Abstract

Glass fibre reinforced plastic (GFRP) composite has found an important place in the industries replacing many metals and alloys. These composites are produced to the final shape, but additional machining is required for efficient assembly of parts. Conventional drilling is the most commonly used secondary manufacturing process in the industry nowadays. Moreover, drilling of glass fibre reinforced plastics is difficult to carryout due to the anisotropic, non-homogeneous structure and high abrasiveness of the glass fibre and the complex geometry of the twist drill. For these reasons, the damage gets induced to the hole/workpiece and wear of the cutting tool. Hence the joints formed are found to be the weakest portions of the assembled GFRP parts. Considerable amount of work has been carried out by earlier researchers in analysing the drilling process by experimental studies. The effect of process parameters, tool geometry and fibre reinforced plastics of different volume fraction on thrust force, torque, cutting temperature, power consumption, peel-up and push-out delaminations, tool wear and hole quality. In all the above said works, the tool life criteria is not considered since the number of experiments to be conducted would be enormous.

In this present study, central composite design approach is employed to identify the effects of process input parameters on the output factors and to analyse the drilling process. From the available data set of the experimental results, regression model has

been developed for output predictions. Design of experiments is used to derive inference regarding the effect of different process parameters on the characteristics of the process. The process input parameters chosen are drill diameter, cutting speed, feed, fibre volume fraction and point angle. The output factors/responses are the thrust force, torque, power, temperature, tool life, surface roughness, deviation from nominal diameter of the hole, deviation from circularity, deviation from cylindricity, peel-up and push-out delaminations. In every set of experiment, an exhaustive work has been carried out till each drill bit reached tool life criteria of 200 μm. The regression models developed help in choosing appropriate combination of the above mentioned process parameters within suitable range for predictions of the outputs and may be used for different optimization studies.

Keywords: Drilling, Glass fibre reinforced plastic (GFRP), Delamination, Design of experiments (DOE), Central composite design, Regression model.