Investigation of EDM wire cut parameter for Austenite stainless steel

A.parthiban[1*], C.Dhanasekaran[2], S.Sivaganesan[3], R.Pugazhenthi[4]

[1-4] Associate Professor, Department of mechanical Engineering, School of Engineering, Vels institute of Science, Technology and Advanced Studies

*pathibana@yahoo.co.in

Abstract: *The EDM Wire cut is advanced thermal energy based cutting process it's most accurately to cut the different shapes. This present work to investigate the wire EDM parameters for AISI 316 austenite stainless steel and to achieve the high material removal rate without affect, quality of cutting surface. This work to involve optimizing the various input cutting parameters like Pulse on Time, Pulse Off time and Current influencing the Material Removal Rate for AISI 316 austenite stainless steel. Response surface methodology is used to optimize the cutting parameters by using Box-behenken design, conformation experiment to validate the result.*

Key words*: EDM wire cut, AISI 316, ANOVA, MRR.*

1. INTRODUCTION

EDM wire is one of the thermal energy based contact type cutting process in the order to cut the of all type of material [1]. The different types of wire electrode mainly affect on quality of cutting material. [2, 3]. Further the process of EDM wire cut was was examined with some researcher and their results revealed that Wire electrode generated good surface quality with moderate Current. For that reason a lot of researchers were worked on Material removal rate so as to predict the MRR. Their results show that current, Pulse On time improves the Material removal rate during EDM wire cut.

The many researchers was work at to develop mathematical models for predicting accurate experimental values for EDM wire cut [4, 5]. On MRR, Pulse On Time, Pulse Off time and Current were investigated with Taguchi methodology [6, 7]. In experimental design is higher experimental run for central composite and Box Behnken designs for reducing the experimental run. Comparatively EDM Wire cut consumes high cost for carrying out the production. In response the design of experiment concepts were utilized by some of the researchers to reduce the experimental run to avoid the trial and error cost expenditure [8]. So this work tries the Box-Behnken design for conducting the experiments.

The hybrid Taguchi method and Response surface methodology approach has been developed the response models and to optimize the EDM wire cutting process for Surface roughness. The optimization EDM Wire cutting process of st-37 steel with performance characteristics based on grey relational analysis, Such as surface roughness [9]. To develop an expert system using fuzzy logic model to predict the

effect of EDM Wire cut quality based on EDM wire cutting parameter Pulse On time, Pulse Off time and Current of inconal alloy. To conformation test for experimental result have shown good agreement with predicted result. the influencing parameters for instance Pulse on time, Pulse Off time and Peak current as well as the work piece material on Material Removal Rate.

2. EXPERIMENTAL PROCEDURE

The experiments are carried out on CONCORD make EDM wire cut machine as shown in fig.1 and the specification of machine as shown in table 1. The work piece considered for this work is AISI 316, and the specimen size was 1000 X 1000 X 10mm. The work piece was carefully clamped on work table [10].

Table 1 Specifications of the Used Wire EDM

Technical Specifications	
Table Size L x W	200 x 340 mm
Table Travel X, Y axis	120 x 160 mm
Maximum Work Piece Thickness	100 mm
Machining Accuracy	0.010 mm
Maximum Work Piece Weight	80 Kg

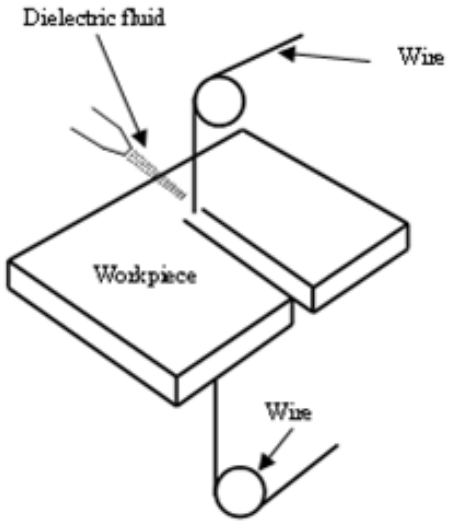

Figure 1 Schematic representation of WEDM

Table.2.Experimental Value

S.No	Pulse On Time (µs)	Pulse Off Time (µs)	Current (amps)	MRR (mm^3/min)
1	104	64	180	0.9921
2	104	60	190	1.2312
3	104	64	180	1.8932
4	100	64	190	2.3121
5	104	60	170	2.4561
6	104	68	190	3.4521
7	100	60	180	3.9823
8	104	68	170	3.8751
9	104	64	180	3.7851
10	108	60	180	0.9432
11	104	64	180	3.7892
12	104	64	180	3.2341
13	108	64	190	3.9821
14	108	68	180	2.9832
15	100	64	170	2.8764
16	100	68	180	0.8912
17	108	64	170	2.8965

