Editorial

Wood Productions and Renewable Materials: The Future Is Now

Pierre Blanchet * and Charles Breton

NSERC Industrial Research Chair on Ecoresponsible Wood Construction (CIRCERB), Forest and Wood Sciences Department, Université Laval, 2425 rue de la Terrasse, Quebec City, QC G1V 0A6, Canada; charles.breton.2@ulaval.ca

* Correspondence: Pierre.Blanchet@sbf.ulaval.ca

Received: 27 May 2020; Accepted: 30 May 2020; Published: 9 June 2020

Abstract: The forest sector plays a key role in meeting the climate change challenge. Forest products and renewable materials are masterpieces in achieving this role. This editorial details the benefits of these forest products and celebrates the contributions of the authors who submitted their work to this special edition of Forests journal. This edition presents 11 papers, which include the characterization of a new fiber supply, the description of advanced materials and their environmental impact, and an examination of structural products, wood protection, and modifications.

Keywords: forest products; renewable materials; product development; wood protection; environmental impact; wood characterization; wood structures; advanced renewable materials

The forest sector play a key role in meeting the climate change challenge. The Intergovernmental Panel on Climate Change recognizes forests as part of the solution, with their significant contribution to mitigation efforts and multiple environmental and social co-benefits [1]. Furthermore, the forest sector represents an important share of the economy in many countries. Wood and renewable materials are among the final links of the forest value chain. Under sustainable management, forest products transform forests into carbon sequestration tools, provide essential goods and services, and contribute to the gross domestic product.

To keep global warming below 2 °C in 2100 and to reach the goals set by the Paris Agreement, building construction must become carbon-neutral or carbon-negative before 2030 [2]. This objective will require substantial efforts to reduce both the embodied and operational impacts of buildings where most renewable materials are used. This could be achieved in terms of embodied energy (in MJ) and carbon, which is commonly used in the literature as a substitute for total greenhouse gas (GHG) emissions (in kg CO₂eq) [3].

As the 2030 deadline approaches, there is a limited window of opportunity for action. If efficient strategies are implemented quickly and adopted, the large mitigation potential of renewable building materials could be exploited at low to negative cost using available technologies, while providing other value-added benefits [4]. Otherwise, suboptimal practices could be locked in for several decades due to the long-life cycles of the non-renewable building materials, which would represent a threat to climate change mitigation [5].

To take advantage of the benefits of bio-based materials, a better understanding of these materials needed. Product development and optimized processes are key actions to make these positive benefits happen in our societies. This requires a thorough knowledge of the products and their value chain. Plantation trees are part of the solution. Chien et al. [6] has proposed using beams and self-tapping screws as metal connectors and resorcinol formaldehyde resin as glue to assemble components, based on various assembly configurations of Japanese cedar (Cryptomeria japonica (L. f.).
D. Don) lumber obtained from a plantation in Taiwan. Typical flexural load-bearing capacity and bending failure modes were observed in their studies, paving the way for the use of this plantation stock to structural application. New products must find their way to the market. The industry’s competitiveness is an asset and Vu et al. [7] has suggested an assessment for the international competitiveness of the Vietnamese wood processing industry.

Renewable materials require protection strategies. Before and after surface protection treatment, near-infrared red spectroscopy has been demonstrated as a technique to understand the wood surface workability [8] of Cryptomeria japonica (L. f.) D. Don and Chamaecyparis obtusa ((Siebold and Zucc.) Endl.) after oil treatments. The technique has a promising potential to discriminate the type of oil present on these traditional construction species in Japan. Wood protection can be achieved through wood modification. Impregnation is a wood modification technique that has existed for many years, but the use of new impregnation products such as maleic anhydride can lead to significant reduction of wood’s moisture sensitivity [9].

