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Process Parameter Investigation for Three Different Design of Cut Using EDM Machining for EN-24 Object Material

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A B S T R A C T

Better exactness of miniature openings or little opening (in scope of 1mm breadth) are required and fundamental due to their low dimensional qualities, so ordinary traditional machining isn't satisfy this prerequisite and non regular machining devices like EDM is reasonable apparatus for making high precise little openings. In present examination the minuscule round opening is made by utilizing EDM for uniquely designed for EN-24 steel which has high strength due to carbon content. The reaction boundary chose for this examination is surface unpleasantness estimated by utilizing Surface harshness analyzer accessible in school research center. In present examination all out four info boundaries are chosen and Taguchi technique is chosen for making the test runs for these four boundaries. The four boundaries are top current, Ton, Toff and pressing factor having four levels each. Complete 18 tests are planned utilizing Taguchi technique. Sign to clamor proportion investigation and non straight relapse demonstrating is performed for this exploration study. Surface unpleasantness is exceptionally impact by Peak current and least impact by Pulse off time. Diverse sort of relapse displaying is available in this examination.

Keywords: EDM drilling, Taguchi Method, Signal To Noise Ratio, MMC, Al-SiO2, Regression modeling, surface roughness

1. Introduction

Variuos researchers studied on EDM machine to investigate the role of process parameters used for this machine. The material used in this machining process is AISI steel M2. This type of steel has high strength. Taguchi method is used to develop the experiments table. Copper and brass electrodes are used in this research work. Three input parameters like current, pulse on and pulse off is selected as factors and Metal removal rate is selected as response parameters. Signal to noise ratio analysis is performed in this study and testing of regression equation developed for MRR is performed using ANOVA analysis.

Some researchersexplored the machining characteristics of a made crossbreed procedure of electrical release machining (EDM) in gas with rough stream machining (AJM). The examinations as to boundary improvement were arranged with a L18 symmetrical cluster in view of the Taguchi system. The essential procedure boundaries, for instance, machining extremity, peak current, beat term, gas pressure, grain gauge, and servo reference voltage were picked to choose their ramifications for machining execution relating to material expulsion rate (MRR), anode wear rate (EWR) and surface harshness (SR) for SKD 61 mechanical assembly steel. The test response regards were traded to motion toward clamor (S/N) extents, and from that point onward, the enormous machining boundaries identified with the machining execution were assessed by examination of fluctuation (ANOVA). The perfect blend measurements of the machining boundaries were also gotten from the response plots of S/N extents. The preliminary outcomes exhibit that the critical machining boundaries impacting the MRR were machining extremity, top current, and heartbeat length; the top current was the tremendous boundary with association with the EWR; in addition, the apex current, beat term, similarly as gas pressure were enormous concerning the SR. Additionally, Some researchers alsoexamined the qualities and deficiencies of ordinary warmth trade models for a lone release are discussed. For this propose a constrained

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part model is developed and effects of different exhibiting boundaries on the gained results have been investigated. Furthermore, potential outcomes of pivot microstructure.

2. Machine Technical Specification

In present study EDM machining is selected as research product. For research six parameters are selected as per research requirement, thee parameters are discussed in this chapter. In present chapter technical specifications and materiel properties are discussed Measuring instruments which are used for response measurement are also discussed

Figure 1 EDM machine used for present study

Input factors and their Range Selection

As discussed in previous section of this chapter, the very first step is to conduct some pre stage experiments to find the proper range of parameters on which experiments are possible on EDM machine. After conducting the pre stage experiments the final range for input parameters are present in table 2 for all six input parameters.

Table 1 Process Parameters, Symbols and Their Ranges

Process Parameters	Symbol	Range (machine units)	Units
Shape	S	Circular, Rectangular, Hexa	NA
Pulse On Time	TON	100-120	Micro sec
Pulse Off Time	TOFF	45-55	Micro sec
CURRENT	C	10-14	Amp
Voltage	V	30-40	Voltage
Pressure	P	0.8-1.0	Bar

Factors and Levels

Table 2 Factor and Levels

Factors	I	II	III
Shape	1	2	3
	Circular	Square	Hexa
TON	100	110	120
TOFF	45	50	55
CURRENT	10	12	14
Voltage	30	35	40
Pressure	0.8	1	NA

