Influence of EDM process parameters using various electrode bottom profile in machining Inconel 718 - A Study

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Abstract

With high precision and surface polish requirements, electrical discharge machining (EDM) is a well-liked non-conventional technology for cutting hard materials and geometrically difficult forms. Due to its high strength, corrosion resistance, and capacity to keep its qualities over a wide temperature range. Inconel 718 is a nickel-chromium alloy that is frequently used in the aerospace, petrochemical, and power generation industries. The study you described intended to comprehend the impact of different process parameters on Inconel 718 EDM machining. It was discovered that establishing ideal EDM conditions heavily depends on the electrode's bottom profile. Experimental investigation would be required to confirm the output parameters, such as the material removal rate (MRR) and tool wear rate (TWR).

Keywords: *EDM, optimumconditions, MRR, TWR*

1. Introduction

That effectively condenses the fundamentals of EDM. Just to give a little more information, the high voltage pulse applied between an electrode and the workpiece. The dielectric fluid ionize and generates a plasma channel, which is how the electrical spark in EDM is produced. The extreme heat produced by the plasma channel melts and vaporizes the material from the electrode and the workpiece, removing it from both. EDM is very helpful for machining materials whose hardness, toughness and other characteristics make them challenging to work with conventional techniques. Since the electrode can be moulded to generate the desired geometry, the procedure can also be utilized to create very small or complicated features in a workpiece.

2. Working Principle of EDM

EDMisathermoelectricprocessusedtoremovemetalbyaseriesofdiscretesparksbetweenthetoolandworkpiece.InEDManelectricsparkisusedasthecuttingtooltocut(erode)the workpiece and produce the required shape.The electrical discharge machining working processis based on the generation of sparks and metal removal byerosion of material.TheFig.1.shows the whole setup of EDM process.The material from the work piece is eroded as a result of the frequent and continuous electric spark generation.The gap between tool and workpiece is maintained by the help of feed mechanism indicated in Fig. 1.

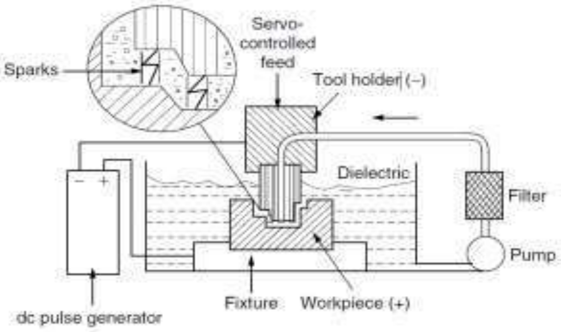

Fig.1.Setup of Electrica lDischarge Machining

The workpiece serves as the anode while the tool serves as the cathode. Spark generation begins to form at regular intervals of 10 microseconds at high voltage. Positive ions and electrons begin to migrate. When a spark is discharged, it disturbs the equilibrium between electrons and ions and produces a plasma channel. Instantaneous loss of the prior channel's electric resistance enables a high current density, which produces ionization and a powerful magnetic field.

The spark exerts pressure on the workpiece and the tool, causing them to heat up to a high degree when melting and metal elimination take place. Metal is removed as a result of this temperature increase. The substance is eliminated through melting and vaporization into powder form. After the potential difference is eliminated, the plasma channel will close, as seen in Fig. 2. A crater of unwanted metal is created around the impacted spark location as a result of the collapsing, which creates pressure or shock waves.

