Design of Natural Fiber and Wastepaper Composite Using Numerical Analysis Method

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The consumption of papers in various applications has been increased rapidly during the past decades. To produce one ton of paper; 12 trees, 540 000 liters of water, fuel consumption for transporting the trees are used whereas 10 liters of water is needed to make one A4 paper. Thus, during paper production natural resources are enormously utilized as well as many chemicals are involved in the process. Therefore, this study was conducted to design a wastepaper-based composite with natural fiber as reinforcement. Jute, coir, silk, and wool fibers selected as reinforcement and the study was carried out using simulation in SOLIDWORKS software. Among the selected fibers jute fibers showed better properties and therefore it was selected for composites simulations.

Firstly, volume fraction was calculated, and the critical volume fraction was determined. Critical fiber volume fraction was nearly 0.23. Then the fiber volume fraction was optimized using COMSOL Multiphysics software. The periodicity boundary condition and rule of mixture techniques were used to compare and obtained the most suitable fiber volume fraction. The optimized fiber volume fraction was 0.4. Thereafter the micromechanics analysis of a unit cell was carried out with the most suitable fiber volume fraction. The elasticity matrix was obtained for the material. Finally, the stress analysis of the composite was done by applying a 100N load on the composite, which was fixed from four edges. The longitudinal elastic modulus obtained was 8.0726GPa with a thickness of 0.4mm and a Grammage of 488.92 gm-2. Thus, a natural fiber composite with wastepaper can be produced with most suitable fiber volume fraction of 0.4 with numerical analysis methods.

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