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STUDY & EXPERIMENTAL INVISTIGATION OF EDM PROCESS PARAMETERS ON OHNS MATERIAL

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Abstract - *The experimental investigation of material removal rate, and Electrode Wear Rate during machining of OHNS steel using EDM machine was study in this paper. The input parameters include peak current, pulse on time, Pulse off time were used for experimental work S/N ratio graphs have been used to optimize the machining parameters of EDM on OHNS steel using the Taguchi method and ANOVA methods. The study will carry out to investigate the effect of which parameter has the largest effect on the material removal rate of OHNS steel by machining. The optimum machining condition for material removal rate (MRR) and electrode wear rate has been find out with the ANOVA analysis and regression equation. This study is carried out by using the experimental investigation method and Taguchi analysis, at the end of this study we come to the conclusion of optimum conditions of the machining for OHNS material.*

Key Words: s/n, ANOVA, HRB, EDM, OHNS.

1. INTRODUCTION

OHNS steel is a vital apparatus and kicks the bucket material, for the most part on account of its high quality, high hardness, and high wear obstruction. It has a high particular quality because of that it can't be effectively machinable by traditional machining strategies. EDM is a non-customary machining process that expels material by warm disintegration, for example, dissolving and vaporization of material. To comprehend the machining qualities of OHNS steel by EDM were investigated in this test think about. Pichai Janmanee et al. (2012) contemplated considers the impact of a copper-graphite anode material on tungsten carbide work pieces amid machining by EDM. The investigation found that by expanding the release current there was directed to the more material expulsion rate (MRR) and more anode wear proportion (EWR). Dilshad Ahmad Khan et al. (2011) talked about the impact of hardware extremity on the machining of silver steel by electric release machining. They presumed that immediate extremity is appropriate for higher MRR and lower relative EWR, yet turn around extremity gives better surface wrap up. N.Arunkumar et al. (2012) displayed the aftereffects of exploratory work did in EDM of EN31 utilizing three diverse instrument materials in particular copper, aluminum and EN24. They reasoned that copper experiences less instrument wear rate and high material evacuation rate.

Electrical Discharge Machining (EDM) is another customary machining process which is utilized to discover the change in beat voltage between a wire anode and a conductive work piece when instigated start disintegrates work piece material, evacuating material in such away is frequently invaluable where the work piece material is hard to be machined with a conventional machine device due its high quality hardness, sturdiness and so forth. Material is expelled from the work piece through restricted liquefying and vaporization of material. Electric sparkles are created between two cathodes when the terminals are held at a little separation from one another in a dielectric medium and a high potential distinction is connected crosswise over them. Confined districts of high temperatures are framed because of the sparkles happening between the two terminal surfaces. Work piece material in this limited zone softens and vaporizes. A large portion of the liquid and vaporized material is diverted from the interelectrode hole by the dielectric stream as flotsam and jetsam particles. After the material is evacuated because of a start, this hole increments and the area of the following sparkle movements to an alternate point on the work piece surface. The fitting feed movement of the instrument towards the work piece is by and large accommodated keeping up a consistent separation of hole between the apparatus and the work piece amid machining. This is performed by either a servo engine control or stepper engine control of the apparatus holder. As material gets expelled from the work piece, the apparatus is moved descending towards the work piece to keep up a consistent between anode hole. Ordinarily in oil pass on sinking EDM, beat DC control supply is utilized where the apparatus is associated with the negative terminal and the work piece is associated with the positive terminal. Material evacuation rates of up to 300mm3/min can be accomplished amid EDM. The surface complete (Ra esteem) can be as high Irjet template sample paragraph Irjet template sample paragraph.

As 50 µm amid harsh machining and even under 1 µm amid get done with machining. The volume of material evacuated per release is commonly in the scope of 10-6 - 10-4 mm3 and the material expulsion rate is more often than not somewhere in the range of 2 and 400 mm3/min relying upon particular application.

1.1 OBJECTIVE OF THE PRESENT WORK

1. To find feasibility of machining OHNS tool steel using copper electrode, aluminium electrode and aluminium electrode internal flushing.
2. To analyze the responses surface roughness, and material removal rate over cut by using the machining parameter selected for pulse current, pulse on time, pulse on time and diameter of the tool using Taguchi design approach.
3. To find the influence of MRR and electrode wear rate with pulse current, pulse duration time.
4. To find the optimum conditions for MRR and electrode wear rate.

