# A Review on Optamization of Process Parameter For EDM

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***Abstract****- Electrical discharge machining (EDM) machining option for manufacturing arithmatically complex or hard material parts that are extremely difficult to machine by conventional process of machining. The machining technique has been continuously evolving from a mere tool and die making process to a micro-scale application machining alternative attracting a significant amount of research interests.*

*In recent years, EDM researchers have explored a number of ways to improve the efficiency in sparking including some experimental concepts that depart from the EDM traditional sparking phenomenon*

***Keywords***- EDM, Orbital Feeding Mechanism, ProcessParameter, MRM.

## I. INTRODUCTION

Electrical discharge machining (EDM), also known as spark machining, spark eroding, burning, die sinking, wire burning or wire erosion, is a manufacturing process whereby a desired shape is obtained by using electrical discharges (sparks). Material is raidly removed from the workpiece by recurring current discharges series between two electrodes with continue supply of voltage ,an high voltage , separated by a dielectric liquid and subject to an electric voltage. One of the electrodes is called the tool-electrode, or simply the "tool" or "electrode," while the other is called the workpiece-electrode, or "workpiece." The process depends upon the tool and workpiece not making actual contact.

When the voltage between the two electrodes is increased, the intensity of the electric field in the volume between the electrodes becomes greater than the strength of the dielectric (at least in some places), which breaks down, allowing current to flow between the two electrodes. This phenomenon is the same as the breakdown of a capacitor (condenser) (see also breakdown voltage). This results in material removal from electrode. Once the current stops (or is stopped, depending on the type of generator), new liquid dielectric is usually conveyed into the inter-electrode volume, enabling the solid particles (debris) to be carried away and dielectric properties of the electrode to be regained. Adding new liquid dielectric in the inter-electrode volume is commonly referred to as "flushing." Also, after a current flow, the difference of potential between the electrodes is restored to what it was before the breakdown, so that a new liquid dielectric breakdown can occur.

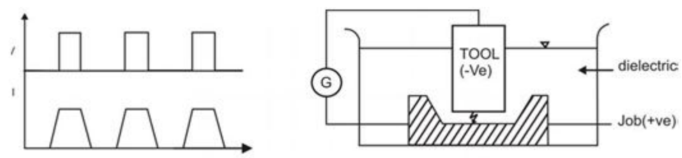


Fig.1 - Schematic representation of the basic working principle of EDM

## II. LITERATURE REVIEW

**Kuppan, A. Rajadurai, S. Narayanan .(2007)** carried out a study on monopoly of EDM parameters in case of Inconel 718. In this work, the parameters such as peak current, pulse on-time, duty factor and electrode speed were chosen to study the machining characteristic and electrolytic copper tube is used as a electrode. The result were material removal rate (MRR) and depth averaged surface roughness (DASR). The results obtained from this investigation was, MRR gets more affected by peak current, duty factor and electrode rotation whereas DASR was strongly affected by peak current and pulse-on time.

**S.H.Tomadi, M.A.Hassan (2009)** studied the influence of operating parameters of tungsten carbide on the machining characteristics such as surface quality, material removal rate and electrode wear. Experiment were carried out on Tungsten Carbide with Copper tungsten as tool electrode. In this work, machining parameters such as peak current, power supply voltage, pulse-on time and pulse-off time were used. The results obtained from experiments were collected and analyzed by using STATISTICA software. In this work, in case of Tungsten Carbide, the parameters which mostly influences to surface roughness were voltage and pulse-off time. For obtaining high MRR, one should use high values of peak current and voltage and for obtaininglow values of electrode wear, high values of the pulse off time and low values peak current should be used.

**A. Electric Discharge Machine**

The thermo electrical process where the material eruption is done by the action of the sparks that are generate between the terminals of the machine. One terminal is the electrode, whose profile is intended on the work piece. Other is the work piece itself. The negative polarity of the electrode helps to achieve the highest material rate. Now a day generally electrode is used as the positive terminal keeping into mind about the electrode wear. Both of the terminals are separated by the die electric medium. There are many function of the die electric medium, which are as follows: acts as conductor, coolant, and the flushing medium for cleaning the carbon particles between the two terminals. Light petroleum based oil is used as the die electric medium. The surface Ra ranges from 0.2 -13 Micrometers. Complex shapes which would not be possible by CNC milling can be obtained by EDM. Extremely hard material to very close tolerances can be machined. Very small work pieces where conventional cutting tools may damage the part from excess cutting tool pressure. There is no direct contact between tool and work piece. Therefore machining process of complex and delicate and weak section material can me manufactured without any defects and any effects . A good surface finish can be obtained. Very fine holes can be drilled.

**B. Orbital Feeding Moment used in EDM.**

Orbital moment of the current is an important factor in EDM machining, the orbital feeding moment which is used in finishing operation in the EDM. The theory revels about cutting process which is observed during EDM. While roughing operation is in action current is made to flow through the electrode only in Z direction. Hence it can be concluded that the electrode wear is observed at the bottom face of the electrode. Some amount of stock about 0.05 is kept for finishing. When the finishing operation is stared the electrode which was entering the cavity earlier through the roughing cycle does not enter in the finishing cycle. In the finishing cycle the current pattern is made to swing in the XY plane hence the cutting is observed at the top most point. Sparks are observed at the top of the cavity. After successive sparking cycles the electrode will reach the bottom of the cavity, spark mark can be observed on the electrode surface. When full current is allowed to flow through the electrode at that time only the cavity size that is to be generated. Full current means the current which is proportion to the spark gap. Usually for graphite 250 pattern for 0.25mm spark gap. Generally for different shapes of electrodes, flow the pattern is decided. The pattern decides the no of vector that are included in the pattern. More the number of vectors more, more would be the deflection of the current in the electrode periphery more will be the amount of current touching the exact profile and trying to finish the electrode profile.

