OPTIMIZATION PROCESS PARAMETERS IN SINKER EDM PROCESS MACHINING OF P20STEEL

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ABSTRACT

The performance characteristics of sinker EDM for machining P20 Steel are investigated in this thesis. Copper is the electrode material. The parameters Tool shape Round, Hexagonal, Square, Spark gap 12.5mm, 12.8mm, 13.1mm, , and current 5Amp, 10Amp, 15Amp are the process parameters whose effect tool wear, material removal rate and surface roughness values is to be determined. The process parameters are arranged as per L9 orthogonal array.

INTRODUCTION

EDM is a process of thermal material removal process in which material is evacuated by nearby vaporizing or melting little zones at the surface of work piece. The EDM procedure expels material by controlled material erosion by repetitive sparks of electricity between the tools immersed in a dielectric medium and workIn the kick the bucket - sinker EDM Machining process, two metal parts are submerged in a protecting fluid and are associated with a wellspring of current which is switched on and off naturally relying upon the parameters set on the controller. At the point when the current is exchanged on, an electric pressure is made between the two metal parts and if the two sections are united to inside a small amount of an inch, the electrical strain is discharged and a start hops over. Where it strikes, the metal is warmed up so much that it dissolves. The plan done by Seepala Kiran [1], The main aim is to assay the achievement characteristics throughout sinker acquittal machining by demography P20 Steel materials. The aqueduct actual is copper. The Pulse on time and off time, spark gap and accepted are anticipation of as ascribe ambit to see aftereffect of ambit on Material Removal Rate (MRR), apparatus abrasion amount and apparent roughness. The plan done by J Jeevamalar [2l Machining may be a one a part of the voltage primarily based Unconventional Machining Technique. The voltage is anon acclimatized yield abroad or cut the metals. It's additionally accepted as Abrasion Machining or Electro Abrasion Machining. The metal is removed by electrical atom acquittal amid apparatus (Cathode) and plan section (Anode). Acquittal Machining is active in mould and die creating industries, Automobile industries and creating of arena elements.

EXPERIMENTAL SETUP AND PROCEDURE

Electric discharge machining is performed to determine the effect of tool shape, current and spark gap on Material Removal Rate, Surface Roughness, and Tool Wear Rate while machining P20 Tool Steel. The parameters tool shape, current and spark gap are the process parameters considered to determine their effect on tool wear, surface roughness & material removal rate.

Round, Hexagonal and Square are taken as electrode shapes. The experiments are conducted as per Taguchi technique L9 orthogonal array to optimize the input parameters for higher MRR, lesser surface roughness and lesser tool wear. The machine details are: **DIE SINK EDM 30A, Make: ELECTRIONCA LTD, United Kingdom**

Dielectric fluid is EDM oil commercial grade (freezing point= 94°C, specific gravity= 0.763) with Cu tool which is pin shaped internal flushing with a pressure of 0.2 Kgf/cm^2.

TAGUCHI PARAMETER DESIGN - OPTIMIZATION OF PARAMETERS USING MINITAB SOFTWARE

Using randomization technique, specimens are machined using Die Sink EDM and surface roughness values, MRR and TWR are determined. The experimental data for the process parameters have been reported in Tables.

The process parameters tool shape, current and spark gap are selected for optimization. They are arranged as per L9 Orthogonal array by taking 3 values for each parameter as shown in below table.

Design of Process parameters as per L9 orthogonal array

Run order	Shape	Current (Amps)	Spark gap (mm)
1	Round	5	12.5
2	Round	10	12.8
3	Round	15	13.1
4	Square	5	12.8
5	Square	10	13.1
6	Square	15	12.5
7	Hexagonal	5	13.1
8	Hexagonal	10	12.5
9	Hexagonal	15	12.8

Table – Arrangement of Process Parameters for machining as per L9 Orthogonal array

CALCULATION AND RESULTS OF MRR AND TWR

Material Removal Rate (MRR), is the ratio of the difference of weight of the work piece material before and after machining to the machining time.

The MRR is calculated by,
MRR (g/min) = Initial Weight of Work piece – Final Weight of Work piece / Time of Machining.

