Experimental Analysis for EDM wire cut parameter for Austenite stainless steel material

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Abstract

The AISI 316 austenite type stainless steel widely used in automobile, food processing industries its mainly used in structural application for aerospace. The cutting of AISI316 austenite steel by using EDM wire cut process it's very difficult to cut because of high hardness material. So that the cut surface quality is affected, the present work to investigate and optimize the Wire EDM process parameters and to achieve the low surface roughness of cutting surface. The considered significant input parameters are like Pulse On time, Pulse Off time and current, Surface roughness is as output variables. Response surface methodology is used to optimize the input parameters and to develop the mathematical modeling for surface roughness, the developed mathematical model best agreement with the experimental value

Key words*: EDM wire cut, AISI 316, ANOVA, Surface roughness*

1. INTRODUCTION

The wire EDM is a advanced thermal energy based cutting process, it is mainly cutting of very hardness material with different complex shapes are to be cut.[1]. The different types of profiles to be cut mainly affect on quality of material. [2,3]. In additional the process of EDM wire cut was examine with some investigator and their results exposed that Wire electrode generated good surface roughness of end of cut with moderate Current and pulse on time. So that a lot of researchers are worked on Surface roughness of EDM wire cutting different materials, current, Pulse On time mainly improves the surface roughness during EDM wire cut.

The lot researchers were work at to develop mathematical models for predicting accurate experimental values for EDM wire cut on surface roughness [4,5]. The Pulse On Time, Pulse Off time and Current were investigated with Response surface 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 based grey relay analysis 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 Surface roughness.

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

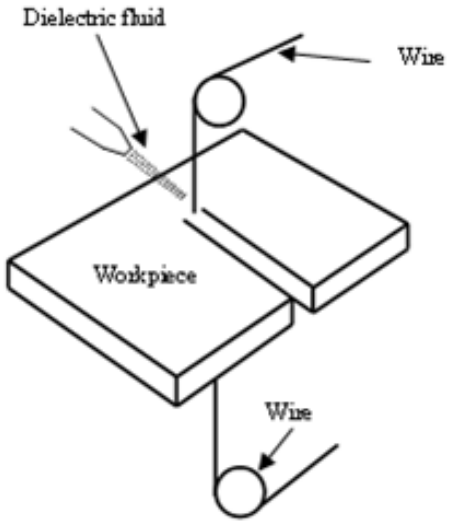

Figure 1 Schematic representation of WEDM

Table.2. Experimental Run

S. No	Pulse On Time (µs)	Pulse Off Time (µs)	Current (amps)	Sr (µm)
1	104	64	180	3.4521
2	104	60	190	4.5672
3	104	64	180	4.9912
4	100	64	190	3.9845
5	104	60	170	4.9823
6	104	68	190	4.9023
7	100	60	180	3.9024
8	104	68	170	3.6712
9	104	64	180	3.6981
10	108	60	180	4.1292
11	104	64	180	3.9231
12	104	64	180	3.9831
13	108	64	190	4.2315
14	108	68	180	4.9936
15	100	64	170	4.8932
16	100	68	180	3.8845
17	108	64	170	3.8569

Table.3. ANOVA table for Surface roughness

Source	Sum of Squares	df	Mean Square	F Value	Prob > F
Model	1.3332	6	0.2222	0.6962	0.6592
A	0.0373	1	0.0373	0.1170	0.7394
B	0.0021	1	0.0021	0.0066	0.9370
C	0.0099	1	0.0099	0.0311	0.8635
AB	0.1946	1	0.1946	0.6098	0.4530
AC	0.4117	1	0.4117	1.2900	0.2825
BC	0.6775	1	0.6775	2.1228	0.1758
Residual	3.1915	10	0.3191		
Lack of Fit	1.8119	6	0.3020	0.8756	0.5797
Pure Error	1.3796	4	0.3449		
Cor Total	4.5247	16			

The "Model F-value" of 0.70 implies the model is not significant relative to the noise. There is a65.92 % 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 there are no significant model terms.Values greater than 0.1000 indicate the model terms are not significant.