Table.3. ANOVA for MRR

Source	Sum of Squares	Df	Mean Square	F Value	Prob > F
Model	8.4887	6	1.4148	1.1957	0.3819
A	0.0690	1	0.0690	0.0583	0.8140
B	0.8377	1	0.8377	0.7080	0.4198
C	0.1587	1	0.1587	0.1341	0.7219
AB	6.5820	1	6.5820	5.5630	0.0400
AC	0.6805	1	0.6805	0.5752	0.4657
BC	0.1608	1	0.1608	0.1359	0.7201
Residual	11.8319	10	1.1832		
Lack of Fit	5.6225	6	0.9371	0.6037	0.7238
Pure Error	6.2094	4	1.5524		
Cor Total	20.3207	16			

The "Model F-value" of 1.20 implies the model is significant relative to the noise. There is a 38.19 % chance that a "Model F-value" this large could occur due to noise.Values of "Prob > F" less than 0.0500 indicate model terms are significant.In this case AB are significant model terms. Values greater than 0.1000 indicate the model terms are not significant.If there are many insignificant model terms. The Box-Cox plot are represent in figure.2. the plots represents residual values are within the limit,so that the experiments are good agreement.

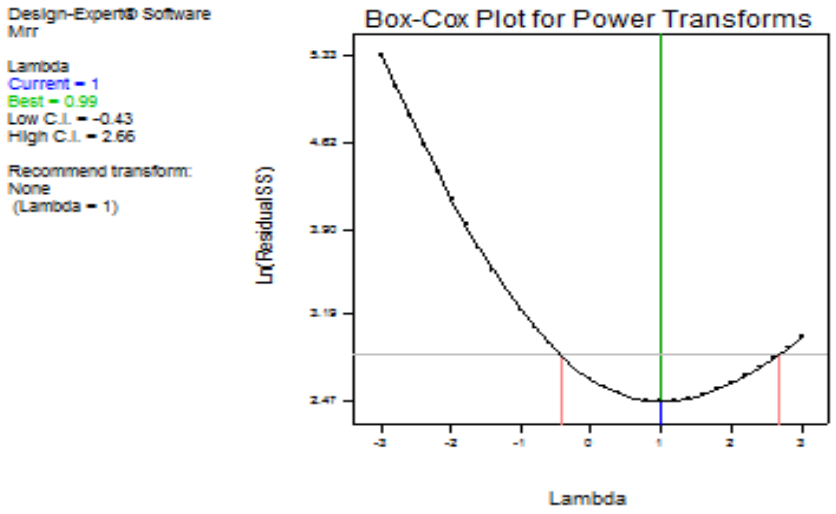

Figure.2.Box-Cox Plot

3. Effect of Material Removal Rate

From the surface graph figure 3 Low pulse on time and off time to achieve high material removal rate. At the same time to increase the pulse on time at the same time the Material removal rate also decreased. The high pulse on time to decrease the Material Removal Rate. And figure 4 shows that the effect of current and pulse off time for Material removal rate. The low current at high level of pulse off time to achieve high material removal rate. At the same time high current at low pulse off time to minimum Material Removal Rate for cutting.

