Environmental impact of natural wood and wood plastic composites uses in constructions

Frederico Dalton Souza[1]; Renato Lemos Cosse[2]; Tobias van der Most[2]; Rik Brouwer[2]; Daan van Rooijen[2]; Rudy Folkersma[2]

[1]Forest Engeneering Department, Federal University of Viçosa, Brazil; Green PAC, [2]NHL Stenden Hogeschool, The Netherlands

Background

The use of wood in its current production model induces the questioning of renewable building materials. Due to the growing demand for housing, it is interesting to conceptualize green buildings, whose focus is to reduce the energy consumption of a house and its negative impacts on human health. However, the selection of greener materials that can withstand mechanical efforts demanded in these buildings' situations, is also one of the main discussions when it comes to ecological constructions.

Objective

Based on a Life Cycle Analysis (LCA) methodology, the work evaluates the difference between the environmental impact caused by production process of a roof beam manufactured from Norway Spruce wood and its Wood Plastic Composite (WPC) counterpart.

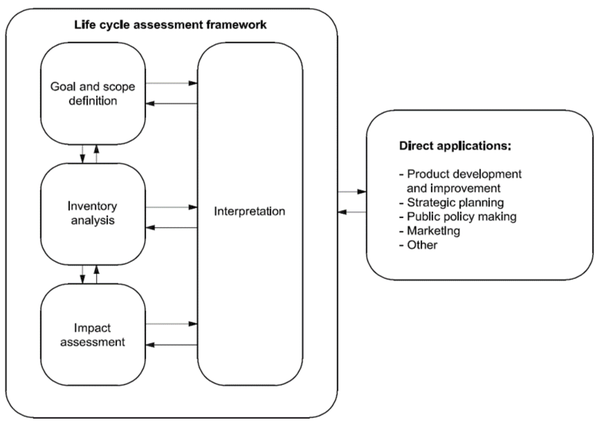

Figure 1. Steps of Life Cycle Analysis

Table 1. LCA Goal and Scope Definition

Products	Function	Function Unit	Reference Flows	Key Parameters
Wood Beam	Resist to loads	Resisting to *X* Newtons	*Y'* m³ of wood	Lifetime resisting capacity ratio
WPC Beam			*Y''* m³ of WPC	

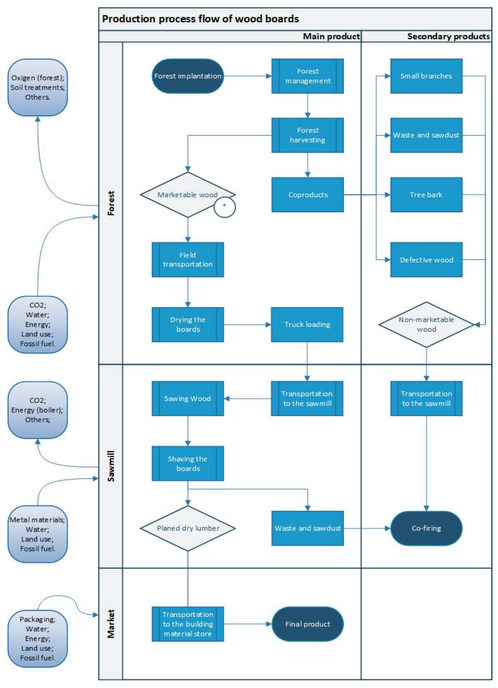

Figure 2. Production Process Flow of Wood Boards

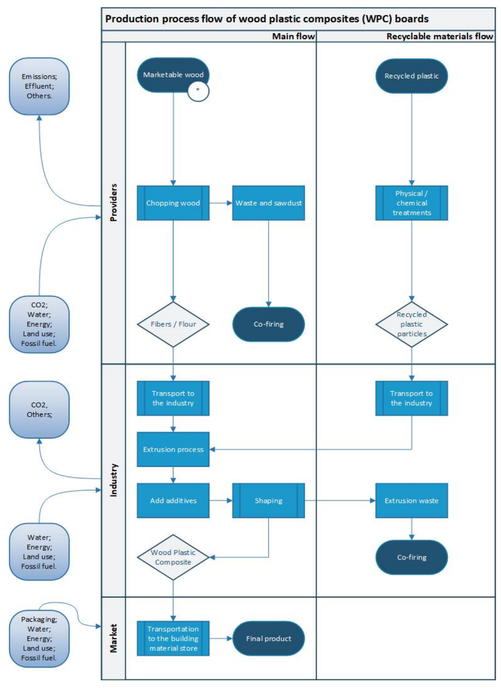

Figure 3. Production Process Flow of WPC Boards

Mechanical Tests Results

- Analyzing the bending tests, the elastic modulus of wood was equivalent to 6458 MPa, a higher value than the wood plastic composite, 2020 MPa.
- For the compression tests, the elastic modulus of Norway Spruce's wood was also higher, 2758 MPa in total, while the result of the WPC was 1593 MPa.
- However, the wood plastic composite presented a much lower standard deviation rate.