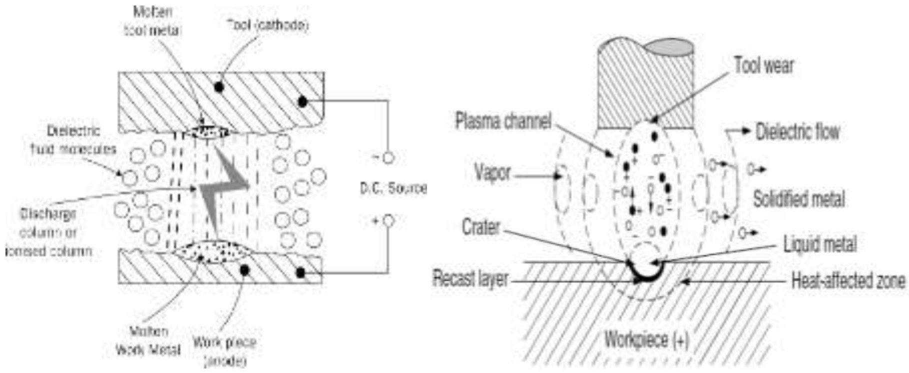

Fig. 2 Working Principle of ElectricaldischargeMachining

3. Literature Study

A literature review is a comprehensive summary of previous research. The literature review provides a description, summary and evaluation of each source. It also provides the scope for the present study. This chapter will play a part to get the information about electrical discharge machine and will give the idea to operate the test and form the early stage of the projects, various literature studies have been done. This chapter compiles and summarizes someimportant research documents which show the effect of input and output parameters on EDM process.

Manohar et al.[1] found that various factors, including material removal rate (MRR), electrode wear rate (EWR), surface roughness, and surface integrity, were influenced by the electrode's bottom surface profile. Fig. 3(a). illustrates the thickness of the recast layer using the flat bottom profile electrode and the convex bottom profile electrode. Convex profile electrodes provide better access to the electrolyte for draining the molten metal and decreasing the formation of RCL than flat or concave profile electrodes do. However, compared to flat profile electrodes, the thickness of the recast layer generated in the case of convex profile electrode is significantly less (nearly half). Fig. 3(b). shows that flat profile electrodes are quicker than concave profile electrodes.

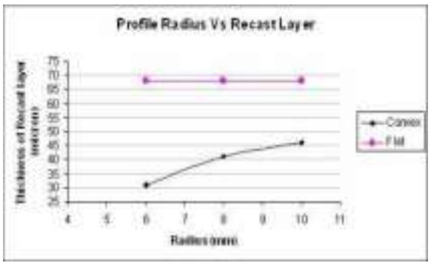

Fig.3 (a).Effect of electrode profile On radius and recastlayer thickness.

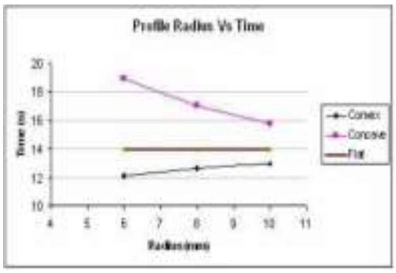

Fig.3(b). Effect of electrodeprofile on redius and time.

Basha et al. [2] concluded from the literature review that increases in peak current increases MRR illustrates in Fig. 4(a). Under starting conditions, pulse-on time increases MRR indicate in Fig. 4(b).

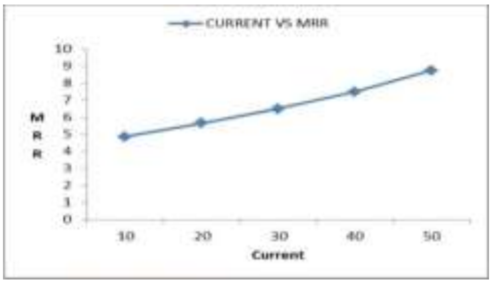

Fig.4 (a). Effect of peak current on MRR.

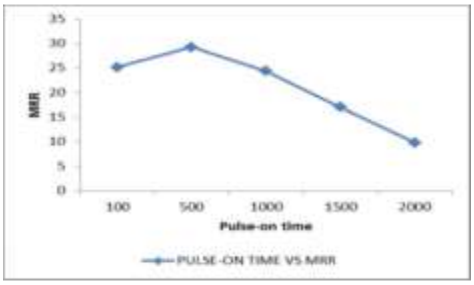

Fig.4(b). Effect of pulse on-time on MRR.

Peak current increases as surface roughness increases as more material is removed from the surface. As shown in Fig. 5 (a), the structure is wider and has a deeper crater. When specific conditions are met, as illustrated in Fig. 5(b), SR increases and pulse-on time increases. As a result of less material being removed, the pulse-on time is increased after that, lowering the Ra.