2. LITERATURE REVIEW

Mehul Manoharan, Material Removal Rate, Tool Wear Rate and Surface Roughness Analysis of EDM Process, Electrical discharge machining (EDM) is one of the non-traditional machining processes, based on thermo electric energy between the work piece and an electrode. In this process, the material removal is occurred electro thermally by a series of successive discrete discharges between electrode and the work piece. The parametric analysis of the EDM process by using different electrode materials has been carried out. The Material Removal Rate (MRR), Tool Wear Rate (TWR) and Surface Roughness (SR) is measured and recorded for detailed analysis. Different electrode.

For high discharge current, copper electrodes show highest MRR, whereas Brass gives good surface finish and normal MRR. Since EDM is a thermal method, special attention must be paid to surface integrity. Surface and subsurface damage may be induced owing to thermal fatigue or to the material recast on the surface after removal. The MRR could be improved by carrying out research on electrode design, process parameters, EDM variations, powder mixed dielectric and electrically insulated electrodes. It is found that the basis of controlling and improving MRR mostly relies on empirical methods. This is largely due to stochastic nature of the sparking phenomenon involving both electrical and non-electrical process parameters along with their complicated interrelationship.

Indhu Sekaran.N, Experimental Investigation and Optimization of Machining Parameters in Electrical Discharge Machining. This experimental aims at achieving the integrated approach to solve the optimization problem of EDM process. At any stage, the dominance factor of the input variables and output variables contained in the constraints and objective functions can be computed. Electric discharge machining is categorized as a thermoelectric process in which heat energy of spark is used to remove material from the work piece. The machining process involves controlled erosion of electrically conducting material by the initiation of rapid and repetitive electrical spark discharges between the tool and work piece separated by the dielectric medium. The present work is aimed at characterizing the electric discharge machining of HCHCR steels on EDM. Since an electrode with micro features is employed to cut its mirror image in the work piece, it is necessary to investigate the machining efficiency of the electrodes used. Furthermore, to improve the machining efficiency. The combination of gap voltage, Ampere setting were new line considered for maximum Material Removal Rate (MRR), Surface Roughness (SR), constrained circularity error and overcut. The experiments were carried out as per L9 orthogonal array with each experiment performed under different conditions of such as Ampere rating, sparking voltage while machining

In this study, the Taguchi technique and ANOVA were used to obtain optimal EDM parameters in the machining of HCHCR. The experimental results were evaluated using Taguchi technique. Optimal control factor and percentage of contribution were evaluated. Through this experimental finally we have found efficient machining optimum parameter for HCHCR material machining with graphite electrode.

Nibu Mathew, Study Of Tool Wear Rate Of Different Tool Aterials During Electric Discharge Machining Of H11 Steel At Reverse Polarity, In this paper an exertion has been made to analyze the handiness of cathode made through Powder Metallurgy (PM) in examination with customary copper terminal amid electric release machining. Exploratory outcomes are introduced on electric release machining of H11 steel in standard EDM oil with copper tungsten (75% Cu and 25%W) apparatus terminal made through powder metallurgy method and Copper cathode (99%Cu). A L18 (21 X 33) symmetrical cluster of Taguchi Methodology was utilized to distinguish the impact of process input parameters (viz. anode compose, top current, voltage and obligation cycle) on the yield factor (viz. Device wear rate). It was discovered that copper tungsten (CuW) improved through powder metallurgy gives TWR when contrasted with ordinary terminal (Cu) and the best parametric setting for least TWR is with CuW powder metallurgy instrument cathode, 4 ampere current, 40 volts hole voltage, 0.72 obligation cycle, i.e., A2B1C1D1.

Following ends can be drawn from the investigation of the outcomes. • From the trial results it was discovered that powder metallurgy instrument terminal (CuW) gives better TWR when contrasted with customary cathode. • TWR increments with the expansion in crest current, hole voltage and obligation cycle. • Best parametric setting for least TWR is with CuW powder metallurgy device terminal, 4 ampere current, 40 volts hole voltage, 0.72 obligation cycle. That is A2B1C1D1.

