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A REVIEW PAPER ON PARAMETRIC ANALYSIS OF ELECTRIC DISCHARGE MACHINING USING TAGUCHI METHOD

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ABSTRACT: Electric Discharge Machining (EDM) is a thermal electric non conventional machining process in which material removal takes place through the process of controlled spark generation between a pair of electrodes which are submerged in a dielectric medium. In the present paper reviews is conducted of experimental investigations carried out to study the effect of EDM parameters on material removal rate (MRR), Tool Wear Rate (TWR) & surface roughness (Ra).

The non-contact machining technique has been continuously growing from a plain tool and dies making process to a micro-scale application machining alternative attracting a significant amount of research interests & offers several special advantages including higher machining rate, better precision and control, and a wider range of materials that can be machined. By use of Taguchi's method for design of experiment, analysis and optimization. The machining parameters selected as a variables are Pulse off time, Pulse on time, Gap Voltage & Discharge Current. The output measurement includes MRR, TWR and surface roughness.

Keywords: EDM, MRR, TWR, Surface Roughness

I. INTRODUCTION

The basic concepts of EDM process is cratering out of metals affected by the sudden stoppage of the electron beam by solid metal surface on the anode. The portion of the anode facing the direct electric pulse reaches the boiling point. Even in case of medium long pulse the rate of temperature increases in tens of millions of degree per second which means dealing with explosion process. The shock wave produced spreads from the centre of the explosion inside the metal and deforms crystals.

In the very small duration of the process the entire energy can only be expended in the surface layer of the anode. Actually, the mechanism of thermal conductivity has no time to start before violent process of energy transfer is completed. When suitable pulse voltage is applied across two electrode separated by a dielectric fluid, the latter breaks down. The electrode so liberated, are accelerated in presence of electric field collide with the dielectric molecules. The process grows and multiplies with secondary emission followed by avalanche of electrons and ions.

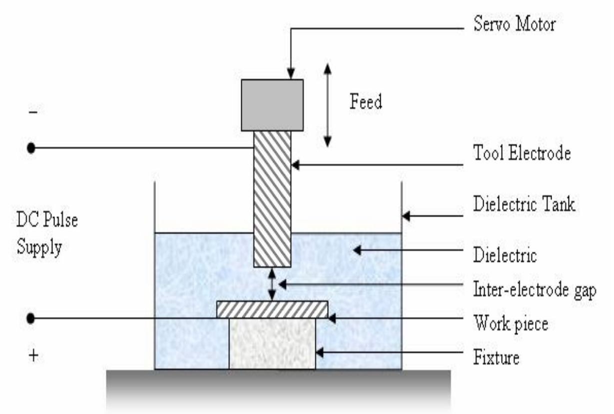

Fig. 1 Schematic of an Electric Discharge Machining Machine Tool

The resistance of dielectric layer drops as it is ionized resulting into ultimate breakdown. The electric energy is discharged into the gap and multifarious actions take place electrodynamics waves set in and travel at high speed causing shock-impact and high temperature rise at the electrodes surfaces. The instantaneous temperature may reach as high as 10000°C causing localized vaporization of electrodes and material removal take place from work piece [1].

II. RESEARCH METHODOLOGY

The aim of the study is to investigate the optimum values of process parameters in the Electric Discharge Machining. Low carbon steel used as metal which dimensions is 100mmx50mmx10mm. Input parameters are Pulse on time, Pulse off time, Gap Voltage, and Discharge Current to optimize the MRR, TWR & Surface Roughness. Design the experimental runs and find the optimal process parameter combination by using Taguchi's Method. After the number of experiments ANOVA and MINITAB used to generate validate the optimum values.

III. LITERATURE SURVEY

J.L. Lina, K.S. Wangb, B.H. Yan and Y.S. Tarng et. al. (2000) in this paper, the application of the Taguchi method with fuzzy logic for optimizing the electrical discharge machining process with multiple performance characteristics has been reported. A multi response performance index is used to solve the electrical discharge machining process with multiple performance characteristics. The machining parameters are work piece polarity, pulse-on time, duty factor, open discharge voltage, discharge current and dielectric fluid are optimized with considerations of the multiple performance characteristics of electrode wear ratio and material removal rate [2]. Samar Singh and Mukesh

