Machine Ability Characteristics of PWEDM Process

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Abstract: ***The traditional machining consists of a specific contact between the tool and work piece. As a result of this contact the tool may wear out after a few operations. In addition to that, the MRR (Material Removal Rate), Surface Finish, etc. is also lowered. As a result of these drawbacks, traditional or conventional machining processes cannot be used to machine ceramic based alloys and thus we opt for unconventional machining process. The Electrical Discharge Machine contains of two spaces one is Electrode and other is Work piece. In this concept the among the tool wear rate is moderate and the surface roughness is to be poor. The tool cost is so high. Hence continuously tool modification is not possible. So in the work main objective of the problem is reduced the tool wear rate and increase the MRR. (Material removal rate). So in the case we are consider in the surface roughness. The surface roughness is to be high is the taken in industrial application. So we have focus with surface roughness. These are the considering with in our problems. In our aim is reducing the toll wear and improve the Material Remove rate. In order to addition of graphite in Electrolyte. When added the electrolyte in Graphite the Toll wear rate decrease and increase a material Removal Rate. Finally we have disc the DOE process***

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Keywords: ***Graphene, Silicon Carbide, EDM, MRR, TWR***

I. INTRODUCTION

The Sic added in a Electrolyte in EDM Machine. The MRR are in increase corresponding TWR are Decreased. The author shown in ANN Technique are used in optimization process[1.] In the paper observe the Al 6063 material cutting in EDM Process when the Nano Ceramic material added in the electrolyte the Material removal rate it will be incrased.[2].The Nano Powder Mixed in EDM when the material removed rate increase in 25 to 30 % and the corresponding Toll wear rate it will be decrased[3].in the paper focused Inconel powder mixed with electrolyte material and improved the machining characterstation[4]. The research work focused on metallic powder added in a Electrolyte. When the metallic powder added in a electrolyte the surface finished are improved gradually .[5]. The rotary and vibro rotary mechanism used in a EDM machine the surface finish are to be improved[6]. The machining parameter optimize in various optimization technique. When the machining parameter optimizes the material removal rate improve 30%.[7]The pulse on and pulse off time are optimized in a Taguchi method. The pulse on and pulse off time optimize the Material Removal Rate are to be increased[8]the researcher focus on the electrolyte gap between tool and electrolyte. When the gap is focused the improvedsurface finish[9].the author focused in a alumina powder as a electrolyte. The powder added in a electrolyte the surface roughness are increasing[10].

II. DOE PROCESS METHDOLOGY

The doe process methodology as shown in tables in the process block diagram as in a DOE Table. The tables consider as a no of variables the table shown in below

a) EXPERIMENTAL TABLESETUP\

Table 1. Experimental Setup

S.NO.	CONTENT	SETUP-1	SETUP-2	SETUP-3
1	DIELECTRIC FLUID	EDM OIL	EDM OIL	EDM OIL
2	POWDER	NIL	SILICON CARBIDE	GRAPHENE
3	WORK PIECE	AL-SIC	AL-SIC	AL-SIC
4	WORK PIECE DIMENSIONS(MM)	117X55X20	117X55X20	117X55X20
5	TOOL	COPPER	COPPER	COPPER
6	TOOL DIAMETER	6MM	6MM	6MM

The table shown in a experimental set up in the block diagram. The set up shown that the variance of the process

b) Process Flow chart

The process flow chart shown in the folw chart. The chart with explained the process of the doe. The process chart with discuss about how the process will going on. Finally flow process has been concluded.

Revised Manuscript Received on November 30, 2019.
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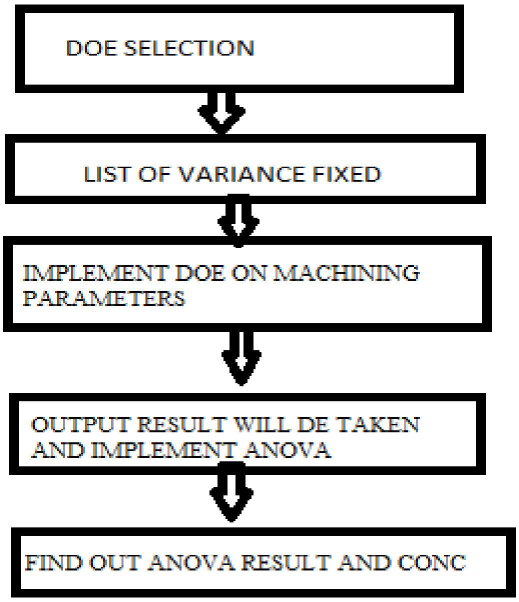

