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EXPERIMENTAL INVESTIGATION IN MICRO DRILLING OF EN8 USING HSS DRILL

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ABSTRACT: In the present growing world of technology, the micro-machining process has demanding operation in various sectors like aerospace, oil, defence, automobile, biomedical science and many industries at micro and nano levels of manufacturing and designing. In various types of micro machining, micro-drilling is the part of solid tool based micro-machining operation. Generally micro-drilling is used to fabricate micro-holes in micro-products. In the present investigation convectional micro-drilling has been carried out in EN8. Here an endeavour has been made for finding the optimal conditions to the micro-drilling operation upon acrylic sheet of polymer. For the optimum condition for micro-drilling operation, various factors are to be considered and these factors are known as process control parameters. In this study, the cutting speed and feed rate and drill diameter will be taken as process parameters, drilling torque, thrust force and material removal rate has been measured. In this study, percentage contribution in micro drilling process on a EN8 by application of the DOE (Design of Experiment) method. Taking into account the drilling torque, thrust force, metal removal rate, machining Controllable parameters such as federate, spindle speed, are optimized based on the DOE method. A Run order was developed by taking the three factors each having 3 levels using Statistical package. Based on the sequence, drilling was done by taking HSS drill bit of size 1mm,0.7 mm,0.5 mm dia..Find out percentage contribution of each parameter through anova analysis.

I. INTRODUCTION

This type of tiny drilling machine of height within around 200 mm is placed or clamped on a table, as shown in Fig. and operated manually for drilling small holes of around 1 to 3 mm diameter in small work pieces. Micro drilling is characterized not just by small drills but also a method for precise rotation of the micro drill and a special drilling cycle. In addition, the walls of a micro drilled hole are among the smoothest surfaces produced by conventional processes. This is largely due to the special drilling cycle called a peck cycle. The smallest micro drills are of the spade type. The drills do not have helical flutes as do conventional drills and this makes chip removal from the hole more difficult. Drills with a diameter of 50 micrometers and larger can be made as twist drills. Drills smaller than this are exclusively of the spade type because of the difficulty in fabricating a twist drill of this size.

1.2 Types of Drills for Micro Drilling

1.2.1 According to Material

1.2.1.1 Steels

Generally steels are used to manufacture of drill-bit in a large number.

Low Carbon Steel: Mainly used for wood material as work-piece. The market value of this type of material tool is less expensive than other type of material tool is less expensive than other type of longer- lived bits. High Carbon Steel (HCS): These are more hardening and tempering an nature as compared to low carbon steel. High Speed Steel: This type of material is highly resistive towards heat and largely used in commercial applications. Cobalt Steel Alloy: In this type of alloy the percentage of cobalt is more in high speed steel. High-Moly Tool Steel: Its heat treating temperature is at 1196° C i.e 2185° F and also has nitro-carburize finished at 510° C i.e. 950° F which stands for higher drilling temperature.

1.2 Application of Micro drilling

Drilling is one of the most fundamental machining technologies and is moving toward high precision/high speed applications for productivity enhancement. One notable drilling technology, micro-hole drilling, is becoming increasingly more prominent in a variety of precision industries, such as the production of automotive fuel injection nozzles, watch and camera parts, medical needles, air bearing, etc. Especially, its applications in the electronics and computer industries are rapidly expanding. It is mainly used in machining of printed circuit boards (PCB) and IC masking. The increase in the degree of integration demands improved technologies for the manufacture of smaller holes with larger aspect ratios for higher density circuit boards. Furthermore, the increasing competition in micro part developments puts an additional impetus on micro-hole manufacturing technologies.

II. LITERATURE REVIEW

Hangyan Shi , Fumin Song, Hiangu Fu are this paper micro drilling process on compatible PCBs, halogen free PCBs and ultra small hole drilling processes are investigated with using CNC machine, using kisler tool dynamometer with input parameter are drill bit, spindle speed and feed rate. They measured drilling force is very sensitive to drill breakages and to detect breakage in the PCB micro drilling process. Ashish Bharti, S.K.Moulick. They are carried out micro drilling process on titanium plate using HSS tool on CNC machine with different point angle, speed and feed rate and measure material removal rate with using software Minitab 15 used for calculate SNR value and Annova. Researcher found that spindle speed and feed rate increase , material removal rate increase along with nominal diameter but tool

point angle not significant effect and remain constant in this process. C.S.KALRA, Alake Manna, V.K.Singla This paper present ECMM (electro chemical micro machining) set up has been designed during micro drilling of hybrid AL/(AL_2O_3+SICP+CP)-MMC with using steel wire 1 mm diameter manufacturer micro tool used with parameters supply current, voltage, pulse on time and electrolyte concentration and determined material removal rate based on volume of hole generated, average radial over cut, taper cut..They found that MRR increase with increase supply current, supply voltage, pulse on time and Electrolyte concentration but same time average radial cut and taper cut increase. So observed that low dimensional micro tool are not suitable for ECMM operation because high dissolution rate of electrode material change the tool geometry.

III. ANALYSIS OF VARIANCE (ANOVA)

In the analysis of variance many quantities such as degrees of freedom, sums of squares, mean squares, etc., are computed and organized in a standard tabular format .Through this method find out the % contribution.

