EXPERIMENTAL INVESTICATION AND OPTIMIZATION OF WIRE EDM PARAMETERS FOR SURFACE ROUGHNESS, MRR AND MACHINING TIME IN SS304

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ABSTRACT

With the increasing demands of high surface finish and machining of complex shape geometries, conventional machining process are now being replaced by non-traditional machining processes. Wire EDM is one of the non-traditional machining processes. Surface roughness, material removal rate and machining time are of crucial importance in the field of machining processes. The objective of optimization is to attain the minimum machining time, best surface integrity and material removal rate simultaneously. In this present study stainless steel SS304 is used as a work piece, brass wire of 0.25mm diameter used as a tool and water is used as a dielectric fluid. For experimentation Taguchi's L9 orthogonal array has been used. The Test of hypothesis of the model resulted satisfactorily for the fitness function. Further a mathematical model developed using regression analysis which can be used for finding optimized values of pulse on time, pulse off time, peak current, and voltage.

Keyword: *Wire edm, Taguchei's orthogonal array etc….*

INTRODUCTION

Generally, manufacturing process are classified into two types. They are Primary and secondary process. The Casting, Welding, Forging, etc. comes under primary manufacturing process and the machining comes under Secondary manufacturing process. The selection of objectives of this work includes the following validation. The Surface roughness,MRR and the Machining time are the basic critical factors for production time and the Surface Roughness (Ra) is the most important criteria that to be reduced as far as possible because of its effect of leading to failure in the mating parts due to friction. The work material used for the present study is SS304 stainless steel. The chemical composition of the work material are as shown in the table below.

Silicon	Chromium	Sulphur	Phosphorus	Iron
0.75Max	18.00-20.00	0.03Max	0.045Max	Remaining

EDM has been substituting traditional machining operations. Now today EDM is a popular machining operation in several manufacturing productions all over the world's countries. Most of the traditional machining process such as drilling, grinding and milling, etc. are failed to machine geometrically complex or difficult shape and size. Those materials are easily machined by EDM non-traditional machining process which leads to broadly utilized as die in addition to mold assembly industries, making aeronautical parts and nuclear instruments at the minimum cost. Electric Discharge Machining has also established its presence touched on the different subject areas such as make use of sporting things, medicinal and clinical instruments as well as motorized research and development regions.

It was found that the factors that highly influence the process efficiency and output characteristics are pulse on time, Pulse off time, peak current, and voltage. Experimental works have been carried out on the above mentioned Parameters.

MATERIAL AND METHODS

This analysis deals with the finding the optimal cutting conditions in Wire EDM of SS304 stainless steel plat (work piece 60x40x6 mm) using brass cutting tool in Wire EDM for nine different values of pulse on time, Pulse off time, peak current, and voltage. The details of Levels and Factors are shown in Table.

Levels/Factors	**-1**	**0**	**+1**
Pulse on time	106	114	122
Pulse off time	44	53	63
Peak current	150	190	230
Voltage	20	55	90

The above table which shows the minimum, middle and maximum levels of three different parameters such as pulse on time, Pulse off time, peak current, and voltage of the work material.

EXPERIMENTAL DESIGN

Selection of experimental design is a decision making process which decides the degree of validity of the desired model in finding optimal cutting parameters. This work is carried out using Taguchi L9 orthogonal array methodology.

TAGUCHI METHODOLOGY

The Taguchi method involves reducing the variation in a process through robust design of experiments. The overall Objective of the method is to produce high quality product at low cost to the manufacturer. The Taguchi method was developed by Genichi Taguchi. He developed a method for designing experiments to investigate how different parameters affect the mean and variance of a process performance characteristic that defines how well the process is functioning. The experimental design proposed by Taguchi involves using orthogonal arrays to organize the parameters affecting the process and the levels at which they should be varied. Instead of having to test all possible combinations like the factorial design, the Taguchi method tests pairs of combinations. This allows for the collection of the necessary data to determine which factors most affect the product quality with a minimum amount of experimentation, thus saving time and resources. The Taguchi method is best used when there is an intermediate number of variables (3 to 50) few interactions between variables, and when only a few variables contribute significantly. The Taguchi L9 orthogonal array technique is used.

