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A REVIEW : AN EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF DRILLING PARAMETERS IN COMPOSITE MATERIAL

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ABSTRACT

Metal removal Techniques is a mature technology involving several disciplines of sciences. It is a continuously change in line with strategies material developments though out the manufacturing industry worldwide and also developing the metal cutting industry. This review paper aims to make an experimental investigation on drilling behavior of Glass Fiber – EPE foam sandwich composite plate and attempt made to optimize the process parameters using L9 Orthogonal array design of experiment of Taguchi methodology.Analysis of Variance (ANOVA) will be applied to study performance characteristics of drilling parameters(Delamination Factor and Surface Roughness).In the experiment the independent variables are feed rate, speed and drill bit diameter for sandwich composite material made from glass fiber as skin, EPE foam as core and epoxy resin as adhesive.

KEYWORDS glass fiber - EPE foam sandwich composite, drilling, feed rate, speed, Taguchi, OA.

I. INTRODUCTION

A composite is a material which can be defined as a combination of two or more materials that results in better properties than those of the individual materials. A formal definition of composite materials given by ASM Handbook is "macroscopic combination of two or more distinct materials, having a recognizable interface between them" [7]

We know that growing use of composite materials, specifically the FRP outside the defense industry and the aerospace industry, the unit cost replaces the performance at any cost as the main concern for production. So, the production technologies, especially the machining of composites, are performing more and more significant role. Machining composite materials is a rather complex task due to its heterogeneity, heat sensitivity, and to the fact that reinforcements are extremely abrasive. Conventional machining methods should be adapted in such a way that they reduce the effect of thermal and mechanical damage.

Drilling is a frequently practiced machining process in industry because the need for component assembly in mechanical pieces and structures. The drilling of sandwich composite materials is largely affected by the tendency of these materials to delaminate and the fibers to bond from the matrix.[6]

Drilling is a cutting process that uses a drill bit tool to cut a hole of circular cross-section in solid materials. The drill bit is usually a rotary cutting tool, often multipoint. The bit is pressed against the work piece and rotated at rates from hundreds to thousands of revolutions per minute.

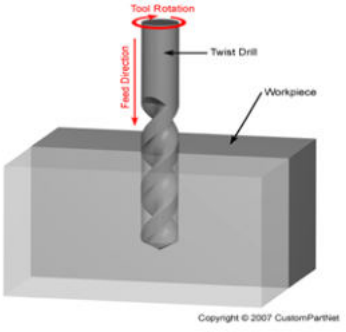

Fig. 1 Drilling Operation

Composite is a combination of two or more material having individual chemical, mechanical and physical properties. After combining these material, the property of the particular material change and a better single material is obtained, as a composite.

Advantages :

High Strength, Lightweight, Ready to Mold Complex Shapes, High durability, Low maintenance.

Disadvantages :

Few material systems cost very high.
Technology is still progressive towards it maturity.

Applications :

The use of composite materials in aeronautical, automotive, aerospace, marine and civil engineering applications is getting wider these days.

There are various issue while performing Drilling in Composite Materials. Delamination is a standout amongst the most discriminating issue happened while drilling a composite. Some of composite are delicate materials made up of filament and while the machining processes these filaments may break undesirably as a result of the thrust generated.Delamination is the major concern during drilling of composite. Drilling-induced delamination occurs both at the entrance and at the exit planes.

Delamination Factor, Fd = D / d
D = harm zone around the hole
d = hole diameter

II. LITERATURE REVIEW

j.PualoDavim et al in 2003 presented drilling of metal matrix composite based on taguchi techniques the effect of cutting parameters(cutting velocity and feed rate)and cutting time. By the result it was concluded that Cutting time is the factor which has great influence on the tool wear (50%) followed by feed rate (24%).[1]

C.C. Tsao et al. in 2004 investigated delamination factor associated with various drill bits in drilling of composite material by Taguchi analysis. The results showed thatthe feed rate and drill diameter make the largest contribution to the overall performance. &the candle stick drill and saw drill cause a smaller delamination factor than twist drill.[2]

N.S. Mohan et al .in 2006 experimentally investigated the

delamination analysis in drilling process of glass fiber reinforced plastic (GFRP) composite materials.It was concluded that the feed rate, cutting speed and material thickness make the largest contribution to the delamination effect and the use of high cutting speed and low feed favor the minimum delamination on both entry and exit of the drilling surface which makes better surface finish and tool life.[3]

R.A. Kishore et al. in 2008 investigated analysis of the residual tensile strength after drilling in glass fiber reinforced epoxy composites by Taguchi analysis. It was concluded that the drilling-induced damage at higher cutting speeds severely affects the residual tensile strength of drilled laminates.[4]

K. Palanikumar in 2011 presented an effective approach for the optimization of drilling parameters with multiple performance characteristics based on the Taguchi's method with grey relational analysis. The order of the importance for the controllable factors based on the grey relational grade is feed rate followed by spindle speed. [5]

III. OBJECTIVE

1. To Study the effect of input parameters on performance parameters.
2. To get the optimum input & output parameters for selected drill tool & work piece material.
3. To reduce the Delamination Factor, Surface Roughness while drilling.

IV. EXPERIMENTAL SET UP

For work piece : Sandwich Composite with different core to skin ratio.
As a Skin – Glass Fibre
As a Core – Expanded Polyethylene Foam (EPE)
As Adhesive – Epoxy resin
Tool – Carbide Tool

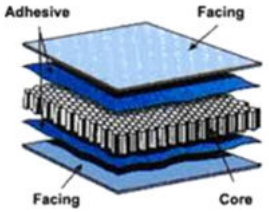

Fig. 2 Work piece Material

The sandwich composite material which will be used in investigation is glass fiber as skin material, EPE foam as core material and epoxy resin as adhesive.

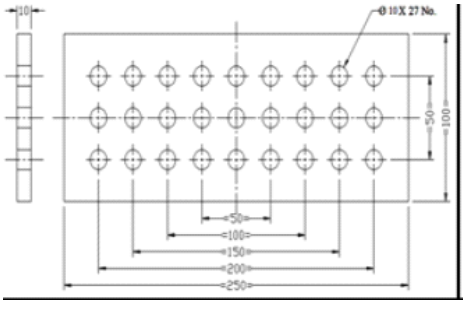

Fig.3 Size of sandwich plate

For the plan of experiment, Taguchi method with three factors at three levels will be used. The level of the drill bit diameter, spindle speed and feed rate will be considered. Orthogonal array of L9 will be chosen. The input factors which will be considered in the study are cutting speed, feed rate, and drill diameter.And output parameters are delamination factor and surface roughness.

In the plan of experiments with 9 tests,Drilling tests will be conducted on vertical milling machine. The machining sample will be prepared in the form of 250mm×100mm×10mm block. The Twist drill (Carbide) will be used.

Fig. 4 Vertical Milling Machin for Drilling Operation

In the experiment, parameter selected having three factor and at the level. The combination in L9 orthogonal array designs is shown in the table.

Table1 Factors and their Level

Factors	Level 1	Level 2	Level 3
Speed (RPM)	600	1000	1400
Cutting Feed (mm/min)	100	200	300
Drill bit diameter(mm)	6	8	10

Table 2 Experimental Table by L9 OA

No. of run	Speed	Feed	Drill Bit Diameter
1	600	100	6
2	600	200	8
3	600	300	10
4	1000	100	8
5	1000	200	10
6	1000	300	6
7	1400	100	10
8	1400	200	6
9	1400	300	8

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