

**ENGINEERED 'GREEN' COMPOSITES USING KENAF AND BAMBOO  
FIBERS WITH MODIFIED SOY PROTEIN RESIN**

**A Thesis**

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**by**

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## ABSTRACT

In this thesis, fully 'green' composites using nonwoven kenaf mats and modified soy protein isolate (SPI) resin were fabricated. Moreover, fibrillated bamboo fiber (FBF) sheets were also incorporated into some kenaf mat composites to obtain engineered hybrid green composites. Potential mechanical properties of these cutting-edge materials have been proposed.

Initially, an appropriate SPI resin composition for optimal composite properties was determined by varying pH values and the amounts of glycerol, used as plasticizer. The final composition contained 10% glycerol (by wt. of SPI) and 11 pH. The effects of a self cross-linking Phytigel<sup>®</sup> on the tensile properties of the modified SPI resins were evaluated. The tensile strength and Young's modulus of SPI resins showed a significant improvement by adding Phytigel<sup>®</sup>. The kenaf fiber/modified SPI resin interface was characterized using the single fiber fragmentation technique. The mechanical properties of these green composites fabricated with SPI modified with various percentages (0, 10, 20 and 40%) of Phytigel<sup>®</sup> (by wt. of SPI) were characterized. The tensile properties of the green composites didn't increase significantly with the Phytigel<sup>®</sup> content. The flexural strength and chord modulus of the composites containing 20% Phytigel<sup>®</sup> in SPI resin were, however, 1.6 and 1.4 times higher than the composites with 0% Phytigel<sup>®</sup>, respectively. The composites with 40% Phytigel<sup>®</sup> in SPI resin possessed the highest impact strength.

The tensile strength and modulus of the hybrid composites using FBF sheets and SPI resin modified with 20% Phytigel<sup>®</sup> were 37.1 MPa and 2187 MPa, respectively, which represent a 10% and 20% improvement over the kenaf mat composites using the same resin. The impact strength of the kenaf mat composites improved 116% after incorporating FBF sheets.

## BIOGRAPHICAL SKETCH

Yuzo Yamamoto was born in Osaka, Japan on July 31, 1979. He attended Doshisha University in Kyoto, Japan, after completing high school. He received a Bachelor of Engineering in the department of Mechanical and Systems Engineering from Doshisha University. He spent one and a half years and completed all the required courses at the graduate school of Doshisha University. In February of 2004, he started to work as a non-degree student in Fiber Science Program at Cornell University. He received a Master of Science degree in Fiber Science Program from Cornell University in the summer of 2006. After his master degree, he will start working for BOSCH Corporation in Yokohama, Japan.

To my parents, Minao Yamamoto and Kiyomi Yamamoto,  
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