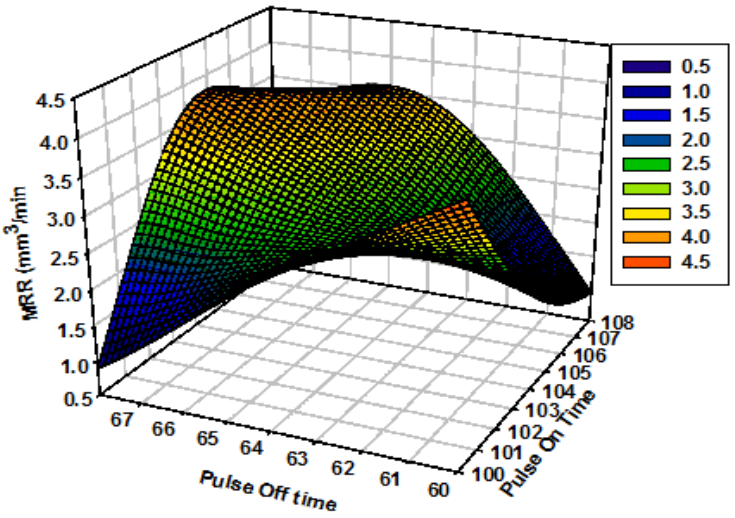

Figure.3.Response surface graph for Material removal rate

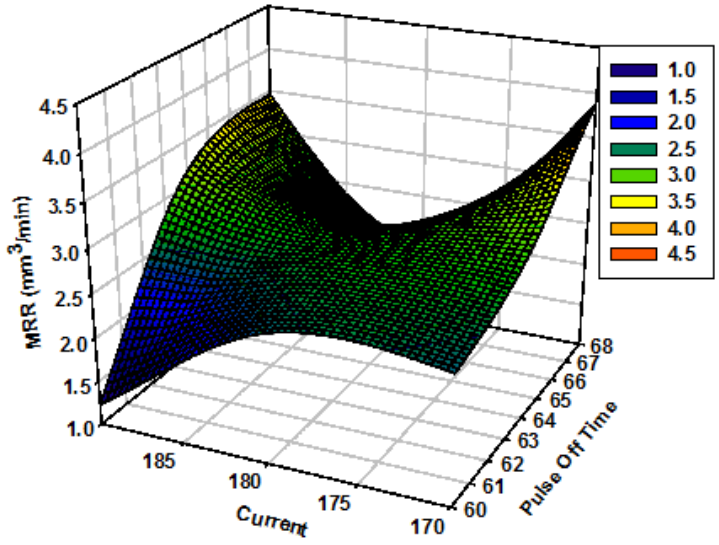

Figure.3.Response surface graph for Material removal rate

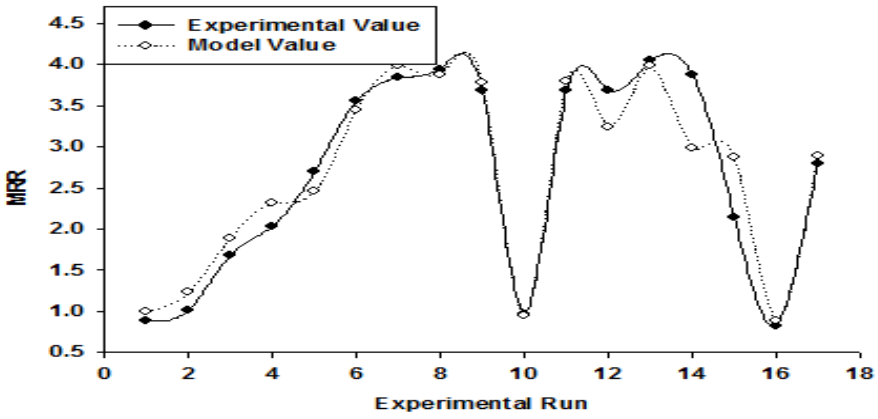

Figure 5 Experimental value vs Modeling value

The figure.5. shows the experimental value are with in the limit at all the experimental run. So that the to developed mathematical model are satisfied.

4. CONCLUSION

The main objective of this work was to develop the mathematical modeling and to find out the optimized combination of Pulse on time, Pulse off time and current for AISI 316 stainless steel for EDM wire cut. In the EDM wire cut process, the experimental work carried out by Box-behenken design, Optimal Parametric combinations were found out, Through the Response surface graphs, it can be observed that High Pulse on time and pulse off time to achieve Maximum Material Removal Rate for EDM wire cut for AISI 316 stainless steel.

Reference

1. A Parthiban, M Chandrasekaran, V Muthuraman, S.Sathish 2018, Optimization of CO 2 Laser Cutting of Stainless Steel Sheet for Curved Profile, Materials Today: Proceedings,Vol.5(6), pp 14531-14538
2. A.Parthiban, S. Sathish, M. Chandrasekaran, 2017, Optimization of Abrasive Water Jet Cutting Parameter for AISI 316L Stainless Steel Sheet, JOURNAL OF APPLIED FLUID MECHANICS,Vol.10, pp.15-22.
3. A Parthiban, M Chandrasekaran, S Sathish, 2107 Comprehensive Analysis Of Milling Parameters on Aluminium Alloys,ARPN journal of Engineering and Applied Science Vol.12 (8), pp. 2467-71.
4. A Parthiban, R Ravikumar, B.Suresh Kumar, N Baskar 2015 Process Performance with Regards to Surface Roughness of the CO2 Laser Cutting of AA6061–T6 Aluminium Alloy Lasers in Engineering Vol.32 (3), pp.327-341
5. A Parthiban, S Sathish, M Chandrasekaran, R Ravikumar, 2017, Optimization of CO2 laser cutting parameters on Austenitic type Stainless steel sheet, IOP Conference Series: Materials Science and Engineering, Vol. 183,pp 012022 doi:10.1088/1757-899X/183/1/01202.

6. Sathish, S., Parthiban, A., Balakrishna, R., Anandan, 2108;Development of ANN models for optimization of methane yield from floating dome digester, International Journal of Engineering and Technology(UAE),Vol.7 (2.21), pp 316-318.
7. S Sathish, A Parthiban, S Venugopal, 2107, Performance and Analysis of Floating dome Anaerobic Digester with Wet and Dry Feedstock, IOP Conf. Series: Materials Science and Engineering, Vol. 183, pp.012033 doi:10.1088/1757-899X/183/1/01203.
8. S Sathish, A Parthiban, M Chandrasekaran,2017, Analysis of Biomethanation Process from market waste to generate bio energy. IOP Conf. Series: Materials Science and Engineering,Vol. 183, pp.012033 doi:10.1088/1757-899X/183/1/01203.
9. V.Vijayan,A.Parthiban, T.Sathish,S.Sivachandran,R.Venkatesh,2018,Performance analysis in End milling operation,Intrnational Journal of Mechanical Engineering and Technology,Vol.9(11),pp.2263-2271.
10. B. Suresh kumar, V. Vijayan, N. Baskar, 2016, “Comparison of coated and uncoated carbide drill bits for drilling titanium grade 2 material”, Mechanika, Vol. 22 no 6, 571-576.