Influence of fabric orientation and compression factor on the mechanical properties of 3D E-glass reinforced epoxy composites

ABSTRACT

3-D E-glass fabric reinforced epoxy composites at 6 mm thickness were fabricated for various orientations of the binder yarn viz. 0°, 30°, 45°, 60° and 90° respectively. Tensile, flexural, interlaminar shear stress tests were conducted to ascertain the influence of binder yarn orientation on the mechanical properties of the composites. The composites with 0° binder yarn orientation showed the best strength followed by 90° whilst the others showed highly depleted traits in comparison. Shear stress induced at the interface of each lamina was seen as the major reason for drop in the strength. A secondary study was carried out to explore the effect of compression factor during fabrication on the mechanical properties of the composites. Laminates with varying thickness namely, 4 mm, 5 mm and 7 mm but, with same number of plies of 3D E-glass fabric at 0° orientation were fabricated. The test results were compared with the results of 6 mm composites from the primary study. The results showed that, compression factor affected the mechanical properties of the composites and had a direct relation with increasing compression factor up to a certain value beyond which a drop in properties was seen. Composites pressed to a thickness of 5 mm showed the best properties. Drop in properties was attributed to close packing of reinforcement and crushing of fibres leading to inefficient stress transfer. Scanning electron microscopy was employed to understand the modes of failure. The major failure modes observed were delamination, matrix cracking and debonding. Based on the results obtained, these composites can be seen as a material system for applications like ballistic armours, structural renovations and automobile components.

Keyword: 3D E-glass fabric; Fabric orientation; Hand lay-up; Compression moulding; Compression factor; Mechanical properties