Applying the Taguchi Method on an EDM Machine

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Abstract - In this paper, we are going to see the Taguchi method and apply it to an Electro-discharge machine(EDM) we will cut the mild steel in this process and generate a report which helps us to understand the error which we will be going to face while doing the work. In this work, we will use Minitab 19 to have results in a statics format which will help to find a special scale that helps to make a chart. In this process, we will take some parameters such as peak current, spark on time, spark off time, flushing pressure.it found that on machine characteristics such as metal removal rate(MRR) and tool wear rate(TWR). By this type of data, we will put in the Taguchi method. Experimental results will provide us to study the Taguchi

Key Words: EDM, Taguchi,minitab19, MRR, TWR

1.INTRODUCTION

In this paper, we are going to study EDM by using the Taguchi method. Nowadays we are going to modern work and using an automatic machine which does our work fast and gives output fast but as we all know that every machine has some error which we have to identify and we have created a solution which can change the world. In this research work, we will go to find MRR and TWR in machine form which will lower the cost of making and improve the product quality.

1.1 EDM Machine working

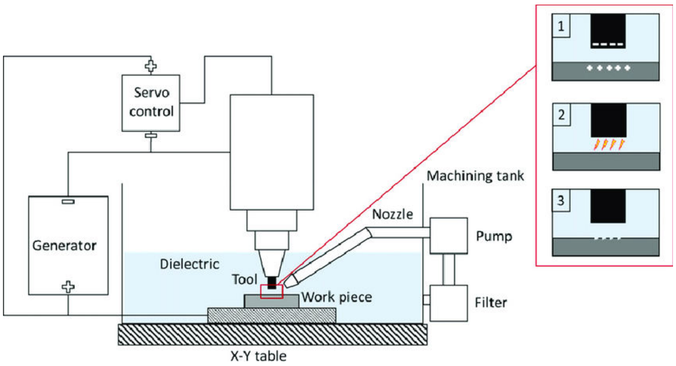


fig 1 EDM machine

EDM means electrical discharge machining this machine is also known as spark machining, spark eroding, die sinking, wire burning, or wire erosion. This machine is the first to note in 1770 by Joseph Priestley. Two Russian scientists, B. R. Lazarenko and N. I. Lazarenko was tasked in 1943 to research ways of preventing the erosion of tungsten electrical contacts thanks to sparking.

In the process of EDM, the material is removed with the help of an electrical spark which helps the material wear out. This principle works on Thermal electrical energy because when the spark is created the heat is also produced due to this material is removed from the workpiece, therefore, it is basic on Thermal electrical energy.when the heat is generated it go to 8000 ℃ to 12000 ℃.In this process, we use Di-electrical fluid work as an insulator to the workpiece and also going on process but if the fluid gets ionized then the spark is created. In the EDM process tool, we provide a negative charge, and in the workpiece, we provide a positive charge.

In the working process of EDM, we provide a DC voltage In this process negative charge goes to the tool and the positive charge goes to the workpiece. Over a tool, there is a motor that helps a tool and gives a feed to the tool. As the workpieces are having a positive charge, we have to fix the workpiece on the fixture so as not to move. This all assembly is put in one container and also we put a Dielectric fluid in it.t. As when the DC current flow to the workpiece and tool the fluid get ionize and created a spark in it and due to spark the heat is produce remove the material for the workpiece

2. Taguchi method

Genichi Taguchi was a scientist who developed the Taguchi method. This Taguchi has developed for improving the TQM. The Taguchi method has been introduced to identify the failure and variations. Taguchi has developed the 2 methods known as Robust design and Taguchi loss function. The robust design helps to set a specification of failure so to the term of failure. Therefore in this study, we will use some parameters like peak current, spark on time, spark off time, flushing pressure. and find the variation in this process

3. EXPERIMENT PROCESS

In this process, the target is mild steel which has a 30mm diameter the experiment is performant on an EDM machine which is working thermal electrical energy