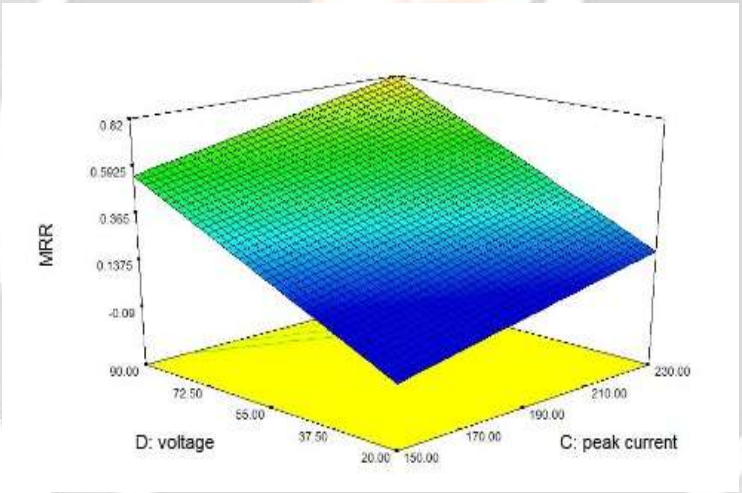
DATA COLLECTION

Data collection plays a major role in the statistical analysis of any field, as it decides the progression of the analysis to the best or worst. A proper and suitable data collection leads to good results from analysis. In such focus it is very Much essential to choose a well suitable data collection technique for the analysis. In this work, Data collection for

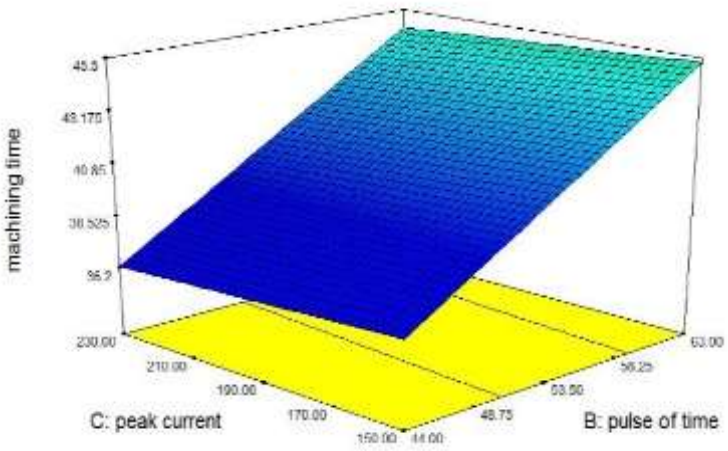
The Wire EDM process is selected for proceeding with Taguchi L9 orthogonal array methodology. The values predicted using the model in Wire EDM of SS304 stainless steel plate using brass cutting tool has been shown in Table.

Pulse on time (sec)	Pulse off time (sec)	Peak current (amps)	Voltage (volts)	Surface roughness (Ra)	Material removal rate (grams)	Machining time (mm/min)
122	44	230	55	2.155	0.5	39
106	44	150	20	2.093	0.1	53
114	63	150	55	1.901	0.3	55
122	53	150	90	2.173	0.5	40
106	63	230	90	1.77	1	58
114	44	190	90	2.141	0.8	43
106	53	190	55	1.91	0.4	57
122	63	190	20	1.844	0.1	44
114	53	230	20	2.029	0.2	48