**Material removal mechanism**

In EDM machine, y is produced by short circuit of two current carrying wires. A small portion of metal is eroded during the machining process and also leaving a small gratify. This phenomenon is used in EDM. As sparks are generated in this machining process, therefore it is also known as spark erosion machine.

Further models of what occurs during electric discharge machining in terms of heat transfer were developed in the late eighties and early nineties, including an investigation at Texas A&M University with the support of AGIE, now Agiecharmilles. It originated in form of three scholastic papers: the first presenting a thermal model of material removal on the cathode, the second presenting a thermal model for the erosion occurring on the anode and the third introducing a model describing the plasma channel formed during the passage of the discharge current through the dielectric liquid. Validation of these models is supported by experimental data provided by AGIE.

These models give the most authoritative support for the claim that EDM is a thermal process, removing material from the two electrodes because of melting and/or vaporization, along with pressure dynamics established in the spark-gap by the collapsing of the plasma channel. However, for small discharge energies the models are inadequate to explain the experimental data. All these models hinge on a number of assumptions from such disparate research areas as submarine explosions, discharges in gases, and failure of transformers, so it is not surprising that alternative models have been considered more recently in the literature trying to explain the EDM process.

Among these, the model from Singh and Ghosh reconnects the removal of material from the electrode to the presence of an electrical force on the surface of the electrode that could mechanically remove material and create the craters. Due to revised mechanical properties it is possible to increase temperature which is caused by the passage of electric current. The authors' simulations showed how they might explain EDM better than a thermal model (melting and/or evaporation), especially for small discharge energies, which are typically used in μ-EDM and in finishing operations.

The model which are available , in which the material removal mechanism in EDM is not well understood and that further investigation is not clearly clarify and clarification is necessary, especially considering the lack of experimental scientific evidence to build and validate the current EDM models.This explains an increased current research effort in related experimental techniques.

## III. PROCESS PARAMETERS

The EDM process parameter are related to the waveform characteristics. Fig. 2 shows a general waveform used in EDM.

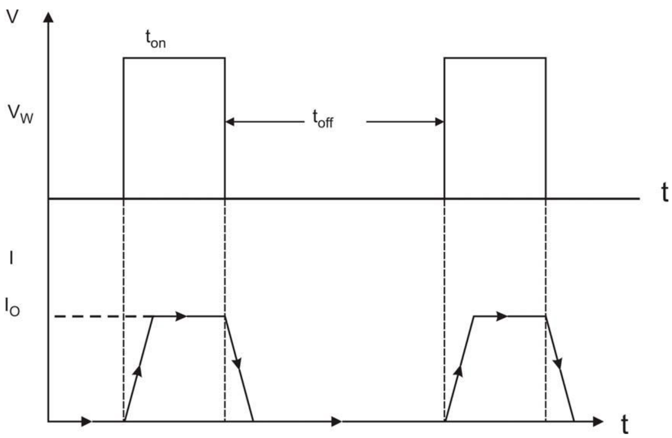


Fig. 2 Waveform used in EDM

The waveform is characterised by the

- The open circuit voltage - $V_o$
- The working voltage - $V_w$
- The maximum current - $I_o$
- The pulse on time – the duration for which the voltage pulse is applied - $t_{on}$
- The pulse off time - $t_{off}$
- The gap between the workpiece and the tool – spark gap - δ
- The polarity – straight polarity – tool (-ve)
- The dielectric medium
- External flushing through the spark gap.

**Characteristics of EDM**

a) The process can be used to machine any work material if it is electrically conductive
b) Rather than material strength and its hardness, material removal depends upon thermal properties of work material.
c) In EDM there is a physical tool and geometry of the tool is the positive impression of the hole or geometric feature machined

- The tool should be electrically conductive. The tool wear rate depends upon thermal properties of the tool material
- Though the local temperature rise is rather high, still due to very small pulse on time, there is not enough time for the heat to diffuse and thus almost no increase in bulk temperature takes place. The heat affected zone is rangrd to 2 – 4 μm of the spark crater
- Material removal rate of mechanism - Melting and evaporation supported by cavitations (spark erosion).
- Working fluid - Dielectric fluid (generally kerosene)
- Material Wear Ratio - 0.1 to 10.
- Max. material removal rate is 5× 103 mm3/min.
- Power consumption - 1.8 W/mm3/min.
- Distance between work piece and tool is 10 -125 μm.
- EDM Advantages:
- L/D ratio can be achieved upto 20.
- Absence of forces acting on machine due to no contact between tool and workpiece. This results in no residual stresses are generated in machining.
- Among all other unconventional machining methods, EDM gives highest MRR,
- Mechanism for chip formation i.e melting and evaporation , the mechanical properties of work piece material will not influence the material removal rate (MRR).
- Better surface finish.

**EDMDisadvantages**

- This process is only used electrically conductive material.
- Electrode wear is more.
- Heat generated results in re-hardening during machining.
- Exact square corners are not possible.

**Applicationsof EDM process:**

- With help of blind cavities and narrow slots in dies, minimum diameter hole upto 0.13mm can be produced.
- L/D ratio upto 20 can be achieved.
- Machining of small holes, aircraft engines,slots in fuel injection nozzles, airbrake valves.

## IV. CONCLUSION

The analysis of the experimental observations highlights that the metal removal rate, electrode wear ratio, gap size and surface roughness in electrode discharge machining are greatly influenced by the various dominant process parameter considered in various study . New technology in the EDM is continuously advancing to make this process more suitable for the Machining. In the field of manufacturing more focus is on the optimization of the process by reducing the number of Electrode.

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