The appearance of wood products is part of the quality of this material. Architects and designers tend to value its appearance in the works. Reducing discoloration of wood due to photodegradation caused by ultraviolet (UV) and visible (VIS) radiation by means of hindered amine light stabilizers (HALS) and nanoparticle pretreatments has been studied [10] on Siberian (Larix sibirica Ledeb.) and European larch (Larix decidua Mill). Their most effective pretreatment was a combination of UVA and HALS in a synergistic effect without affecting the gloss of the product.

Understanding renewable materials also means characterizing their anatomy. The windmill palm (Trachycarpus fortune (Hook.) H.Wendl.) and its application potential have been characterized by its anatomy [11]. Techniques such as scanning electron microscopy (SEM), atomic force microscopy (AFM), and a nanoindenter allow for the development of a new use for this abundant raw material. AFM has also been used by Wu et al. [12], who characterized the microstructure and mechanical properties of Poplar catkin fibers. Their work is essential to have good information on the fiber material, which has the potential to be part of the advanced material of tomorrow.

The development of advanced renewable materials started about 10 years ago. This represents an interesting path to include more bio-based materials in our society and to offer new opportunities to value forest resources. An example of this is the formulation of a nanocellulose aerogel from Poplar (Populus tomentosa) Catkin fiber [13]. The use of cellulose nanofibrils modified polyurethane foam composite as structural insulated material is another example of the use of an additive for advanced materials from renewable materials [14].

The development of new materials involves knowledge of their in-service behavior, especially in airtight environment where VOCs can be released. It was the aim of Cao et al. [15] to characterize the VOCs from plywood under such conditions. Advanced materials from renewable raw materials should also be developed in respect with reducing energy consumption and limiting CO2 emissions, which is more than a trivial approach. The life cycle analysis (LCA) and its variations (static, dynamic, consequential, input/output, etc.) are powerful tools to support the product development scientist. These are powerful tools but are too cumbersome to be useful for product developers. Streamlined approaches such as those proposed by Heidari et al. [16] have great potential to support the scientific community in the early stage of product development.

The future of wood products and renewable materials is promising. There is a tremendous potential for our environment and our economies, and there remains much work to be done. This special issue reflects some of the great advances in this research field and I would like to express my gratitude to all the authors for their timely and high-quality contributions. I would also like to thank all the anonymous reviewers for maintaining the quality standard of the special issue. A final thank you to the editorial team at MDPI forests.
Author Contributions: Both authors contributed to the writing process. P.B. and C.B. wrote the introduction together, P.B. wrote the part going through the special edition, and C.B. did a review of this part. All authors have read and agreed to the published version of the manuscript.

Funding: The authors are grateful to Natural Sciences and Engineering Research Council of Canada for the financial support through its IRC program (IRCPJ 461745-18) as well as the industrial partners of the NSERC industrial chair on eco-responsible wood construction (CIRCB).

Conflicts of Interest: The authors declare no conflict of interest.

References

1. IPCC. Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change; Edenshofer, O.R., Pichs-Madruga, Y., Sokona, E., Farahani, S., Kadner, K., Seyboth, A., Adler, I., Baum, S., Brunner, P., Eickemeier, B., et al., Eds.; Cambridge University Press: Cambridge, UK, 2014.

2. Rockström, J.; Gaffney, O.; Rogelj, J.; Meinshausen, M.; Nakicenovic, N.; Schellnhuber, H.J. A Roadmap for Rapid Decarbonization. Science 2017, 355, 1269–1271, doi:10.1126/science.aah3443.

3. De Wolf, C.; Pomponi, F.; Moncaster, A. Measuring embodied carbon dioxide equivalent of buildings: A review and critique of current industry practice. Energy Build. 2017, 140, 68–80, doi:10.1016/j.enbuild.2017.01.075.