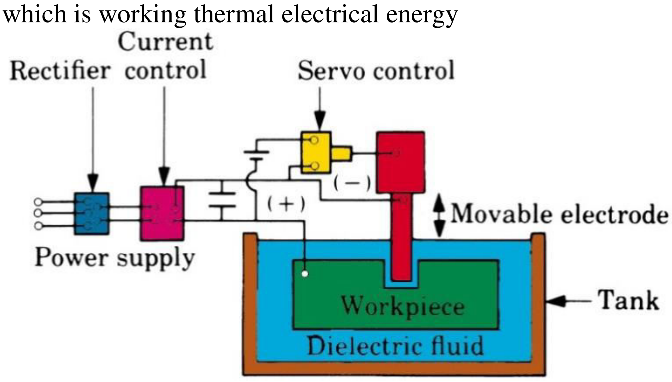


fig:2 of EDM Machine

4.OBJECTIVE

1.To study the influence of EDM parameters on Mild Steel.

2.Study the Taguchi method

3.To find the variations

5.EXPERMENT SETUP

In the experimental setup, we have a 30mm diameter rod of mild steel. In this process, we find the MRR and TWR the workpiece is fixed in the fixture

6. PARAMETER

Ip(A)	Ton(us)	Toff(us)	Fp(kg/cm^2)
10	5	3	0.2
10	10	5	0.3
10	15	7	0.5
12	5	5	0.5
12	10	7	0.2
12	15	3	0.3
14	5	7	0.3
14	10	3	0.5
14	15	5	0.2

This parameter we going to use to find the MRR and TWR error

7.RESULTS AND DISCUSSION FOR MILD STEEL

To measure the diameter we will go to use a vernier caliper we will take 9 readings on the material. In this process, we will be going to use the Taguchi method

A. Taguchi Design

Design Summary

Taguchi Array	L9(3^3)
Factors:	3
Runs:	9

Columns of L9(3^4) array: 1 2 3

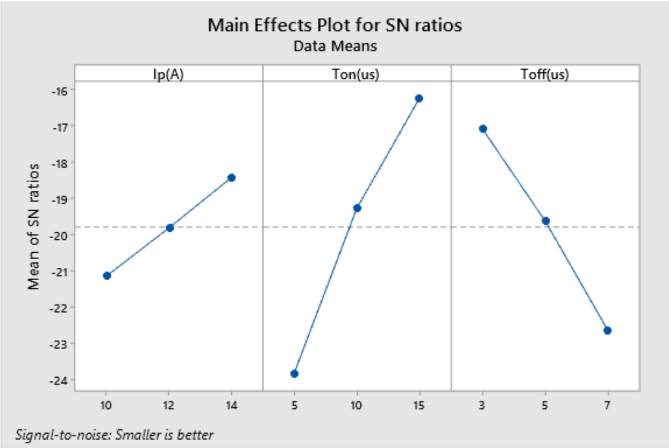
B. EDM Results (Taguchi Design)

Ip(A)	Ton(us)	Toff(us)	Fp(kg/cm^2)	machine time(Min)	MRR (gm/min)	TWR (gm/min)	SNRA1	STDE1	MEAN1
10	5	3	0.2	27	0.000037	0.01458	-22.6069	13.4645	6.80365
10	10	5	0.3	20	0.00005	0.0176	-20.001	9.948	5.07941
10	15	7	0.5	22	0.0000454	0.01589	-20.8301	10.9165	5.62898
12	5	5	0.5	32	0.0000312	0.01745	-24.0835	15.9154	8.12937
12	10	7	0.2	26	0.0000384	0.01925	-22.2791	12.9638	6.55482
12	15	3	0.3	9	0.000111	0.03958	-13.0692	4.4454	2.33492
14	5	7	0.3	35	0.0000285	0.01576	-24.8611	17.4479	8.82895
14	10	3	0.5	12	0.0000833	0.04625	-15.5706	5.9132	3.13658
14	15	5	0.2	11	0.0000909	0.04163	-14.8088	5.4604	2.81043

