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Research Article

Comparative Analysis of Drilling Behaviour of Synthetic and Natural Fiber-Based Composites

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For comparison, the drilling behaviour of abaca fiber-reinforced polymer (AFRP) composites and Kevlar-reinforced epoxy polymer (KFRP) composites has been studied in the specified experimental condition. The different geometrical drilling tools have been used for the investigation, namely, candlestick (T1), core (T2), standard twist drill (T3), and step cone (T4). The tool feed of 30, 45, and 60 m/min and rotational speed of 1000, 1500, and 2000 rpm have been used for the investigation. The thrust force is chosen as a response parameter for this study. The results revealed that, at lesser rotational speed and tool feed, the thrust force has declined. The result obtained correlates with the abaca fiber-based systems. However, the thrust force of KFRP is higher compared to AFRP composite systems. The axial force generated by candlestick drill is minimal compared to the other drill bits. The following may be responsible for lower thrust force: (1) the axial force distributes circumferential of the cutting tool instead of focusing at the center and (2) the interfacial adhesiveness between the matrix and the fiber is higher. The optimization of drilling process parameters, namely, tool feed and rotational speed on thrust force, has been studied. The results reveal that the tool feed contributed more to axial force compared to rotational speed.

1. Introduction

The studies have revealed that drilling is quite essential in the final machining process in the assembly of components. Drilling in fiber-reinforced matrix composite is difficult owing to the anisotropic nature of materials. Nowadays, delamination-free hole in the fiber-based composite is a challenging task faced by researchers; it leads to thinking of alternate technology for the drilling process. Further, the applications of different geometrical drill bits, predrilled hole, supporting plate, and different unconventional drilling techniques are studied. The special drill portrays various intensities of axial force along with tool feed during the drilling process [1]. The geometrical drill bits, namely, saw, candlestick, core drills, and more, distributed thrust force circumferential of the hole instead of focusing on the center (twist drill) of hole. The backup plates in fiber-based composite protect hole walls from peel-up delamination [2]. The drilling in KFRP is analysed by standard and modified twist drill bit with negative point angle. It is reported that the tests are performed in cryogenic and ambient temperatures. The delamination is analysed by two methods, namely, the linear elastic fracture model and the three-dimensional finite element model. The results reveal that the drilling is done successfully in Kevlar-based composite by high-speed steel drill bit with negative point angle. Moreover, the effect of temperature during drilling generates delamination in the composite specimen [3]. The investigation on drilling is