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HYBRID ELECTRO DISCHARGE MACHINING PROCESS INVESTIGATION: A REVIEW

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ABSTRACT

Hybrid electro discharge machining (hedm) was the combination of dissimilar machining processes to manufacturing parts with a better response of the machining performance. the main aim of the hybrid machining was applying for the incremental effect of their individual processes. the tendency of rising hybrid processes was for the hard materials with excellent properties, necessities of better machining accuracy, the complicated geometry part for machining which was difficult or possible to machining by conventional and non-conventional machining technologies. "hybrid process" in machining was particularly associated with integrating a specific process by using an additional medium or energy used. hedm was a combination of conventional grinding and edm process used for enhanced mr and surface finishing. this review article based on improvement and investigation of (hedm) processes for mr, tw and sr. the performance of the machining on the work-piece surface machined by hedm had optimized by using different techniques by the various researchers. the main application of edm method was applying for manufacturing of dies, moulds, aerospace parts, automotive industry, tool making industries, medical instruments and surgical components etc with high accuracy.

keywords*: hedm; edm; mrr; tw; surface roughness.*

Introduction

In the modern era advance technology was most important for development and improvement in engineering fields. Hybrid processes have a big achievement in the different material removal process field because of factors for example improvement in the machinability and minimize the process forces. Also, the progress of hybrid processes represents a new chance for the augmentation of manufacturing technology. The improvement of such processes has revolutionized the machining of very complicated shape on hard-to-machine metals devoid of any compromise in the quality of SF. These nontraditional machining processes have helped get high accuracy and dimensional accurateness even for the most complicated shape at a realistic

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rate [1]. This is an advanced machining process mainly used for machining materials difficult to machine performance by the conventional techniques. The major limitation of EDM process was to work only electrical conducting/semi-conducting materials. There was no contact between workpiece and tool materials. The EDM process was developed in In EDM material removed by thermal energy which was generated by electreic spark. It is also called spark erosion machinie. The Hybrid machining process is combination of more than one process for more material removal rate. There were two types of hybrid machining processes:

1. Assisted hybrid machining processes(A-HMP)
2. Pure hybrid machining processes(P-HMP).

In the assisted-HMP, the MR by the primary and secondary source of energy. In P-HMP some advanced mechanisms were available. First one is the hybridized method in the EDM process [3]. In this research articles, we discussed the hybrid electric discharge machining process for MRR, TWR, SR etc based on hybrid electric discharge machining process [4].

METHODOLOGY

Process parameters of HEDM processes

In the above table information of the optimization of the chosen important parameters that can affect theMRR, TWR and quality of the SR [1].

Hybrid machining process

Machining operation may be categories into two different types. First one is mechanical machining in this process abrasive wheels or cutting tools were used to cut the work-piece and material removed easily so, we got the required shape of the work-piece. Unconventional machining processes refer to the machining operations that remove unwanted material by a different mode of operations relating to the all type energy used

Hybrid machining shown in fig. 1, combining different processes within one machining podium (for example, chronological drilling and electric discharge machining (EDM).

Advances in Hybrid EDM Process

At the present time high accuracy and ultra-precision machining processes are capable to accomplish the MRR above 1024 mm^3/sec and very high accuracy in the range 10 to 100 nm.

P. McKeown et al. suggested that superior, reliable, and produces new products, particularly when miniaturization, mechatronics and high performance are significant. These multipurpose machining centers or machines only integrate conventional machining processes. So, the traditional machining does not give a better response on the machining of some hard, advanced engineering materials such as superalloy, composite materials, ceramic and hard steels[5]. This machining process cannot keep away the conventional defects, for example, the creation of burrs and small tool life. Further, the non-conventional

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machining processes can achieve better and more consistent work-piece quality and higher efficiency in the processing of the hard-to-machine materials than the traditional machining processes. The combination of the traditional and non-traditional machining process can improve the response of the machining process. This results in hybrid machining technology [6].

