Experimental Investigation of the Effect of Brass Electrode on Incolen 800 on Electrical Discharge Machine

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Abstract - Components with complicated features, which are challenging to obtain using traditional manufacturing procedures, are often made using electrical discharge machining (EDM), a non-traditional machining technique. The current, pulse on time, and pulse off time are the input parameters in this study, whereas the MRR and surface roughness are the output parameters. The experiment is designed according to Taguchi L9 orthogonal array with three different level of each input parameter. For result interpretation, analysis of variance (ANOVA) was conducted and optimum parameters selected on the basis of the signal to noise ratio, which confirms the experimental result. Find out most important role of input parameter on output parameter. Experiment will be performed on profile such as Flat, Concave, Convex of Inconel 800. Tangible observation will be analyzed with parameters like MRR, Surface roughness test. Conclusion will be displayed in durability of Inconel 800 with respect to Electric Discharge Machine.

Keywords: **EDM, Incolen-800, Taguchi method, Minitab.**

1. INTRODUCTION

Electricity discharge The unconventional machining process known as machining involves the removal of material by use of the thermal energy of a spark. This is achieved through a series of electrical ejections that occur in recurrent sequences between a small gap between an electrode and the work piece. For cutting electrically conductive hard metals and alloys, EDM is widely utilised in the die-making, automotive, and aerospace sectors. Electrode machining (EDM) is a technique that shapes metal sections by repeatedly ejecting an electrical current between a tool (cathode) and a work piece (anode) in an environment of dielectric liquid, therefore removing debris and unwanted material. In this machining technique, the anode refers to the work piece connected to the positive terminal and the cathode to the negative terminal. Some examples of dielectric fluids are kerosene, transformer oil, and distilled water.

2. OBJECTIVE

➢ I have selected Inconel 800 sheet material for carried out the experiment.

➢ Using a Taguchi method, establish the correlation between the input parameters (Peak current, Pulse on time, Pulse off time) and the response variable (Surface Roughness).

➢ Examine the varied effects of various input factors and analyse their impact on output process parameter, as well as determine their relative relevance. This is accomplished by using an L9 orthogonal array based on the Taguchi method to investigate their major effects as well as interaction effects.

➢ Optimization to find the best values for the input process parameters.

3. DESIGN OF EXPERIMENT

3.1 Different Techniques of DOE

1. Factorial design
2. Response Surface Method
3. Mixture Experiments
4. Taguchi Design

3.2 Application of DOE

- The product's most ideal design
- Optimal process parameter combinations
- Long-term answers to issues with production
- The most important criteria for validation and durability tests
- Best strategy for collecting survey data

3.3 Process Parameters

Input Parameter

Factor A:- Current (A)
Factor B:- Pulse On Time **(**μs)
Factor C:- Pulse Off Time **(**μs)

1.
2.

Output Parameter

MRR (mm^3/min)

Surface Roughness (μm)

Table-1: Level of process parameter

Parameters	L-1	L-2	L-3
Current	13	17	28
Pulse On Time	150	180	265
Pulse Off Time	15	16	20

Table-2: L9 Orthogonal Array Level

Ex. No.	Current	Pulse On Time	Pulse Off Time
1	13	150	15
2	13	180	16
3	13	265	20
4	17	150	16
5	17	180	20
6	17	265	15
7	28	150	20
8	28	180	15
9	28	265	16

4. EXPERIMENTAL WORK

Fig-1: EDM Machine

Fig-2: Convex, Flat & Concave Profile Electrode

Table-3: Results Table For Convex Profile

Ex. No.	Current	Pulse On Time	Pulse Off Time	MRR	SR
1	13	150	15	2.9500	4.200
2	13	180	16	4.0750	7.973
3	13	265	20	3.4000	5.778
4	17	150	16	4.8375	5.624
5	17	180	20	6.0625	7.370
6	17	265	15	6.6000	7.820
7	28	150	20	5.9375	7.771
8	28	180	15	9.2250	9.520
9	28	265	16	8.5125	11.720

Table-4: Results Table For Flat Profile

Ex. No.	Current	Pulse On Time	Pulse Off Time	MRR	SR
1	13	150	15	2.2500	4.8560
2	13	180	16	3.9956	8.3652
3	13	265	20	2.6852	6.8535
4	17	150	16	2.9023	5.9985
5	17	180	20	5.9035	8.8562
6	17	265	15	5.9863	9.6522
7	28	150	20	8.8530	8.6525
8	28	180	15	4.8025	12.3035
9	28	265	16	7.5000	9.9900

Table-5: Results Table For Concave Profile

Ex. No.	Current	Pulse On Time	Pulse Off Time	MRR	SR
1	13	150	15	2.4048	9.3050
2	13	180	16	2.5004	6.0510
3	13	265	20	2.0451	6.9922
4	17	150	16	1.8085	7.4000
5	17	180	20	3.8699	9.6547
6	17	265	15	3.9701	10.8005
7	28	150	20	3.7064	13.5025
8	28	180	15	6.2542	8.9846
9	28	265	16	5.3039	10.9801