C. BLOCK DIAGRAM

The EDM shown in figure 1. Since the experiments require the work piece to be completely submerged in the dielectric fluid, a customized tank of mild steel having dimensions 180x180x100 mm was made. The image of the EDM machine is shown as below:

Fig 1.BLOCK DIAGRAM

III. DESIGN OF EXPERIMENTS USING TAGUCHI METHODS

The experiment set up shown in table 2. The experement contain based on pulse on, pulse off and lift time of the toll. The L27 parameter valve shown in table 3.

A. Process parameters and their levels:

Table II . Parameters and Levels

PARAMETERS	LEVEL 1	LEVEL 2	LEVEL 3
CURRENT	10	20	30
PULSE-ON	40	60	80
PULSE-OFF	2	5	8
LIFT TIME	1	2	3

B. Plan of Experiments:

Table III. Plan of Experiments

S.NO.	I	T_{ON}	T_{OFF}	LIFT TIME
1.	10	40	2	1
2.	10	60	5	2
3.	10	80	8	3
4.	20	40	5	3
5.	20	60	8	1
6.	20	80	2	2
7.	30	40	8	2
8.	30	60	2	3
9.	30	80	5	1
10.	10	40	2	1
11.	10	60	5	2
12.	10	80	8	3
13.	20	40	5	3
14.	20	60	8	1
15.	20	80	2	2
16.	30	40	8	2
17.	30	60	2	3
18.	30	80	5	1
19.	10	40	2	1
20.	10	60	5	2
21.	10	80	8	3
22.	20	40	5	3
23.	20	60	8	1
24.	20	80	2	2
25.	30	40	8	2
26.	30	60	2	3
27.	30	80	5	1

The values of the different parameters are then set into the EDM machine and then the corresponding output parameters are calculated.

C. Final Value Of Mrr And Twr:

After the experiments are conducted the values of the MRR and TWR are tabulated and are listed as below:

Table IV :FINAL VALUE OF MRR AND TWR

S.NO.	I (A)	T_{ON} (μS)	T_{OFF} (μS)	LIFT TIME(S)	MRR (MG/MIN)	TWR (MG/MIN)
1.	10	40	2	1	9.169980383	0.489847
2.	10	60	5	2	9.886003745	0.545041
3.	10	80	8	3	9.399215879	0.492828
4.	20	40	5	3	37.51543125	2.595326
5.	20	60	8	1	20.07170813	1.414433
6.	20	80	2	2	16.85791613	1.337926
7.	30	40	8	2	41.21213772	3.0115
8.	30	60	2	3	39.30366469	3.006638
9.	30	80	5	1	24.05147935	1.984416
10	10	40	2	1	16.65750824	0.654296
11	10	60	5	2	14.32434998	0.550341
12	10	80	8	3	10.45526773	0.386521
13	20	40	5	3	42.05575254	2.046287
14	20	60	8	1	28.56336932	0.969895
15	20	80	2	2	23.88985063	1.12843
16	30	40	8	2	48.59425768	2.134642
17	30	60	2	3	45.63920236	2.330458
18	30	80	5	1	33.82185937	1.373403
19	10	40	2	1	34.6726217	0.756179

Retrieval Number: A3962119119/2019©BEIESP
DOI: 10.35940/ijitee.A3962.119119
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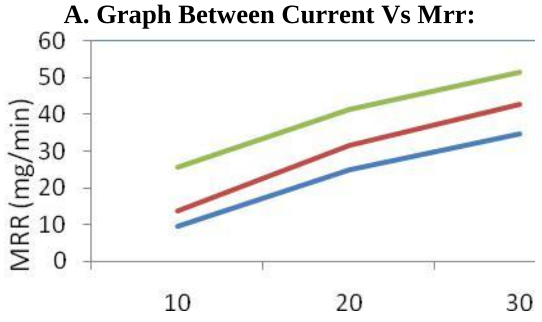
20	10	60	5	2	26.12489386	0.577216
21	10	80	8	3	15.81311456	0.359387
22	20	40	5	3	53.92234476	1.491836
23	20	60	8	1	39.18903608	0.655453
24	20	80	2	2	30.65540402	0.529778
25	30	40	8	2	62.29890228	1.460006
26	30	60	2	3	54.16945119	1.335615
27	30	80	5	1	38.522389	0.532911