Major Concern of Hybrid EDM Technology

The latest and new advance machining is hybrid machining technology in which the hybrid machine tool take place to hold and control inventive cutting tool for the removal of unnecessary, frequently hard to machine specimen material, which supports to produce 3D shapes also accuracy in addition to the high-quality surface. Process modeling is also a significant part of hybrid machining technology to assist in the process progress the metrology system, the work management system, and the process modeling technique [7].

Performance characteristics of hybrid edm process

Material Removal Rate

MRR is the volume of material removed per unit time. In the hybrid electro-discharge machining process the material removal rate depends upon the behavior of electric conductive work-piece material, tool material and machining parameters. If the materials having a low melting point so that having elevated material removal rate but surface finish is lower. [11-12]. They found that with the increase in pulse current and constant pulse-on-time material removal rates increases but the surface finishing quality of the material is low and affect the smoothness of the outer surface or the work-piece [13]. Optimum values for material removal rate we can get at low values of current by the help of the current control system

The surface roughness was the most important phenomenon of the hybrid EDM process. Surface finish was a target of machining in HEDM. In CMC's pulse on time is the most important factor which affects the surface roughness. They found that SR increases with the increase in discharge current and (T-on) because if the gap between Ton and (T-off) were more than the over-cut problem can be created [13]. Tosun N., suggested that the improved surface finishes without surface cracks at low values of current [14].

Tool Wear Rate

Abdulkarim et al. [15] in the experimental investigation the cryogenic cooling effect on electrode wear rate and surface roughness quality of the workpiece used in hybrid EDM process. By the help of the cryogenic cooling process the electrode wear ratio minimized up to 27% and also we can get up to 8% improvement in the surface roughness. Amandeep Singh et al. [16] reported that the copper electrode was used in the EDM process cause of low electrical resistance in the copper electrode and which is helpful to transfer successfully energy to the work-piece. The most powerful process of the cooling effect of liquid nitrogen improves the electrical and thermal

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conductivity of copper and it is a very helpful to heat transfer inefficient quantity from the copper electrode gives reduced the rate of electrode wear. They verified that the cryogenic process gives the (TWR) by 58.77% and the surface roughness minimizes by the 8%. For the cryogenic titanium (Ti) work-piece at least value of TWR is (0.00943443gm/min) of (TWR) was achieved with plain as Ti as the tool and current was 2 A.

CONCLUSIONS

The EDM and hybrid electric discharge machining is a multi-tasking non-traditional process, capable to manufacture complicated shapes and it is free from the mechanical properties of the work-piece. The basic of scheming hybrid EDM process mostly relies on experimental method mostly caused by the stochastic character of the sparking occurrence concerning with electrical and non- electrical process parameters. HEDM has brought lots of improvements and development in machining of composite material, metal matrix composite materials advance material in current years.

A serious remark on various research works is obtainable and the following remarks were completely based on this study is that explain below.

1. In this study anthology of EDM research work in the hybrid technique which used in the advanced machining process area to get there for the best production conditions, which is an essential need for production systems towards manufacturing the quality of products at lower cost.

2. For every technique introduced and apply in HEDM process, the objectives are the same: to improve the ability of hybrid machining operation, to get superior production rate, to improve technique to machined new materials like that supper alloy, composite and hard materials enhance working conditions.

3. Through the current research work and experimental study by using the hybrid techniques in EDM for maximized the MRR and minimized the TWR or EWR, SR and improved surface quality.

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The different input process parameters were chosen that can inflicted the MMR, TWR and SR of the HEDM process is as follows.

