EFFECT OF LAYUP CONFIGURATION ON QUASI-STATIC PENETRATION PROPERTY TO 3D PRINTED RAMIE-FIBER REINFORCED BIOCOMPOSITES

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ABSTRACT

The natural fiber reinforced biocomposite gained the attention in the research field due to environmental awareness. The use of continuous fiber was known to improve the impact properties of laminated composites. However, the loading behavior of composites was changed by different layup methods and support span to punch diameter ratios (SPR). This work focused on the effect of layup configuration on the out-of-plane properties of biocomposites under different SPRs, which was studied through quasi-static penetration test (QSPT) that may represent impact problem albeit the speed difference. We evaluated the penetration property of continuous ramie-fiber reinforced polylactic acid thermoplastic composites (RFPLA), and different layup laminates were selected to study the influence of layup method on QSPT properties of RFPLA under three SPRs. The results showed that the woven biocomposite exhibited superior penetration force (541.63 N) and energy absorption capability (4.28 J) compared to samples of the unidirectional and the orthogonal layup configurations at SPR = 5. The energy absorption and maximum penetration force of the woven biocomposites increased by 31.2%, and 18.0% compared with other layup biocomposites. The penetration damage mechanisms of 3D printed samples highly depended on the layup configuration and SPR. In addition, the energy absorption was proportional to the crack length and damage area, and damage-energy absorption relationship was quite linear.

Keywords: continuous ramie fiber; biocomposites; layup configuration; penetration; 3D printing