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Verma et. al. (2012) Electric Discharge Drill Machine (EDDM) is a spark erosion process to produce micro holes in conductive materials. This process is extensively used in aerospace, medical and automobile industries. As for the performance evaluation of the Electric discharge drilling machine it is very essential to study the process parameters of machine tool. In this research paper a brass rod 2 mm diameter was selected as a tool electrode. The experiments generate output responses such as material removal rate (MRR). The best parameters such as pulse on-time, Pulse off-time and water pressure were studied for best machining characteristics. This investigation presents the use of Taguchi approach for better MRR in drilling of Al-7075. A plan of experiments, based on L27 Taguchi design method, was selected for drilling of material. From the analysis of variance (ANOVA) shows the percentage contribution of the control factor in the machining of Al-7075 in EDDM. The optimal combination levels and the significant drilling parameters on MRR were obtained. The optimization results showed that the combination of maximum pulse on-time and minimum pulse off- time gives maximum MRR. Influences of EDDM process parameters on MRR of Al 7075 were investigated in this paper. ANOVA shows that Pulse on time has the maximum contribution i.e. 94% on MRR and Pulse off time has 4 % contribution on MRR. It is also concluded from this research that with increase of pulse on time MRR increases and with the increase of Pulse off time MRR decreases [3]. Anand Pandey and Shankar Singh et. al. (2010) he wrote that Present manufacturing industries are facing challenges from these advanced materials viz. super alloys, ceramics, and composites, that are hard and hard to machine, requiring high precision, surface quality which increases machining cost. To meet these challenges, non-conventional machining processes are being employed to achieve higher metal removal rate, better surface finish and greater dimensional accuracy, with less tool wear. Electric Discharge Machining (EDM), a non-conventional process, has a wide applications in automotive, defense, aerospace and micro systems industries plays an excellent role in the development of smallest amount cost products with more reliable quality assurance. They have discuss different type of EDM processes like Die sinking EDM, Rotating pin electrode (RPE), Wire electrical discharge machining (WEDM), Micro EDM, Dry EDM, Rotary disk electrode electrical discharge machining (RDE-EDM). They had summarized the paper as EDM has resulted out as most cost effective and precision machining process in recent years. The capacity of machining hard and hard to machine parts has made EDM as one of the most important machining processes. The contribution Variants of EDM has brought fabulous improvements in the surface finish of machined advanced engineering materials. Powder mixed EDM and Ultrasonic assisted EDM has not only reduces tool wear but also increases material removal rate. Modeling and optimization of various electrical and non electrical parameters in EDM improved in precision machining of work materials The review of the research trends in EDM on rotary EDM, dry EDM machining, EDM with powder additives, Ultrasonic assisted EDM ,WEDM and Micro EDM performances is presented. In each topic, the development of the methods for the last few years is discussed [4]. Prakesh et. al. (2012) In EDM use of gas is a new machining method which has a great advantage of very low level of electrode wear which is reported to be independent of the pulse duration. This work aims at developing a hybrid process using both liquid and gas as dielectrics to check the feasibility of the process and to study the effect on tool wear rate and material removal rate. The experiments are conducted using Taguchi design of experiments. This study takes into account the influence of three design factors, discharge current (DC), pulse-on time (Ton) and gap voltage (V). It is found out that the developed hybrid machining process results in increase in MRR and reduction in TWR. ANOVA tests lead to the conclusion that gap voltage becomes the most significant parameter when both kerosene and air are used as dielectric as compared to discharge current being the most important when only kerosene is used [5]. S.Gopalakannan et. al. investigated the effect of pulsed current on material removal rate, electrode wear, surface roughness and diametric overcut in corrosion resistant stainless steels viz., ss316 L and 17-4 PH. They observed that the output parameters such as MRR, EWR and Ra of EDM increase with increase in pulsed current. The results tell that high MRR have been achieved with copper electrode whereas copper-tungsten yielded lower electrode wear, smooth surface finish and good dimensional accuracy [6]. S. S. Uttarwar et. al. (2009) studied the effect of ECM process parameters of SS302B by brass tool electrode on machining criteria such as MRR and with gradual increase in voltage MRR increases. Inter Electrode gap variable is maintained constant during the whole experimentation. The machining voltage 45V (0.33A) gives the appreciable amount of MRR [7]. Parashar et. al. (2010) investigate the effects of WEDM parameters on kerf width while machining Stainless steel, it was found that pulse on time and dielectric flushing pressure are the most significant factors, while gap voltage, pulse off time and wire feed are the less important factor on the kerf width [8]. Tosun, N. et al. (2004) presented an investigation on the level of importance of the machining parameters on the kerf width by using ANOVA. It was found that open circuit voltage and pulse duration were the highly effective parameters where as wire speed and dielectric flushing pressure were less effective factors. According to this research open circuit voltage for controlling the kerf width was about three times more important than the second ranking factor pulse duration [9]. Swain, A.K., et al. (2012) also studied the kerf width and it was found that just gap voltage is the significant factor that affect kerf width and pulse on time and pulse off time are not important [10]. Guo et al. (1997) studied the machining mechanism of wire EDM (WEDM) with ultrasonic vibration of the wire and found that the combined technology of WEDM and ultrasonic facilitates the form of multiple-channel discharge and raise the utilization ratio of the energy that leads to the improvement in cutting rate and surface roughness. High frequency vibration of wire improves the discharge

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concentration and reduces the probability of rupture wire [11].

IV. CONCLUDING REMARKS

- In this literature survey have been concluded that Discharge current is as effective parameter in EDM.
- After that Gap voltage, Pulse on time and Pulse off time can affect the EDM.
- For Design of Experiment various methods are available but for more process parameters Taguchi's method is suitable for optimization.

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