Optimization of Process Parameters in High RPM Micro Drilling Machine

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Abstract-Micro drilling is one of the most fundamental machines technologies and it is moving high precision and high spindle speed application in manufacturing field and increasing productivity and quality. This is a conventional micro drilling processes in order to find the best quality of drilling for different types of work piece material (MS, Aluminum alloy & PCB) to using number of size of drill bit (0.5mm-0.1mm) were performed by different high spindle speed (10,000-50,000 rpm) and feed at five different levels. The results were analyzed using optimization of process parameters, MRR and comparatives analysis. has been done between accuracy of drilling holes by experimentation.

Keywords: Micro drilling, MRR, RPM, drill bit, dimensional accuracy.

I. INTRODUCTION

Now a day's micro drillings have a great use for manufacturing to apply special parts and items. Micro hole drilling is the precision hole drilling technology to use in manufacturing and work shop. The micro drill tools play a critical role is increasing the productivity of a cutting process. Although the price of a cutting tool itself is relatively low, the costs caused by tool failures are considerably higher. Therefore, from the viewpoint of cost and productivity, modeling and optimization of drilling processes are extremely important for the manufacturing industry. The poor removal of chips in deep drilling of small diameter is often the cause of tool breakage and poor quality surface. High speed machining technology, the smaller the tools, the higher the spindle speed you will need to efficiently machine quality parts and avoid tool breakage. High-frequency spindles with speed ranges.

II. PROPOSED ALGORITHM

Figure 1.Fabrication of Micro Drilling Machine

The micro drilling experiment was conducted on this machine. There are four machining parameter that had been put into consideration of this experiment which is material, drilling tool size, spindle speed and feed rate. These parameters have large influences on the investigation result in the previous researches. HSS drilling tool is used in this project with starting diameter 0.5mm to 0.1mm. Rotation drilling speed 10,000, 20,000, 30,000, 40,000 and 50,000 the feed rate is set as 1mm/rev. MS was used as work material in this experiment. The block size of all material is 50mm x 50mm x 0.5mm for length, width and thickness respectively. The drill hole on work piece is shown in table. The performance of drilled holes are been measure in term optimization, Taguchi's technique, dimensional accuracy, MRR. The MRR was calculated using model developed by B.Y. Lee et al, (1996). The MRR is:

$$MRR = \frac{\pi D^2 fN}{4}$$

Which, MRR = Metal removal rate
D = Drill diameter [mm]
f = Feed rate [mm/rev]
N = Rotational speed of the drill [rpm]

III. Experiment and Result

MRR, machine time, drill hole quality and productivity are obtained from the experiment using calculation. The calculation is based on the three parameter RPM, feed and drill bit diameter, continuously two parameter is constant and one parameter is variable and find out the MRR.

Table-1 RPM & Feed is Constant

Sr. No.	Material	RPM	Feed/Rev. (mm)	Drill Bit Diameter (mm)	MRR (mm^3/rev)
1	MS	10,000	1	0.1	78.53
2	MS			0.2	314.15
3	MS			0.3	706.85
4	MS			0.4	1256.62
5	MS			0.5	1963.47

Table-2 Feed & Drill Bit is Constant

Sr. No.	Material	Feed/Rev.(mm)	Drill Bit Diameter (mm)	RPM	MRR (mm^3/rev)
1	MS	1	0.1	10,000	78.53
2	MS			20,000	15.70×10^5
3	MS			30,000	$4.71X\ 10^{10}$
4	MS			40,000	$1.88\ X\ 10^{15}$
5	MS			50,000	$9.42\ X\ 10^{19}$

Table-3 RPM & Drill Bit is Constant

Sr. No.	Material	RPM	Drill Bit Diameter (mm)	Feed/Rev. (mm)	MRR (mm^3/rev)
1	MS	10,000	0.1	1	78.53
2	MS			2	157.00
3	MS			3	471.20
4	MS			4	1884.91
5	MS			5	9424.77

IV. CONCLUSION

The experiment using calculation drill bit diameter, feed and RPM is increase. The MRR is also increase. In a logical sense, if the feed rate is increases, the time taken to finish the drill operation is faster and machine time is reduced and productivity is increase. The reason for this phenomenon is when the tool diameter is large; the force acting towards on the material also increases. So that the large diameter can removes more material in one revolution. The large tool diameter has a large flank on the tool. So the material can be removed through this flank easily.

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