ABSTRACT

Composite materials have been continuously replacing traditional materials, because of their superior properties, such as high tensile strength, low thermal expansion, and high strength-to-weight ratio. Natural fiber reinforced composites are more attractive, due to their high specific strength, lightweight, biodegradability and environment friendly nature. Natural fiber mixed with glass fiber reinforced polymer composites are finding increased applications in many engineering fields, especially in the construction, automobile and aviation industries.

In the present study, sisal-glass fiber reinforced polymer (SGFRP) hybrid composites, jute-glass fiber reinforced polymer (JGFRP) hybrid composites and sisal-jute-glass fiber reinforced polymer (SJGFRP) hybrid composites have been fabricated with two different fiber orientations of 0° and 45°, by using the hand lay-up method, and pressure applied using the compression moulding machine. The mechanical properties such as tensile, flexural and impact strengths of these composites are evaluated with the help of the universal testing machine and charpy impact testing machine. Experiments have been carried out for five samples in each case, and the average values are used for a detailed analysis.

The machining of composite materials is difficult when compared to the traditional engineering materials because of their anisotropic properties and inhomogeneous nature. Hence, in this experimental work, an attempt has been made to investigate the drilling characteristics of
SGFRP, JGFRP and SJGFRP hybrid composite materials, by using solid carbide brad and spur drills of diameters 6mm, 9mm and 12mm. The experiments have been carried out in dry cutting conditions in an auto feed drilling machine, attached with a multi-component piezoelectric dynamometer for three different spindle speeds of 1000rpm, 2000rpm, 3000 rpm and feed rates of 0.04mm/rev, 0.06mm/rev, 0.08mm/rev. The output responses, such as the thrust force and torque are measured by the kistler dynamometer, and delamination is evaluated with the help of the profile projector.

The quadratic response models are developed by using response surface methodology (RSM) for the observed responses, and are employed to find the optimum drilling condition. The results obtained by using the response surface regression equation are compared to the experimental values, which predicted that there is a high correlation between the model and the experimental values.

The influence of the drilling parameters on the output responses and drilling induced damages, are analyzed by using the analysis of variance (ANOVA). From the results, it is found that, the feed rate is the most influencing parameter followed by spindle speed and the drill diameter is the least influencing parameter on the output responses. The interfacial relationships between the fiber and the matrix, internal cracks, fiber pullout, fiber dispersion into the matrix and the inner surfaces of the
drilled holes are examined by using the scanning electron microscopy (SEM) analysis.

From the experiments it has been observed that, the mechanical properties of these hybrid composites are favorable for medium load applications and comparable with those of pure synthetic fiber reinforced polymer composites. High or moderate cutting speed, low feed rate and low drill diameter are preferred for the machining of glass and natural fiber reinforced hybrid composites. It is suggested that these hybrid composites can be used as an alternative material for synthetic fiber reinforced polymer composites, especially for medium load structural applications, as they significantly reduce the problems related to environmental concerns.