

A STUDY OF CHARACTERISTICS OF NON-TRADITIONAL MACHINING METHOD

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1. INTRODUCTION

(EDM) generally known as Electrical Discharge Machining is type of non-traditional machining in which removal of the material takes place as a result of electric discharge produced as a result of electric pulsation generated in between an anode and a cathode. Most of the time the work piece is taken as an anode and tool is provided with a negative charge so act as a cathode, A gap is generally maintained in between tool and work piece known as spark gap through which the electron jumps towards the work piece and as a result of heating, melting and vaporization process removal of material takes place but to complete this circuit the work piece is dipped in a liquid known as Di-Electric [1].

2. EDM - PROCESS

In EDM process what exactly happens that tool which is acting as an electrode is pressed or moved towards a work piece and it is pressed up to that point until the gap in between the tool and workpiece is not that much which is responsible to produce an electric spark in the presence of Di electric material and this Di electric material may be considered as kerosene oil also [2].

When the set up is ready to use for the machining purpose then sparks of very short durations after a continuous cyclic processes are produced as a result of a complete electric circuit and then focused on to the workpiece and electric erosion cum machining of material starts. In EDM process, spark discharge generally produces and repeated at rates between 50 kHz to 500 kHz.

The spark discharges always travels the shortest distance between 0.01 – 0.5mm towards the closest point of the work piece.

The removal of the material generally takes place as an erosive action in between tool and workpiece and can also be considered as an anode and cathode but the jumping of the electrons is only possible until unless the workpiece is not dipped in the Di electric material [3].The set is having some problems during machining and these are related with the chatter marks produced over the surface of workpiece. This happens due to the vibrations produced in the system. Voltage range between 50V and 380V and the current supply is from 0.1A to 500A.

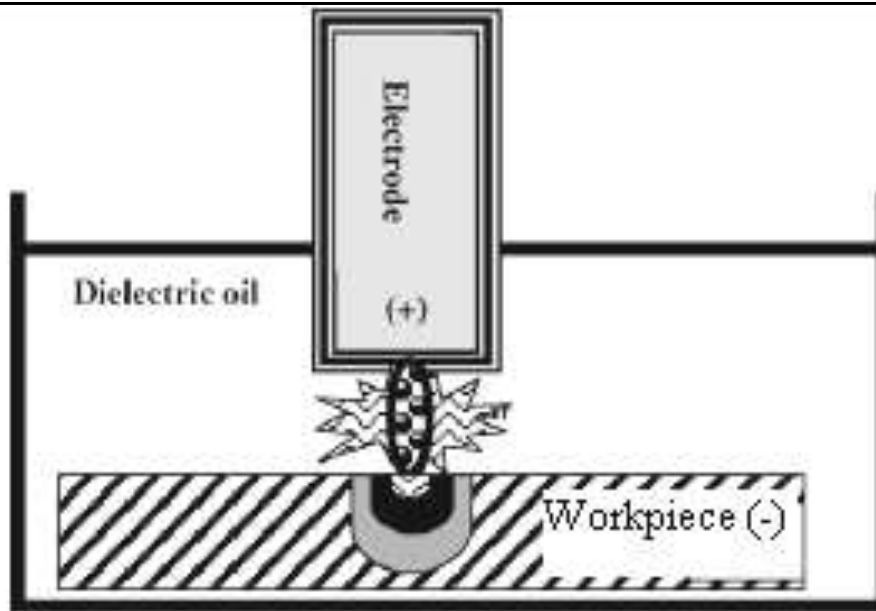


Figure 1 shows the schematic diagram of EDM process

2.1 FABRICATION OF EDM TOOLS

- Electrode is made of conductive material.
- Electrode should possess thermo-mechanical characteristics & retain specified accuracy of final shape.
- The electrode used in the system is having the same shape as the shape of the cavity being cut or machined on the work surface.

