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# Influence of EDM Electrode Manufacturing Techniques on Performance Parameters of Machining - A Review

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***Abstract: Electric discharge machining is a non-traditional machining process used to machining of high strength alloys with high accuracy. In Non-traditional machining processes direct contact between tool and workpiece is absent and tool wear is less. EDM works on the principle of spark erosion technique. thousands of sparks are produced between the work piece and electrode and due to the high heat generation in the gap material from the work piece is melted and vaporized, which is fused out by feeding dielectric fluids electrically conductive material respectively of hardness can be machined due to such characters EDM can be used for finishing dies and moulds, parts of aerospace, automotive and surgical equipment. The performance of EDM is mainly depends on electrode workpiece and the controlling parameters. This paper reviews the recent trends of EDM tool processing technique which is being used to develop the EDM tool with different techniques.***
***Keywords: Electric discharge machining (EDM), heat treatment (HT), cryogenic treatment (CT), electrode coating, selective laser sintering (SLR).***

## I. INTRODUCTION

The new concept of manufacturing uses non-conventional energy sources like sound, light, mechanical, chemical, electrical, electrons and ions. With the industrial and technological growth, development of harder and difficult to machine materials, which find wide application in aerospace, nuclear engineering and other industries owing to their high strength to weight ratio, hardness and heat resistance qualities has been witnessed. New developments in the field of material science have led to new engineering metallic materials, composite materials and high-tech ceramics having good mechanical properties and thermal characteristics as well as sufficient electrical conductivity so that they can readily be machined by spark erosion. Non-traditional machining has grown out of the need to machine these exotic materials. The machining processes are non-traditional in the sense that they do not employ traditional tools for metal removal and instead they directly use other forms of energy. The problems of high complexity in shape, size and higher demand for product accuracy and surface finish can be solved through non-traditional methods. Currently, non-traditional processes possess virtually unlimited capabilities except for volumetric material removal rates, for which great advances have been made in the past few years to increase the material removal rates. As removal rate increases, the cost effectiveness of operations also increases, stimulating ever greater uses of non-traditional process. The Electrical Discharge Machining process is employed widely for making tools, dies and other precision parts.

## II. EDM PROCESS

Electro Discharge Machining (EDM) is an electro-thermal non-traditional machining Process, where electrical energy is used to generate electrical spark and material removal mainly occurs due to thermal energy of the spark. EDM is mainly used to machine difficult-to-machine materials and high strength temperature resistant alloys. EDM can be used to machine difficult geometries in small batches or even on job-shop basis. Work material to be machined by EDM has to be electrically conductive. In this process the metal is removing from the work piece due to erosion case by rapidly recurring spark discharge taking place between the tool and work piece. Show the mechanical set up and electrical set up and electrical circuit for electro discharge machining. A thin gap about 0.025mm is maintained between the tool and work piece by a servo system shown in fig 1.1. Both tool and work piece are submerged in a dielectric fluid. Generally, kerosene oil and deionized water type of liquid dielectric although gaseous dielectrics are also used in certain cases.

