Introduction

Special Issue on "Biobased Construction Materials" in the *Journal of Renewable Materials*

Conventional construction materials (e.g., steel, concrete, glass) are resource- and energy-intensive to manufacture, and their production contributes to greenhouse gas emissions, climate change, and recalcitrant waste. Along with increased environmental awareness, consumer education, and the popularity of green building certification programs, the demand for innovative, green material alternatives in the construction sector continues to grow. Green building certification programs, such as the United States Green Building Council's Leadership in Energy and Environmental Design (LEED), the United Kingdom's Building Research Establishment Environmental Assessment Methodology (BREEAM), and the United States Green Building Initiative's Green Globes building certification programs, advocate for the use of sustainable, durable material technologies not only from recycled materials (e.g., industrial byproducts), but also from low embodied energy and low embodied carbon constituents with high biobased and biorenewable content. As reported by the World Green Building Council, the green building materials market is currently estimated at $200 billion and is projected to increase at a rate of 5% annually for the next 15-20 years. This market growth has promoted innovative advances in materials research and development of alternative building products that are biorenewable and biodegradable.

Construction materials are considered sustainable when environmental, economic, and social impacts are weighed and carefully considered over the entire lifespan of the product – from raw resource allocation, material processing, application and use, to end-of-life recovery. This perspective necessitates materials research on a multitude of scales, from fundamental process-structure-property investigations, to durability and weathering, lifecycle assessment, and demonstrations of full-scale prototypes. Historically, innovations in building materials have been laborious, due to the industry's need to provide substantial evidence of adequate in-situ performance and long-term durability. Given the global demand for biobased building materials, researchers from around the world are collectively contributing new knowledge to this emerging field.

This special issue offers insights into the multi-scale spectrum of cutting-edge research related to construction materials with high biobased and/or biorenewable content. The first paper by Lawrence motivates this special issue by demonstrating how the use of biobased materials can significantly reduce the environmental impact of construction materials. The following three papers focus on experimental testing and lifecycle assessment of novel biobased building products from animal proteins. Dorr, et al., investigated the feasibility of gelatin to serve as adhesives for wood and engineered wood products. Demonstrating the necessity to quantify and compare environmental impacts of innovative materials, Roedel, et al., conduct a lifecycle assessment of a novel biocomposite produced using a biobased resin from bovine serum. In the following paper by Hess and Srubar, the development and characterization of a protein-based flax-fiber alternative, namely gelatin-flax composites, is presented and compared to epoxy-fiberglass fiber-reinforced polymer composites that are conventionally used in construction applications. In contrast to the three papers that focus primarily on the initial mechanical and environmental performance of biobased materials, the subsequent three papers address concerns with *in-situ* durability. These papers focus on the development and validation of predictive performance models that are necessary to advance the design and analysis of biobased building materials. The study by Hosseini, *et al.*, reports on the development and application of a finite element model that predicts the viscoelastic mechanical response of flax fiber-reinforced polyurethane composites. Yadama and Wolcott apply a previously validated fiber undulation model to predict the elastic constants of

DOI: 10.7569/JRM.2015.634113

laboratory manufactured oriented wood-strand composite panels, and Amiri, et al. demonstrate that time-temperature superposition could be a useful tool for accelerated testing of long-term behavior of biobased composites. Two closing papers showcase real-world applicability of biobased building materials. Voth, et al., discuss the development of a thin-walled wood strand 3-D core element and demonstrate its promise for a variety of panelized construction applications, including building envelopes. Finally, Hoiby and Netravali discuss the development of a virtual model of a cabin built entirely from natural fiber-reinforced soy protein composite materials. This final paper provides an excellent case-study example of how materials scientists, engineers, and architects can work collaboratively to reduce the carbon footprint of buildings through the use of sustainable and durable biobased building materials.

This special issue on *Biobased Construction Materials* has resulted in a collection of papers, which we view as a representative, yet non-exhaustive, compilation of works that highlight the current trends and future potential of biobased building materials. We have enjoyed preparing this special issue for the readership of the *Journal of Renewable Materials*, and we hope you find this compilation of interest.

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Special Issue on Biobased Construction Materials
July 13, 2015