Scientific Journal of Impact Factor (SJIF): 4.72

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 4, Issue 4, April -2017

A Review on Optimization of Cutting Parameters in Drilling Process

Anurag Tewari

Department of Mechanical Engineering, ASET, Amity University, Noida, Uttar Pradesh, India

***Abstract**: Drilling is one of the most widely used machining processes for various purposes. Now a days it is frequently used in aircraft, aerospace and automotive and dies or mold industries. Drilling is material removal process within the work piece via a rotating drill bits in circular form and creation of holes take place with longitudinal force. Lot of researcher has been already scramble to find out most efficient parameter for low surface roughness and high material removal rate. This paper reviews the various literatures on the optimization of cutting parameters in drilling process such as spindle speed, drill diameter, drill point angle, feed rate on the performance parameters material removal rate, surface roughness and thrust force during drilling process.*

***Keywords**: Drilling process, Material removal rate, Optimization, Surface roughness, Thrust force.*

I. INTRODUCTION

Drilling is one of the most common, simplest and manageable way to machine among many kinds of machining methods. Now a day's drilling process is widely used in automobile, aircraft and marine industries. Drilling involves the formation of holes that are right circular cylinders. The drill bit is a rotary cutting tool, also known as multipoint cutting tool. The drill bit is pressed against the workpiece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the work piece, cutting off chips from the hole as it is drilled.

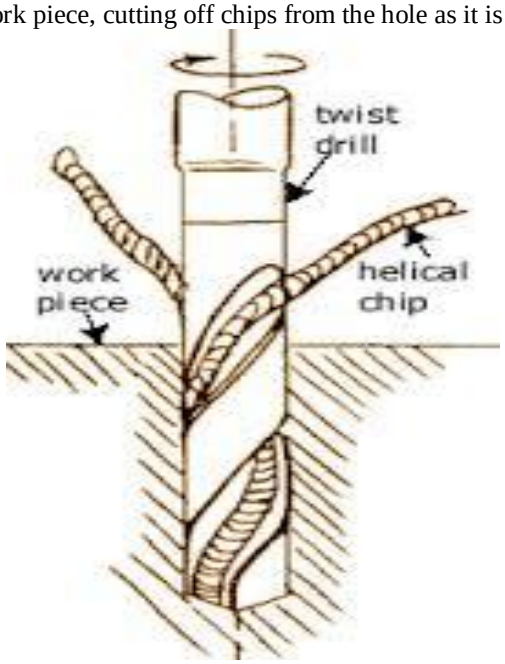

Fig. 1 Cross Section of a hole

A drill bit cuts a blind hole or a through hole with a diameter equal to that of the tool when it enters the work piece axially (Fig. 1). A drill bit is a multi-point tool and typically has a pointed end. There are many types of drill bits such as spot drill, tap drill or center drill. In drilling process generally two types of cutting edge is contributed cutting lips (cut out the material and produced the majority of the drilling torque and thrust) and chisel edge (extrudes into the work piece material and present substantially to the thrust force).

II. LITERATURE REVIEW

Reference [1] used a material 304 stainless steel for study the performance of input parameters on Surface roughness in drilling. Modified HSS drill with 10 mm diameter used as tool for experimental investigations. They used Taguchi method to solve the optimization of surface roughness. The optimal results of the surface roughness were obtained at and higher drilling speeds and lower feed rate by using 0.5 μm drill. They concluded that modification of feed and drill bit were the most important factors on the surface roughness.

Reference [2]worked to investigate the influence of drilling parameters on material removal rate, tool wear, surface roughness and hole diameter error in drilling of OHNS material. HSS spiral drill bit used as tool for experimental

investigation. MINITAB 13 software was used to analyze the effect. On material 18 number of experimental trials has been conducted. From this study it is found that feed and speed are the most critical factor that effects the output response characteristics.

Reference [3] used AISI 316 austenitic stainless as a material toinvestigated the effect of deep cryogenic and cutting parameters on surface roughness in drilling. Cutting parameters such as cutting tools, cutting speeds and feed rate was taken. M35 twist drill bit were used as tool for doing the experiment. L8 orthogonal array was used and multiple regression analysis was performed to find out predictive equation of surface roughness.