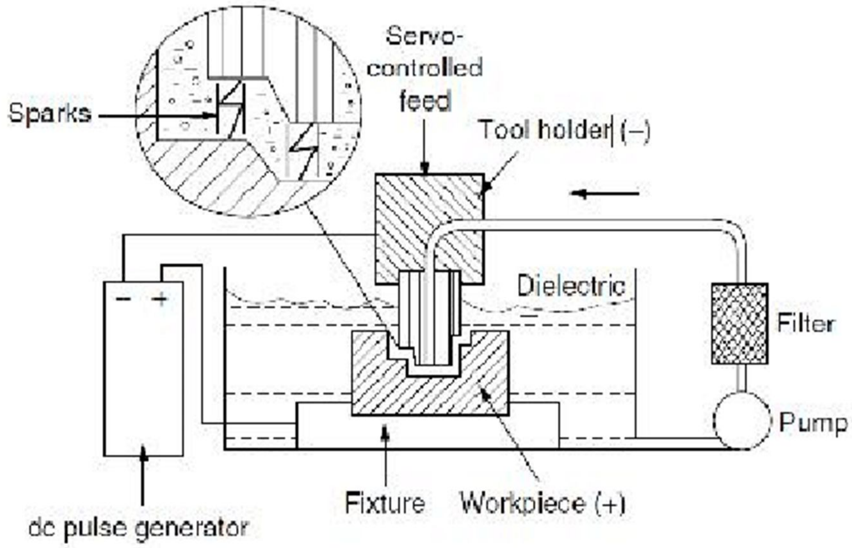



Figure no.1.1: working principle of EDM

## III. LITERATURE REVIEW

Many authors reported new techniques for development of EDM electrode to improve the performance measures some of the techniques are studied in this paper are given below,

### A. *Overview On Electrode Coating*

Z chen [1] studied o WEDM with different material wires with INCONEL 718 as work material and observed that increase in machining efficiency 24-78% for in 718 and 15-39% for ti-6al-4v.

T R ablyaz et al [2] selected copper electrode for machining of 38x2h2ma steel and observed, copper coated aluminium electrode used cheaper material core was used to reduce the cost of manufacturing electrode.

### B. *Overview of rapid Prototyping*

Fefar d savan [3] Performed analysis of metalized electrode fabricated with FDM rapid prototyping technique for electro-discharge machining, and found that TWR, MRR similar to that of solid copper electrode but better surface finish obtained.

Fred l almoriam lohrengel [4] developed an EDM electrodes made by selective laser sintering technique and observed that copper electrode showed worst results. But cost saving in preparation of electrode. This is due to porosity and weak bond strength TWR increases.

### C. *Overview of Cryogenic Treatment*

J m Jefferson and P Hariharan [5] Investigate machining performance of cryogenically treated electrodes in micro electric discharge machining made comparative analysis and found TWR decreased by 58% for tungsten,51% for brass MRR increased by 55% for tungsten, 39% for brass.

Sanjeev Kumar [6] observed the effect of cryogenically treated copper-tungsten electrode on tool wear rate during electro-discharge machining of Ti-5Al-2.5Sn alloy. And conclude that, peak current is significantly affecting the MRR WCT and DCT electrode of copper-tungsten tested and TWR improve by 15.86% this is due to finement of grain particles in DCT electrode, which improves thermal and electrical conductivity.

### D. *Overview of heat Treatment*

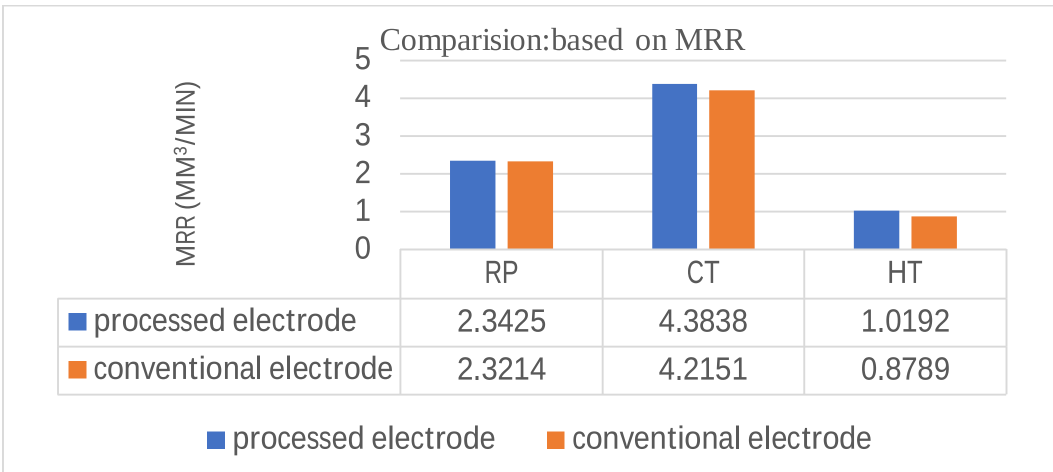
Upasana ray [7] Investigate the parameter optimization in EDM using heat treated tool and without heated cu tool, and found that effective process parameters: peak current, flushing pressure, pulse on time TWR significantly reduces with HT cu electrode.

