Effect of Process Parameter on Performance of EN-31 steel And copper Tool

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ABSTRACT

EDM is a non-conventional and non-contact machining process of hard material of component that are difficult to machine such as heat treated tool steels, composites, super alloys, ceramics, carbides, heat resistance steel. The present experimental research on EDM studies the process parameters that are affecting the machining performance and productivity of EDM. A combined approach used for the optimization of parameter and performance characteristics based on Taguchi method. In the present work the optimized for maximum material removal rate (MRR), TWR and hole enlargement during EDM of EN-31 steel. A scanning electron micro scope was used to characterize the machined surface. It was found that improved characterization and understanding of EDM can load to better machining of EN-31.

***Keywords*—EDM, Surface Roughness, EN31 steel, MRR, TWR.**

I. INTRODUCTION

EDM is of the most popular technique of the manufacturing process. The EDM utilizes the wire which acts as a tool upon passing current so as to erode the work material by the generation of

Spark between the work and tool. The work and tool are completely immersed in a dielectric fluid in order to remove the material by erosion and avoid over heating of the material. The gap between work piece and wire is usually range from 0.025-0.5 mm and the maintained constant by computer controlled positing system. The process is mainly used in mould and making, aerospace and automotive industries [14].

Productivity of high is the minimum cast it the entire industrial motive and increases the demand for quality of the EDM process. It will copper of the orthogonal array to remove is Taguchi method orANOVA software and the optimization of the process parameter are achieved the high quality.

II.LITERATURE REVIEW

Subramanian &Thiagarajan Senthilvelan[1] etal to find the effect of pulsed current on material removal rate, electrode wear, surface roughness and diameteral overcut in corrosion resistant stainless steels viz., 316 L and 17-4 PH. The materials used for the work were machined with different electrode materials such as copper, copper-tungsten and graphite. It is observed that the output parameters such as material removal rate, electrode wear and surface roughness of EDM increase with increase in pulsed current.

The results reveal that high material removal rate have been achieved with copper electrode whereas copper-tungsten yielded lower electrode wear, smooth surface finish and good dimensional accuracy.

Another investigation conducted by George [2] etal optimized the machining parameters in the EDM machining of C-C composite. The process variables affects electrode wear rate and MRR, according to their relative significance, are gap voltage, peak current and pulse on time respectively.

Daneshmand, Kahrizi & Ghahi[3]considering the importance of titanium alloys in aerospace, automobile and medical industries, the impact of electrical discharge machining (EDM) on smart NiTi60 alloy has been reviewed in this research. In view of the high competition that exists among various industries to lower the time, cost of production, and improve the quality, the parameters of material removal rate (MRR) and tool wear rate (TWR) are highly significant. In this research, the impact of process input parameters such as pulse on time, pulse off time, discharge current (A) and gap voltage (V) on output parameters such as tool wear rate, material removal rate and surface roughness (SR) has been investigated. For determining the better parametric settings, lot of work has been done in the engineering design. The WEDM processes are having several performance characteristics like Metal Removal Rate, Surface roughness, Kerf width; Dimensional error etc. The optimal parametric settings with respect to different performance characteristics are different.

R.Ramakrishnan & L.Karunamoorthy[4]in their paper have applied the Taguchi's method, which is one of the methods of robust design of experiments to optimize multi responses of the wire cut electric discharge machining operations. Experimentation was carried out using L16 orthogonal array. Each experiment was conducted under different cutting conditions of pulse-on time, wire tension, delay time, wire feed, speed, and ignition current intensity to measure material removal rate, surface roughness, and wire wear ratio as the multi responses.

Jose Marafona and Catherine Wykes [5] have investigated a new method of optimizing MRR using EDM with copper- tungsten electrodes. This paper describes an investigation into the optimization of the process which uses the effect of carbon which has migrated from the dielectric to tungsten copper electrodes. This work has led to the development of a two stage EDM machining process where different EDM settings are used for the two stages of the process giving a significantly improved material removal rate for a given wear ratio**SS. Mahapatra and Amar patnaik** [6] have described in their paper about Parametric Optimization of Wire Electrical Discharge Machining (WEDM) Process using Taguchi Method. In this study27 experiments are Performed based on the Orthogonal array of L27 considering Discharge current, Pulse duration, Pulse frequency, wire speed, Wire tension and dielectric flow rate as control factors and the responses measured are Surface finish (Ra) and MRR. With Zinc coated copper wire electrode and proposed some optimized parameter settings for desired yielding.