Table 3 Orthogonal Array

Run	Pressure	Shape	TON	TOFF	Current	Voltage
1	0.8	1	100	45	10	30
2	0.8	1	110	50	12	35
3	0.8	1	120	55	14	40
4	0.8	2	100	45	12	35
5	0.8	2	110	50	14	40
6	0.8	2	120	55	10	30
7	0.8	3	100	50	10	40
8	0.8	3	110	55	12	30
9	0.8	3	120	45	14	35
10	1	1	100	55	14	35
11	1	1	110	45	10	40
12	1	1	120	50	12	30
13	1	2	100	50	14	30
14	1	2	110	55	10	35
15	1	2	120	45	12	40
16	1	3	100	55	12	40
17	1	3	110	45	14	30
18	1	3	120	50	10	35

Signal to noise ratio analysis is performed to find the rank of factors for selective response parameters. S/N ratio are the log formulation of the simple results gathered from EDM machine and then these log formulations are going to average for making the delta which help to find the best and least ranked of factors among all factors for selective response parameter.

Signal to noise ratio is the formulation of response using log based formula which is deffer as per requirement. In this response parameter study the S/N ratio is set for "smaller is better" because by changing the cutting time in small manner then productivity is increased which is much more required thing for any industry. The same formula is used for surface roughness response parameters also, The formula used for S/N ratio calculation is present here:

$$S/N_{small} = -10 * \log\left(\frac{\sum y^2}{n}\right)$$

Here Y is response cutting time or surface roughness, n is how much time the same experiment is going to repeat, in our case the experiment is done for one time so n is equal to one.

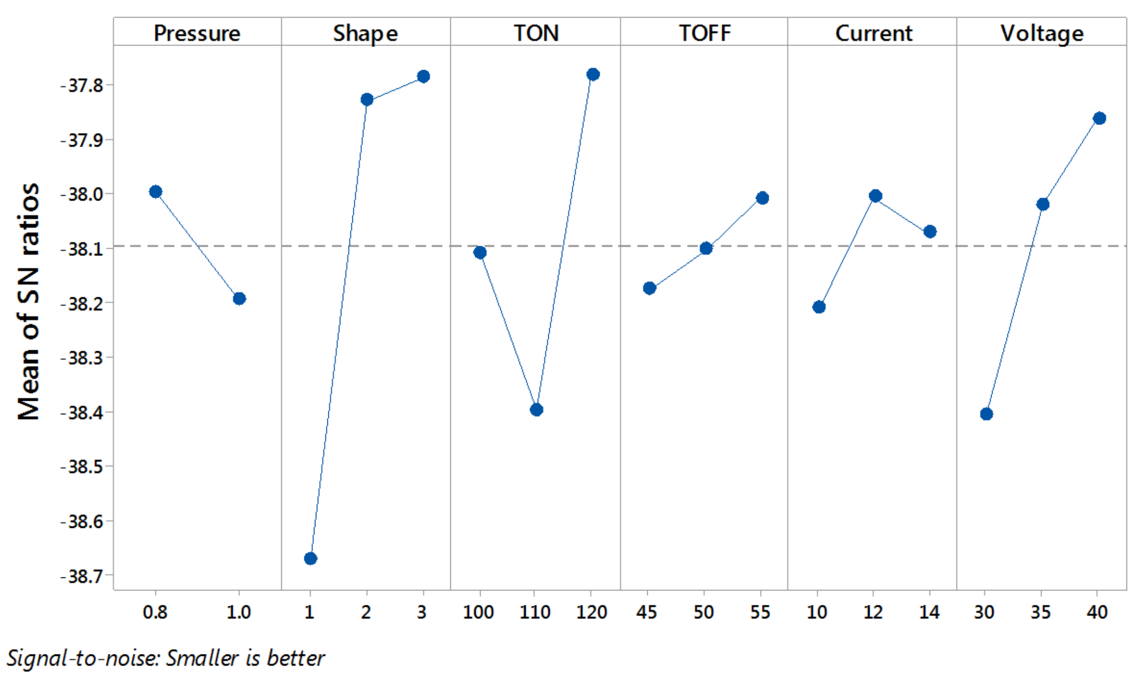
3. S/N ratio for Cutting Time

Signal to noise ratio analysis is performed for cutting time response parameter and the analysis is done for "smaller is better" option. The results are present in table 4 in which rank is identified for the response parameter "cutting time". Individual S/N ratio is calculated using the formula as present in previous section is present in table 4 for response parameter cutting time.