Response Table for Signal to Noise Ratios

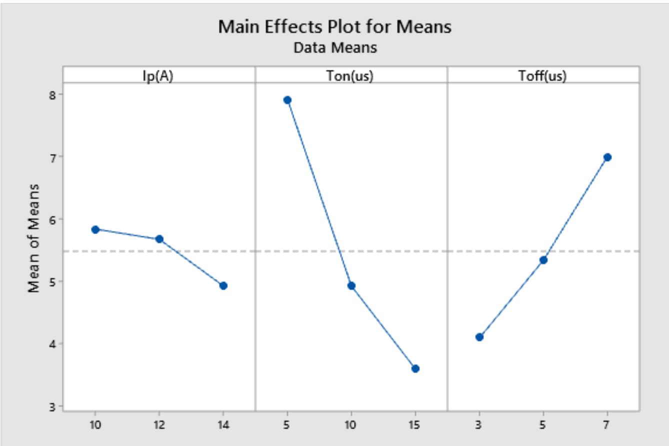
Smaller is better

Level	Ip(A)	Ton(us)	Toff(us)
1	-21.15	-23.85	-17.08
2	-19.81	-19.28	-19.63
3	-18.41	-16.24	-22.66
Delta	2.73	7.61	5.57
Rank	3	1	2



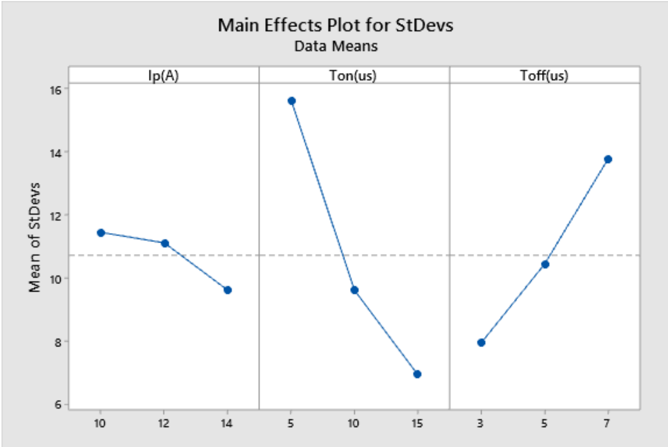
Response Table for Means

Level	Ip(A)	Ton(us)	Toff(us)
1	5.837	7.921	4.092
2	5.673	4.924	5.340
3	4.925	3.591	7.004
Delta	0.912	4.329	2.913
Rank	3	1	2



Response Table for Standard Deviations

Level	Ip(A)	Ton(us)	Toff(us)
1	11.443	15.609	7.941
2	11.108	9.608	10.441
3	9.607	6.941	13.776
Delta	1.836	8.669	5.835
Rank	3	1	2



B. Analysis of variance

General Linear Model: MRR (gm/min) versus Ip(A), Ton(us), Toff(us)

Method

Factor coding	(-1, 0, +1)

Box-Cox transformation

Rounded λ	-1
Estimated λ	-1.14342
95% CI for λ	(-1.46192, -0.817918)

Factor Information

Factor	Type	Levels	Values
Ip(A)	Fixed	3	10, 12, 14
Ton(us)	Fixed	3	5, 10, 15
Toff(us)	Fixed	3	3, 5, 7

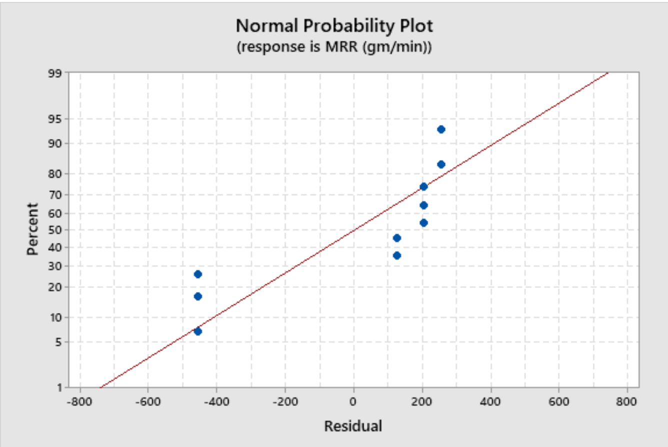
Analysis of Variance for Transformed Response