4. ANALYSIS & RESULTS

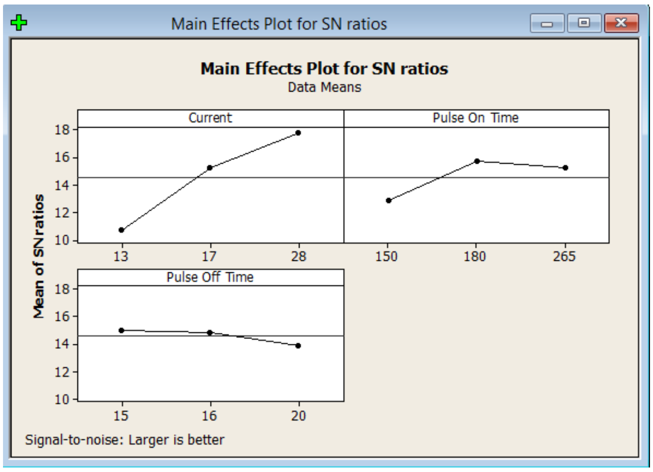

Fig-3: Main SN ratio effect plot (MRR-Convex)

This figure shows the principal plot for MRR at 3 mm thickness for current, pulse on time, and pulse off time. Experimental data indicates the highest MRR at 28 A, 180 μs pulse on time, and 15 μs pulse off time. The lowest MRR was observed at 13 A, 150 μs pulse on time, and 15 μs pulse off time.

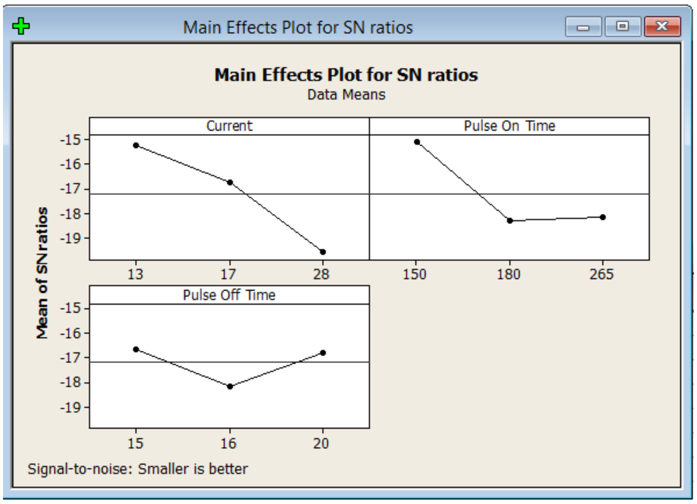

Fig-4: Main SN ratio effect plot (SR-Convex)

Current, pulse on time, and pulse off time affect the main plot for surface roughness at 3 mm thickness, as seen above. Experimental results indicate that surface roughness was maximum at 28 A current, 265 μs pulse on, and 16 μs pulse off, and lowest at 13 A current, 150 μs pulse on, and 15 μs pulse off.

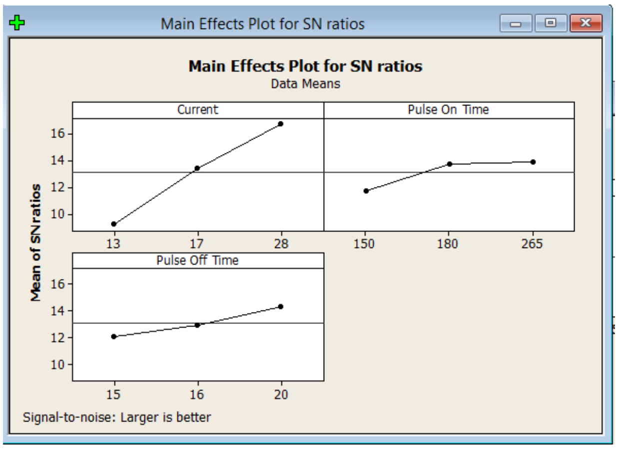

Fig-5: Main SN ratio effect plot (MRR-Flat)

This figure shows the principal plot for MRR at 3 mm thickness for current, pulse on time, and pulse off time. The largest MRR was seen at 28 A current, 150 μs pulse on time, and 20 μs pulse off time in experiments. The lowest MRR was observed at 13 A, 150 μs pulse on time, and 15 μs pulse off time.

