The Feasibility and Sustainability of Architectural Biomaterials
Cataloging emergent biobased & renewable materials that redefine the built environment

Patrick J. Becker¹, Blaine E. Brownell²
¹Department of Bioproducts and Biosystems Engineering, College of Food, Agriculture, & Natural Resource Sciences
²School of Architecture, College of Design

ABSTRACT

This research was centered on the development of a materials database as a resource for architects, designers, contractors, scientists, and consumers. A primary focus of the research is the feasibility and sustainability of materials with composite or biobased biological applications of biomaterials and recycled materials. Critical factors in the design process can significantly reduce the impact on construction and the structure it generates. However, the impact depends on the influence of architects in the design process, specifically material selection. The usage of the application directly on the material, specifically material designers, contractors, scientists, and consumers in a cross-sectional research collaboration. A primary focus of the research is the feasibility and sustainability of materials with composite or biobased biological applications of biomaterials and recycled materials. Critical factors in the design process can significantly reduce the impact on construction and the structure it generates. However, the impact depends on the influence of architects in the design process, specifically material selection. The usage of the application directly on the material, specifically material designers, contractors, scientists, and consumers in a cross-sectional research collaboration.

MOTIVATION

- Blaine Brownell is the mentor for this project and the research focuses on disruptive material applications and environmental building strategies.
- Brownell collaborated with the prominent scholars of advanced materials for architecture and design, having authored the Transmaterial series with Princeton Architectural Press (2006-2010).
- The aim of this research was to compile a database of materials for future research in the field.
- We included the newest materials in the built environment, particularly those that are innovative and environmentally friendly.
- Eligible materials that are not yet in commercial production and that have unique characteristics or advantages for architectural or building applications.
- Exploring materials through industry publications and research networks, several hundred materials have been cataloged for future publication.

BACKGROUND

- The Transmaterial series explores emergent materials that can transform the structural space, surfaces, and scale of projects with the highest level of technical and environmentally friendly products.
- Emphasis is given to biomaterials, which are notable for their unique environmental or biological factors, including biodegradability, cost, biocompatibility, biodegradable, waste reduction, and many other transformative sustainability technologies.
- Materials cataloged are property of Transmaterial, unless copyrighted images have been featured in the Transmaterial series. They may not be reproduced without permission.

METHODS & MATERIALS

- Material awareness and information acquisition: research was conducted in numerous industries and peer-reviewed journals, professional association newsletters, and university research publications.
- Database creation: each entry includes a name, images, description, and technical information.
- Cross-sectional research collaboration: communications, one of the primary roles of the undergraduate and graduate research assistants in the series.
- Correspondence has been ongoing and conducted via email to contributors worldwide.
- Compilation: once obtained, materials were added to the database for review.

CASE REALITY & FUTURE REALITY

- The built environment is constantly changing and demands new and innovative materials to meet the needs of the present and future.
- Numerous materials were discovered as part of this research, many of which have distinct environmental benefits and remarkable characteristics that make them eye-catching and beautiful.
- Most importantly, the future depends on human ability to create, develop, manufacture, and distribute technologically superior materials that exist synergistically with the natural environment.
- Biomaterials, natural, and composite represent the future because they are planet-friendly and carbon-neutral.
- Innovations in materials can transform the space, structures, and surfaces, in ways that aren't only technologically superior to their predecessors, but also environmentally friendly.
- Through collaboration with students, graduates, and faculty researchers, the Transmaterial series contains the inside track of the materials of the future.

TECHNOLOGY

- Various technologies were employed in the creation of the materials cataloged in our research.
- Numerous materials were created using nanotechnology, which isolates characteristics of materials at the molecular and atomic levels.
- Some examples include: a self-healing membrane which has the potential to be a vapor-responsive artificial skin, an innovative polymer that provides design and environmental tools, protecting the biofuel organ of which it is part.
- The development of smart, biomimetic actuators such as these are soft and resilient, and can outperform conventional rigid mechanical devices/materials. Illustrated below.
- Other technologies involve creating composites of natural low-impact environmental materials.
- Some examples include the combination of lignocellulose fibres with renewable polymers to create nanocellulose solar cells, color-changing microalgae dye, and Chitosan bioplastic, a chitin-based biodegradable polymer. Chitosan is composed primarily of the exoskeletons of shrimp.
- Biomaterials like Chitosan, and several of the materials that were part of our research, are known for their characteristics such as improved toughness, durability, flexibility, softness, and biodegradability.

RESULTS

- Architectural biomaterials are indeed feasible within the bounds of the physics that governs their existence. With regard to sustainability, biomaterials contain organic and biological materials, which by their nature allow them to be less impactful than synthetic and engineered products.
- So, if the biomaterials are created with regard to their impact, they are also sustainable. The results of our research include the database of materials that will form the foundation of future Transmaterial publications.
- The image around this poster depicts many of the materials that we explored. Exploration such as this is critical and ongoing in the development of the materials.
- Future materials will continue to challenge the boundaries of physical possibility while accomplishing environmental and biological goals of our society; we test the boundaries of the planet on which we depend for life.

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View our work online at transmaterial.net