III. SELECTION OF MATERIAL

The work piece selected of material the experiment is EN 31, the EN 31 is widely used for the mechanical tooling purposes. The chemical composition of EN31 is as follows:

Table-1 Composition of EN-31 steel

S.No	Metal	Range (%)	Reference
1	Carbon	0.90-1.20	Anurag joshi
2	Chromium	1.00-1.60	Anurag joshi
3	Silicon	0.10-0.35	Anurag joshi
4	Manganese	0.30-0.75	Anurag joshi
5	Sulphur	0.050 max	Anurag joshi
6	Phosphorous	0.050 max	Anurag joshi

IV. EXPERIMENTAL SET UP

About experimental set up. The experiment performed on ZNC electrical discharge machining.The basis parts of EDM consists of a wire electrod, a work table, and a servo control system, a power supply and dielectric supply system. The practical experiment conducted at MMMUT (Madan Mohan Malaviya University of Technology, Gorakhpur).

Fig.1. Electro Discharge Machine

1. Tool wear rate can be calculated by:

TWR=volume of tool removed /machining time×100

Table 2: Specifications of EDM

Dielectric fluid	**UNIT**	**Deionized water**
Tank capacity	Liters	250
De-ion resin	Kg	7.5
Filter cartridge	Microns	10 microns paper filter
Ion exchanger capacity	Liters /H	70

Table 3: Fixed Parameters of the machine

Wire used	Brass wire of dia. 0.180mm
Shape cut	10mm square
Angle of cut	Vertical
Location of the work piece	At the center of table
Stability	Servo control
Number of passes	One

Fig.2.-EN 31 steel after machining

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Table 4: Experimental plan with assigned values

S.No.	Pulse On	Pulse Off	Bed Speed	Current
1	50	25	150	5
2	50	26	200	10
3	50	27	300	15
4	60	30	200	5
5	60	31	300	10
6	60	32	150	15
7	70	35	300	5
8	70	36	150	10
9	70	37	200	15

Table 5: Process parameters and their level

Parameter	Unit	Level1	Level2	Level3
Pulse ON Time	µs	250	500	750
Pulse OFF Time	µs	15	30	45
Current	A	5	10	15
Speed	mm/min	150	200	300

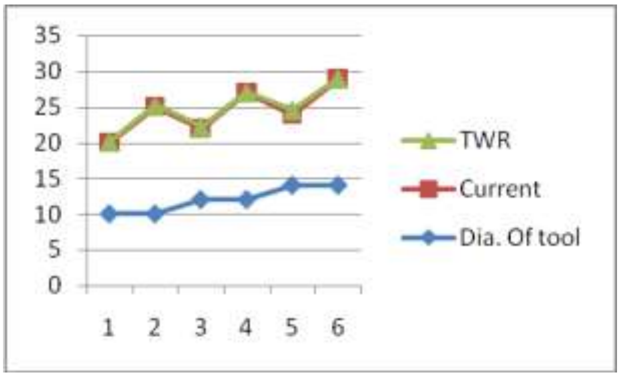
V. RESULT AND ANALYSIS

The result obtained from EDM when we are using work piece of material EN-31 and tool material is copper is predicted in the following table 6.

Table-6 calculation for TWR

Exp. no	Dia.	Current	TON	TOFF	M/c Time	TWR
1	10	5	150	10	15.10	0.100
2	10	10	200	20	12.12	0.100
3	10	15	300	30	8.37	0.199
4	12	5	200	30	14.19	0.060

5	12	10	300	10	8.30	0.190
6	12	15	150	20	5.13	0.060
7	14	5	300	20	24.13	0.020
8	14	10	150	30	20.54	0.570
9	14	15	200	10	10.04	0.010



In above table and graph tool wear rate are varying with different process parameters.

VI. CONCLUSION

We are seeing above table 6 when increasing the current rate at a constant diameter of TWR isincreasing.
In next result we are seeing when current is increasing and also increasing dia. of TWR isdecreasing.
In last result we are seeing when current rate is increasing and also increasing the dia. of the TWR is decreasing.
Finally we can predicate from above table 6 TWR will be decreased when increasing the diameter of the tool and current.

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