## IV. OBSERVATION FROM THE LITERATURE SURVEY

From the above literature survey three cases considered [3],[5],[7] and the electrodes are compared on the basis of material removal rate as shown in table no.4.1 among the three electrode which are processed with special treatment the heat-treated electrode shows the better results.

Table no. 4.1: Comparison between post processed electrode and conventional electrode on the basis of MRR

| Processing technique | Electrode | Mean value of MRR ($mm^3/min$) | % Improvement |
|---|---|---|---|
| Rapid prototyping | RP electrode | 1.26259 | 1.4% |
| | Conventional | 1.280908 | |
| Cryogenic treatment | CT electrode | 4.3838 | 4% |
| | Conventional | 4.2151 | |
| Heat treatment | HT electrode | 1.0192 | 10.79% |
| | Conventional | 0.8789 | |

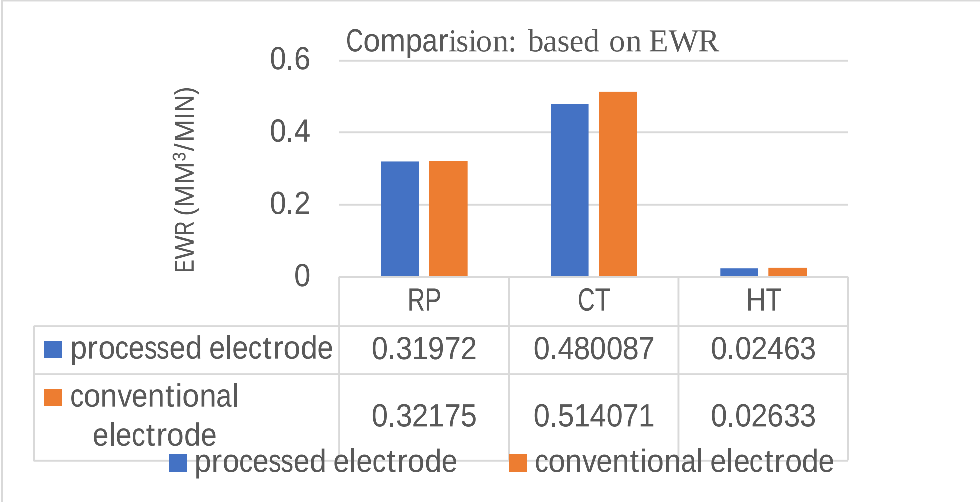



Graph no.4.1 : Comparison between post processed electrode and conventional electrode on the basis of MRR

From the above literature survey three cases considered [3],[5],[7] and the electrodes are compared on the basis of electrode wear rate as shown in table no.4.2 among the three electrode which are processed with special treatment the heat-treated electrode shows the better results.

Table no. 4.2: Comparison between posts processed electrode and conventional electrode on the basis of MRR

| Processing Technique | Electrode | Mean value of EWR ($mm^3/min$) | % Improvement |
|---|---|---|---|
| Rapid Prototyping | RP Electrode | 0.109787 | 1.01% |
| | Conventional | 0.110914 | |
| Cryogenic Treatment | CT Electrode | 0.480087 | 6.61% |
| | Conventional | 0.514071 | |
| Heat Treatment | HT Electrode | 0.02463 | 6.92% |
| | Conventional | 0.02633 | |




Graph no. 4.2: Comparison between post processed electrode and conventional electrode on the basis of MRR

## V. CONCLUSION

In this study the post processed electrode shows the better result than conventional electrodes. Here we consider three cases for study and fond the best technique to post processing of electrode and on the basis of above data we have drawn following conclusion:

*A.* The input parameters like peak current, pulse voltage, flushing pressure, pulse on time governs the performance measures (MRR, EWR, and surface roughness).
*B.* Overall improvement in material removal rate with RP electrode is 1.4%, cryogenically treated electrode is 4%, and heat-treated electrode is 10.79%.
*C.* Overall improvement in electrode wear rate with RP electrode is 1.01%, cryogenically treated is 6.51%, and heat treated is 6.92%.
*D.* Post processing techniques used shows better result over the conventional electrode of same material used for machining.
*E.* Among the three techniques heat treated tool shows good result.