Tool Wear Rate (TWR), is the ratio of the difference of weight of the tool before and after machining to the machining time. TWR is calculated using the formula given as,

TWR (g/min) = Initial – Final Weight of Tool / Time of Machining

Average Surface Roughness (Ra)

Surface roughness is an important output performance in EDM which is influences the product quality and cost. Surface roughness is measured by surface roughness tester.

Fig – Hexagonal Electrode, circular and square electrode.

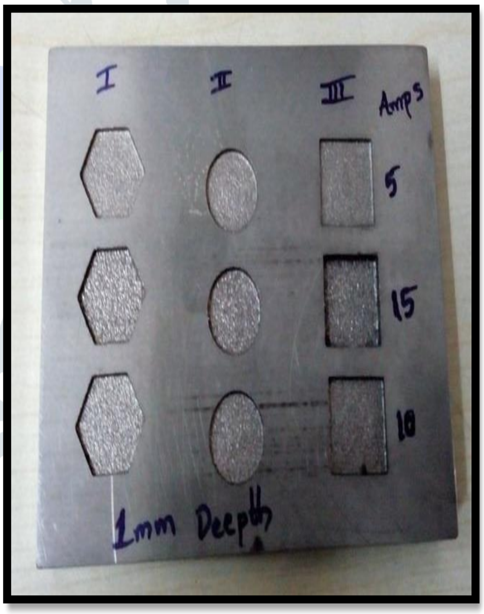

Fig – Final work piece after machining

EXPERIMENTAL RESULTS

Run order	Shape	Current (Amps)	ark gap (mm)	TWR (mm^3/min)
1	Round	5	12.5	0.0154
2	Round	10	12.8	0.0176
3	Round	15	13.1	0.0189
4	Square	5	12.8	0.01754
5	Square	10	13.1	0.01952
6	Square	15	12.5	0.01985
7	Hexagonal	5	13.1	0.01756
8	Hexagonal	10	12.5	0.01654
9	Hexagonal	15	12.8	0.01436

The MRR values calculated are shown in below table.

Run order	Shape	Current (Amps)	ark gap (mm)	MRR (mm^3/min)
1	Round	5	12.5	0.074
2	Round	10	12.8	0.105
3	Round	15	13.1	0.0908
4	Square	5	12.8	0.0624
5	Square	10	13.1	0.0768
6	Square	15	12.5	0.0702
7	Hexagonal	5	13.1	0.0570
8	Hexagonal	10	12.5	0.1666
9	Hexagonal	15	12.8	0.1818

Table – Calculated MRR values

The Tool wear rate values are shown in below table

Surface finish results

In this project most important output performances in Die Sink EDM such as Surface Roughness (Ra) is considered for optimizing machining parameters. The surface finish value (in µm) was obtained by measuring the mean absolute deviation, Ra (surface roughness) from the average surface level using a Computer controlled surface roughness tester.

Run order	Shape	Current (Amps)	ark gap (mm)	Surface Finish Values R_a (µm)
1	Round	5	12.5	4.36
2	Round	10	12.8	3.87
3	Round	15	13.1	5.28
4	Square	5	12.8	7.141
5	Square	10	13.1	6.92
6	Square	15	12.5	6.47
7	Hexagonal	5	13.1	7.72
8	Hexagonal	10	12.5	5.53
9	Hexagonal	15	12.8	6.85

Table–Measured Surface Roughness values

SELECTION OF OPTIMAL PARAMETER COMBINATION FOR BETTER SURFACE QUALITY, HIGHER MRR AND LESSER TOOL WEAR EATE USING TAGUCHI TECHNIQUE

Taguchi Technique is performed in Minitab 17 software to optimize the process parameters in die sink machining of P20 Steel for better surface quality, higher material removal rate and lesser tool wear rate.