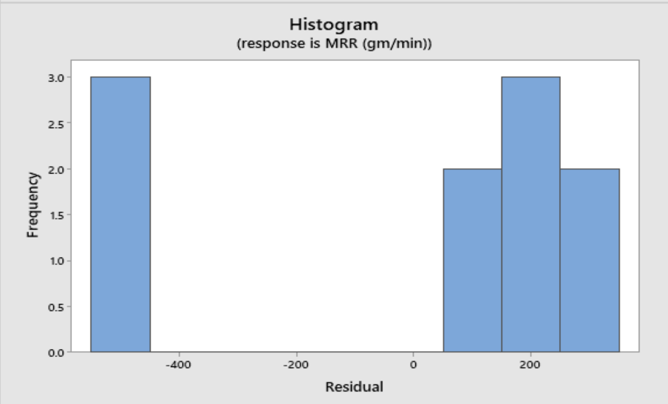
Source	DF	Adj SS	Adj MS	F-Value	P-Value
Ip(A)	2	23695433	11847716	38.75	0.007
Ton(us)	2	534336134	267168067	873.82	0.000
Toff(us)	2	228519520	114259760	373.71	0.000
Error	3	917238	305746		
Lack-of-Fit	2	917238	458619	*	*
Pure Error	1	0	0		
Total	9	732677233			

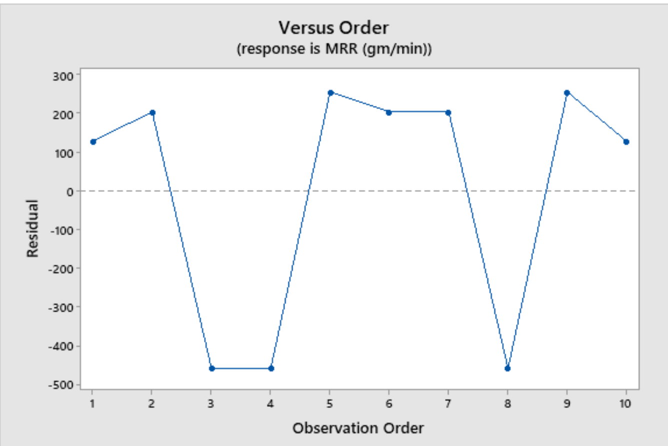
International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 04 Issue: 11 | Nov -2020 ISSN: 2582-3930

Coefficients for Transformed Response

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	-21569	178	-120.86	0.000	
Ip(A)					
10	-1406	244	-5.77	0.010	1.34
12	-798	257	-3.11	0.053	1.29
Ton(us)					
5	-9777	244	-40.10	0.000	1.34
10	2220	257	8.65	0.003	1.29
Toff(us)					
3	5598	244	22.96	0.000	1.34
5	552	257	2.15	0.121	1.29







2)General Linear Model: TWR (gm/min) versus Ip(A), Ton(us), Toff(us)

Method

Factor coding	(-1, 0, +1)
Box-Cox transformation	
Rounded λ	-2
Estimated λ	-1.76148
95% CI for λ	(-2.42098, -1.09998)

Factor Information

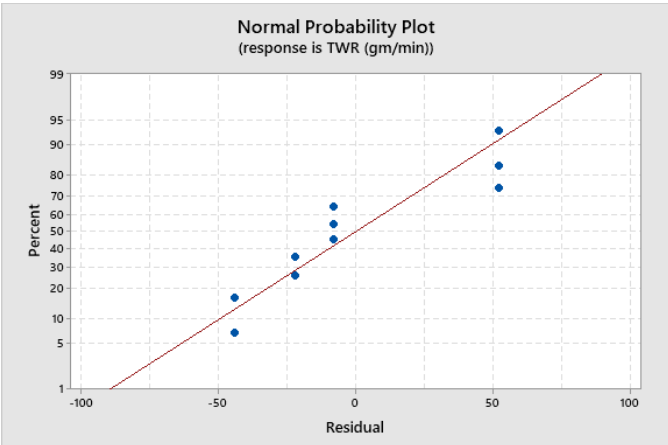
Factor	Type	Levels	Values
Ip(A)	Fixed	3	10, 12, 14
Ton(us)	Fixed	3	5, 10, 15
Toff(us)	Fixed	3	3, 5, 7