IV. TAGUCHI DESIGN

This experiment design proposed by Taguchi involves using orthogonal array to organize the parameters affecting the process and the levels at which they should be varied; it allows for the collection of the necessary data to determine which factor most affect product quality with a minimum amount of experimentation, thus saving time and resources. Through this process Mean plot graph ploted and which is influence parameter.

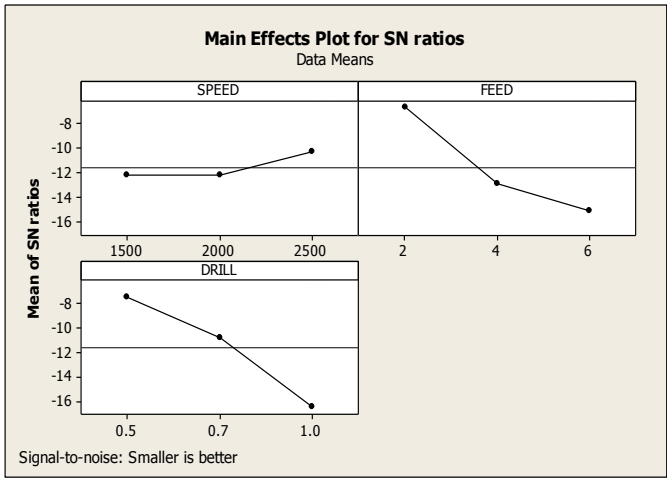
V. EXPERIMENT SET UP

In this research VMC Jyoti make machine used and material is EN8 drill is HSS. L27 orthogonal array table is used with use of Minitab-15 with Taguchi method.Input parameter are feed rate (mm/min),Spindle speed (rpm), drill diameter (mm)and output parameter is torque, thrust force and material removal rate.

TAB.1 Experimetal result

Feed mm/ min	Speed	HSS-Drill dia mm	Torque	Thrust force	MRR kg/min
2	1500	0.5	0.1	2.22	1.4756
2	1500	0.7	0.1	2.22	2.42
2	1500	1	0.1	2.35	4.9603
4	1500	0.5	0.1	2.22	5.714
4	1500	0.7	0.1	2.45	9.603
4	1500	1	0.1	3.75	15.7408
6	1500	0.5	0.1	2.22	5.586
6	1500	0.7	0.1	3.87	6.527
6	1500	1	0.1	2.35	19.536
2	2000	0.5	0.1	3.87	1.4756
2	2000	0.7	0.1	2.35	2.4801
2	2000	1	0.1	3.87	5.945
4	2000	0.5	0.1	3.35	2.814
4	2000	0.7	0.1	2.35	4.338
4	2000	1	0.1	3.87	14.285
6	2000	0.5	0.1	3.85	8.5714
6	2000	0.7	0.16	2.22	5.5556
6	2000	1	0.16	3.82	15.363
2	2500	0.5	0.16	3.87	0.992
2	2500	0.7	0.16	3.33	3.1796
2	2500	1	0.16	0.82	6.394
4	2500	0.5	0.16	0.82	2.857
4	2500	0.7	0.16	0.82	5.108
4	2500	1	0.16	0.82	14.285
6	2500	0.5	0.16	0.82	4.392
6	2500	0.7	0.16	0.82	14.763
6	2500	1.0	0.16	0.82	15.363

FIG 1 MEAN PLOT OF THREE PARAMETER SN RATIO



Response Table 2 SN RATIO.

LEVEL	FEED	SPEED	DRILL DIA
1	3.560	1.823	2.061
2	3.421	3.579	2.859
3	2.821	4.399	4.882
DELTA	0.739	2.576	2.822
RANK	3	2	1

From using experimental result with Minitab 15 software, analysis the Taguchi design graphical representation of micro drilling of EN8 material of mean torque graph using feed, speed, drill dia and found out ,above result influence parameter of micro drilling is drill diameter compare to feed and speed.

VI. CONCLUSION

Percentage contribution of torque has feed 84.63%, spindle speed 1.159 % ,drill diameter has 1.159 and error 13.04 %.The percentage contribution of MRR has about feed 0.84%, spindle speed has 33.84 % , drill diameter 47.45 % and error has 17.78 %.And last percentage contribution of thrust force feed has 81.35 %, spindle speed has 1.42 % , drill dia 1.54% and error has 15.68 %. The after analysis of plot for torque ,thrust force and MRR Vs three process parameter it is concluded that for torque increase feed compare others, for trust force increase increase feed and speed and significant and MRR drill diameter is significant parameter.
From using experimental result with Minitab 15 software, analysis the Taguchi design graphical representation of micro drilling of EN8 material of mean graph using feed, speed, drill dia and found out ,above result influence parameter of micro drilling is drill diameter compare to feed and speed.

VII. FUTURE SCOPE.

In this dissertation work, we have selected three input parameters (Feed rate, Spindle speed, drill diameter), but in future we can take another input parameters. Here, we have selected three output parameters (Torque. Thrust Force, MRR), but in future we can take another output parameters. In this dissertation work, we have selected Taguchi method, but we can take another optimization process for future work. In this dissertation work, we have selected EN8 material and HSS drill dia-0.5,0.7,1.0, but in future work we can change drill diameter of smaller size. In this dissertation work, we have use EN8 material and HSS drill, but future we can change material and drill dia.

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