SURFACE ROUGHNESS

Results Table

↓	C1-T	C2	C3	C4	C5
	TOOL SHAPE	CURRENT(Amps)	SPARK	SURFACE	SNRA1

			GAP(mm)	ROUGHNESS	
1	ROUND	5	12.5	4.36	-12.7897
2	ROUND	10	12.8	3.87	-11.7542
3	ROUND	15	13.1	5.28	-14.4527
4	SQUARE	5	12.8	7.141	-17.0752
5	SQUARE	10	13.1	6.92	-16.8021
6	SQUARE	15	12.8	6.47	-16.2181
7	HEXAGONAL	5	13.1	7.72	-17.7523
8	HEXAGONAL	10	12.5	5.53	-14.8545
9	HEXAGONAL	15	12.8	6.85	-16.7138

Table – Calculated Signal to Noise Ratios for Smaller is better

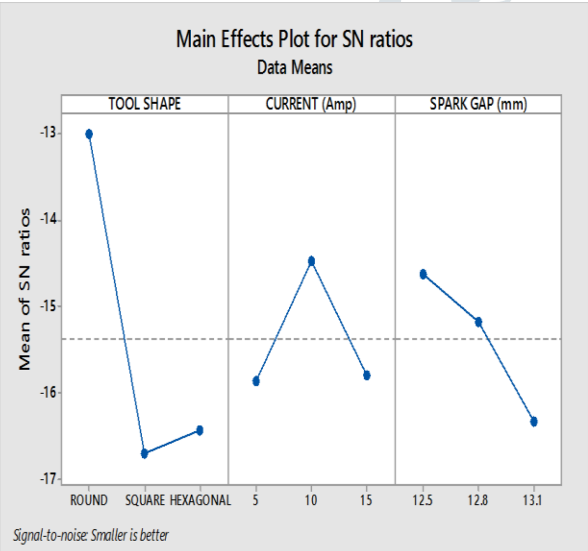

Fig - Effect of machining parameters on Surface Roughness for S/N ratio for Smaller is better.

Analysis and Discussion

Regardless of the category of the performance characteristics, a greater S/N value corresponds to a better performance. Therefore, the optimal level of the machining parameters is the level with the greatest value.

Tool Shape: -The effect of parameter "Tool Shape" on surface roughness values is shown above figure for S/N ratio. The optimum Tool Shape is Round.

Current: -The effect of parameter "Current" on surface roughness values is shown above figure for S/N ratio. The optimum Current is 10Amp.

Spark Gap: -The effect of parameter "Spark Gap" on surface roughness values is shown above figure for S/N ratio. The optimum Spark Gap is 12.5mm.

HIGHER MRR

Results Table

↓	C1-T	C2	C3	C4	C5
	TOOL SHAPE	**CURRENT (Amps)**	**SPARK GAP(mm)**	**MRR**	**SNRA2**
1	ROUND	5	12.5	0.074	-22.6154
2	ROUND	10	12.8	0.105	-19.5762
3	ROUND	15	13.1	0.0908	-20.8383
4	SQUARE	5	12.8	0.0624	-24.0963
5	SQUARE	10	13.1	0.0768	-22.2928
6	SQUARE	15	12.5	0.702	-23.0733
7	HEXAGONAL	5	13.1	0.057	-24.8825
8	HEXAGONAL	10	12.5	0.1666	-15.5665
9	HEXAGONAL	15	12.8	0.1818	-14.8081

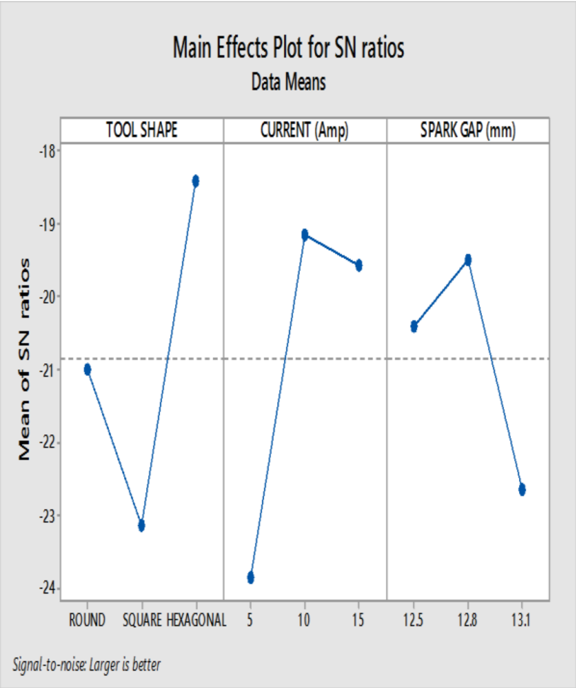

Fig - Effect of machining parameters on MRR for S/N ratio for Larger is better

Analysis and Discussion

Regardless of the category of the performance characteristics, a greater S/N value corresponds to a better performance. Therefore, the optimal level of the machining parameters is the level with the greatest value.