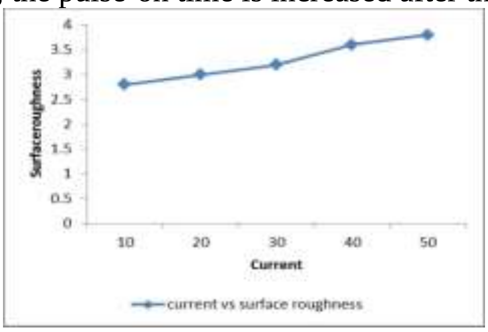

Fig.5(a). Effect of peak current on surfaceroughness.

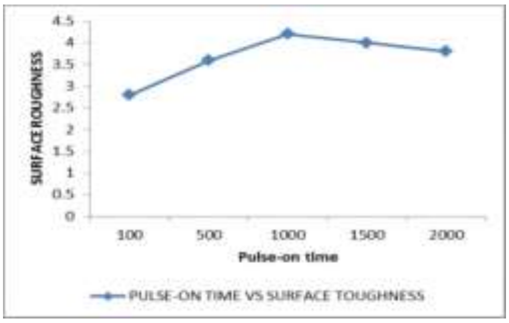

Fig.5(b).Effect of pulse on-time on surfaceroughness.

Morankar et al. [3] investigate the peak current is significantly more important for MRR and TWR. Feed is less important for TWR. Higher MRR values often result from lower gap voltage. As the discharge current and open discharge voltage increase, Ra value climbs while lowering as the duty factor, current, and gap voltage. The Ra value is decreased when copper electrodes are used. The processparametersaffectingMRR,TWRandRa shown in Fig. 6.

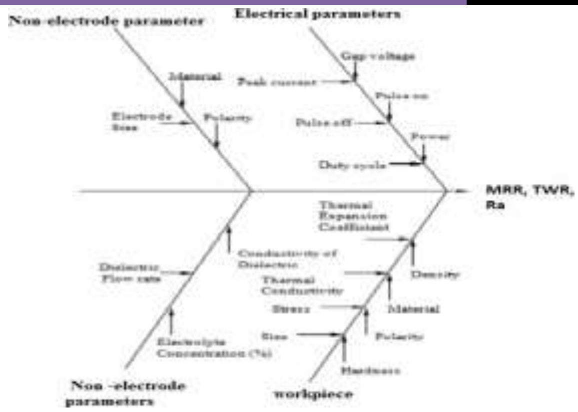

Fig.6. Fish bone diagram showing process parameters affecting MRR, TWR and Ra.

Sudhakara et al. [4] investigated MRR typically rises as the current rises. The intensity of the spark increases with increasing current, which causes significant metal loss.Surface roughness also increases with an increase in current. Because of an increase in current, the strength of the spark also rises. As a result, the MRR per minute rises. Finally, there is an increase in surface roughness.As current increases, hardness will decline. because an increase in current causes the spark to become stronger.current is increased, the crack length, crack widths are also increased due to the high temperature generation at high currents.duty factor is increases, the MRR is also increases. The higher the duty factor, intensity of spark and machining time is increased and results in high metal removal will takes place.

Nowicki et al. [5] determined how the graphite tool electrode's grain size affects the Hastelloy C-22 alloy's material removal rate (MRR), tool wear rate (TWR), and surface roughness (Ra).Graphite with larger grains offers greater process effectiveness at the expense of greater relative tool electrode wear. In terms of surface roughness, graphite with smaller grain sizes had the lowest value (AF-5). Calculated that the graphite electrodes grain size and the machining settings affected the MRR, TWR, and Ra roughness parameter. He came to the conclusion that S-180 graphite had more relative wear of the working electrode because of its bigger grain size, lower resistivity, and perceived density. For both the AF-5 and S-180 graphite electrodes, the relative tool wear value fell as the discharge current increased.

Sen et al. [6] concluded after experiment carried out among all three electrode graphite shows the highest rate of material removal, while brass shows the least amount of material removal. Copper and brass have very little tool wear. Graphite, on the other hand, exhibits a significant amount of tool wear during machining. Brass electrode machining reveals an EDMed surface with good surface polish. In the case of the graphite electrode, the average surface roughness value (Ra) is excessive.The MRR, TWR, and surface quality of the EDMed surface are significantly impacted by peak current.