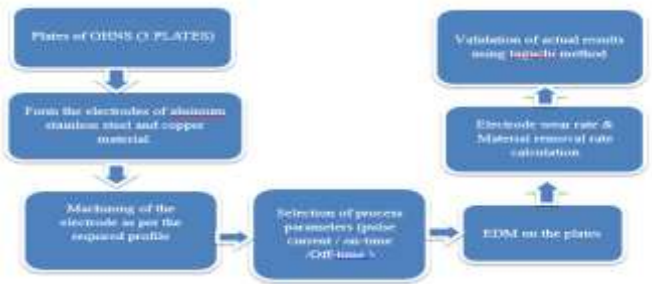
Kamaljit Singh Mahal, An Experimental Investigation: Machining of OHNS Steel by EDM, The exploratory examination of material expulsion rate, and smaller scale hardness amid machining of OHNS steel utilizing EDM machine was consider in this paper. The information

parameters incorporate pinnacle current, beat on time; voltage hole and flushing weight were utilized for exploratory work. Mean impact plot and S/N proportion diagrams have been utilized to streamline the machining parameters of EDM on OHNS steel utilizing the Taguchi technique and ANOVA strategies. It very well may be seen that Current has the biggest impact on the material expulsion rate of OHNS steel by machining. It very well may be seen that flushing weight has the biggest impact on the hardness of OHNS steel by machining. The ideal machining condition for material expulsion rate (MRR) with positive extremity are Current (30 A), Pulse-on (100 µs) Voltage Gap (10 v) and flushing weight (20 lb/in2). The ideal machining condition for with positive extremity for hardness are, Current (10 amp.), Pulse-on (100 µs), voltage hole (20 volt) and flushing weight (10 lb/in2).

Following ends were made for ideal MRR and Hardness amid the machining of OHNS steel on EDM. 1. For OHNS steel ideal machining condition for material evacuation rate (MRR) amid machining on EDM were Current (30 A), Pulse on (100 µs), Voltage Gap (10 v) and flushing weight (20 lb/in2) with positive extremity. 2. For OHNS steel ideal machining condition for better hardness were, Current (10 amp.), Pulse-on (100 µs), voltage hole (20 volt) and flushing weight (10 lb/in2).

Kamaljit Singh Mahal, An Experimental Investigation: Machining of OHNS Steel by EDM, The exploratory examination of material expulsion rate, and smaller scale hardness amid machining of OHNS steel utilizing EDM machine was think about in this paper. The info parameters incorporate pinnacle current, beat on time; voltage hole and flushing weight were utilized for trial work. Mean impact plot and S/N proportion charts have been utilized to improve the machining parameters of EDM on OHNS steel utilizing the Taguchi strategy and ANOVA strategies. It tends to be seen that Current has the biggest impact on the material expulsion rate of OHNS steel by machining. It tends to be seen that flushing weight has the biggest impact on the hardness of OHNS steel by machining. The ideal machining condition for material expulsion rate (MRR) with positive extremity are Current (30 A), Pulse-on (100 µs) Voltage Gap (10 v) and flushing weight (20 lb/in2). The ideal machining condition for with positive extremity for hardness are, Current (10 amp.), Pulse-on (100 µs), voltage hole (20 volt) and flushing weight (10 lb/in2).

3. METHODOLOGY



Experimental procedure

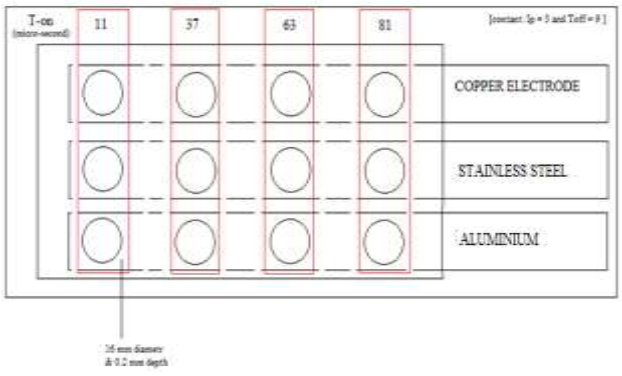
1. The work piece material selected for this study was WPS material tool steel. The chemical composition of wps steel is shown in above Table. The specimen is of rectangular in shape with 105 mm length, 85 mm breadth, and 6 mm thickness. 3 kinds of tool electrode materials using as a electrode such as brass, copper and graphite.

