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Optimization of Process Parameter in Machining Inconel 800 by Electrical Spark Eroding Machine

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ABSTRACT

This paper is about analyzing optimum value of parameter in electrical eroding machining of Inconel 800 with electrolytic copper and silver coated Electrolytic copper as a tool for improving the machining process. The experiments were performed with variable input conditions and the response of material rate is measured for individual experimental value of parameters. To get optimum values of machining the parameters like pulse on time, operating current and voltage are used. The results of this experiment have showed the increasing material removal rate with decreased tool wear.

KEY WORDS: Material Removal Rate, Tool Wear Rate, Silver coated tool.

1. INTRODUCTION

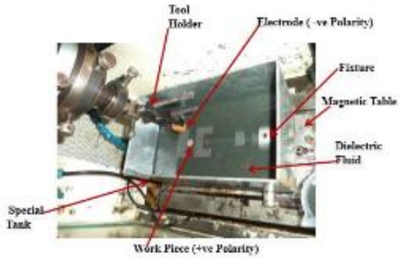
Electrical discharge machine is an unconventional Spark eroding machine, which removes metal from specimen by means of Electrical sparks (heat energy) and friction of powders in dielectric medium. Electrically conductive materials are only machined in electrical discharge machining. Comparing to conventional method of machining, it can machine high hardened material, simultaneously, there is a lower material removal rate (MRR) with good surface finish (less surface roughness) (Anil Kumar, 2010). The machining precision of the work piece mainly depends on the electrical conductivity of tool. In this work the tool is coated with silver, hence it increased the electrical conductivity due to this 26.8% material removal rate has increased and 25% of Tool wear rate has decreased. In this work graphite powder is added in kerosene dielectric medium, which brought 30% reduction of breakdown voltage in 50µm inter Electrode Gap with 4g/l of powder, results in increasing the material removal rate. Powder mixed in dielectric medium in electrical eroding machining had improved the machining rate and quality of machining. Here the silicon powder is added to dielectric medium which increased the material removal rate improving the surface roughness. The production rate is increased with 10% by reducing time of machining for tool steel.

In this work different type of powders are used for predicting the effects in machining work piece. The addition of graphite powder provides smooth and defect-less surface, while alumina powder produced higher inter electrode gap and material removal rate. This work explains the handling of process parameter in EDM in order to get optimum value of MRR, TWR and SR. The Effect of increasing current increased MRR and MRR depends on pulse on & pulse off time also. Initially increasing pulse on time is increased for decreasing MRR. Simultaneously, TWR is based on current and the current directly proportional to the TWR (Wong, 1998). He clearly derived about effect of silicon powder used in dielectric medium with AISI D2 steel. The amount of silicon powder addition in dielectric medium affects MRR in PMEDM (Jothimurugan, 2012). Varying the pulse off time, discharge current, voltage had significant of MRR. The pulse on time of 400µs, pulse of time of 1600µs, current of 15A and voltage 40v was experimented to get a maximum MRR using RSM in EDM process.

2. EXPERIMENTAL METHODS

The experiments were conducted with two factors, three levels for two different tools to complete the machining in die sinking EDM machine and it is tabulated in Table 1. The tools used were electrolytic copper and silver coated electrolytic copper with the dimensions of 25mm in diameter and 23mm in length as in Figure 1a. The work piece used for machining is Inconel 800 with dimensions of diameter 22mm and 20mm in length. The dielectric medium used here is EDM oil. The experiments have been performed on V-5030 EDM machine manufactured by Electronica as shown in Figure 1b and the parametric description is shown in Table 2. Here pulse on time and peak current value has been varied. Material removal rate and Tool Wear rate has been observed with silver coated electrolytic copper and electrolytic copper tool with machining time period of 5 minutes.


a



b

Figure.1a & 1b. shows copper and silver coated tool, Experimental Setup.

Table.1. Experimental levels

Electrolytic copper and Silver coated Electrolytic copper			
Factors	Level		
	1	2	3
Current	5	10	15
Pulse on time	6	7	8

Table.2.Parametric description of the EDM process

Working parameter	Description
Work piece	Inconel 800
Tool	Electrolytic copper and Silver coated electrolytic copper
Dielectric medium	EDM oil
Peak Current	5,10,15 (A)
Pulse on time	6,7,8 (µs)
Pulse off time	5 (µs)
Supply voltage	240 (V)
Polarity	Straight

3. RESULTS & DISCUSSION

The experiments were conducted with the different set of peak current (I) and pulse on time with silver coated electrolytic copper and standard electrolytic copper tool. The experiment was conducted and the obtained resulted value has been tabulated below in Table 3 and Table 4. The resulted values were graphically represented from graph 1 to graph 9 and analyzed to obtain optimal combination. MRR Value (g/min), the ratio between the weight loss of the work piece in grams and duration of machining in minutes. TWR (g/min) Value, the ratio between the weight loss of the tool electrode in grams and duration of machining in minutes. At here, some notation were followed the Peak Current I in A, Pulse on time μs, Weight of the work piece before machining is W_1 in g, Weight of the work piece after machining is W_2 in g, Weight of the tool electrode before machining is E_1 in g and Weight of the tool electrode after machining is E_2 in g.