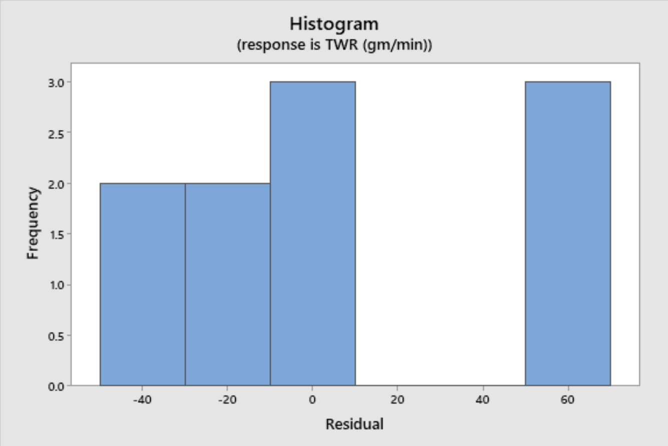
Analysis of Variance for Transformed Response

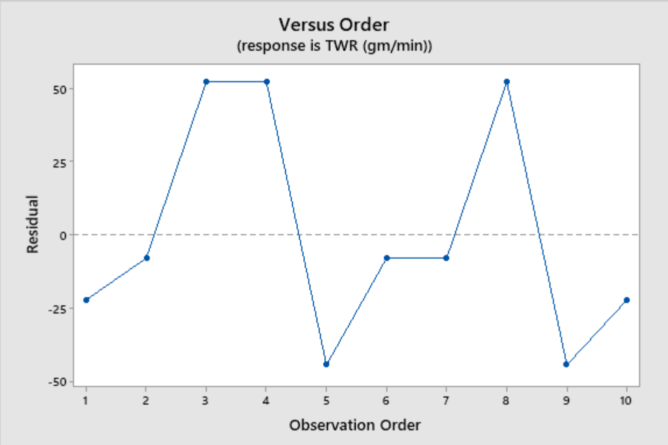
Source	DF	Adj SS	Adj MS	F-Value	P-Value
Ip(A)	2	9756123	4878062	1099.52	0.000
Ton(us)	2	10172560	5086280	1146.45	0.000
Toff(us)	2	4525528	2262764	510.03	0.000
Error	3	13310	4437		
Lack-of-Fit	2	13310	6655	*	*
Pure Error	1	0	0		
Total	9	25576810			

Coefficients for Transformed Response

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	-2623.0	21.5	-122.01	0.000	
Ip(A)					
10	-1348.8	29.4	-45.92	0.000	1.34
12	416.0	30.9	13.46	0.001	1.29
Ton(us)					
5	-1389.2	29.4	-47.30	0.000	1.34
10	491.5	30.9	15.90	0.001	1.29
Toff(us)					
3	678.9	29.4	23.12	0.000	1.34
5	259.9	30.9	8.41	0.004	1.29







Material Removal Rate

as the chart of these shows the main effect of MRR various level condition .we have observed that as the pulse duration increases with peak current the MRR increase in EDM

3. CONCLUSIONS

as we find the relation between the MRR and TWR

Regression Equation

General Linear Model: MRR (gm/min) versus Ip(A), Ton(us), Toff(us)

1)-MRR (gm/min)^-1

=-21569 - 1406 Ip(A)_10 - 798 Ip(A)_12 + 2205 Ip(A)_14 - 9777 Ton(us)_5

+ 2220 Ton(us)_10 + 7557 Ton(us)_15 + 5598 Toff(us)_3 + 552 Toff(us)_5

- 6150 Toff(us)_7

General Linear Model: TWR (gm/min) versus Ip(A), Ton(us), Toff(us)

2)TWR (gm/min)^-2

=-2623.0 - 1348.8 Ip(A)_10 + 416.0 Ip(A)_12 + 932.8 Ip(A)_14

- 1389.2 Ton(us)_5 + 491.5 Ton(us)_10 + 897.7 Ton(us)_15

+ 678.9 Toff(us)_3 + 259.9 Toff(us)_5 - 938.8 Toff(us)_7

As we study the taguchi on EDM we have find many like efficiency and loss of material many other things as we see in paper

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BIOGRAPHIES

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