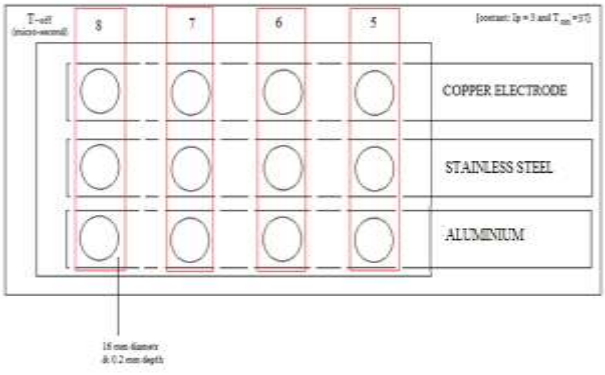
2. Spark gap which was maintained by a distance of 0.02 mm, depth of cut of 0.20 mm and dielectric fluid of standard EDM oil are the constant parameters in this study. Cu electrode made through powder metallurgy is of diameter 16.00 mm and a length of 120 mm respectively. Here in this project the effect of input machining parameter (viz. electrode type, gap voltage, and on / off time) on tool wear rate is studied here. The values were noted as per the design of experiment trial conditions using taguchi method.

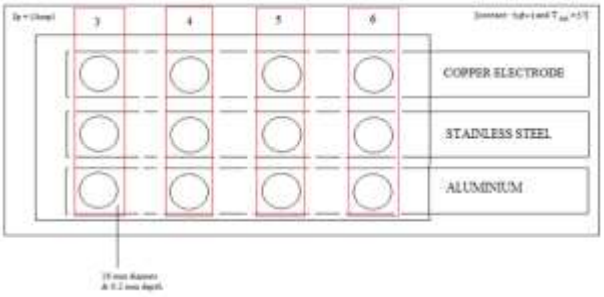
3. There are 3 plates taken and 3 parameters has been selected such as t-on, t-off, and voltage gap (v_g) to perform the EDM process on the 3 plates of WPS materials by the three types of electrode material such as copper, brass and graphite.

4. The results are in the form of material removal rate and surface roughness.

4. Experimental design







5. PERFORMANCE ANALYSIS

Responses MRR and input factors

EXP	INPUT FACTORS			OUTPUT RESPONSES		
Trial no.	Ton µs	Ip amp	Toff µs	MRR-Cu	MRR-AL	MRR-SS
1.	37	4	7	3.215	3.1565	3.1025
2.	37	5	6	3.658	3.254	3.0258
3.	37	6	5	3.958	3.152	3.125
4.	63	4	5	4.257	4.126	3.852
5.	63	5	7	4.856	5.354	5.10
6.	63	6	6	5.265	4.125	4.052
7.	81	4	6	4.565	5.126	3.512
8.	81	5	5	5.456	4.158	4.856
9.	81	6	7	4.264	5.532	5.123

Responses of EWR and input factors

EXP	INPUT FACTORS			OUTPUT RESPONSES		
Trial no.	Ton µs	Ip amp	Toff µs	SR-copper	SR-AL	EWR-SS
1.	37	4	7	0.00276	0.0158	0.00289
2.	37	5	6	0.00368	0.0189	0.00490
3.	37	6	5	0.0048	0.0212	0.00656
4.	63	4	5	0.0072	0.0235	0.00821
5.	63	5	7	0.0095	0.0286	0.0136
6.	63	6	6	0.0195	0.0310	0.0210
7.	81	4	6	0.0265	0.0386	0.0295
8.	81	5	5	0.0291	0.0481	0.0326
9.	81	6	7	0.0354	0.0514	0.0367

6. PERFORMANCE ANALYSIS

parameters	Work material		
	COPPER	ALUMINIUM	STAINLESS STEEL
Optimum MRR condition	A7B6C7	A9B9C8	A8B8C9
Peak current contribution	10.4698675	4.398665698	18.89698492
Pulse ON time contribution	88.2045511	95.46665417	60.04656616
Pulse OFF time contribution	0.85246312	16.23	20.95142379

