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A Review Of Electro Discharge Machining (Edm)Technique analysis

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Abstract- Electro Discharge Machining, or EDM, is a machining technology that is usually used to produce objects out of hard metals or things that cannot be made any other way. As a result, one of the most important non-traditional machining methods is electro discharge machining (EDM). It is used to cut difficult-to-cut materials such as composites and intermetallic materials. This is analogous to an electrical short that burns a small hole in the metal that it comes into contact with. The spark erosion in EDM is the same piece. Both the work piece material and the electrode material must be able to conduct electricity in order for the EDM process to work. EDM allows you to create complex profiles utilised in prosthetics and other biomedical applications, such as a heart valve. Electro Discharge Machining (EDM) can also be used to create complex forms, small holes with high precision, and high-strength metals that can endure high temperatures. This study examines some of the most innovative work in the field of EDM. It also allows the EDM to expand in the future.

Keywords- electrode material, complex forms, small holes etc

I. INTRODUCTION

EDM is an acronym of Electric Discharge Machining. This technique of metal removal process, is a high temperature phenomenon in which electrical energy is transformed into Thermal energy, is utilized in which intermittent electric discharge produces a very high temperature in micro seconds that melt and vaporizes the material mainly from workpiece and a little from tool, both workpiece and tool electrode is submerged in a suitable dielectric fluid also work as cooling and insulating medium, between positive and negative electrodes such an unconventional, contactless machining process is known as Electric Discharge Machining.

A temperature in the range of 8000 oC to 12,000 oC is generated during Electric spark that developed plasma channel between positive and negative electrode in EDM which sufficiently high to melt and evaporate any type of hardest material provided it must be conductive. This plasma canal breaks down during pulse off duration when no current flows. In this time dielectric fluid acts as flushing agent and flush out debris of molten metal and minute microchips from electrode surface.

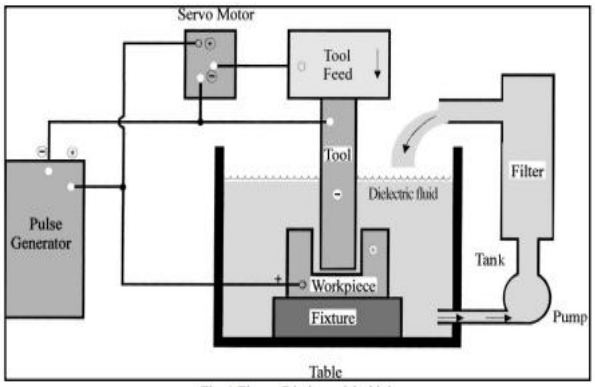

Fig. 1 Electro Discharge Machining

Classification of EDM
Generally, two different forms of EDM are used

1. Die-sinking EDM
In Die-sinking type of EDM workpiece which is anode and tool electrode which is cathode both submerged in a sinking tank filled with dielectric fluid the discharge current is turned on and off intermittently and automatically. In the pulse on duration an electric spark is generated due to break down of dielectric strength of fluid and a spark jumped out. This intermittent sparking creates very high temperature which leads to metal removal by vaporization due to melting. Every time pulse is on and a discharge current flows in the circuit, sparks strike on by one at different location in the spark gap between workpiece and tool electrode, since spark strike between the minimum vertical height between the gap space, so every spark produces crater formation with peak and a valley so by this way minimum distance changes and spark strike at different locations. These spark produces in more numbers within

fraction of seconds. If the workpiece is eroded faster due to these sparks, then size of spark gap increases and servo system sense the gap and move the tool to such a distance so that again sparks continues.

Wire-cut EDM

Wire-Cut EDM machine is another type of very popular EDM process uses a single wire very strong and thin of the order of 0.25 mm is used generally made up of an alloy of copper and Zinc known as Brass. It also uses dielectric fluid, which is generally de-ionized water (for the purpose of electricity conduction) which acts as cooling medium during pulse on duration and flushing agent in pulse off duration to washout debris form during sparking process in the form of microchips.

A small hole is created in the workpiece and then a thin single – strand brass metal wire is passed through that hole and as per the size of hole and wire distance sparks is created and then mechanism is used to move wire through the workpiece in order to generate a required profile around the surface of workpiece by the movement of wire. Any number of profiles can be cut with the help of wire-cut EDM or WEDM. This type of EDM is mostly used in order to cut the metal plates with maximum thickness of 300 mm and for making any contour shape or cut any type of profile. Application of WEDM in manufacturing dies, punches and tools from workpiece material which very toughness and high hardness or very fragile and thin can't be machined by any convention type of machine.