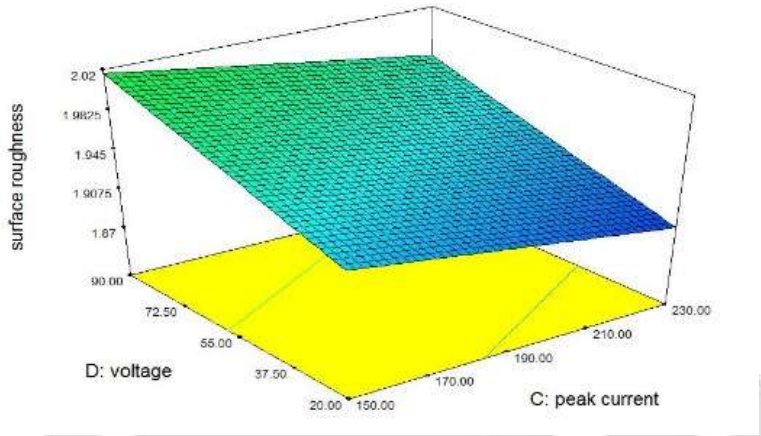
Normal plot of residual



Normal plot of residual



Normal plot of residual



RESULT AND DISCUSSION

From ANOVA, It is predicted that the considered parameters of pulse on time, Pulse off time, peak current, and voltage are significant for the objective functions Machining time and Surface Roughness. As the Ra value of Surface Roughness, material removal rate, and Machining time are greater than 0.8 which ensures the navigation of model through the design space. Machining time Decreases considerably increase in pulse on time. Surface roughness is minimum for balance pulse on time, voltage. Material removal rate increases considerably decrease in peak current and pulse off time.

CONCLUSION

This paper presents the findings of an experimental investigation into the effect of pulse on time, Pulse off time, peak current, and voltage of surface roughness, material removal rate and machining time when Wire EDM of SS304 stainless steel.

REFERENCES

1) Pujari Srinivasa Rao and KoonaRamji (2014) An experimental study of WEDM an Aluminium Alloy. Procedia Materials Science 5 (2014)2197-2206.

2) Amitesh Goswami and Jatinder Kumar (2014) An experimental study of WEDM an Nimonic-80A alloy. Engineering Science and Technology, an International journal 17 (2014) 236-246.

3) A.V.S.Ram Prasad and Koona.Ramji (2014) An experimental study of WEDM an TI-6Al-4V. Procedia Materials Science 5 (2014) 2567 – 2576.

4) Shivkant Tilekar and P.K. Patowari (2014) An experimental study of WEDM an Aluminium and Mild Steel . Procedia Materials Science 5 (2014)2577-2584.

5) Pujari Srinivasa Rao and Beela Satyanarayana (2016) An experimental study of WEDM an Aluminum 2014 T6 alloy.Alexandria Engineering Journal (2016) 55 1077-1084

6) Dwaipayan De and Titas Nandi (2017) An experimental study of WEDM an Pure Sintered Titanium. Material Today: Proceedings 5 (2018) 5374- 5383.

7) S.K. Lalmuan Vaiphei and S. Samanata (2018) An experimental study of WEDM an Al6061 Hybrid Nano Composites. Material Today: Proceedings 5 (2018) 8206-8215

8) D. Srinivasan and N. Ganesh (2018) An analysis of multi pass drilling with different drill bits on gfrp using fuzzy interference systems vol (14)1748-0345.

9) N. Ganesh B.Sudharsan , P.Suganth , A.Ranjith , B.Vishnuvarthan , N.Karthikeyan (2018)An Process Parameter Investigation Of TIG Welding On SS316L Using RSM International Journal of Recent Trends in Engineering & Research.

10) G Rajkumar, R Balasundaram, N Ganesh, S Rajaram(2018) an Investigation of turning parameters of machining INCONEl 718 using Titanium and carbide Inserts science direct vol (11283-11294).

11) N Ganesh, M Udaya Kumar, C Vinoth Kumar, B Santhosh Kumar(2014) an OPTIMIZATION OF CUTTING PARAMETERS IN TURNING OF EN 8 STEEL USING RESPONSE SURFACE METHOD AND GENETIC ALGORITHM an International Journal of Mechanical Engineering and Robotics Research Vol 3

12) H Ramakrishnan, R Balasundaram, N Ganesh, N Karthikeyan (2018) Experimental investigation of cut quality characteristics on SS321 using plasma arc cutting springer link vol 40

13) K.Ravisankar, R.Samiraja, P.Saravanan, M. Sudharsan, N. Ganesh (2018) EXPERIMENTAL INVESTIGATION ON HARD TURNING TO FIND OPTIMAL PROCESS PARAMETERS vol 4