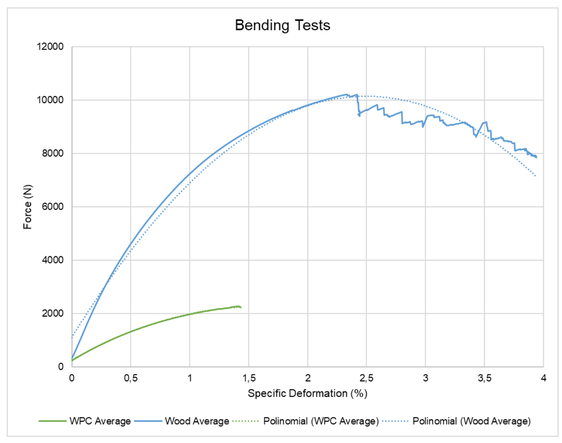

Figure 3. Bending Tests Comparison

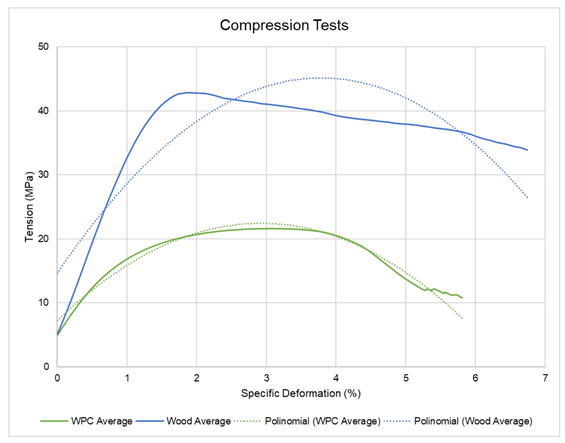

Figure 4. Compression Tests Comparison

Life Cycle Analysis Results

- WPC beam's production provides an environmental eco-cost of 1,2 EUR per kilogram, while Norway Espruce wood has a positive coefficient of approximately -1,3 EUR per kilogram.

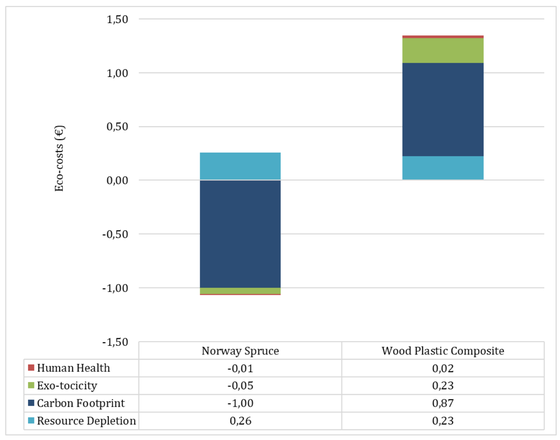

Figure 5. Comparison of Different Environmental Impacts

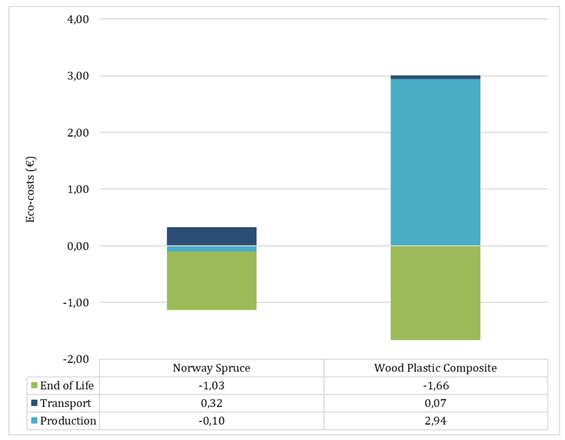

Figure 6. Comparison of Environmental Impacts by Process

Conclusions

- A wooden product made through a highly sustainable management, provides a positive impact to the environment in relation to the management of natural resources and the carbon footprint. On the other hand, WPCs, despite using recycled materials, deal with the use of plastic, which have a great negative impact on LCA.
- It is very important to say that wood plastic composites are great alternatives to recover and reuse logging resources. WPCs can also be used as a coating on wood structures, since these composites have low maintenance requirements and are resistant corrosion, excess moisture and attacks of fungi and insects.

Acknowledgements

All thanks to the technical support of everyone at NHL Stenden Hogeschool in Emmen, as well as the members, professors and interns of the Green PAC group, and for my tutors from the Federal University of Viçosa - UFV, my home at heart. A special thanks to the Living Lab Biobased Brazil team and the UFV Office of International Affairs for their efforts to promote such important programs for the scientific education of our countries.