UNIT III

ELECTRICAL ENERGY BASED PROCESSES

ELECTRICAL DISCHARGE MACHINING (EDM) :

Electrical discharge machining (EDM) is one of the most widely used non-traditional

machining processes. The main attraction of EDM over traditional machining processes such

as metal cutting using different tools and grinding is that this technique utilizes thermoelectric process to erode undesired materials from the work piece by a series of discrete electrical sparks between the work piece and the electrode. The traditional machining processes rely on harder tool or abrasive material to remove the softer material whereas non-traditional machining processes such as EDM uses electrical spark or thermal energy to erode unwanted material in order to create desired shape. So, the hardness of the material is no longer a dominating factor for EDM process. Tool and the work piece are immersed in a dielectric fluid.

WORKING PRINCIPLE :

Electric discharge machining process is carried out in presence of dielectric fluid which creates path for discharge. When potential difference is created across the two surfaces of die electric fluid, it gets ionized. An electric spark/discharge is generated across the two terminals. The potential difference is developed by a pulsating direct current power supply connected across the two terminals. One of the terminal is positive terminal given to work piece and tool is made negative terminal. Two third of the total heat generated is generated at positive terminal so work piece is generally given positive polarity. The discharge develops at the location where two terminals are very close. So tool helps in focusing the discharge or intensity of generated heat at the point of metal removal. Application of focused heat raise the temperature of work piece locally at a point, this way two metal is melted and evaporated.

EQUIPMENTS :

Base and Container

A container of non-conducting, transparent material is used for carrying out EDM. The container is filled with dielectric solution. A base to keep workpiece is installed at the bottom of container. The base is made of conducting material and given positive polarity.

Tool

Tool is given negative polarity. It is made of electrically conducting material line brass, copper or tungeten. The tool material selected should be easy to machine, high wear resistant. Tool is made slightly under size for inside machining and over sized for cut side machining. Tool is designed and manufactured according to the geometry to be machined.

Dielectric Solution

Dielectric solution is a liquid which should be electrically conductive. This solution provides two main functions, firstly it drive away the chips and prevents their sticking to workpiece and tool. It enhance the intensity of discharge after getting ionized and so accelerates metal removal rate.

Power Supply

A DC power supply is used, 50 V to 450 V is applied. Due to ionization of dielectric solution an electrical breakdown occurs. The electric discharge so caused directly impinges on the surface of workpiece. It takes only a few micro seconds to complete the cycle and remove the material. The circuit can be adjusted for auto off after pre-decided time interval.

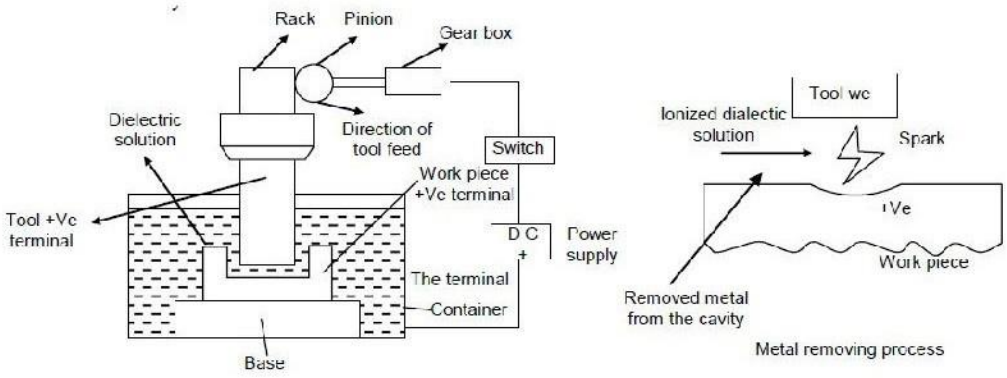
Tool Feed Mechanism

In case of EDM, feeding the tool means controlling gap between workpiece and the tool. This gap is maintained and controlled with the help of servo mechanism. To maintain a constant gap throughout the operation tool is moved towards the machining zone very slowly. The movement speed is towards the machining zone very slowly. The movement speed is maintained by the help of gear and rack and pinion arrangement. The servo system senses the change in gap due to metal removal and immediately corrects it by moving the tool accordingly. The spark gap normally varies

from 0.005 mm to 0.50 mm.

Workpiece and Machined Geometry

The important point for workpiece is that any material which is electrical conductor can be machined through this process, whatever be the hardness of the same. The geometry which is to be machined into the workpiece decides the shape and size of the tool.



APPLICATION OF EDM :

This process is highly economical for machining of very hard material as tool wear is independent of hardness of workpiece material. It is very useful in tool manufacturing. It is also used for broach making, making holes with straight or curved axes, and for making complicated cavities which cannot be produced by conventional machining operations. EDM is widely used for die making as complex cavities are to be made in the die making. However, it is capable to do all operations that can be done by conventional machining.

Process Parameters

- Voltage
- Capacitance
- Spark gap
- Melting temperature of work

SURFACE FINISH AND MRR :

Surface finish tolerance of the order of ± 0.05 to 0.13 mm are commonly achieved,in normal production and with extra care,tolerance of ±0.003 to 0.013 mm are possible.

The material removal rate, MRR, in EDM is calculated by the following foumula:

$$MRR = 40\, I / Tm^{1.23}\ (cm3/min)$$

Where, I is the current amp,

Tm is the melting temperature of work piece

ELECTRODE / TOOL :

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POWER AND CONTROL CIRCUITS :

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TOOL WEAR :

Tool wear mainly depends on the tool material. Tool material may be copper,brass.tool wear is directly proportional to the current supply of the system.

DIELECTRIC :

During the EDM process the workpiece and the electrode are submerged in the dielectric oil, which is an electrical insulator that helps to control the arc discharge. The dielectric oil, that provides a means of flushing, is pumped through the arc gap. This removes suspended particles of workpiece material and electrode from the work cavity.