Buschaiah et al. [7] investigated that the surface roughness increases with an increase in current. When the discharge current is high, the spark power and intensity are also high, which results in a deep crater on the workpiece surface and a high surface roughness value. When the pulse-on-time is increased from 90 to 270 µs, the surface roughness decreases. The intensity of plasma diminishes with an increase in pulse-on time. As a result, the depth of the crater that is generated in each scenario is reduced, which also reduces the roughness of the surface. While the intensity of the plasma arc reduces as electrode diameter grows from 10mm to 16mm, the surface roughness value increases reduces the crater's depth.

Kuppan et al. [8] has studied the use of the EDM method for small, deep Inconel 718 drilling. For the purpose of analyzing the machining characteristics, variables including peak current, pulse on-time, duty factor, and electrode speed were selected. As a tool electrode, a copper electrolytic tube with a 3 mm diameter was chosen. Material removal rate (MRR) and depth-averaged surface roughness (DASR) were measured as the output responses. Using response surface methodology (RSM), mathematical models were created for the aforementioned responses. According to the data, peak current, duty factor, and electrode rotation have a greater impact on MRR than DASR, which is highly influenced by pulse on time and peak current. The parameters were finally adjusted using a desirability function technique to achieve the maximum MRR and desired surface roughness value.

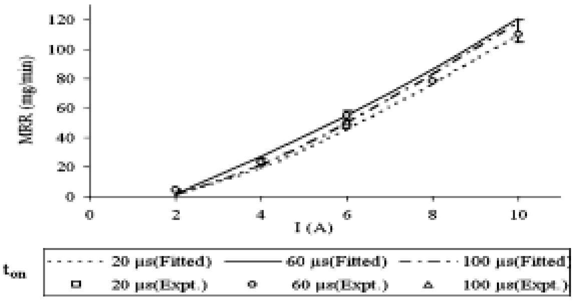

Fig.7. Effect of peak current on MRR.

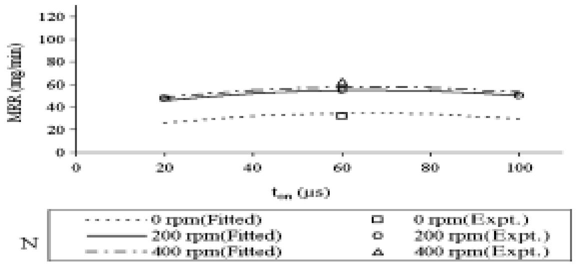

Fig.8. Effect of pulse on-time on MRR.

Fig. 7. shows the relationship between MRR and peak current at different pulse on-time. It can be shown from the figure that the MRR increases with the increase in current. Figure8 shows the relationship between MRR and peak current at different pulse on-time. It can be shown from the figure that the MRR increases with the increase in current.

Selvarajan et al. [9] concluded that in copper electrode, pulse on time 12µs and pulse of time 4 µs influences material removal rate is 0.036 gm/min where as in graphite electrode pulse on time 10 µs and pulse of time 6 µs influences material removal rate is 0.036 gm/min. In copper electrode, pulse on time 10 µs and pulse of time 8 µs influences roughness average is 2.045 µm where as in graphite electrode pulse on time 12 µs and pulse of time 8 µs influences roughness average is 3.385 µm In copper electrode, pulse on time 12 µs and pulse of time 8 µs influences machining time is 13 min where as in graphite electrode pulse on time 12 µs and pulse of time 4 µs influences machining time is 13 min. Calculated copper electrode measurement (machining time-21 min, metal removal rate-0.036 gm/min, gap current-14 amps) & graphite electrode measurement (machining time-15 min, metal removal rate-0.036 g/min, gap current-14 amps). Graphite electrode performs better than copper electrode on identical inputs.

