Concept selection of car bumper beam with developed hybrid bio-composite material

ABSTRACT

Application of natural fibre composites is going to increase in different areas caused by environmental, technical and economic advantages. However, their low mechanical properties have limited their particular application in automotive structural components. Hybridizations with other reinforcements or matrices can improve mechanical properties of natural fibre composite. Moreover, geometric optimizations have a significant role in structural strength improvement. This study focused on selecting the best geometrical bumper beam concept to fulfill the safety parameters of the defined product design specification (PDS). The mechanical properties of developed hybrid composite material were considered in different bumper beam concepts with the same frontal curvature, thickness, and overall dimensions. The low-speed impact test was simulated under the same conditions in Abaqus V16R9 software. Six weighted criteria, which were deflection, strain energy, mass, cost, easy manufacturing, and the rib possibility were analyzed to form an evaluation matrix. Topsis method was employed to select the best concept. It is concluded that double hat profile (DHP) with defined material model can be used for bumper beam of a small car. In addition, selected concept can be strengthened by adding reinforced ribs or increasing the thickness of the bumper beam to comply with the defined PDS.