Experimental set 1: At this experimental setup, Pulse on value has been maintained at 6 µs and Peak current value is varied 5A, 10A and 15A. The graph 1 shown in below are the MRR and TWR which has been observed with electrolytic copper as tool with a machining time period of 5 minutes.

Experimental set 2: At this experimental setup Pulse on value has been increased to 7 µs and Peak current value is varied 5A, 10A and 15A. The graph 2 shown in below are the MRR and TWR which has been observed with electrolytic copper as tool with a machining time period of 5 minutes.

Experimental set 3: At this experimental setup Pulse on value has been increased to 8 µs and Peak current value is varied 5A, 10A and 15A. The graph 3 shown in below are the MRR and TWR which has been observed with electrolytic copper as tool with a machining time period of 5 minutes.

Experimental set 4: At this experimental setup Pulse on value has been maintained at 6 µs and Peak current value is varied 5A, 10A and 15A. The graph 4 shown in below are the MRR and TWR which has been observed with silver coated electrolytic copper as tool with a machining time period of 5 minutes.

Experimental set 5: At this experimental setup Pulse on value has been increased to 7 µs and Peak current value is varied 5A, 10A and 15A. The graph 5 shown in below are the MRR and TWR which has been observed with silver coated electrolytic copper as tool with a machining time period of 5 minutes.

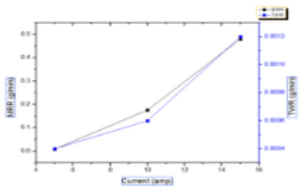
Experimental set 6: At this experimental setup Pulse on value has been increased to 8 µs and Peak current value is varied 5A, 10A and 15A. The graph 6 shown in below are the MRR and TWR which has been observed with silver coated electrolytic copper as tool with a machining time period of 5 minute

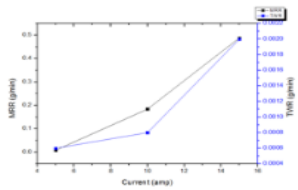
Table.3. Result observed in without coated Electrolytic copper tool.

S.No	I (A)	Pulse on (µs)	Machining Rate			MRR (g/min)	Tool Wear			TWR (g/min)
			W_1 (g)	W_2 (g)	$(W_1$-$W_2)$ (g)		E_1 (g)	E_2 (g)	$(E_1$-$E_2)$ (g)	
1	5	6	74.63	74.59	0.04	0.008	108.805	108.803	0.002	0.0004
2	10	6	81.84	80.86	0.98	0.176	108.803	108.80	0.003	0.0006
3	15	6	77.54	75.14	2.4	0.48	108.80	108.79	0.006	0.0012
4	5	7	76.02	75.13	0.89	0.008	108.794	108.791	0.003	0.0006
5	10	7	80.55	79.63	0.92	0.184	108.791	108.787	0.004	0.0008
6	15	7	77.57	75.13	2.44	0.488	108.787	108.777	0.01	0.002
7	5	8	77.48	77.17	0.31	0.062	108.777	108.773	0.004	0.0008
8	10	8	82.05	80.97	1.08	0.216	108.773	108.766	0.007	0.0014
9	15	8	78.53	75.59	2.94	0.588	108.766	108.75	0.016	0.0032

Table.4. Result observed with silver coated Electrolytic copper tool.

SNo	I (A)	Pulse on (µs)	Machining Rate			MRR (g/min)	Tool Wear			TWR (g/min)
			W1 (g)	W2 (g)	(W1-W2) (g)		E1 (g)	E2 (g)	(E1-E2) (g)	
1	5	6	75.74	75.65	0.009	0.018	117.586	117.58	0.006	0.0012
2	10	6	75.72	74.64	0.98	0.196	117.58	117.56	0.02	0.004
3	15	6	72.48	69.65	2.83	0.566	117.56	117.53	0.03	0.006
4	5	7	77.99	77.56	0.43	0.086	117.53	117.52	0.01	0.002
5	10	7	75.82	74.20	1.62	0.324	117.52	117.50	0.02	0.006
6	15	7	81.28	78.26	2.92	0.584	117.49	117.44	0.05	0.01
7	5	8	78.76	75.13	0.63	0.126	117.44	117.42	0.01	0.004
8	10	8	77.52	75.72	1.81	0.362	117.42	117.38	0.04	0.008
9	15	8	76.89	73.65	3.24	0.648	117.38	117.30	0.08	0.016