Singh et al. [10] has examined the impact of several input factors, such as gap voltage (Vg), peak current (Ip), and pulse on time (Ton), on material removal rate (MRR) and surface roughness (SR, Ra) during electrolytic copper-based EDM of Inconel 601 material. Utilizing Box-Behnken Design (BBD) and various combinations of process parameters, experimental work is conducted. Response Surface Methodology and ANOVA are used to analyze the significance of the developed model and to correlate the process parameters with the responses. It is clear from the findings that MRR rises as the current rises. Current directly affects surface finish.

Ozkavak et al. [11] investigated that the value ofsurface roughness is challenging for machinability. The best surface roughness values are produced by employing low current values, as has been demonstrated once more. Small-sized and infrequent microcracks have little to no impact on the part's fatigue life. The results from the GEP and ANN approaches are greatly influenced by some parameters, including chip adhesion to the surface as a result of chip jams during EDM, abrasion of the electrode employed or not in a homogeneous structure, and calibration variations in the surface roughness device. Prediction accuracy (r2) in the ANN was 0.93 and in the GEP, it was 0.66.It was concluded that the ANN method gave more accurate results for this study.

Ahmed et al. [12] found that the temperature characteristics of the electrode material are quite important for Inconel 718 HEDAM drilling. Brass electrode offers the maximum MRR for all current values, followed by Cu and CuW electrodes. For all the current settings, brass electrode provides the highest MRR followed by Cu and CuW electrodes. CuW electrode has the lowest EWR, followed by brass and CuW electrodes. Increased corner wear (tapering) of the electrodes is a side effect of higher flushing pressure. Higher corner wear is seen as a result of incorrect deionization of arcs at lower rpm. Additionally, at 100 rpm, more carbon is deposited due to increased wear. Average surface roughness (Ra) is significantly influenced by the electrical and thermal characteristics of the tool electrode material.

Ahmad et al. [13] concluded MRR rises as current and pulse duration grow, peak current and pulse length are important parameters in Inconel 718 EDM utilizing copper tungsten electrode. While EWR steadily decreases as pulse duration grows, it rises as peak current increases. Deposition of carbon and workpiece material on the surface of the CuW electrode may enhance the EWR and act as an electrode wear resistance. The improved Ra value brought about by the union of a longer pulse length and a lower peak current. The 20A peak current and 400µs pulse duration, respectively, resulted in the lowest Ra of 8.62 µm. Higher peak current is not recommended if a good surface finish is desirable. It would be recommended that the optimum cutting condition in EDM of Inconel 718 by using CuW electrode could be performed by a combination of the highest peak current and pulse on-time at 40A and 400µs, respectively.

Bhaumik et al. [14] investigated that the copperelectrode provides a good surface finishfollowed by brass and zinc electrodes. Copper and brass electrodes are used in EDM to produce good surface finishes at lower peak current (10A) and pulse on time (100µs) values. Copper tool gives less radial overcut followed by brass and zinc electrode. The overcut of the brass and zinc electrode is less pronounced at lower peak currents (10A). Compared to brass and zinc electrode, copper electrode exhibits the highest level of surface cracks. As the peak current rises, it is found that the recast layer is thicker. Peak current raises EWR, while pulse duration increases EWR gradually. Deposition of carbon and workpiece material on the CuW electrode surface may raise the EWR and act as an electrode wear resistance. The increased pulse duration and lower peak current gave a superior Ra value. At 20A and 400µs of peak current and pulse duration, respectively, the minimum Ra of 8.62 µm was attained.

Shankar et al. [15] has studied Electrical Discharge Machine (EDM) parameters which have a significant influence on machining characteristic like material removal rate (MMR) and tool wear rate (TWR). Inconel 718 is used as a work material and tool electrode made up from brass. Experiments are conducted using face centred central composite design. Material removal rate gets increased with the increasing current. Tool wear rate slightly gets increased by the increasing current. With increase in pulse on time, material removal rate gets slightly decreased. Metal removal rate is better when using copper electrode at all the values of current, pulse on time and pulse off time when compared with the brass electrode. Tool wear rate of brass electrode is lesser than the copper electrode. Due to the higher thermal conductivity, the material removal rate gets increased when mixing with nano powders in the dielectric fluid as compared with the conventional EDM process.