Reference [4] reports the influence of cutting parameters such as spindle speed, drill point angle and feed rate on torque and thrust force in drilling of Glass Fiber Reinforced Composite. HSS twist drill used as a tool for experiments and a mathematical model correlating the interactions of cutting parameters and their effect on torque and thrust force. After experiment it was found that the torque and thrust force both depends on the spindle speed, drill point angle and the feed rate, and both of them increase with increase in feed rate and drill point angle.

Reference [5] investigates the drilling of Al/SiC/ Graphite hybrid composite material (Al6061) with input parameter such as spindle speed, drill diameter, feed rate and type of drill and surface roughness as performance parameter. They used Response surface methodology (RSM) to solve the optimization of surface roughness. It was found that minimum surface roughness could be achieved at lower feed rate, higher spindle speed and low or moderate drill diameter.

Reference [6] focuses study on the influence of input parameters- feed rate, cutting speed and cutting environment on the surface roughness obtained in drilling of AISI 1045. It was found that minimum surface roughness is obtained at lower cutting speeds, while feed rate increased it deteriorates. Surface roughness was much better for the MQL condition than for the dry drilling and under dry drilling it increases.

Reference [7] used EN-31 material to optimizes the cutting parameters- spindle speed, feed, type of tool and depth of cut to get better surface finish and hole accuracy in dry Drilling. They used Taguchi L9 orthogonal array, ANOVA, Regression analysis,S/N ratio were done to find out the optimal settings. Optimal settings for surface roughness were feed (.2 mm/min), Cutting speed (30 m /min) and type of tool (HSS uncoated).

Reference [8] studied optimization of the input parameters such as spindle speed, feed rate, and depth of cut to investigate their influence in drilling composite Al-TiBr2. They used Taguchi method with grey relational analysis to optimize the factors. L9 orthogonal array has been used and optimal settings found for better surface finish were feed rate (1.5 mm/rev), spindle speed (1000 rpm) and depth of cut 6 mm.

Reference [9] investigated the impact of input parameters such as point angle, feed rate and cutting speed on surface roughness in drilling of AL 6463 material. HSS drill bit was used as a tool and the experiment was done in CNC drilling machine. They used Taguchi L9 orthogonal array to find out the optimal settings. Signal to noise ratio (S/N), ANOVA has been employed to find out the optimal drilling parameter. After the experiment it was found that feed rate, point angle and cutting speed plays significant role on surface roughness during drilling operation.

Reference [10] investigated the effect of input parameters feed rate, depth of cut and spindle speed for minimizing surface roughness and maximizing material removal rate in drilling mild steel. They used Taguchi L9 orthogonal array to find out the optimal settings. Results are analyzed using Taguchi DOE software. After the experiment they concluded that feed rate largely affects material removal rate and spindle speeds affects most surface roughness.

Reference [11] studied the effect of process parameters feed rate, drill diameter, point angle, material thickness and spindle speed on torque and thrust force generated during drilling of Glass Fiber Reinforced Polymer (GFRP) composite material. Solid carbide drill bit used as a tool. They used Taguchi method and Response Surface Methodology. After the result it was found that, thrust force is significantly effect by spindle speed. Higher the drill diameter, larger will be the thrust force and cutting torque required. With the increase in drill point anglethrust force increases and cutting torque decreases. Both cutting torque and thrust force increase with the increase in material thickness and feed rate.

Reference [12] used Austenitic stainless Steel (AISI 316) material to investigate the input parameter spindle speed drill diameter and feed rate. They used Taguchi L9 array to find out the optimal setting. After experiment they concluded that spindle speed plays the most dominating role in material removal as well as surface finish rate in drilling.

Reference [13]have done an experimental investigation on drilling on EN-24 steel blocks using Taguchi L9 array. Spindle seed, drill diameter and feed rate was taken as process parameter. Uncoated M32 HSS twist drill was used as a tool under dry condition. S/N ratio was employed to get optimal control factors. They found that cutting speed was the main significant factors on tool life and surface roughness.

Reference [14] studied the effect of drilling parameters such as feed rate, point angle and cutting speed for resharpened HSS twist drill bit on hardened boron steel using Taguchi method. L16 orthogonal array method has been used to perform the experiment in a double spindle drilling machine. ANOVA was used to find out effects of control factors on surface roughness. It was found that point angle was the main significant factor for feed rate and tool wear for surface roughness.

