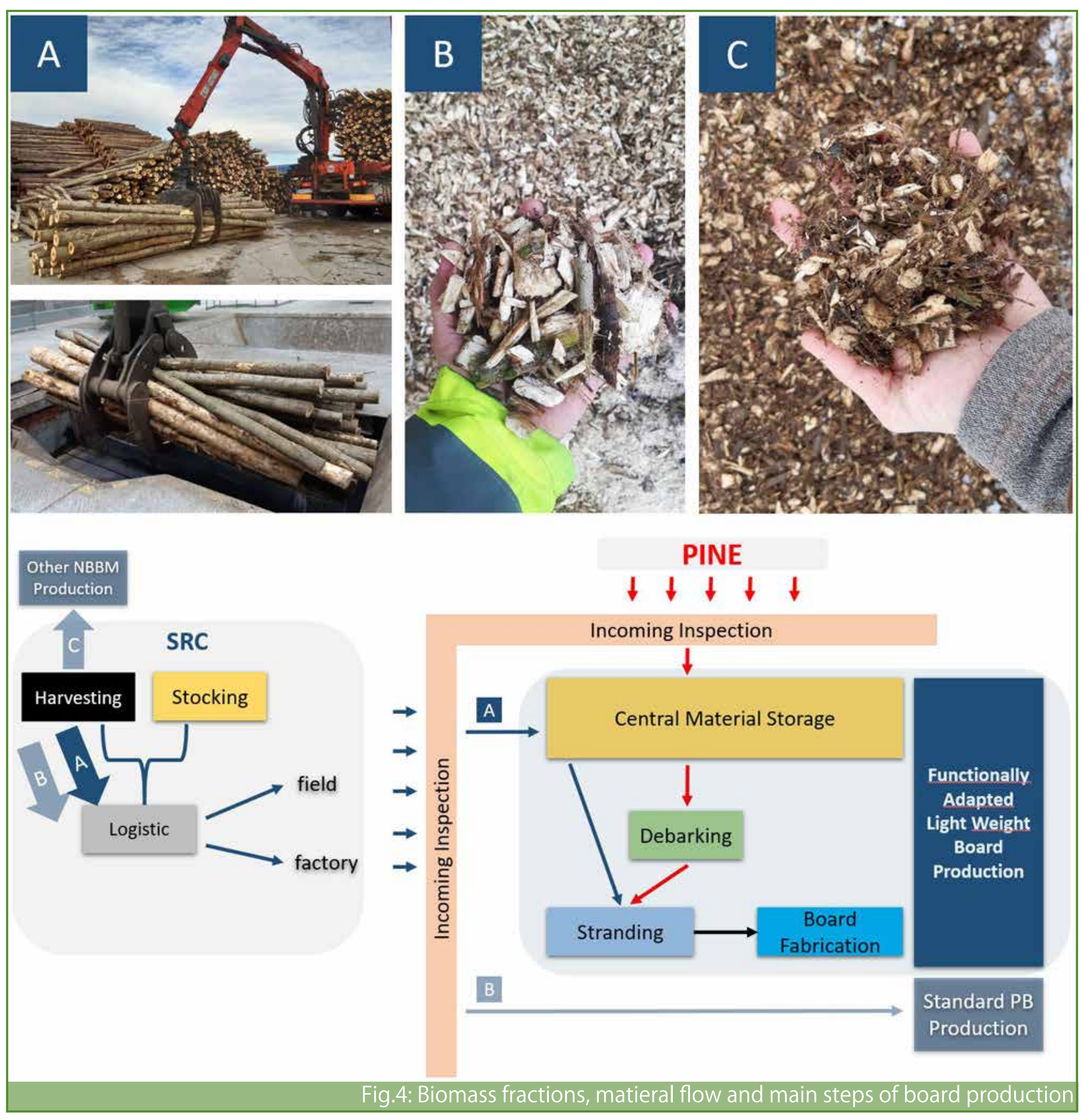

Fig.4: Biomass fractions, matieral flow and main steps of board production

Conclusions

SRC poplar material was successfully implemented into the production process without the need of additional investment adjusting the current technological setup. Introducing a 30 % proportion of poplar strands clearly improves the quality of the boards, thus this material stream will be used in board production in various share in the production of the factory. The tops and side panels produced from all 3 density categories of FA LWB containing 30% SRC poplar fulfilled the requirements of the customer and will be sold to IKEA supply chain.

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