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A REVIEW ON DRILLING PARAMETERS AFFECTING HOLE QUALITY

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ABSTRACT

REVIEW ARTICLE

In the industry, the drilling process is the most interesting among all the other machining process which has to maintain quality of holes are required for producing riveted and bolted joints in the many more operation of work piece. The major tasks which arise from the drilling on any materials are characterized by the poor hole quality which might initiate cracks within its frame structure and reduces their reliability. Hence, appropriate selection of tool geometry, tool material and machining parameters, is required to meet the requirement of hole quality. Based on this motivation this review aims to found better hole quality on drilling parameters to maintain the hole size and circularity error, surface roughness, and burrs formation during the drilling of different materials. The focus will be mainly on aluminium alloys since they are most commonly used and reported in the vulnerable literature.

1. INTRODUCTION

Hole quality in drilling is evaluated in terms of hole diameter and cylindrical shape, it is generally used for parts requiring the great reliability and resistance of wear, and therefore high hole quality must be maintained. Higher surface roughness can possibly lead to severe wear, catastrophic fatigue, and lower ability to resist corrosion. However, the surface of alloy is easily damaged during machining operations. Damage appears in the form of micro-cracks, plastic deformation, heat-affected zones, and tensile residual stresses. Two critical criteria (hole diameter and cylindrical shape) were usually applied to determine the hole quality in terms of size and shape. The average hole diameter has to be within the size tolerance which is described as two concentric circles. Cylindrical shape is the extension of roundness into the entire length of the hole. The cylindrical shape tolerance zone is established by two concentric cylinders between which the machined hole (a cylinder) must lie. Most drilling processes will create a burr on both entrance and exit surfaces. In most cases the main concern is the exit burr which is much larger in size.

2. LITERATURE REVIEW ON OPTIMIZATION

Aamir et al. [1] worked on Multi-spindle drilling using a poly-drill head is an industrial hole-making approach that allows drilling several holes simultaneously. Optimizing process parameters also improves machining processes. Abhishek et al. [2] investigated drill wear reduction in drilling using a torque control method though measurement of a spindle motor current. Vibration signals are widely used for condition monitoring. Amrana. et.al. [3] investigates the

effects of drilling parameters such as spindle speed, feed rate and drill diameter on the surface roughness and surface texture of drilled hole by applying RSM. There were interactions between all the parameter of spindle speed, feed rate and drill diameter in drilling process under investigation. Bharti & Moulick [4] optimized multi response factors for micro drilling operation. Drilling operation is influenced by spindle speed, feed rate, tool point angle, presence of coolant & lubricating agent, vibration, tool material, clearance and chip length. Cheng et al. [5] pointed out, while fabricating micro holes and micro channels on Pyrex work piece by spark-based electrochemical machining process; at the transition voltage, a stable electrochemical discharge activity could be generated, thus producing the smallest deviation of contour dimensions.

3. REVIEW ON PROCESS PARAMETERS

Davim, [6] presented a study on the influence of cutting parameters such as cutting velocity, feed rate, cutting time on drilling contributing towards surface roughness of drilled holes. Demir [7] observed abrasive and adhesion wear of the tools at high cutting speeds. Furthermore, during the dry drilling of Al2024, adhesion and BUE were also examined at high cutting speed. The high cutting speed increased the temperature that activated the diffusion process by the transfer of aluminium from the work piece to the tool. Garg [8] were performed an experiment on CNC MILL MT250 Machining Center on AISI H11 steel. Different drying parameters like speed, feed rate and hole depth were used for the optimal setting of the parameters on drilling AISI H11 steel. Goyal. et.al. [9] presents cutting parameters like Spindle speed, Feed rate, and Slurry concentration in order to improve the surface finish of stainless steel SS304 in the abrasive assisted drilling RSM has been adopted for planning of experiments and ANOVA has been used to find the contribution of process parameters and the interaction among them. Gupta et al. [10] Conventional micro Conventional micro-drilling processes in order to find the best quality of drilling for different types of work piece material, experiment is carried out using calculation drill bit diameter, feed and RPM is increases the MRR is also increase. Hanif et al. [11] recommended high speed and feed rate to reduce the burr height in aluminium. They investigated that the hole surface roughness increased at low point angle when drilling at a lower feed rate. Smaller feed rate was recommended for dimensional accuracy of holes while no noticeable impact of the spindle speed was found. In addition, more burrs were formed when an increase in both the spindle speed and feed rate was noted. Hassanpour et al. [12] analyzed machined surface integrity through multiple sensor monitoring based on cutting force, acoustic emission and vibration signal analysis. Heisel. et.al. [13] investigates the influence of the point angle of a drill tool and increased cutting speeds on machining forces and drill hole quality and increase in cutting speeds result in elevated feed forces and decrease in drilling torques while the drill hole quality remains almost unaffected. Hinds & Treanor [14] analyze on finite element method Three-dimensional models of drills are defined by setting node points of the drill geometry. In addition, the nano fluid MQL effectively eliminates remaining chips and burrs to enhance the quality of drilled holes.