Kuppan et al. [16] examined that the graphite and copper-tungsten electrodes, the copper electrode performed better. The highest EWR values were found in graphite, copper, and copper-tungsten electrodes. Out of the three electrode materials that were looked at, copper is the option that offers the highest MRR. The copper electrode achieved a high rate of material removal and a low level of surface roughness. A graphite electrode would undoubtedly be the best tool electrode from the standpoint of low EWR. Due to its brittleness and difficulty in creating large aspect ratio tiny diameter tube electrodes, graphite is typically not chosen for small diameter deep hole drilling. The copper tube electrode is more desirable from an economic standpoint. Copper electrode, which has a high material removal rate and a low surface roughness, is the best option out of the three electrodes employed in the current study for deep Inconel 718 holes drilled by electric discharge.

Jeevamalar et al. [17] investigated that the impact of Peak Current, Pulse on and Pulse off times on the Inconel 718 Surface Roughness.Surface roughness increases as peak current increases. Higher Surface Roughness is attained at high values of peak Current, while lower Surface Roughness is at high values. The SR rises with increasing pulse on time for all peak current values. Surface roughness increases when the pulse on time is high and decreases when the pulse on time is low. The SR rises with increasing pulse off time for all peak current values. When the pulse off time is low, the surface roughness is higher, and when it is high, the surface roughness is lower.

Torres et al. [18] investigated that the aspect for both polarities in MRR, according to the research, is current. Positive polarity considerably increases material removal rate over negative polarity. Moreover, lower electrode wear is a result of increased current. Compared to positive polarity, electrode wear is substantially more severe in the negative direction. For both polarities via Ra, Rt, and Pc, the most important variables affecting surface roughness are current and pulse duration. Negative electrode polarity is advised for achieving good surface roughness. Positive polarity with copper electrodes is advised if very high MRR values are needed.

Majhi et al. [19] Conclusion The material removal rate (MRR) is directly influenced by the variables pulse on time, pulse off time, and discharge current, and increases along with their expansion. Tool wear rate (TWR) falls as pulse off time increases. The surface roughness of AISI D2 tool steel highly affected the pulse on-time and off-time. With increased pulse current, surface roughness rises. enhance the pulse on time and pulse current to enhance tool wear. Surface roughness and tool wear are reduced as pulse off time increases. The EDM procedure results in a higher-quality surface finish while reducing TWR thanks to lower pulse current and pulse on time.

D'Urso et ai. [20] investigated that an increase in power discharge is reflected on a decrease in drilling time when using tungsten carbide electrode, damaging TWR and overcut. In actuality, the electric sparks amplitude is greater, the top diameter grows and the rate of taper continues. Time reduces increasing the power discharge while TWR increases using brass and copper electrodes. Brass and copper have a better electrical conductivity than tungsten carbide, which makes it easier to create microholes more quickly. On the other hand, because copper and brass have a lower melting point than tungsten carbide electrodes, this results in more tool wear. Faster micro-hole creation is made possible by brass and copper's higher electrical conductivity when compared to tungsten carbide electrodes; however, this is counterbalanced by an increase in tool wear due to brass and copper's lower melting temperature. When tungsten carbide electrode is used instead of brass or copper electrode, the diameters, top and bottom, DOC, and TR are smaller. The solidification of melted material has a greater negative impact on the top view of micro holes when a brass electrode is utilised. Copper electrodes are the most productive in terms of drilling time, regardless of the machining grade.

Lahbishi et al. [21] investigated that geometry of electrode influences on process parameter of Electrical Discharge Machining Process. For all electrode tip angles, the 1mm electrode tip radius yielded the highest MRR values. The MRR increases as the electrode tips' angles rise from 45°, 60°, 75°, and 90°. The smallest value of EWR ever recorded is for an electrode tip with a radius of 0 mm and an electrode tip angle of 45°. The EWR drops as the angles of the electrode tips go from 90°, 75°, and 60° to 45°. When the electrode tips' angles were raised from 45° to 60° and eventually to 75°, the white layer's thickness grew. But when the electrode tip was at a 90° angle, the white layer was thinner than at other angles because the heat was distributed evenly.

