

Doctor Thesis
DESIGN, PROCESSING AND CHARACTERIZATION OF JUTE AND
PALM NATURAL FIBERS SANDWICH COMPOSITE PANELS

AHMED ELSAYED ABDELFATTAH ELBADRY

Abstract

The strict environmental regulations have faced the composite industry to find alternatively eco-friendly reinforcements and resin systems to produce environmentally friendly composite materials. Therefore, the objectives of this work are to investigate the effect of jute and glass skin layers on the mechanical, impact properties and notch sensitivity of jute and palm mats reinforced unsaturated matrix composites. The objectives of chapter 2 and 3 were to investigate the effect of jute fiber weight contents of jute mat composites (JMC) on the mechanical properties including the tensile, bending, impact properties and the notch sensitivity. Moreover, the effect of the scratch with different scratch loads on the drop weight impact properties of JMC compared to glass mat composites (GMC) has been investigated and the fracture behavior of the composites was also examined. The results showed that as the jute fiber weight content increases, the mechanical and impact properties of JMC increase. The impact energy of JMC and GMC is improved by adding scratch to the tension side of the specimen. The fracture surface of JMC indicates that the radial matrix cracks are trapped and arrested and constraint to propagate a long a weak preferable path (scratch path) and so suppress any tendency of crack branching out of the scratch path. By adding the scratch to the tension side of GMC for different scratch loads, the crack deflection and delamination propagate along the weak preferable path (scratch path) and so the area of the crack increases and this dissipates most of the impact energy and so the impact energy is improved. Moreover, the notch sensitivity of JMC composites decreases by increasing the fiber weight content and the characteristic distance which represents the distance from the hole boundary at which the brittle fracture starts to occur is validated to be substitute for the material properties for JMC instead of fracture toughness value. Chapter 4 and 5 investigate the effect of skin fabrics (jute and glass fabrics) on the mechanical properties and notch sensitivity of hybrid composites. The results indicated that by adding the jute and glass cloths as skin layers, the tensile and bending properties

of hybrid composites were significantly improved compared to those of neat resin and JMC while the notch sensitivity of hybrid composites increases compared to that of JMC. Moreover, Moreover, by adding the jute and glass cloths as outer and inner skin layers, the izod impact strength and the total impulse impact energy were improved compared to those of neat resin and JMC. Chapter 6 investigate the mechanical properties of palm mat composites (PMC) composites and the effect of skin fabrics (jute and glass fabrics) on the mechanical and impact properties of palm mat composites. The results indicated that the mechanical properties of PMC are very weak compared to those of the neat resin because the interfacial properties between the palm fiber and the matrix are very weak due to the presence of SBR binder which prevents the palm fiber to be wetted by the matrix for different fiber weight contents. Moreover, by adding the jute and glass cloths as outer and inner skin layers, the mechanical properties were improved compared to those of PMC and the neat resin. Moreover, the effect of the palm fiber has more significant effect on the improvement of the impact properties of PMC than that of tensile and bending properties compared to those of neat resin and by adding jute and glass cloth as skin layers the total impulse impact energy and the izod impact strength were significantly improved compared to those of neat resin and PMC.