2.2 TYPES OF ECDM

- SINKING EDM
- WIRE EDM

2.2 SINKING EDM

Figure. 2 Shows the sinking type electric discharge machining which is having some advantage over the EDM. It is having a possibility that the electrode used in sinking process can be controlled and operated in three mutually perpendicular directions so that the complex and contour profiles can easily be machined with this kind of machine, more over this machining set up provides a better surface finish and high accuracy due the numerical control of the electrode. The tool used in case of this type machining set up is having the same geometry that we actually wanted to produce or machine on the work surface. A strainer is also used which is used to remove the debris from the electrolyte so that a better surface finish can be attained. A special Di electric based upon hydrocarbon solution is generally used so that a high low value

of surface roughness can be achieved. The wear and tear of the electrode is comparatively low because of the presence of the electrolyte and less compensation of electrode or tool material [4]

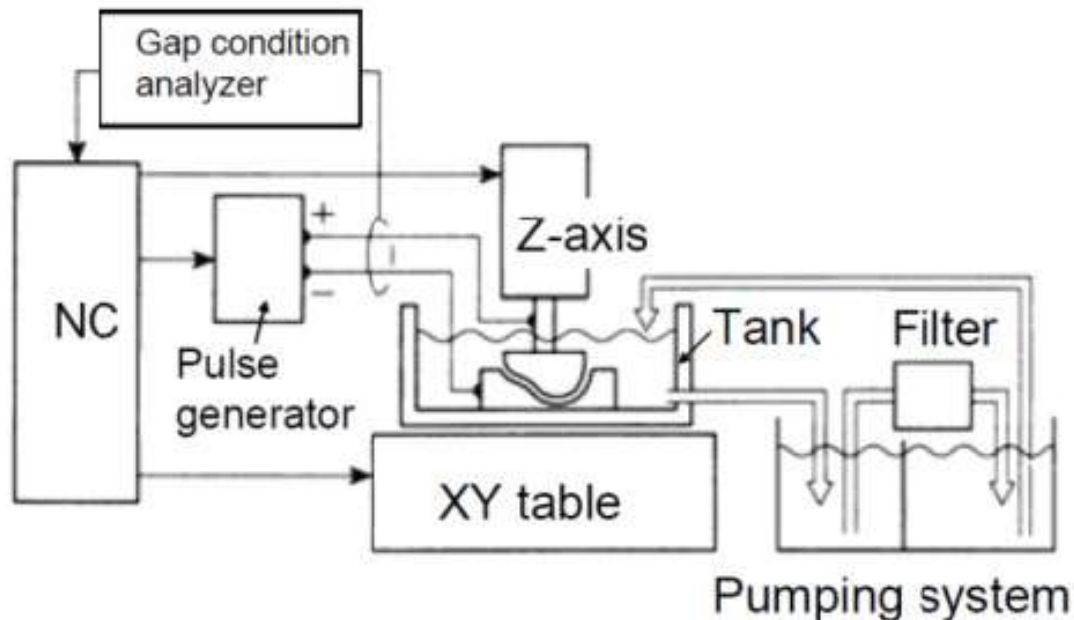


Figure 2: Electrical Discharge Machining (Sinking type)

2.3 WIRE ELECTRIC DISCHARGE MACHINING

In wire EDM we use the wires of very small diameter and the machining is basically done by the cutting action of this wire only the wires are generally made up of brass but sometimes we use steel wires coated with graphite or brass. To overcome the effect of overheating we use water as a coolant in the system. The wire generally mounted on a set of rollers known as the driving rollers operated by the electric motors only. The surface being cut or machined is held firmly on the bed of EDM and cutting is produced by wire only. Further to overcome the effect of vibrations we operate the wire over work surface at very moderate speed so that required accuracy and finish can easily be attained.

The wire can be driven on the work surface in horizontal axis so the machining in this machining set up is limited for two directions only.