Graph.1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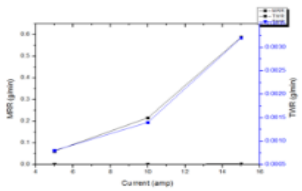
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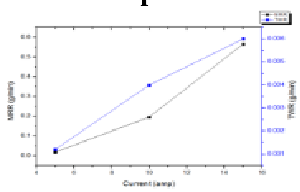
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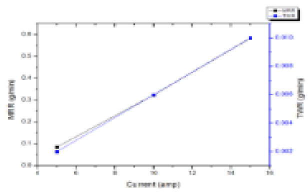
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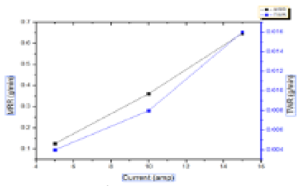
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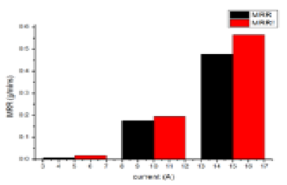
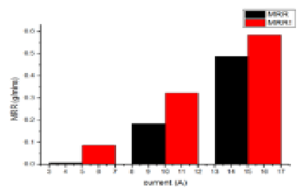

Graph.7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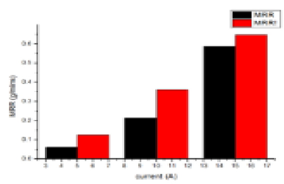
Graph.9

graphs of the MRR and TWR

At 5a Peak Current: At this experimental setup Pulse on value has been maintained at 6 µs and Peak current value is 5A. The graph 7 shown in below are the MRR and MRR! Which has been observed with electrolytic copper and silver coated electrolytic copper as tool with a machining time period of 5 minutes.
At 10a Peak Current: At this experimental setup Pulse on value has been maintained at 6 µs and Peak current value is 10A. The graphs 8 shown in below are the MRR and MRR! Which has been observed with electrolytic copper and silver coated electrolytic copper as tool with a machining time period of 5 minutes.
At 15a Peak Current: At this experimental setup Pulse on value has been maintained at 6 µs and Peak current value is 15A. The graphs 9 shown in below are the MRR and TWR. Which has been observed with electrolytic copper and silver coated electrolytic copper as tool with a machining time period of 5 minutes.

Table.6. Optimum parameter Combination

Peak Current (A)	electrolytic copper			Silver coated electrolytic copper		
	Pulse on time (µs)	MRR (g/min)	TWR (g/min)	Pulse on time (µs)	MRR (g/min)	TWR (g/min)
5	8	0.062	0.0008	8	0.126	0.004
10	8	0.216	0.0014	8	0.362	0.008
15	8	0.588	0.0032	8	0.648	0.016

4. CONCLUSION

The study of the performance measures of EDM were carried out for different selection of parameters and obtained the optimum combination. The following are the effects of electro plated tool in to the dielectric medium on MRR, TWR for the EDM process. The test results have shown that there is significant effect of electroplated tool upon all the output parameters selected. The tool coated with silver, increased the electrical conductivity due to this 20% material removal rate has increased simultaneously tool wear rate has slightly increased which is due to the low thermal conductivity of electrolytic copper over silver coated electrolytic copper and also the electrode material does not absorb more amounts of heat and improved the material removal rate. The TWR is marginally higher with silver coated electrolytic copper.

REFERENCES

Anil Kumar, Maheshwari S, Sharma C, Naveen Beri, A Study of Multi objective Parametric Optimization of Silicon Abrasive Mixed Electrical Discharge Machining of Tool Steel, Materials and Manufacturing Processes, 25, 2010, 1041–1047.

Jeswani M.L, Effect of the addition of Graphite powder to Kerosene Used as the dielectric fluid in Electrical Discharge Machining, Elsevier Sequoia S.A., Lausanne, 1981, 133-139.

Pecas P, Henriques E, Influence of silicon powder-mixed dielectric on conventional electrical discharge machining, International Journal of Machine Tools & Manufacture, 43, 2003, 1465–1471.

Jothimurugan R, Amirthagadeswaran K.S, Joel Daniel, Performance of Silver Coated Copper Tool with Kerosene-Servotherm Dielectric in EDM of Monel 400, Journal of Applied Sciences, 12 (10), 2012, 999-1005.

Uno Y, Okada A, and Cetin S, Surface Modification of EDMed Surface with Powder Mixed Fluid, 2nd International Conference on Design and Production of Dies and Molds, 2001, 146-154.

Tzeng Y.F, and Lee C.Y, Effects of Powder Characteristics on Electro discharge Machining Efficiency, International Journal of Advanced Manufacturing Technology, 17, 2001, 586–592.

Wong Y.S, Lim L.C, Iqbal Rahuman, Tee W.M, Near-mirror-Finish phenomenon in EDM using powder-mixed dielectric, Journal of Materials Processing Technology, 79, 1998, 30-40.