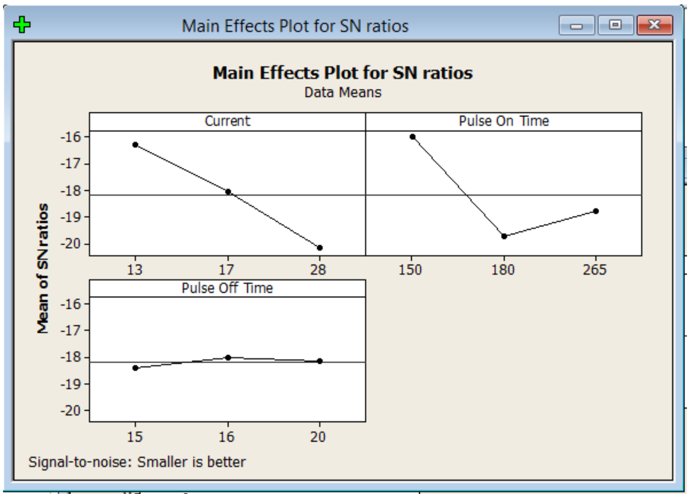

Fig-6: Main SN ratio effect plot (SR-Flat)

Current, pulse on time, and pulse off time affect the main plot for surface roughness at 3 mm thickness, as seen above. Maximum surface roughness was attained at 28 A current, 180 μs pulse on time, and 15 μs pulse off time, according to experimental results. The lowest surface roughness was observed at 13 A, 150 μs pulse on time, and 15 μs pulse off time.

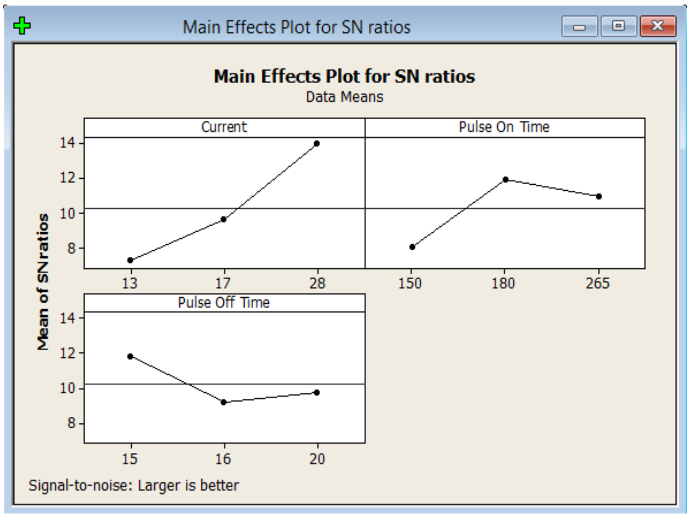

Fig-7: Main SN ratio effect plot (MRR-Concave)

This figure shows the principal plot for MRR at 3 mm thickness for current, pulse on time, and pulse off time. The highest maximum return ratio (MRR) was observed at 28 A, 180 μs pulse on time, and 15 μs pulse off time, according to experimental results. The lowest MRR was observed at 17 A, 150 μs pulse on, and 16 μs pulse off.

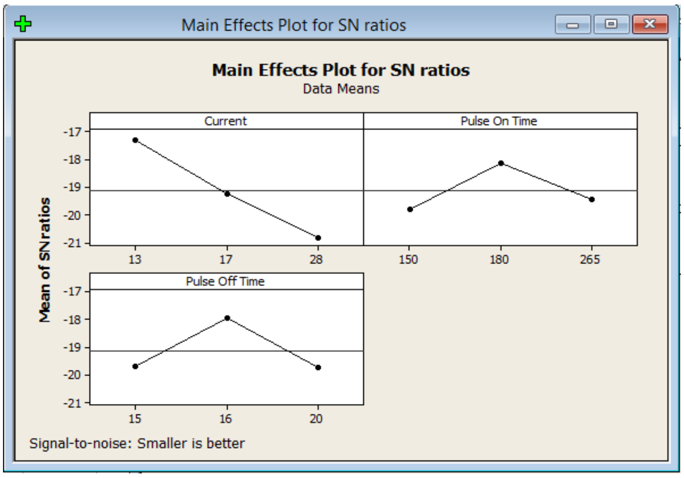

Fig-8: Main SN ratio effect plot (SR-Concave)

Current, pulse on time, and pulse off time affect the main plot for surface roughness at 3 mm thickness, as seen above. The experiment found that the maximum surface roughness was achieved at 28 A, 150 μs pulse on time, and 20 μs pulse off time. The lowest surface roughness was observed at 13 A, 180 μs pulse on and 16 μs pulse off.

5. CONCLUSION

In present work experiment carried out on EDM machine with inconel-800 material by using taguchi design Convex, Flat, Concave shape brass electrode can be used in experimental work For getting high MRR then current must be high Pulse off time is insignificant for MRR Pulse on time up-to certain range impact on MRR The most significant parameter is current for more effect on output parameter Compared to electrodes with flat or concave profiles, those with a convex bottom profile work better.

Flat profile electrode performs better than the concave profile electrode.

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