Factors Above Shows the Toff, Ton, And Ip, Values As under,

A5 = 63 µs, A7 = 81 µs, A8 = 81 µs, A9 = 81µs

B5 = 5A, B9 = 6 A, B8 = 5 A, B6 = 6 A, B3 = 6 A,

C5 = 7 µs, C3 = 5 µs, C7 = 6 µs, C9 = 7 µs

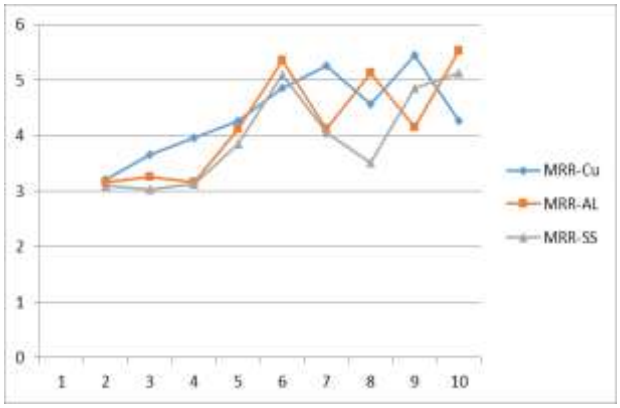
7. CONDUCT THE CONFIRMATION TEST

In this study, the influence of the process parameters and optimization of copper, graphite and brass materials in the die sinking EDM was studied by using taguchi method, from the results; it was found that Toff, Ip, and Ton found to play more significant role in EDM operation. Also it was found that, the optimum level of the factors for SR and MRR are different for each other. From the ANOVA, pulse ON time is more significant than other factors.

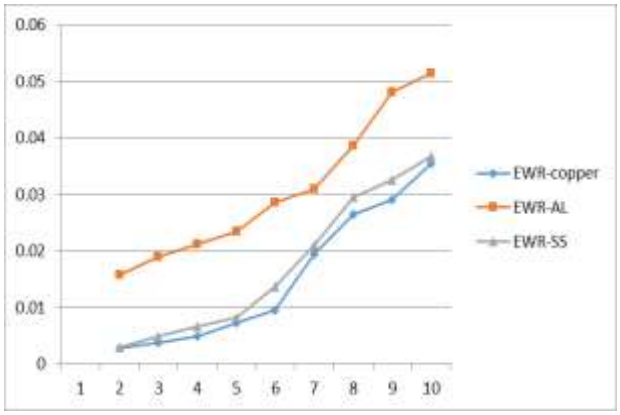
Verification of optimum results

Performance measure	Optimum condition	Experimental optimum values	Predicted value.
MRR for Copper (mm^3/min)	A7B6C7	4.87	4.67
MRR for aluminium (mm^3/min)	A9B9C8	5.31	5.64
MRR for SS (mm^3/min)	A8B8C9	4.51	4.67
EWR for Copper (µs)	A9B9C7	16.75	17.81
EWR for Aluminium (µs)	A5B5C5	24.25	25.67
EWR for SS (µs)	A7B3C3	26.82	25.98

Comparison of Experimental Material Removal Rate between Copper, Aluminium and SS



Comparison of Experimental ELECTRODE WEAR RATE between Copper, Aluminium and SS



8. CONCLUSIONS

This study covers the observations about the electrode wear rate, material removal rate over the OHNS material by the process of EDM machine for the different input parameters to thoroughly study over the effect of EDM machining process on the OHNS material. Throughout the experimentation I got some results as under.

1. The electrodes used are aluminium, copper and stainless steel, out of which the aluminium electrode having the maximum wear as compared to the copper and stainless steel as its hardness is lower than the other two electrodes.
2. The copper electrode having the minimum wear as compared to the aluminium and stainless steel as its hardness is higher than the other two electrodes.
3. The electrode wear rate is depends on the hardness of material as copper having hardness 18-20 Hrb Its Wear Rate Is Lower than Other Two Materials.
4. The electrodes used are aluminium, copper and stainless steel, out of which the copper electrode having the maximum material removal rate as compared to the aluminium and stainless steel as its hardness is lower than the other two electrodes.
5. The aluminium electrode having the minimum material removal rate as compared to the copper and stainless steel as it takes maximum time to remove the material over the OHNS material than the other two electrodes.
6. The optimum conditions found by the experimentation process and followed by the Taguchi analysis, from the analysis I got the optimum conditions for the electrode wear rate and material removal rate as given in above result table.

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