3. Effect of Surface roughness

From the surface graph figure 2 Low pulse on time and off time to achieve Low surface roughness. At the same time to increase the pulse on time at the same time the surface roughness also decreased. The high pulse on time to decrease the Surface roughness, And also that the effect of current and pulse off time for Surface roughness. The low current at high level of pulse off time to achieve Surface roughness, at the same time high current at low pulse off time to minimum surface roughness for cutting.

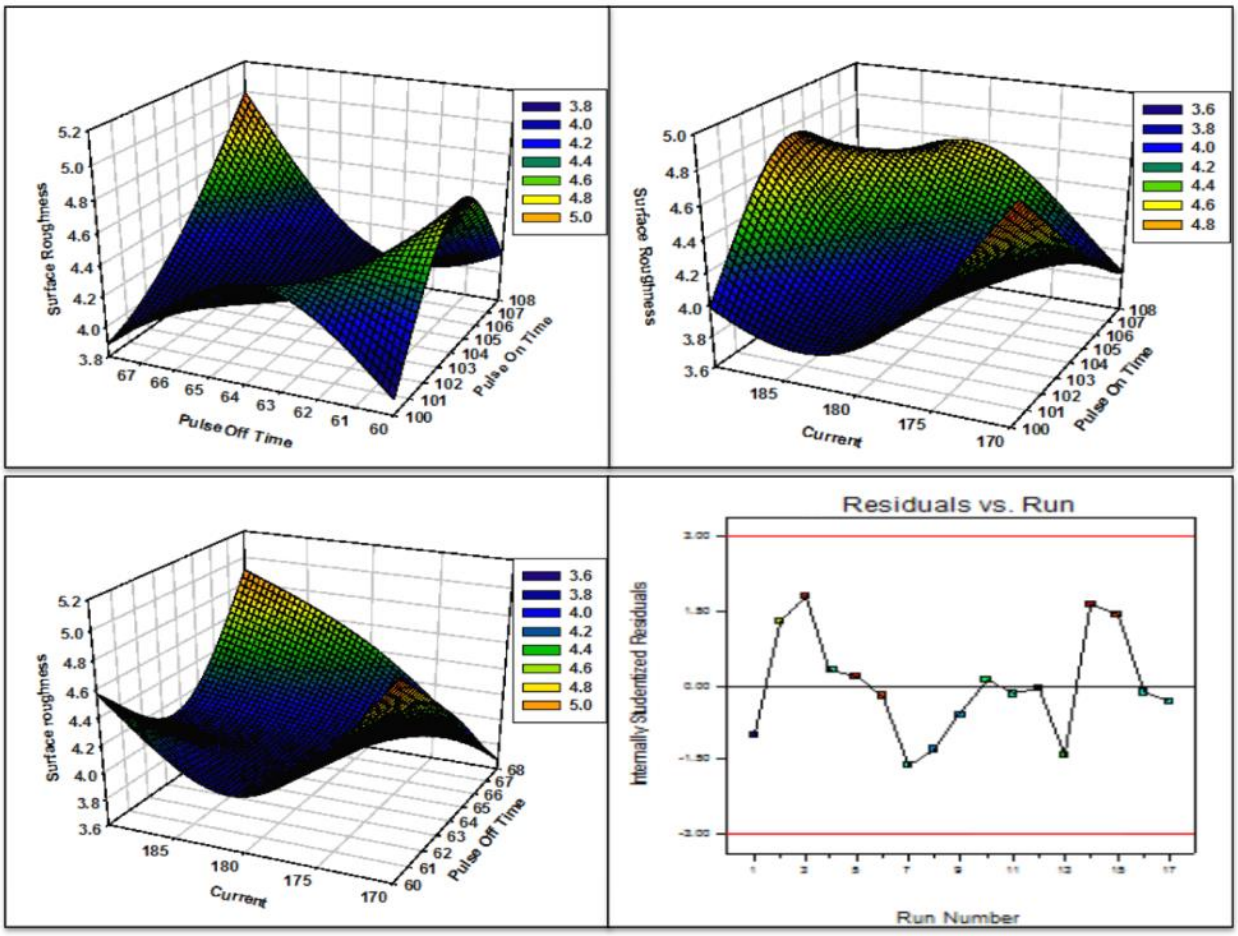

Figure.2. Response surface graph for Surface roughness

4. CONCLUSION

The main purpose 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 for surface roughness. 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 Minimum Surface roughness for EDM wire cut for AISI 316 stainless steel.

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