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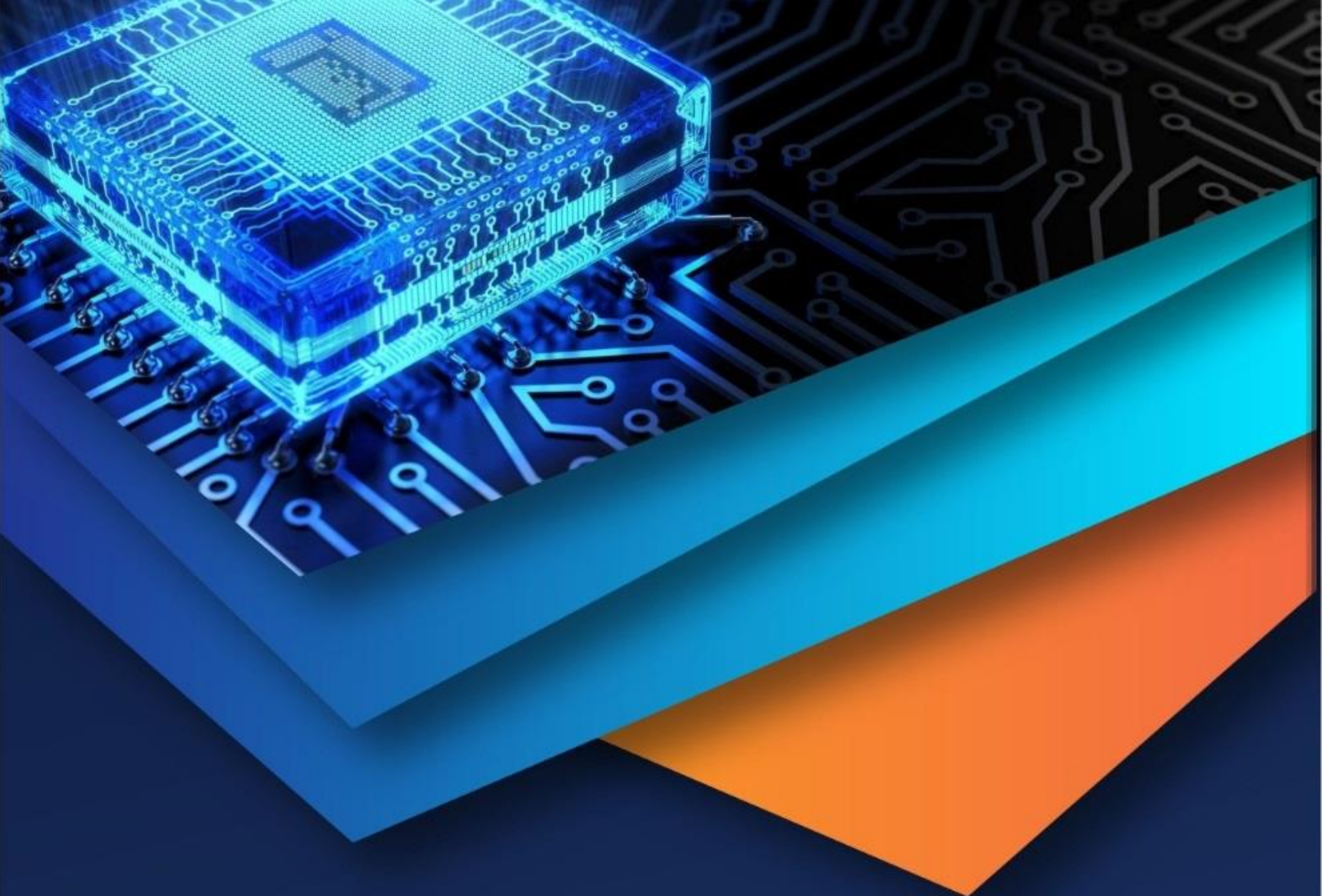

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