III. CONCLUSION

By reviewing all the research papers, we finally come to the conclusion that there are many researchers took input parameters- feed rate, depth of cut, cutting speed, cutting fluid, drill tool diameter, cutting tools, point angle, clearance angle and type of tool and output parameters- surface roughness, material removal rate (MRR), Thrust force, hole accuracy, roundness error and hole diameter. It is found that for surface roughness the most significant parameters are spindle speed, feed and drill diameter, cutting fluids and DOC is least dominant parameter.

REFERENCE

[1] N. S. Kurzekar, M. S. Tufail. "A review on optimization of drilling process parameters of AISI 304 austenite stainless steel by using response surface methodology." *International Journal of Engineering Development and Research*, vol. 4, no. 2, 2016

[2] J. P. Kumar and P. Packiaraj. "Effect of drilling parameters on surface Roughness, tool wear, material removal rate and hole diameter error in drilling of ohns." *International Journal of Advanced Engineering Research and Studies*, vol. 1, pp. 150-154, 2012.

[3] A.Çiçek, T. Kıvak, and G.Samtaş. "Application of Taguchi method for surface roughness and roundness error in drilling of AISI 316 stainless steel." *Strojniškivestnik-Journal of Mechanical Engineering*, vol. 58, no.3, pp. 165-174, 2012.

[4] S. Jayabal and U. Natarajan. "Influence of cutting parameters on thrust force and torque in drilling of E-glass/polyester composites." 2010.

[5] A. M.Raj, S. L. Das, and K. Palanikumarr. "Influence of drill geometry on surface roughness in drilling of Al/SiC/Gr hybrid metal matrix composite." *Indian journal of science and technology*, vol. 6, no.7, pp. 5002-5007, 2013.

[6] E. Kilickap, M. Huseyinoglu, and A.Yardimeden. "Optimization of drilling parameters on surface roughness in drilling of AISI 1045 using response surface methodology and genetic algorithm." *The International Journal of Advanced Manufacturing Technology*, vol. 52, no.1, pp. 79-88, 2011.

[7] P. S.Nalawade and S. S. Shinde. "Cutting Parameter Optimization for Surface Finish and Hole Accuracy in Drilling Of EN-31", *IOSR Journal of Mechanical and Civil Engineering*,vol. 12, no. 9, pp. 20-27, 2015.

[8] B.Shivapragash, K.Chandrasekaran, C.Parthasarathy and M. Samuel, "Multiple Response Optimizations in Drilling Using Taguchi and Grey Relational Analysis", *International Journal of Modern Engineering Research (IJMER)*, vol. 3, no.2, pp-765-768, 2013.

[9] I.S. Reddy, F. A. Raju, A. Gurunadham, "Determination of Optimum Parameters in CNC Drilling of Aluminium Alloy Al6463 by Taguchi Method", *International Journal of Engineering Research & Technology (IJERT)*,vol. 3, no. 2, 2014.

[10] Y. Tyagi, V. Chaturvedi, and J.Vimal. "Parametric optimization of drilling machining process using Taguchi design and ANOVA approach." *Journal of Emerging Technology and Advanced Engineering*, vol. 2, no.7, pp. 339-347, 2012.

[11] B.Murthy, L. L. Rodrigues and A. Devineni. "Process Parameters Optimization in GFRP Drilling through Integration of Taguchi and Response Surface Methodology," *Research Journal of Recent Sciences*,vol. 1, no. 6, pp. 7-15, 2012.

[12] M. Sundeep, M.Sudhahar, T. T. M.Kannan, P. V. Kumar and N. Parthipan. "Optimization of drilling parameters on Austenitic stainless steel (AISI 316) using Taguchi's methodology",

[13] S.Kadam and M. G. Rathi. "Application of Taguchi method in the optimization of drilling parameters", *International Journal of Engineering Research and Technology*, vol. 2, no. 8, 2013.

[14]V. N. Rane, A. P.Edlabadkar, P. D.Kamble andS. S.Chaudhari. "Optimization of process parameters for resharpenedHSS drill Using Taguchi Methods", *International Journal on Engineering Technology and Sciences*, vol. 2, no. 3, 2015.