Table 4 S/N ratio analysis for Cutting Time

Level	Pressure	Shape	TON	TOFF	Current	Voltage
1	-37.99	-38.67	-38.11	-38.18	-38.21	-38.4
2	-38.19	-37.83	-38.4	-38.1	-38	-38.02
3		-37.78	-37.78	-38.01	-38.07	-37.86
Delta	0.2	0.89	0.62	0.17	0.21	0.55
Rank	**5**	**1**	**2**	**6**	**4**	**3**

Figure 2 Signal to Noise ratio analysis for Cutting Time



4. Optimal Solution for Cutting Time

Signal to noise ratio analysis is also help to find the optimal solution for cutting time using the figure 2 and the optimal solution for cutting time is present in table 5

Table 5 Optimal Solution for Cutting Time

Pressure	Shape	TON	TOFF	Current	Voltage	CT Exp Value
0.8	Hexa	120	55	12	40	70.4

Plotting for Cutting Time

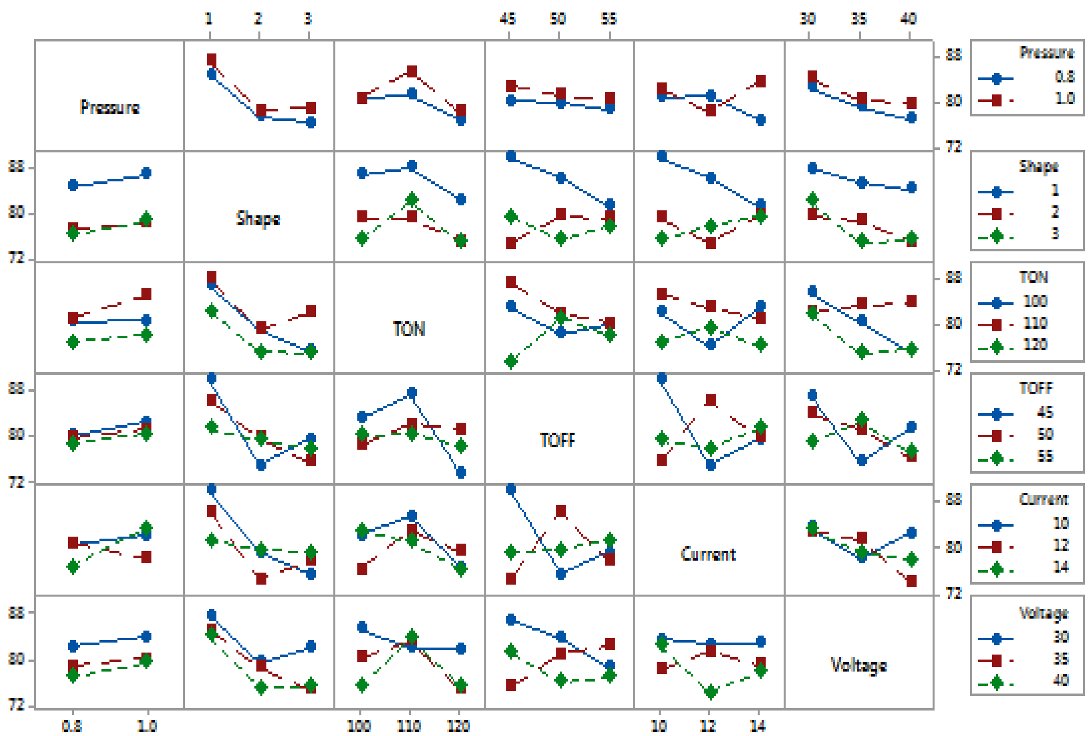


Figure 3 Interaction plot for all selective factors and cutting time

5. Conclusion

the first ranked factor is shape of tool which is responsible for cutting time smaller is better option, second ranked factor is pulse on time, third ranked factor is voltage, fourth ranked factor is current, fifth ranked factor is pressure applied on the tool during experiment and least ranked factor is pulse off time. The rank is calculated by using Delta option which is the difference among highest S.N ratio and lowest S. N ratio value generated for cutting time. The optimal solution for cutting time is found at Pressure=0.8, Shape= Hexa, Ton=120, Toff=55, Current=12 and Voltage=40. These values are the optimal solution for cutting time in which minimum cutting time can be achieved for the EDM machining.

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