The mechanical properties of corrugated core structures based on flax fibre composites

ABSTRACT

Background: The mechanical properties of novel flax fibre reinforced corrugated composite structures subjected to quasi-static and dynamic compression loading are investigated in this paper. Polypropylene (PP) and polylactic acid (PLA) have been used as thermoplastic matrices to enhance the recyclability of the composite material. Methods: The corrugations were manufactured using matched-die compression moulding and then used as cores in sandwich panels having facings of the same material. The effect of increasing the number of corrugations on the compressive properties of the sandwich panels was investigated by subjecting them to compression loading. Results: The results indicated a monotonic increase in the absorbed energy as the number of corrugations increased from two to five. All of the panels based on flax/PP composites showed a greater energy- absorbing capability compared to those made from flax/PLA. Conclusion: The cores exhibited progressive cell-wall buckling and cell wall folding, characteristic of a typical energy-absorbing structure. The predominant mode of failure was buckling, and then cell wall fracture for the flax/PP corrugations in contrast to interlaminar delamination, and fibre buckling for the flax/PLA cores. Failure maps indicate that the cell walls buckle at low relative densities (up to 0.01) with cell wall fracture occurring at higher relative densities. At the balanced relative density, where both buckling and fracture of the cell walls occur simultaneously, the corresponding stresses are 0.8 MPa for the flax/PLA composite and 0.6 MPa for flax/PP composite. The associated relative density is about 0.01 for both cases.

Keyword: Natural fibre; Flax fibre; Polypropylene; Polylactide; Corrugated core; Mechanical properties