IV. RESULT ANALYSIS

A. Graph Between Current Vs Mrr:

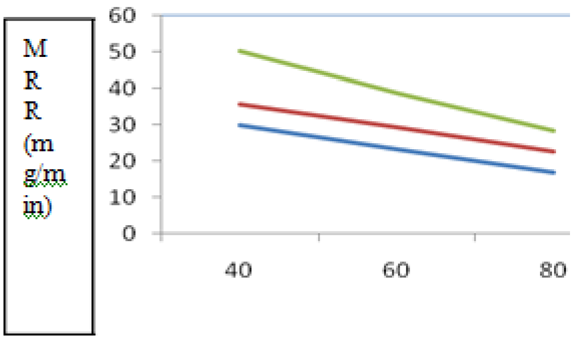


PEAK CURRENT

Fig 2 : Graph between Current Vs MRR

The above pictorial representation gives the shown between the three setups. In this graph the current is plotted in the X-axis and the corresponding MRR value is plotted in the Y-Axis. The maximum MRR value that was recorded as 51.6636 mg/min when the current was 30A and Graphene was mixed to the EDM oil. The next highest value of MRR was found to be 42.6851 mg/minwhen the current was at 30A and Silicon Carbide was mixed in the EDM oil. At 30A the MRR was found to be least (34.8558 mg/min) when no powder was added. It is clearly visible from the graph, the MRR increases as the current increases. So from the graph it can be incurred that the MRR is directly proportional to the current. It can also be inferred that the addition of Graphene considerably increases the MRR when compared to the other two setups. This is because Graphene has high thermal conductivity when compared to Silicon Carbide and thus acting as a better medium to transmit the spark from the tool to the work piece.

B. Graph Between Pulse-On Time Vs Mrr:

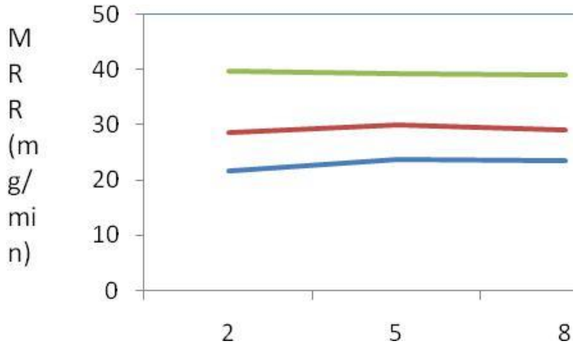


PULSE-ON TIME

Fig 3: , Graph Between Pulse-On Time Vs Mrr

The above graphical representation gives the shown between the three setups. In this graph the Pulse-on time is plotted in the X-axis and the corresponding MRR value is plotted in the Y-Axis. The maximum MRR value that was recorded as 50.298 mg/min when the Pulse-on time was 40µs and Graphene was mixed to the EDM oil. The next highest value of MRR was found to be 35.7692 mg/min when the Pulse-on time was at 40 µs and Silicon Carbide was mixed in the EDM oil. At 40 µs the MRR was found to be least (29.9918 mg/min) when no powder was added. It is clearly visible from the graph, the MRR decreases as the Pulse-on time increases. So from the graph it can be incurred that the MRR is indirectly proportional to the Pulse-on time. It can also be inferred that the addition of graphene considerably increases the MRR when compared to the other two setups. The gradual decrease in MRR with respect to T_{on} can be credited to deburr being formed in between the tool and the workpiece. As a result further removal of workpiece is slowed down, and thus MRR decreases.

