"Green" Composites using Modified Soy Protein Resin and Flax Yarns and Fabrics

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ABSTRACT

"Green" composites made from environment-friendly, fully biodegradable fibers and resins offer an attractive alternative to many moderate strength conventional composites made using petroleum-based or synthetic resins and fibers. Conventional composites do not degrade over many decades. Since they contain two dissimilar components composites cannot be easily recycled or reused. As a result, most of them are disposed of in landfills. On the other hand 'green' composites, after their useful life, can be easily discarded or composted without harming the environment.

This paper will discuss properties of glutaraldehyde (GA) modified (cross-linked) soy protein concentrate (MSPC) polymer and 'green' composites made using MSPC and flax yarns and fabrics. Soy protein concentrate (SPC) polymer in its pure form has low tensile properties and poor moisture resistance. In addition, it is also very brittle and often processed with high plasticizer content e.g. glycerin. SPC modification was carried out to improve these properties and make the resin more suitable for composites.

SPC forms a miscible blend with GA and reacts with the amine groups in the protein, increasing its cross-link density. MSPC showed 35% increase in fracture stress and 55% increase in Young's modulus over SPC as well as improved its moisture resistance and thermal stability. The interfacial bond strength between MSPC and flax fibers, using microbead test, was found to be around 13 MPa. Unidirectional yarn reinforced composites yielded strengths of up to 275 MPa in the direction of the yarns. Fabric reinforced composites show good stability in mutually orthogonal warp and weft direction, more balanced properties in the fabric plane and better impact resistance. The paper will discuss the composite properties in both tensile and flexural modes and the effect of resin modification.

These green composites may be used in automobiles, housing and other consumer goods to replace metals and many conventional plastics.