4. Levine, M.; Ürge-Vorsatz, D.; Blok, K.; Geng, L.; Harvey, D.; Lang, S.; Levermore, G.; Mongameli Mehlwana, A.; Miraşgedis, S.; Novikova, A.; et al. Residential and commercial buildings. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change; Metz, B., Davidson, O.R., Bosch, P.R., Dave, R., Meyer, L.A., Eds.; Cambridge University Press: Cambridge, UK, 2007; Chapter 6, pp. 387–446, ISBN 9780521880091.

5. Lucon, O.; Ürge-Vorsatz, D.; Zain Ahmed, A.; Akbali, H.; Bertoldi, P.; Cabeza, L.F.; Eyre, N.; Gadgil, A.; Harvey, L.D.D.; Jiang, Y.; et al. Buildings. In Climate Change 2014: Mitigation of Climate Change: Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change; Edenshofer, O.R., Pichs-Madruga, Y., Sokona, E., Farahani, S., Kadner, K., Seyboth, A., Adler, I., Baum, S., Brunner, P., Eickemeier, B., et al., Eds.; Cambridge University Press: Cambridge, UK, 2014; pp. 671–738.

6. Chien, T.P.; Yang, T.H.; Chang, F.C. Flexural Performance of Built-Up Beams Made with Plantation Wood. Forests 2019, 10, 647.

7. Vu, T.T.H.; Tian, G.; Khan, N.; Zada, M.; Zhang, B.; Nguyen, T.V. Evaluating the International Competitiveness of Vietnam Wood Processing Industry by Combining the Variation Coefficient and the Entropy Method. Forests 2019, 10, 901, doi:10.3390/f10010901.

8. Ito, N.; Okubo, N.; Kurata, Y. Nondestructive Near-Infrared Spectroscopic Analysis of Oils on Wood Surfaces. Forests 2019, 10, 64, doi.org/10.3390/f10010064.

9. He, M.; Xu, D.; Li, C.; Ma, Y.; Dai, X.; Pan, X.; Fan, J.; He, Z.; Gui, S.; Dong, X.; et al. Cell wall bulking by maleic anhydride for wood durability improvement. Forests 2020, 11, 367, doi:10.3390/f11040367.

10. Oberhoferová, E.; Pánek, M.; Podlena, M.; Pavelek, M.; Štěrbová, I. Color Stabilization of Siberian and European Larch Wood Using UVA, HALS, and Nanoparticle Pretreatments. Forests 2019, 10, 23, doi:10.3390/f10010023.

11. Zhu, J.; Li, J.; Wang, C.; Wang, H. Anatomy of the Windmill Palm (Trachycarpus fortunei) and Its Application Potential. Forests 2019, 10, 1130.

12. Wu, Y.; Wu, X.; Shi, T.; Chen, H.; Wang, H.; Sun, M.; Zhang, J. The Microstructure and Mechanical Properties of Poplar Catkin Fibers Evaluated by Atomic Force Microscope (AFM) and Nanoindentation. Forests 2019, 10, 938.

13. Wu, Y.; Sun, M.; Wu, X.; Shi, T.; Chen, H.; Wang, H. Preparation of Nanocellulose Aerogel from the Poplar (Populus tomentosa) Catkin Fiber. Forests 2019, 10, 749.

14. Leng, W.; Pan, B. Thermal Insulating and Mechanical Properties of Cellulose Nanofibrils Modified Polyurethane Foam Composite as Structural Insulated Material. Forests 2019, 10, 200.
15. Cao, T.; Shen, J.; Wang, Q.; Li, H.; Xu, C.; Dong, H. Characteristics of VOCs Released from Plywood in Airtight Environments. *Forests* 2019, 10, 709, doi:10.3390/f10090709.

16. Heidari, M.D.; Mathis, D.; Blanchet, P.; Amor, B. Streamlined Life Cycle Assessment of an Innovative Bio-Based Material in Construction: A Case Study of a Phase Change Material Panel. *Forests* 2019, 10, 160, doi:10.3390/f10020160.

© 2020 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (http://creativecommons.org/licenses/by/4.0/).