Abdullah et al. [22] found that surface integrity properties of cemented tungsten carbide (WC-Co10%) workpiece with conventional ED machined surface and those with ultrasonic assistance ED machined surface to be significantly different. The tool's ultrasonic vibration induces cavitation, which generates intense micro-jets, electric current, and hot spot-core plasma. The ignition delay time is decreased by the hot spot-core plasma and the imposed electric current, and the ignition delay time is improved and unfavorable unstable pulses are reduced by the micro-jets. Surface roughness produced by the typical pure EDM method is slightly lower than that produced by ultrasonic-assisted EDM. Ultrasonic vibration of the tool, when employed specifically in finishing mode machining, minimises the thickness of the heat-affected zone (HAZ) and recast layer, which in turn minimises the quantity, size, and depth of normal and transverse fractures that develop on the machined surface. The surface integrity of cemented tungsten carbide (WC-Co10%) during the EDM process might be considerably improved by ultrasonic vibration of the tool.

Sahu et al. [23] investigated that Brass and copper were the next best performing electrodes, followed by AlSiMg RP electrodes. A higher discharge current and longer pulse on-time resulted in a rougher surface on the EDM-machined surface. Therefore, it is preferable to use lower settings of discharge current and pulse-on time paired with AlSiMg RP electrode to generate specimens with improved surface quality following EDM machining. The MOORA method was used to combine all the responses into a single response, the multi-criteria performance index, or MOORA index (yi), and the best parametric settings for the EDM process. Discharge current (Ip) and pulse on time (Ton) for AlSiMg electrodes produced by selective laser sintering (SLS) should be utilized at the lowest values to provide a superior surface polish.

Hadadet al.[24] investigated that the tool starting surface roughness has a substantial impact on the machining performance. When the initial tool surface roughness rises, MRR tends to fall. An increase in initial tool surface roughness causes an increase in tool wear rate. The initial tool surface roughness has a small impact on the workpiece surface roughness following EDM machining. During the EDM process, the tool's surface roughness changes. It needs to stabilize a set number of times. The number of times varies depending on how harsh the tool surface was at first. Additionally, the EDM machining parameters have a significant impact on the tool surface roughness after machining.

Selvarajan et al. [25] found that the impacts of the process parameters including the spark on time, spark off-time, current and constant IPOL dielectric fluid (C) on the rate of material removal, the surface roughness. The graphite electrode performs better than the copper electrode utilising SS316 material when machining parameters of the two electrodes are compared. Copper electrode pulse on time is higher than graphite electrode for same MRR as 0.036 gm/min. For the same MRR and gap current, graphite requires less machining time than copper does.

Kumar etal.[26] has carried out an extensive review on properties of Inconel 625 and Inconel 718 fabricated usingdirect energy deposition (DED). Thermal distribution and pool cooling rate were found to be significantly impacted by the process input variables of DED. The pieces made of Inconel alloy were dependent on the matching thermal history for their microstructures, solidification behaviour, degree of porosity, and distribution of residual stresses that resulted. The metastable phases that show up in the resulting solidified microstructure have a significant impact on the tensile strength, fracture, and creep characteristics of the Inconel components. Porosity and cracks that formed during the design of DED parts have a negative impact on mechanical performance, particularly fatigue resistance and strength.

4. Proposed Experimental setup

Inconel 718 is a high-strength, corrosion-resistant nickel-chromium alloy that has numerous applications in the petrochemical, aerospace, and power generation industries. Some of its primary traits are a high degree of strength, resistance to corrosion, and the ability to maintain its properties across a wide temperature range. The experimental setup aids in the investigation of the effects of various process variables on Inconel 718 EDM machining.

Use of graphite electrode in electrical discharge machining (EDM) is recommended because it has several properties that make it well-suited for the process.

