Unit-3 Un-conventional Machining

Un-conventional Machining: EDM, Wire cut EDM, process principle, process parameters and their applications. Process capabilities and their applications.

ELECTRICAL DISCHARGE MACHINING

Working principle

Electrical discharge machining process works on the basic principle of spark generation and metal removed by spark erosion. EDM spark erosion is same as electric spark which burn a small hole in a piece of metal through witch it contacts. The spark generated by this process produces heat, which remove metal by erosion and evaporation. In this machining process both the work piece and tool must be made by conductive material.

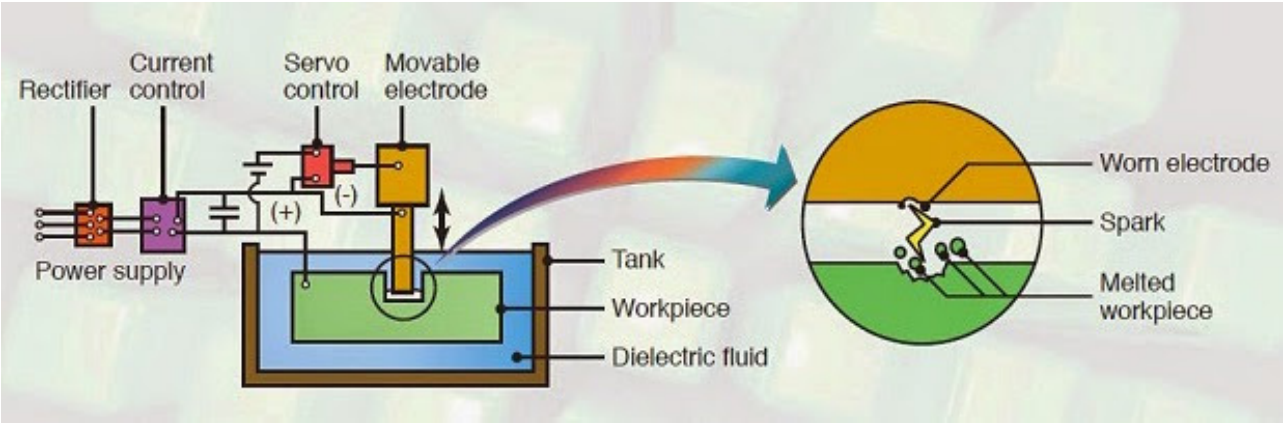

Fig.:Electrical Discharge Machining

Equipment used

The EDM process contains following equipment's as;

Power Supply

In a EDM process a high frequency current used to generate spark between electrode and work piece. This spark generates heat and remove metal form work piece.

Dielectric fluid supply and flushing system

The dielectric fluid acts as a vehicle to drive away the chips and thus preventing them from sticking to the surface. This fluid acts as flushing system for chips. It also helps in increasing the metal removal rate by promoting spark between tool and work. This fluid also works as coolant medium.

Tool and tool holding devices

In EDM process, tool also erodes due to spark hence the selection of tool depends on wear ratio, ease to tool fabrication and cost of material. The most commonly used electrode material are Cu, Tungsten alloy, Cast Iron, Steel, Silver tungsten alloy, graphite.

Work piece and work holding devices

In this process only good conductors of electricity can be machined. So the work piece should have good electric conductivity. This process does not depend on hardness of work piece so there is no criteria of hardness.

Working of EDM

In this process, work piece should be well electric conductive. Only electric conductive material can be machined by this method. The working of EDM is as follow.

- First both work piece and tool are submerged into dielectric fluid. The dielectric fluid helps to control the arc discharge. This also removes suspended particles of work piece material and tool from the work cavity.
- A servomechanism is used which maintains a very small gap between the work piece and the tool. This gap is desirable for proper arc formation. It is about the thickness of human hair.
- The tool is made as the opposite shape of work piece.
- A high frequency current supplied to electrode, which produces a spark between the tool and work piece. This spark generates high in work cavity.
- The metal removed from the work piece due to erosion and evaporate ion.
- The chips or suspended particle between tool and work pieceshould be removed to prevent them to form bridge that causes short circuit. This is done by continuous supply of dielectric fluid.
- The EDM produce a cavity slightly larger than the electrode because of overcut.

Advantages and Disadvantages of EDM

Advantages

- Every conductive material can be cut by this process.
- It is independent on hardness of workpiece so hardened work piece can be machined easily.
- Complex die section and complex shapes can be produce accurately.
- This process is burr free.
- Thin section can be easily machined without deforming the part.

Disadvantages

- In this machining process high tool wear occurs.
- Tool wears limits accuracy and surface finish of metal.
- Only good conductors of electricity can be machined by EDM.

Types of EDM Machines

While there are many specialized forms of electrical discharge machining, industrial EDM machines are commonly grouped into three categories:

1. Die Sinker EDM
2. Wire-cut EDM
3. Hole Drilling EDM

DIELECTRIC FLUID

Die-sinker EDM machines typically use hydrocarbon oil for their dielectric fluid, into which both the workpiece and spark are immersed. In contrast, wire EDM machines normally use deionized water, into which only the sparking area is immersed. Whether oil-based or water-based, the dielectric fluid used in EDM machines serves three critical functions:

- Controlling the spacing of the sparking gap between the electrode and workpiece
- Cooling the heated material to form the EDM chips
- Removing EDM chips from the sparking area

Although they're considerably smaller than those produced in milling or turning processes, EDM does produce chips. These tiny, hollow spheroids are composed of material from both the electrode as well as the workpiece. Just like any chip, they need to be removed from the cutting zone, which is accomplished by flowing the dielectric fluid through the sparking gap. Choosing the right dielectric fluid for EDM application is not always as straightforward as it might seem. Many criteria need to be taken into account. Some are obvious, such as degree of metal removal and electrode wear, while others are much subtler.

EDM MATERIALS

Obviously, any workpiece that's going to be machined with EDM has to be electrically conductive, but there's more to the material limitations of electrical discharge machining than that. For one, certain materials, such as high-nickel alloys—like those found in the aerospace industry—and carbide materials can present a greater challenge for EDM compared to standard tool steels. However, the solutions to the material issues in these cases lie in variations of electrode materials and slower EDM cycle times.

Moreover, while EDM is technically a stress-free machining process—since no direct mechanical force is applied to the workpiece), it's still a thermal process and so has the potential to alter the metallurgy of the workpiece.

Applications of EDM

In practical terms, electrical discharge machining overcomes a major issue found in contact machining: hardness. In traditional processes, metal workpieces are made from special grades of hardenable tool steels machined in an anneal of soft state to facilitate cutting.

One the desired shape has been machined, the parts are then hardened by one or more heat treatments. This adds time, cost and can alter the finished parts' dimensions, especially if the heat treatment process is not properly controlled. The advantage of EDM is that it can cut hardened materials while also providing excellent surface finishes as a bonus. The result is often a reduced need for post-processing or surface treatment.

The principle advantages of EDM are that the process is very predictable, accurate and repeatable. "All EDM machining is performed unattended, so the direct labor rate and manufacturing cost are typically lower for EDM than other methods". In general, the EDM process is reserved for parts with smaller feature sizes and higher accuracy requirements.