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INFLUENCE OF DIFFERENT ELECTRODES MATERIAL ON MRR OF EDM OF DIE STEEL

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ABSTRACT

Electric discharge machining is a thermo-electrical process which is utilized to cut hard materials into complex shapes. The input parameters considered are Pulse on time, Pulse off time, gap voltage and current with dielectric as EDM oil. Copper, brass and tungsten-copper alloy electrodes are used as cutting tool. The pilot experiments have been performed to observe the influence of pulse on time, pulse off time, peak current, gap voltage and electrodes material on the MRR of EDM of die steel. It has been observed that maximum material removal rate is obtained at the highest parameter levels setting of the process variables using tungsten electrode material.

Keywords: *EDM, Copper, Brass, Tungsten, MRR.*

I. INTRODUCTION

EDM is most generally utilized non-traditional process as it is best known for expelling material from the surface of the intense hard work material and getting the most intense to cut materials for getting them into proper shape and measured segments. EDM holds 7% of manufacturing sector and marketing sales around the world. The specialty of EDM process is its functional accuracy and meticulous in accomplishing high tolerances with most of the hard materials at elevated temperatures. The high frequency electric energy produces sparks due to the disintegration of dielectric fluid at the temperature levels up to 13000 K. This temperature will vaporize and soften the workpiece material into required shape and size of the tool. Thus, the melted material is removed in a control supply of dielectric fluid.

Many researchers have published their work related to the electric discharge machining of different material. Singhet al.[1] studied about the some investigations into the electric discharge machining of hardened tool steel using different electrode materials. This paper report the result of an experimental investigation carried out to study the effect of machining parameters such as pulsed current on material removal rate, diametrical over-cut, electrode wear and surface roughness in electric discharge machining of EN-31 tool steel. Lee &Tai [2] represented the machining of the H13 and D2. metal with known parameters and studied the effect of these parameters on the surface of these two metal. Amanullah et al [3] analyzed the physical characteristics of Canola oils as an alternative to mineral oil-based dielectric fluid. the various physical properties such as flash point, fire point, pour point, specific gravity, viscosity, moisture content on mineral oil, canola oil, Canola oil, olive oil, grape seed oil, peanuts oil. Markopoulos et al. [4] studied on the artificial neural network models for the prediction of surface roughness in electrical discharge machining. In the present paper artificial neural networks (ANNs) models are proposed for the prediction of surface roughness in electrical discharge machining (EDM). Recently, the use of machine learning algorithms is highly recommended by authors. Valentincic et al. [5] studied on machine learning induction of a model for online parameter selection in EDM rough machining. In electrical discharge machining (EDM), appropriate average current in the gap has to be selected for the given machining surface in order to obtain the highest material removal rate at low electrode wear.Lajis et al. [6] studied on the the implementation of taguchi method on EDM process of tungsten carbide. In this paper, the cutting of tungsten carbide ceramic using electro-discharge machining (EDM) with a graphite electrode by using taguchi methodology has been reported. Sahoo et al. [7] studied on the fractal characterization of surface profile and optimization in EDM using taguchi method. This

paper presented the experimental study of fractal characteristics of surface profile produced in electrical discharge machining (EDM) and optimization of machining parameters based on L27 Taguchi orthogonal design for tungsten carbide, mild steel and brass. Maji & Pratihar[8]studied on the modeling of EDM machining process using conventional regression analysis and genetic algorithms. The attempt was made to model input output relationships of electric discharge machining process based on the experimental data (collected according to a central composite design) using multiple regression analysis. Valaki et al. [9] investigated sustainability analysis in EDM using biodiesel as dielectric and compared with EDM oil dielectric. The input parameters were considered current, gap voltage, pulse on time and pulse off time on material removal rate, surface roughness and surface hardness. The results obtained indicate that Jatropha bio diesel resulted in higher material removal, lower surface roughness and improved surface hardness than EDM oil. The parameters of WEDM of Inconel 750 have been optimized to get the maximum MRR. Recently, use of advance machine learning algorithm has been proposed by some authors [11-17]. Therefore, huge amount of research work have been reported on the EDM and WEDM of different material. Rare work has been published on the EDM of material using different electrodes material. Hence, we decided to focus on the use of distinct electrodes material during EDM.

II. METHOD & MATERIAL

The operations are conducted in EDM die sinking machine. Fig1 demonstrates the setup for the EDM machine which is utilized for operation. Die steel is chosen as work piece material which is utilized in making dies, rolls and other mechanical industrial products. The pulse on time, pulse off time, gap voltage and current are considered as input variables. The range of the process variables are selected based on previous literature study. The Copper, Brass and Tungsten-copper alloy electrodes are used as cutting tool for the electro discharge machining of die steel. Total 9 pilot experiments have been conducted to observe the influence of different cutting tool material on material removal rate of EDM of die steel as revealed in Table 1.