C. Graph Between Pulse-Off Vs Mrr



PULSE-OFF TIME(µs)

Fig 4:Graph Between Pulse-Off Vs Mrr

The above graphical representation gives the shown between the three setups. In this graph the Pulse-off time is plotted in the X-axis and the corresponding MRR value is plotted in the Y-Axis. The maximum MRR value that was recorded as 39.8325mg/min when the Pulse-off time was 2 µs and Graphene was mixed to the EDM oil. The next highest value of MRR was found to be 28.7289 mg/min when the Pulse-on time was at 2 µs and Silicon Carbide was mixed in the EDM oil. At 2 µs the MRR was found to be least (21.7719 mg/min) when no powder was added. It is clearly visible from the graph that when graphene is added to EDM oil the MRR decreases constantly as the Pulse-off time increases. It can also be observed that the addition of Silicon Carbide increases the MRR to a particular value and then decreases gradually. The same trend can be observed when no powder is added to the EDM oil. The gradual increase in MRR with respect to T_{Off} can be credited to enough time being provided for the deburr to be carried away with the EDM oil that is being circulated.The above graphical representation gives the shown between the three setups. In this graph the Lift time is plotted in the X-axis and the corresponding MRR value is plotted in the Y-Axis. The maximum MRR value that was recorded as41.3016 mg/min when the Lift time was 3 s and Graphene was mixed to the EDM oil. The next highest value of MRR was found to be 32.7167 mg/min when the Pulse-on time was at 3 s and Silicon Carbide was mixed in the EDM oil. At 3 s the MRR was found to be least (28.7394 mg/min) when no powder was added. It is clearly visible from the graph, the MRR increases as the Lift time increases. So from the graph it can be incurred that the MRR is directly proportional to the Lift time.

Retrieval Number: A3962119119/2019©BEIESP
DOI: 10.35940/ijitee.A3962.119119
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D,Graph Between Current Vs Twr:

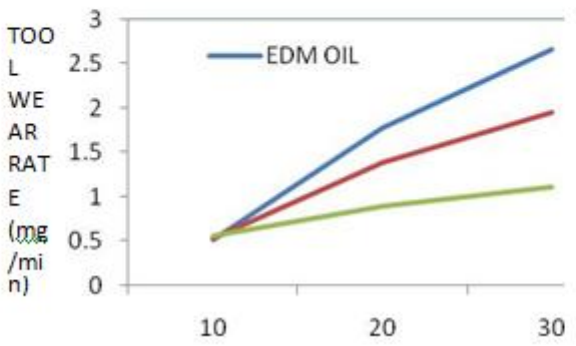

Fig 5: ,Graph Between Current Vs Twr

The above pictorial representation gives the shown between the three setups. In this graph the peak current is plotted in the X-axis and the corresponding TWR value is plotted in the Y-Axis.At 10A the TWR was found to be least when no powder was added in the EDM oil at a value of 0.50924 mg/min. However as the value of peak current increases the TWR with no powder increases and is greater than the TWR of the other two setups. The TWR with graphene mixed dielectric is found to be the least(1.10951 mg/min)at 30A followed by the TWR of Silicon Carbide mixed dielectric at 1.94617 mg/min. The TWR of pure EDM oil was found to be 2.66752 mg/min which is the highest among all the values. Graphene having a repetitive structure and high thermal conductivity, it is an ideal material to conduct heat even at a higher peak current value, as a result there is less damaged caused to the tool and thus less TWR for graphene mixed electrolyte is lesser.

V. CONCLUSION

The Aluminium Silicon Carbide work piece was made using the stir casting process and milling process was used in order to give the finishing.There were various parameters that were listed and out of those parameters, the parameters that were selected were: Peak Current (I),

Pulse-on time (T_{on}), Pulse-off time (T_{off}) and Lift Time (LT).There were four parameters and three levels of the parameter were selected. Later by using Taguchi methods, the L9 set of experiments were selected and the experiment plan was framed.The MRR was found to be highest when graphene was added and the parameters were found to be Peak Current: 30A, Ton: 40µs, Toff: 8µs and Lift Time: 2sThe TWR was found to be lowest when graphene was added and the parameters were found to be Peak Current: 10A, Ton: 80µs, Toff: 8µs and Lift Time: 3sThe MRR was found to be second highest when Silicon Carbide was added and the parameters were found to be Peak Current: 30A, Ton: 40µs, Toff: 8µs and Lift Time: 2sThe TWR was found to be Second lowest when Silicon Carbide was added and the parameters were found to be Peak Current: 10A, Ton: 80µs, Toff: 8µs and Lift Time: 3s

Overall, the addition of graphene has influenced the Material Removal Rate and the Tool Wear Rate in the EDM machining process.

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DOI: 10.35940/ijitee.A3962.119119
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