International Journal of Enhanced Research in Science, Technology & Engineering
ISSN: 2319-7463, Vol. 11 Issue 5, May-2022, Impact Factor: 7.957

Electric Discharge Coating of Hastelloy under Ti Powder Mixed Dielectric Environment

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ABSTRACT

Basically Electrical discharge machining (EDM) is a well-established non-conventional machining process, used for manufacturing geometrically complex or hard and electrically conductive material parts that are extremely difficult-to-cut by other conventional machining processes. Erosion pulse discharge occurs in a small gap between the workpiece and the electrode. This removes the unwanted material from the parent metal through melting and vaporizing in presence of dielectric fluid. Performance measures are different for different materials, process parameters as well as for dielectric fluids. Presence of metal partials in dielectric fluid diverts its properties, which reduces the insulating strength of the dielectric fluid and increases the spark gap between the tool and work piece. As a result, the process becomes more stable and metal removal rate (MRR) and surface finish increases. The EDM process is mainly used for making dies, moulds, parts of aerospace, automotive industry and surgical components etc. This paper reviews the research trends in the EDM process by using used dielectric fluid.

INTRODUCTION

In 1770 English scientist Joseph Priestly firstly invented the erosive effect of electrical discharge machining. After that in the 1930s, the machining of metals and diamond with electrical discharges was done.

Due to evaluation of spark, erosion was caused by intermittent arc discharges occurring in air between the electrode and workpiece which is connected to a DC power supply. Overheating of the machining area restricts the applications of this process, so it is known as “arc machining”.

In 1943 at the Moscow University revolutionary work on electrical discharge machining was carried out by two Russian scientists, B.R. and N.I. Lazarenko. Refined and a controlled process for machining of materials was developed by analysing the destructive effects.

It became easy to maintain and control the gap between the electrode and workpiece with the introduction of RC (resistance–capacitance) relaxation circuit in the 1950s, which provided the first consistent dependable control of pulse times and also a simple servo control circuit.

Later stage RC circuit used as the model for successive developments in EDM technology. In America at the same time three employees came up with the same results by using electrical discharges to remove broken taps and drills from hydraulic valves.

With the reference of this work vacuum tube EDM machine and an electronic circuit servo system that automatically provided the proper electrode-to-workpiece spacing (spark gap) for sparking, without contact between the electrode and the workpiece.

In the 1980s with the initiation of Computer Numerical Control (CNC) in EDM brought remarkable advancement by improving the efficiency of the machining operation. EDM machines have become so stable with the regular improvement in the process, so that these can be used for a long interval of time under monitoring by an adaptive control system.

This process enables machining of any material, which is electrically conductive, irrespective of its hardness, shape or strength.

The improvement of EDM has since then been intensely sought by the manufacturing sector yielding enormous

economic benefits and generating keen research interests.

EXISTING SYSTEM

The dielectric medium commonly used is a low-viscosity hydrocarbon or mineral oil. The different fluids used are kerosene, paraffin oil, transformer oil, lubricating oil, etc. Distilled water is also recommended when higher a rate of material removal is desired. Kerosene is widely used as a dielectric medium in the EDM process. Table gives the performance of different dielectric fluids used in EDM applications. From the table it can be observed that the wear ratio is low with kerosene as a dielectric medium. The material removal rate is also low with kerosene. Distilled water gives higher material removal rate with least wear ratio. Tetraethylene glycol gives a very high MRR. The surface finish produced by the water dielectric medium will be rough compared to other mediums.

S. No.	Dielectric fluid	Material removal	Wear ratio-work
		Rate cm^3/amp min ´ 10^4	material /tool material
1.	Kerosene	40.0	2.8
2.	Distilled water	54.5	2.7
3.	Tetraethylene glycol	103.0	6.8

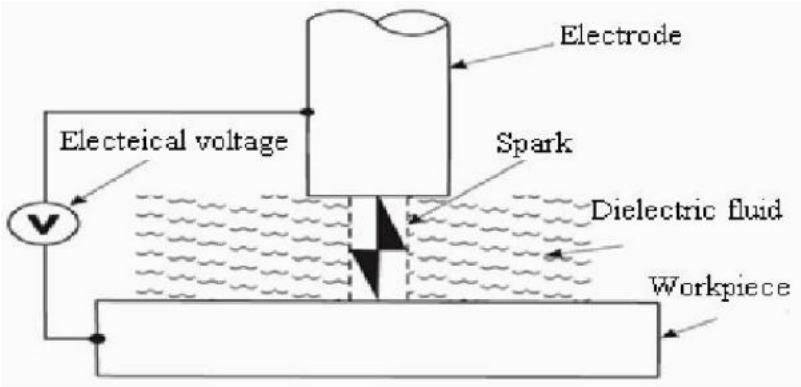
Performance of different dielectric fluid in electric discharge machining using brass tool.

Experimental Work

In this project, Electric discharge coating of Hastealloy under Ti powder mixed dielectric environment and optimization using AI/DS technique as a dielectric fluid for increasing material removal rate, tool wear rate and surface roughness.

EDM is basically a non-conventional machining process but the technique of material erosion employed in EDM is still debatable.

The basic principle followed is the conversion of electrical energy into thermal energy through a series of discrete electrical discharges occurring between the electrode (tool) and workpiece immersed in a dielectric fluid.



RESULT AND DISCUSSION

Tool Electrode (copper)

The tool electrode in wire EDM is simply a wire. To avoid the erosion of material from the wirecausing it to break, the wire is wound between two spools so that the active part of the wire is constantly changing. The copper–copper(II) sulfate electrode is a reference electrode of the firstkind, based on the redox reaction with participation of the metal (copper) and its salt, copper(II) sulfate. It is used for measuring electrode potential and is the most commonly used reference electrode for testing cathodic protection corrosion control systems.

Work Piece (Hastelloy)

Hastealloy is a corrosion resistance nickel alloy that contains other chemical elements such as chromium and molybdenum. This material has high temperature resistance and exceptional corrosion resistance. Hastealloy C276 is one of the grades of Hastealloy used in the oil and gas industry.

Dielectric Fluid

The dielectric fluid has several main functions in the EDM process. It isolates the tool electrode from the workpiece electrode to achieve a high current density in the plasma channel.It cools down the heated surfaces of the electrodes and exerts a counter pressure to the expanding plasma channel . Flushing with dielectric fluid removes the particles after thedischarge process and prevents developing particle linkages causing process interruptions by short circuit, or damage of the electrodes' surfaces.

Titanium Powder

Titanium powder has long been used as an alloying additive for a variety of applications. Recently, technological advances in the production and use of titanium powder have opened doors into many fields including powder metallurgy, thermal spray, laser cladding, metalinjection molding, and additive manufacturing.

Advantage

1. Remain electrically non-conductive until the required breakdown voltage is attained, i.e.,it should possess high dielectric strength.
2. When once the breakdown voltage is reached it should breakdown electrically instantly.
3. Deionize the spark gap, i.e., quench the spark rapidly after the discharge has occurred.
4. Carry away the metal particles removed from the arc gap.
5. Act as a good cooling medium.

DISADVANTAGE

1. High cost
2. High discharge medium
3. Toxic in nature
4. High decomposition rate for long life

CONCLUSIION

In this project we implement a Electric discharge coating of Hastelloy under Ti powder mixed dielectric environment and optimization using AI/DS technique. We know the real time cost of dielectric fluids. Results are observed that used as dielectric fluid provides cheaper price. We conclude that the first phase of our project work, literature survey, mechanical components, productive drawings, cost estimation and complete working are completed.

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