BIO-COMPOSITES FROM CANOLA OIL BASED RESIN AND HEMP FIBERS

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INTRODUCTION
The environmental concerns, including dwindling crude oil resources, high oil prices, pollution, greenhouse CO2 emissions, and toxicity in the environment, married to societal pressures towards sustainable development are currently making countries around the world turn to biomass as a renewable resource for a variety of products: fuels, lubricants, chemicals, polymers, fibers, nutraceuticals, etc. Injection moldable bio-composite, made from natural fibers and polypropylene, has been increasingly used in automotive industry [1-2]. Thermoset resins synthesized from soy-bean oil have been shown to have a great potential as matrix in composites manufactured using VARTM and SMC [3]. This study has been extended to Canola oil [4] since the latter is believed to yield better properties than the soy bean oil based resin due to low amount of saturated fatty acid. The present study is focused on manufacturing and evaluating the properties of biocomposites made using the canola-oil based thermoset resin and hemp fibers.

EXPERIMENTAL DETAILS
Acrylated Expoxidized CO (AECO) and Maleinized Acrylated Epoxidized CO (MAECO) were synthesized from canola oil [4] and were evaluated for their potential as a matrix for manufacturing thermoset composites using VARTM. The monomers were polymerized and cross-linked with styrene as the co-monomer. Curing efficiency with various initiators was studied to optimize the composition of cure mixture. The various initiators evaluated in this study are Luperox26, Trigonox C and Luperox LP which supplied by Sigma Alderich (St.Louis, MO). Rheological and mechanical properties were evaluated using DMA (Dynamic Mechanical Analyzer). Mechanically decorticated (after field retting) hemp fibers supplied by Stemergy Inc., were characterized to generate baseline properties for interpreting composite properties. Non-woven mats were manufactured using the facilities at North Carolina State University, USA and used in manufacturing composites by VARTM.

RESULTS
Storage modulus of the AECO and MAECO resin with different initiators were evaluated with DMA. The results for MAECO are shown in figure 1. As it can be seen MAECO with Luperox LP showed better storage modulus which can be related to the high solubility of the initiator in oil based resin. AECO resin showed inferior storage modulus. Glass transition temperature of MAECO based on tanδ results is 66°C and for AECO is 47°C.
For composite manufacturing, hemp mats were characterized.

Figure 1. Storage modulus of MAECO with different initiators

The aspect ratio of the fibers was measured. Distribution of aspect ratio of fibers was very large due to large variation in fiber diameter. DMA ramp force tests were run to evaluate the modulus of the hemp fiber. Results (figure 2) showed a large variety in modulus of the fibers versus their diameter. Results of random mat composite manufacturing with different volume fraction of hemp fibers and their mechanical strength will be discussed in extended paper.

Figure 2. Change in modulus of hemp fibers with their diameter

REFERENCES