High Electrical Conductivity: Graphite is an excellent conductor of electricity, which is important for the EDM process to work effectively. High Thermal Stability: Graphite can withstand high temperatures without breaking down or changing shape, which is important for maintaining the accuracy of the electrode during the EDM process.
Good Machinability: Graphite can be easily machined to a precise shape, which is important for producing high-quality EDM parts.
Low Cost: Graphite is relatively inexpensive compared to other materials, making it an attractive option for use as an electrode in EDM.
Overall, the combination of these properties makes graphite an ideal material for use as an electrode in EDM, as it can help to produce high-quality parts with good accuracy and consistency.

The graphite electrode with different bottom profiles like flat, convex and concave as shown in figure 3 are found to be relevant for the experimentation. In this figure A, B, C are convex shape profiles with radius of 6 mm, 8 mm and 10 mm respectively, figure D is flat shape profile and figure E, F, G concave shape profiles with radius of 6 mm, 8 mm and10 mm respectively.

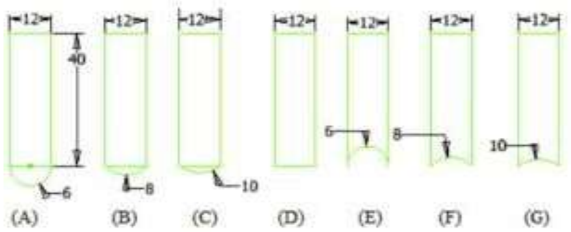

Fig. 8 convex, concave and flat profiles of electrode

Table 1. list the important input parameters in order to analysis the machining conditions using the output parameters.

Sr. No.	Input parameter
1	Peak Current(I)
2	Pulseontime (T_{on})
3	Pulseofftime (T_{off})
4	Gap voltage

Sr. No.	Output parameter
a.	Material removal rate(mm^3/min)
b.	Surface finish (μs)
c.	Tool wear rate (mm^3/min)

5. Methodology

In order to calculate the percentage contribution of each element to the experiment's outcomes, the analysis of variance (ANOVA) statistical procedure is frequently used.To ascertain which of the factors require control and which do not, an analysis's ANOVA table is studied. Running a confirmation experiment after determining the optimal circumstance is typically a wise move. Only a small portion of the entire factorial tests are run in the case of fractional factorial. The technique instead establishes the variability (variance) of the data rather than directly analysing it. Analyses show the variation of elements that can be controlled and random. Robust operating conditions can be predicted by being aware of where and how much variety there is. Utilizing a software program, the analysis is performed.

Grey Relational Analysis (GRA) is frequently used in Electrical Discharge Machining (EDM) to optimise machining settings and raise the calibre of the finished product. It is possible to utilise GRA to analyse the connections between various process parameters. GRA can assist in identifying the ideal machining settings for a specific EDM technique by studying the relationship between these variables.

In a grey relational analysis, experimental data, or measured elements of the product's quality characteristics, are first normalized to a range between zero and one. Grey relational generation is the name of this procedure. The correlation between the desired and actual experimental data is then represented using a grey relational coefficient that is derived using normalized experimental data. The grey relational coefficient corresponding to the chosen responses is then averaged to determine the overall grey relational grade. The derived grey relational grade determines how well the multiple response procedure performs overall. By using this method, a multiple-response process optimization problem is changed into a single-response optimization scenario where the goal function is overall grade correlation. By maximizing the overall grey relationship grade, the best parametric combination is then assessed.

6. Conclusions

One crucial characteristic to consider while researching factors like Material Removal Rate (MRR), Electrode Wear Rate (EWR), Surface Roughness, and Surface Integrity is the bottom profile of the graphite electrode. Due to its special mix of qualities, including high strength, excellent resistance to corrosion and oxidation, and good electrical and thermal conductivity, Inconel 718 is frequently utilised in electric discharge machining (EDM) investigations. These features make Inconel 718 the perfect material for EDM testing and optimisation since it enables for effective material removal while preserving the workpiece's structural integrity.

Inconel 718 is also a challenging material to cut, making it a good test case for determining how well various EDM settings and parameters work. It is necessary to conduct an experimental investigation to evaluate how well an electrode with a convex, flat, or concave bottom profile works in terms of the recast layer, surface finish for simple surface machining, closer geometry, and MRR for hole drilling. The results of the experimental investigation help in the selection of the optimum conditions for employing EDM to create various complicated profiles of interest.

7. References

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