MECHANICAL PROPERTIES OF FIBER-REINFORCED COMPOSITES MADE FROM RENEWABLE RESOURCES

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Most commonly employed construction materials generate substantial environmental costs throughout their life-cycle. For example, producing concrete and steel expends substantial quantities of energy from non-renewable sources (hydrocarbon fuels), and forests are being depleted to provide wood. Burning hydrocarbon fuels for energy releases CO_2 into the atmosphere, and deforestation removes trees that would absorb CO_2. Furthermore, current recycling techniques for construction materials are energy intensive and generally yield materials of lower quality than the originals. There is clearly a need for sustainable construction materials - materials that are less energy-intensive, less destructive to natural resources and the environment, and leave a smaller footprint after demolition.

Fiber-reinforced polymeric composites manufactured from renewable materials ("biocomposites'), such as soybeans and hemp are currently under investigation for their potential application in the building industry. Biocomposites integrate fibers in a matrix to provide mechanical properties useful for structural and/or non-structural applications and have the ability to be biodegraded after their useful service life is reached. Currently biocomposite laminates made up of acrylated epoxidized soybean oil (AESO) resin or cellulose acetate plastic as matrices and hemp or flax fabric as fibers are being investigated for their mechanical properties. The AESO biocomposites are manufactured at room temperature by a vacuum-bagging method [1]. Cellulose acetate biocomposites are manufactured in a hot press, using a process adapted from Mohanty et al. [2]. Tensile, bending and shear properties are being evaluated according to ASTM standards for various biocomposites comparing matrix material and fiber material, orientation, and volume. The results are compared to mechanical properties of the biocomposite materials, including short fiber biocomposites. Tensile strengths equivalent to that of wood have been observed. The ability of traditional micromechanical models for continuous fiber composites to predict mechanical behavior of the tested biocomposites is also being studied and will be reported. Potential applications for the biocomposites in the building industry will also be discussed.

References:

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