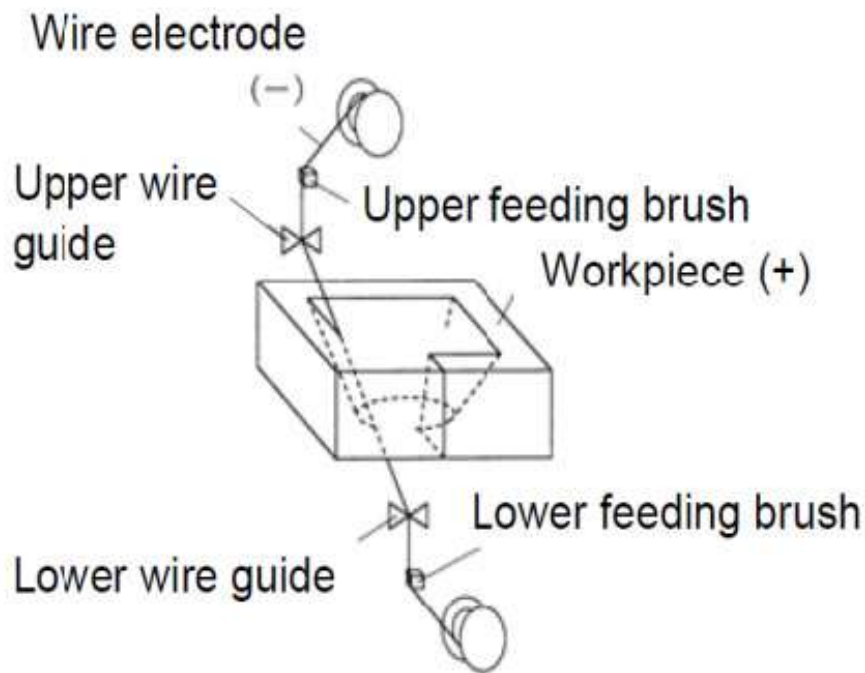


Figure 3: Electrical Discharge Machining (Wire EDM)

3. SELECTION OF ELECTRODE

FACTORS:

1. The electrode must withstand the varying thermal conditions
2. Material to be removed
3. Wear and tear of electrode
4. Control of surface finish
5. Material to be machined (Mechanical and Electrical properties of material)
6. Physical properties of Di Electric and moreover polarity and frequency of pulsation are the important factors of consideration.

3.1 MATERIAL OF ELECTRODE

The use and selection of the material generally depends upon the type of material to be machined and care should be taken while selecting the electrode that its shape should be like that it can produce the desired and required cavity on the work surface. The most common types of electrodes are generally made up of Tungsten, Graphite and sometimes the electrodes made up steel are also being used during the machining process. Study on multiple electrodes has been done where the method has been used to generate parallel spark in EDM machining [5].

3.2 TYPICAL FUNCTIONS OF DIELECTRIC FLUID

- To flow the debris from tool work piece interface
- To enhance the process of ionization
- To provide a cushioning effect and lessen the effect of vibrations
- To balance the thermal conditions by providing cooling of electrode

3.3 TYPES OF DIELECTRICS

There are various types of Di Electric which are most commonly used some of the examples are given below:

- Mineral oils
- Kerosene oil
- Paraffin wax or oil
- Deionised water.

Flushing system either by suction or by injection is used to improve the work efficiency during the machining and flushing pressure will influence the working efficiency and the material removal rate (MRR) [6].

4. MEASUREMENT OF EDM PERFORMANCE

The various elements which is to be considered during measuring of EDM performance are listed below

- Removal of material
- Wear of the Tool (TW).
- Recast layer.
- Surface quality (SQ)

5. MATERIAL REMOVE RATE (MRR)

The volume of material removed from parent metal in time of machining. Some of the study conducted has added additives in dielectric to increase the MRR and improve the surface finish of the machined surface [7].

5.1 TOOL WEAR (TW)

The ratio of amount of electrode to the amount of workpiece removal is defined as the wear ratio (Yao YangTsai, Takahisa Masuzawa) [8,9].The wear of the tool generally depends upon the below parameters.

- Size and shape of electrode
- Length of electrode
- Volume of electrode material

5.2 SURFACE QUALITY

The surface quality basically depends upon spark produced and number of methods applied in research study is adding powder additives in dielectric and simulate the surface finish before the machining process.

5.3 ELECTRIC PARAMETERS IN EDM PERFORMANCE

Four electrical parameter that give major influences in EDM performance are [10]

- Pulse,
- Electrode polarity,
- Peak current and Spark gap.

5.4 NON-ELECTRICAL PARAMETERS

- **Injection flushing pressure:** Flushing pressure is considered as non-electrica parameter. Various researches are done in order to get the optimum value of machining parameter with selected workpiece materials, electrodes, dielectric and techniques [11].
- **Rotational of speed electrode**

5.5 APPLICATIONS OF EDM

- It is used during the production of prototypes
- It is used in die sinking applications
- It is used during the machining of very small holes (Example : Fuel injectors holes)

6. CONCLUSION

- In this survey, a review of EDM machining parameters and its process parameters is done further the main process parameters like Wear of the electrode , removal rate of material functions of di electric were discussed further the parameters responsible for the process parameters are also discussed.
- High current values' will remove more amount of material but at the same time it will affect surface finish of material and increase the tool wear and hence will decrease the tool life.
- The increase in the voltage will increase the spark gap at tool work piece interface and will provide a better surface finish more over it will try to reduce the wear and tear of tool and hence the life of electrode can be increased.

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