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OPTIMIZATION OF EDM SMALL HOLE DRILLING PROCESS USING TAGUCHI APPROACH

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ABSTRACT

Electrical Discharge Machining (EDM) is a process used to remove or cut a material into desired shape through the action of spark discharge between the tool and work piece. The objective of this paper is to optimize the independent variables to achieve better accuracy in EDM small hole drilling by using Taguchi method. The L_9 orthogonal array is employed to study the performance characteristics in drilling operations of mild steel (AS3679) as workpiece by using 1 mm copper (Cu) pipe electrode. Three drilling parameters namely, pulse off time, peak current and servo standard voltage are considered to optimize drilling hole diameter. The result concluded that use of greater pulse off time, greater peak current and medium servo standard voltage give the better hole diameter for the specific test range. Further study in this topic could consider different factor such as pulse on time, material removal rate (MRR) and coolants to investigate how these factors would affect hole diameter.

Keywords: EDM small hole drilling, taguchi approach, AS3679.

INTRODUCTION

Electrical Discharge Machining (EDM) is a process that is used to remove metal through the action of an electrical discharge of short duration and high current density between the tool or electrode and the workpiece (Khanna & Garg, 2013). It has proved valuable and effective in machining of super tough, hard, high strength and temperature resistance of conductive material. These metals would have been difficult to machine by conventional methods (Singh, Chalotra, & Rajpal, 2015).
EDM small hole drilling is one of the EDM stand-alone machine used to drill small hole with an x–y axis that can machine blind or through holes (Hussain & Yusoff, 2014). This machine is one of the best ways in drilling super tough material especially in term of getting micro-hole. Material is removed by means of rapid and repetitive spark discharge across gap between electrode and work piece (Liew, Yan, & Kuriyagawa, 2014).

The basic physical characteristics of the EDM small hole drilling process is essentially similar to that of the conventional EDM process with the main difference being in the size of the tool used, the power supply of discharge energy, and the resolution of the X-, Y- and Z-axes movement. The schematic diagram of the machine is shown in Figure-1.

In previous works, a number of researchers have conduct studies to identify the optimum input parameter setting in gaining the best output in EDM small hole drilling. (Yusoff, Ghazalli, & Che Hussain, 2009) for instance implement Taguchi approach to identify best parameter setting to drill aluminum using EDM small hole drilling. (Dev, Patel, Pandey, & Aravindan, 2009) used similar technique to identify best parameter setting for SiCp-Al composite. Besides that, researcher also studies the machining quality when machining different materials such as titanium alloy (Hussain & Yusoff, 2014) and mould material (Kim & Lee, 2014).

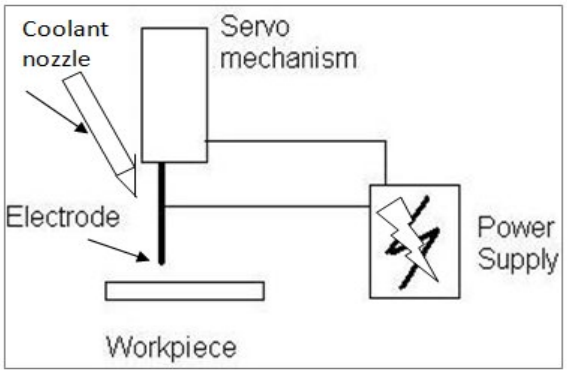

Figure-1. Schematic diagram of EDM drilling.

Even though there are a large number of works on EDM small hole drilling optimization, the needs for optimization is still there because of variance in machine, man and materials. The objective of this paper is to optimize the EDM small hole drilling parameter to machine mild steel grade AS3679 using Taguchi approach. Machining accuracy of the workpiece is one of the main problems to achieve since this characteristic determine hole accuracy. In order to achieve the objectives, optimum parameter of pulse off time, peak current, and servo standard voltage parameter have to be determined.

EXPERIMENTAL DETAILS

In this study, mild steel AS3679 with dimension 50mm x 75mm x 5mm is used as specimen as shows in Figure-2.