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Effect of Different Carbon Fabric Orientations on the Fracture Properties of Carbon Fabric Reinforced Polymer Composites

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Abstract : The main drawbacks of the traditional carbon fabric reinforced epoxy resin (CFRP) are low strain failure, delamination between composites layers, and low impact resistance due to the brittleness of epoxy resin. The aim of this study is to enhance the fracture properties of the CFRP composites laminates via the variation of composite's designs. A series of composites were fabricated in which bidirectional (00/900) carbon fabric (CF) layers were laid inside the resin matrix with orientation codes as F1 [(00, 900)/ (00, 900)], F2 [(900, 00)/ (00, 900)] and F3 [(00,900)/ (900, 00). The mechanical and dynamic properties of the composites were estimated. In addition, the morphology of samples surface was examined by scanning electron microscope (SEM) after impact fracture. The results revealed that the CFRP properties could be tailored fitting specific applications by controlling the fabric orientation inside the CFRP composite design. F2 orientation [(900, 00)/ (00.900)] showed the highest tensile and flexural strength values. On the other hand, the impact strength values of composites were in the order F1 > F2 > F3. The storage modulus, loss modulus, and glass transition temperature Tg values obtained from the dynamic mechanical analysis (DMA) examination was in the order F1 > F2 > F3. The variation in the properties of the composite was clearly explained by the SEM micrographs as the failure of F3 orientation properties was referred to as the complete breakage of the CF layers upon fracture.

Keywords : carbon fiber, CFRP, composites, epoxy resins, flexural strength
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