Figure 1 Electrical Discharge Machine experimental set up

Weights of work piece and electrodes are noted down before and after machining and the following equation (1) is used to calculate the MRR [6].

$$MRR = \frac{W_{wbm} - W_{wam}}{t \times \rho} \frac{mm^3}{min} \qquad (1)$$

The W_{wbm} represents the weight of workpiece before machining (gm) whereas W_{wam} represents the weight of the workpiece after machining (gm). The *t*representsmachining time (min) and ρ represents the density of workpiece material (gm/cm^3).

III. RESULT & DISCUSSION

In this work, die steel is machined with the EDM process utilizing three distinct electrode material in presence of EDM oil. It has been observed that minimum MRR is noted during cutting the material at lowest setting of process variables whereas max MRR is reported in case of highest setting of process variables. The lowest material removal rate is obtained during cutting the material with brass electrodes. The MRR is increased when copper tool electrode is used for cutting. The maximum MRR is observed in case of tungsten tool electrode as revealed in Table 1 and Fig. 2.

Table 1 Experimental result for MRR using copper, brass and titanium tool electrodes

Ton	Toff	IP	V	Electrode	MRR (mm^3/min)
300	100	6	40	Brass	3.39
500	300	8	50	Brass	5.84
700	500	10	60	Brass	6.05
300	100	6	40	Copper	4.85
500	300	8	50	Copper	6.33
700	500	10	60	Copper	8.05
300	100	6	40	Titanium	3.27
500	300	8	50	Titanium	7.39
700	500	10	60	Titanium	8.72

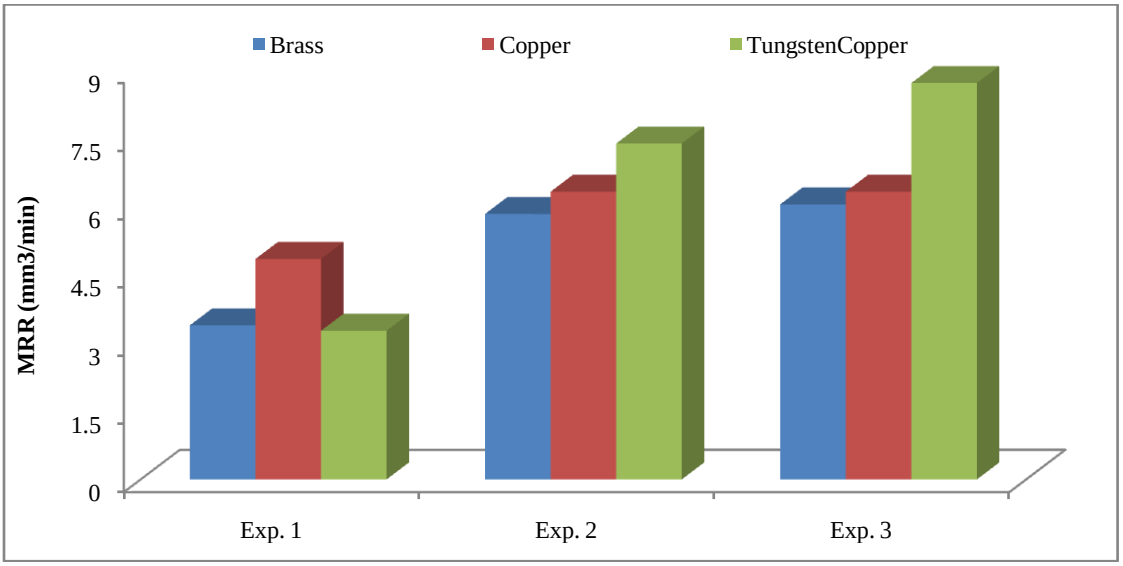

Figure 2 Influenc of different electrode material on MRR of EDM of die steel

The Table 1 and Figure 2 have confirmed that MRR is increased with an increase in the value of the process variables. It also validates that, maximum MRR is observed during machining the material with tungsten copper alloy tool material.

IV. CONCLUSION

Based on the pilot trial it has been confirmed that all the process variables have significant influence on the material removal rate of EDM of die steel. MRR is increased with an increase in the value of process variables. The changes

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in the material of the tool electrodes also affect the MRR of EDM, significantly. Therefore, maximum MRR is reportedduring machining the material with tungsten copper alloy electrode. The increasing order of MRR based on different electrode material is given as: Brass < Copper < Tungsten copper alloy.

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