Using Mycelium as a Matrix for Binding Natural Fibers and as Core Filler Material in Sustainable Composites: Summer 2011
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INTRODUCTION

There have been many advanced in science that improved people’s standard of living; however, these new technologies are usually harmful to the environment in which we live. One of the worst offenders are plastics, more specifically Styrofoam. Styrofoam is notorious for taking many thousands of years to breakdown. It is estimated that 25% of our landfills by volume are filled with Styrofoam which is not going anywhere anytime soon.

Ecovative Design, a green-minded small business based in Green Island, NY, is addressing this issue by trying to replace Styrofoam with mushrooms. Their approach utilizes local agricultural waste to grow mycelium, the vegetative part of mushrooms. Mycelium can be grown in any shape allowing it to replace Styrofoam in product packaging.

Ecovative Design is now trying to expand the use of Mycelium into structural applications by forming composite structures using natural fibers. This new effort requires careful consideration of processing parameters and characterization of the resulting structures.

OBJECTIVES

The overall objective of this study is to optimize the Mycelium/natural fiber composite for structural applications. To achieve this, DoE was used to design experiments that identify the affect critical processing parameters have on the performance of the composite. The specific objectives of the experiments are to help answer the following questions:

• What fiber type (hemp, jute) results in the strongest composite?
• What fiber form (felt, weave) results in the strongest composite?
• Which of the processing parameters (drying w/ and w/o compression, post processing or not) results in the strongest composite?
• Which of the tests performed are best indicators of composite performance?

CONCLUSIONS

This experimental effort was part of a Phase I NSF SBIR designed to evaluate the feasibility of using all natural composite in structural applications. The study is anticipated to receive Phase II funding that will be used to optimize and completely characterize the composite. The conclusions that resulted from the Phase I study are as follows.

• Core compression is a function of mycelium density only.
• Fiber type and fiber form have significant impacts on tensile strength.
• Method to normalize cross-sectional area of the tensile specimens needs to be developed.
• Post processing parameters have little impact on tensile strength.
• Fiber form has significant impact of flexural performance.
• Fiber form, fiber type, and processing conditions appear to impact the type of failure observed in flexural testing.

METHODS

The core compression, composite flexural stiffness (three point bending), and the skin tension were evaluated for each of the over 100 variations of the processing parameters. The core compression was used to determine the load carrying capacity of the core material under varying levels of Mycelium density. The composite flexural stiffness was used to determine core strength, core-face sheet interface strength, and structural performance. The skin tension tests were performed to determine the maximum capacity of the face sheets to carry load under varying levels of Mycelium density.

RESULTS

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<tr>
<th>Stress v. Strain for Compression Of the Core Material</th>
<th>Flexural Load v. Displacement for Composite Bending</th>
<th>Tensile Load v. Strain For Face Sheet Material</th>
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REFERENCES


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