SMALL-HOLE DRILLING USING DIE SINKER ELECTRICAL DISCHARGE MACHINE

Hudiyo Firmanto¹, Felixtianus EkoWismo Winarto²
¹Manufacturing Engineering Department, University of Surabaya, Indonesia
²Diploma Program of Mechanical Engineering, Vocational College, Gadjah Mada University, Indonesia

ABSTRACT

Banyak kesulitan dihadapi pada pemesinan lubang kecil, terutama jika prosesnya dilakukan dengan proses drilling mekanik. Untuk mengatasi kendala yang dihadapi, proses pemesinan non-tradisional seringkali diterapkan. Tulisan ini melaporkan hasil studi pemesinan lubang kecil (diameter kurang dari 1 mm) menggunakan EDM die sinker. Lubang dibuat pada aluminium dengan ketebalan 3 mm. Kawat tembaga berdiameter kurang dari 1 mm dipergunakan sebagai elektroda. Untuk menghindari keausan elektroda yang berlebihan, pemesinan dilakukan dengan menggunakan parameter yang menghasilkan energy rendah. Pemilihan parameter ini juga dimaksudkan untuk mendapatkan kualitas lubang yang baik. Pengamatan dilakukan terhadap kualitas lubang yang dihasilkan. Selain itu studi juga dilakukan pada pengaruh parameter pemesinan terhadap keausan elektroda dan waktu pemesinan. Hasil studi menunjukkan bahwa lubang dengan diameter kurang dari 1 mm berhasil dibuat dengan mesin EDM die sinker. Waktu yang diperlukan untuk pemesinan berkisar antara 5 – 6 menit. Lubang yang dihasilkan memiliki kebulatan yang relative baik dan permukaan yang tajam. Peningkatan energy pemesinan menambah keausan elektroda dan memperpanjang waktu pemesinan.

Keywords: EDM, small hole, drilling, electrode wear

INTRODUCTION

Drilling small holes are frequently required in industries, such as medical, automotive, aeronautics, electronics. Traditional machining may produce the holes, however much problems were encountered in this practice. The accuracy of small hole-drillings is highly influenced by drill bending rigidity and thinning of the chisel point [1]. Vibration drilling improves the hole equality, yet the vibrating frequency has a negative effect on the drill life[2]. Application of cooling fluid in drilling small holes is difficult [2]. Small feed rate and high spindle speed increased the radius error [3]. Worn tool due to drilling process led to microwelding of workpiece material and increased the maximum torque [4].

To overcome mechanical problems faced in traditional drillings, non-traditional machining processes is applied. Laser drilling was applied to drill holes with diameter less than 1 mm in stainless steel and Nimonic 263 [5-7]. Despite its superiority, drilling-using-laser produced significant differences in the final hole shape [8]. Crater was also found on the hole surface due to the collision of ejected metallic particles with the solidified material surface.

Electrical Discharge Machining (EDM) drilling is another technique to produce small hole. It can drill a hole with diameter down to 170 μm[9]. The help of NC and CAD minimized the machining time of small hole drilling [10]. Application of vibration on the tool or the workpiece enabled this method to produce smaller hole size [11]. Drilling micro hole with diameter down to 15μm on copper sheet was attempted by using tungsten electrode [12].

In spite of its wide application in drilling small hole, hole accuracy in EDM micro drilling is more difficult to predict due to the spark-erosion process. Surface roughness of the hole and material removal rate in EDM small-hole drilling was influenced by different variables [13]. Tool wear and workpiece material removal per discharge are important variables [14].

Hole-machining by using EDM drilling can be difficult when tiny electrode diameter is employed. Small-diameter-electrode could be sensitive on mechanical force due to rotation of the electrode. Vibration of the electrode might lead to an uncontrolled-movement. Therefore, drilling by using die sinker EDM might be more suitable since only penetration and retract movement of the electrode is required. This technique was successfully applied to drill micro-hole in low carbon steel [15]. The work was considered as the new process with less cost. With proper parameters selection, holes with diameter of less than 1 mm were successfully drilled. However, slag and recast layer were formed at the surface of the hole. Factors that contributed the slag formation were