Tool Shape: -The effect of parameter "Tool Shape" on MRR values is shown above figure for S/N ratio. The optimum Tool Shape is Hexagonal.

Current: -The effect of parameter "Current" on MRR values is shown above figure for S/N ratio. The optimum Current is 10Amp.

Spark Gap: -The effect of parameter "Spark Gap" on MRR values is shown above figure for S/N ratio. The optimum Spark Gap is 12.8mm.

LESSER TOOL WEAR RATE

Results Table

↓	C1-T	C2	C3	C4	C5
	TOOL SHAPE	**CURRENT(Amps)**	**SPARK GAP(mm)**	**TWR**	**SNR A3**
1	ROUND	5	12.5	0.0154	36.2496
2	ROUND	10	12.8	0.0176	35.0897
3	ROUND	15	13.1	0.0189	34.4708
4	SQUARE	5	12.8	0.01754	35.1194
5	SQUARE	10	13.1	0.01952	34.1904
6	SQUARE	15	12.5	0.01985	34.0448
7	HEXAGONAL	5	13.1	0.01756	35.1095
8	HEXAGONAL	10	12.5	0.01654	35.6923
9	HEXAGONAL	15	12.8	0.01436	36.8569

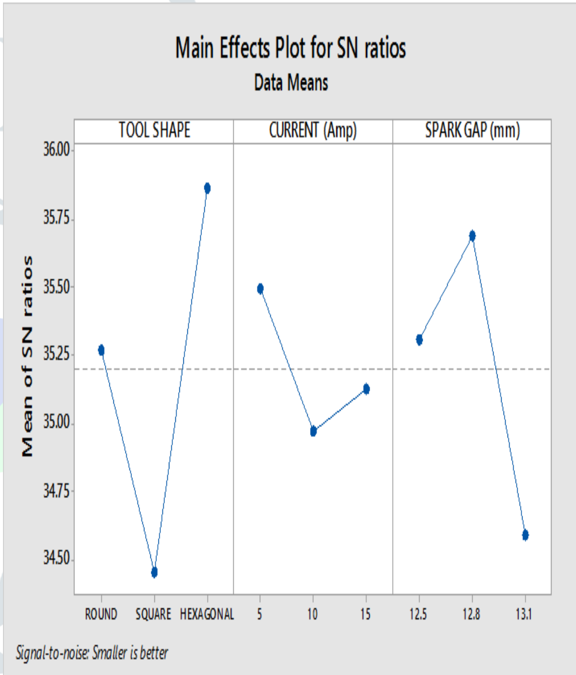

Fig - Effect of machining parameters on TWR for S/N ratio for Smaller is better

Analysis and Discussion

Regardless of the category of the performance characteristics, a greater S/N value corresponds to a better performance. Therefore, the optimal level of the machining parameters is the level with the greatest value.

Tool Shape: -The effect of parameter "Tool Shape" on TWR values is shown above figure for S/N ratio. The optimum Tool Shape is Hexagonal.

Current: -The effect of parameter "Current" on TWR values is shown above figure for S/N ratio. The optimum Current is 5Amp.

Spark Gap: -The effect of parameter "Spark Gap" on TWR values is shown above figure for S/N ratio. The optimum Spark Gap is 12.8mm.

CONCLUSION

By observing the experimental results, the following conclusions can be made:

To achieve better surface quality, the optimal parameters are Tool Shape – Round, Current – 10Amps, Spark Gap – 12.5mm.

To achieve higher MRR, the optimal parameters are Tool Shape – Hexagonal, Current – 10Amps, Spark Gap – 12.8mm.

To achieve lesser TWR, the optimal parameters are Tool Shape – Hexagonal, Current – 5Amps, Spark Gap – 12.8mm.

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