4. REVIEW ON ALUMINIUM DRILLING

Hongyan et al. [15] present a system for accurately measuring drilling force in the printed circuit board micro drilling process and to characterize the drilling force to provide a better understanding of the micro drilling process. Indumathi et.al. [16] presents optimization of machining parameters- Spindle speed, Feed rate & Cone radius ratio for thermo–mechanical form drilling of Aluminium sheet (AA1100) with tungsten carbide tool using desirability function analysis (DFA). Jayabal. et.al. [17] reports the influence of cutting parameters- spindle speed, feed rate & drill point angle on thrust force and torque in drilling. Also it was found that the thrust force and torque both depends on the drill point angle, spindle speed & the feed rate, and both of them increase with increase in drill point angle and feed rate. Jianga et al. [18] established finite element based model to

correlate spark energy and the geometry of removed material and concluded that the prediction of material removal in ECDM (drilling) is reasonable in terms of diameter and maximum depth of deeper holes. Energy of each spark generated was measured. Keerthi et.al. [19] states the impact process parameters- Spindle speed, feed rates, type of drill tool, cutting environment on performance parameters- material removal rate, surface roughness, Torque, cutting force, & power during the drilling of En 8 steel. Kilickap. et. al. [20] focuses study on the influence of machining parameters- cutting speed, feed rate, and cutting environment on the surface roughness obtained in drilling also it increases under dry drilling. Kumar. et.al. [15] utilizes taguchi method to investigate the effects of drilling parameters- cutting speed, feed rate and drill diameter on surface roughness, tool wear by weight, material removal rate and hole diameter error in drilling of OHNS material using HSS spiral drill. Liu [22] investigated that in-process prediction of corner wear in drilling operations on synthesis of polynomial networks (ASPNs). It has been shown that the thrust force is better than the torque as the sensing signal for the in-process prediction of corner wear. Experimental results have shown that the corner wear over a wide range of drilling conditions can be predicted with a reasonable accuracy if the cutting speed, feed rate, drill diameter, and thrust force are given. Madhavan. et.al. [23] reports the effect of drilling parameters - Speed, Feed rate, drill type on thrust force during drilling of holes in Carbon Fibre Reinforced Plastic composite laminate using HSS, Solid Carbide (K20) and Poly Crystalline Diamond insert drills. Experiments were conducted by using Taguchi design of experiments and a model is developed to correlate the drilling parameters with thrust force using Response Surface Methodology (RSM). Murthy et. al. [24] stated the effect of process parameters i.e. spindle speed, feed, drill diameter, point angle & material thickness on thrust force and torque generated during drilling thrust force and cutting torque increase with the increase in feed rate and material thickness. Mustafa et. al [25] performed an experimental investigation in the optimization of cutting parameters for surface roughness in dry drilling process using taguchi method. Mustafa Ay et al [26] discussed about the gray relational analysis method to optimize the micro-electrical discharge machining drilling. The measured and model results were in a good agreement with correlation coefficients Hot and Hd. It is concluded that the EDM hole quality can be improved effectively through this approach.

Nalawde [27], effort had been taken to Optimize Surface Finish and Hole Accuracy in Drilling operation. They performed experiment on EN-31 material. Speed, type of tool, feed, and depth of cut was selected as an input parameter. Onwubolu. et.al. [28] correlates the interactions of drilling parameters such as speed, feed rate and drill diameter & their effects on axial force and torque acting on the cutting tool through a mathematical model by means of response surface methodology with Sheet metal (Aluminium alloy bar) as work piece material. Raj. et.al. [29] investigates the drilling of Al/SiC/ Graphite hybrid composite material (Al6061) with Spindle speed, Feed rate, Drill diameter & type of drill as input parameters and surface roughness as performance parameter by using Response surface methodology. Rahman & Mamat [30] studying on optimum drilling parameter for HSS drilling tool in micro-drilling (0.5 mm to 1.0) processes in order to find the best drilling parameter for brass as a work piece material. For the accuracy of the hole's drills, as drill diameter, feed rate and spindle speed increase the dimensional accuracy of drilled hole will decrease. Ramesh Kumar et al [31] optimize drilling parameters in hybrid Al-6061/SiC/B4C/talc composites were studied using grey relational analysis. The purpose of this research was the investigation of the effect of drilling parameters on Al6061/SiC/B4C/talc composites fabricated using the stir casting. Siddiquee et.al [34] carried out the work to study the effects of control parameters on surface roughness. They use design of experiments and orthogonal array to find range and combinations of drilling parameters like cutting fluid, speed, feed and hole-depth, to

achieve optimal settings of output response variables like surface roughness in drilling operation of AISI 321 Stainless Steel material. Four parameters namely cutting fluid, speed, feed and hole depth are varied to study their effect on surface roughness. Tyagi. et.al. [38] states the impact process parameters- Spindle speed, Feed rate and Depth of cut on Surface Roughness and Material Removal Rate for CNC drilling machine operation by using high speed steel Tool and by applying Taguchi methodology [36]. It was observed that, as spindle speed increases there is increase in the MRR and the surface roughness initially decreases with increase in spindle speed while after some process there is increase in surface roughness. As there is increase in the feed rate there is decrease in both the MRR and the surface roughness. Initially there is decrease in MRR & the surface roughness with increase in depth of cut and after some process, there is increase in MRR and surface roughness with increase depth of cut [39]. Uddin et al. [42] reported that adhesions, BUE, and diffusion on the tool are the most common problems in the drilling aluminium alloys. Therefore, the dominant wear mechanism in aluminium alloys requires better understanding to reduce tool wear which helps in increasing productivity [43]. The significant factors affecting tool wear include drilling parameters [44].

5. CONCLUSIONS

Optimization of drilling process with various work piece materials by studying the references by scholars correlating the relationship between the input process parameters and the output responses in order to optimize the process parameters so that the desired values of performance parameters are obtained and hence making the drilling process cost effective along with the assurance of the quality specifications within the experimental limit through optimization as it supports continuous improvement of output quality of products and process through modelling and determination of optimal cutting conditions.

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