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Machining parameters	Tool parameters	Work-piece parameters
Current Voltage Ton Toff Polarity Flushing method Machining time Duty cycle	Tool types Abrasive materials Abrasive grain size Shape and size of the tool Geometry of the tool	Work-piece materials Work-piece diameter Shape and size of the work-piece Work-piece geometry

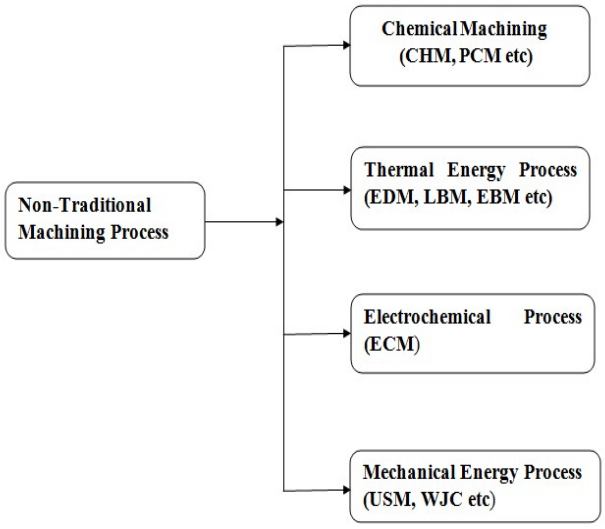

Fig. 1 *Hybrid Machining Processes Diagram*

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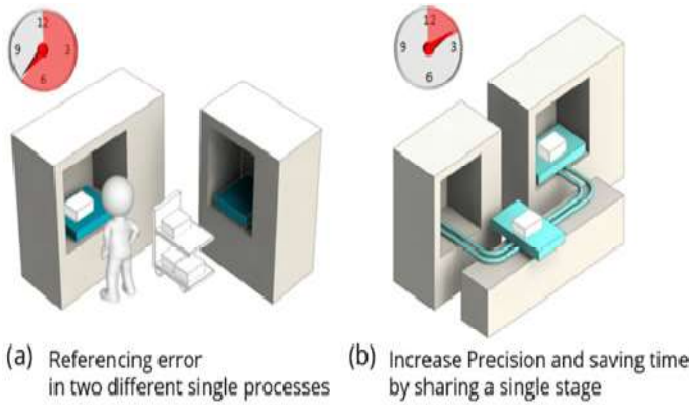

Fig. 2 *In this activity shows the Referencing issues in hybrid manufacturing. [8]*

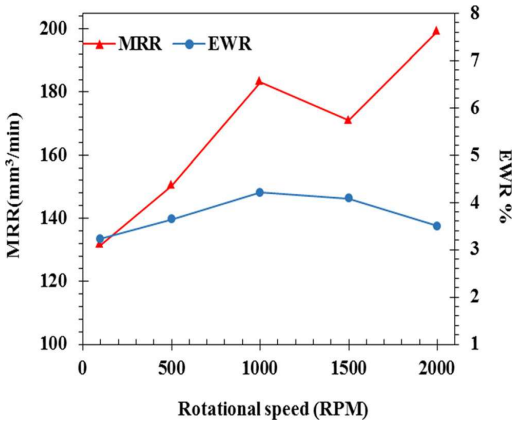

Fig.3*: Effect of RPM on MRR and EWR at 50A and 8 MPa [11] Surface Roughness*

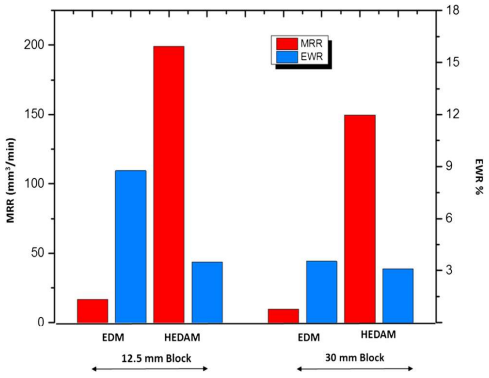

Fig.4*: In this fig. shows the effect of EDM and HEDAM process for dissimilar thicknesses of the Inconel 718 work-piece [12]*