II.LITERATURE REVIEW

G. Ugrasen, et.al [1] (2015) all the four authors of this paper described optimum operational variables in the machining by wire EDM The material which is chosen for the analysis is high carbon high chromium (HCHCr). Taguchi's Technique is utilized to make DOE and as per the design optimization criterial an Orthogonal Arrays of 27 i.e. L27 is decided to be performed and as per that HCHCr material was machined and along with it various operational variables are also evaluated. Operational variables like bed time, current off time (Toff), current on time (Ton), was varied as per DOE given by Taguchi. To gain the knowledge that which parameters affect up to what extent a process called analysis of variance (ANOVA) is also carried out. To verify the result obtained via ANOVA analysis the experiment called texting is also done so that accuracy and level of execution of output variables can be fixed.

S. K. Sahoo, et al [2] (2019) in this paper it was analyzed that when machining is done by WEDM on HCHCr as workpiece then what is the effect of input variables like cutting forces like pulse on time, current off time and the rate at which wire is feed on the response of output variable like SR (surface roughness), MRR (material removal rate) and KW (kerf width). In this research paper MOORA method is utilized for analyzing the effect of more than one complex procedures. The final concluding result is that WEDM is very suitable to machine the workpiece having high carbon and high chromium (HCHCr) content with ease and having high precision and less overall machine time. It was further observed that the output response variables like SR, MRR and Kerf Width have quick increased values when current on time (Ton) increases while their values decreases at a slow rate with current off time (Toff).

ParveenGoyal, et al [3] (2018) the paper examined that for both workpiece and tool electrode as discharged current increases the value of machining variable, material removal rate also increases. For the machining of high chromium platinum steel (HCrPr) a tool manufactured by sintering process having composite material is prepared and used along with Electric Discharge Machine. For the manufacturing stents that is used in cardiovascular angioplasty high chromium and high platinum material is mostly used. Using these electrodes on EDM, the machining of HCrPr has been done. K. Srujay Varma, et al [4] (2018) in this paper it was studied that during the machining of HCHCr steel using copper electrode in wire EDM (WEDM) how the various process parameters like current on time, current off time, servo voltage and discharge current influenced the output response values like MRR, Surface Roughness (SR) and Vickers Hardness. Machinability of HCHcr steel is low as compared to other steels like SS-304 etc.

Sanjay Kumar, et al [5] (2018) Experimental analysis performed by taking a novel ultrasonic vibration hybrid EDM (H-WEDM) method combined with conventional wire-EDM. Together with surface roughness and erosion rate, the impact of residual stresses was left for surface which is machined by EDM hybrid type to improve quality of surface and increase value of service life of HCHCr (D2) tool steel. Taguchi technique is used to analyzed the effect of impact of erosion rate variations on maximum value of discharge current, feed rate of wire, duty cycle and peak value of vibration.

M. Jagadeeswara Rao, et al [6] (2017) Examines the different performances of operational variables of EDM in the machining workpiece Incoloy-800. In the machining of Incoloy-800 a composite of copper 25% and Tungsten 75% by EDM various process parameters examined are current off time, pressure values in flushing, current on time and spark current. Based on Taguchi technique based L9 OA was involved here to perform minimal experimental run and software MINITAB-17 was used to evaluate input response variables on machining data and to determine set of optimized variables for obtaining minimum values of SR and TWR and maximized value of rate of material removal (MRR).

Harish and Dr. P. Srinivasa Rao [8] (2017) analyzed the performance of output response variable such as SR, MRR

when WEDM is utilized and further investigated the effect of current off time (Toff), arc gap, current on time (Ton), pressure value during flushing, servo voltage and wire tension are the vital input variables that affect the output response variables. Taguchi's technique of DOE is used to perform experiments by adjusting the time-pulse parameters, wire tension and current off time. To gain the knowledge that which parameter affect the optimum, a study is done known as analysis of variance (ANOVA).

M. Dastagiri, et al [9] (2016) research is done on 'multi-objective optimization' as a methodology, the effectiveness and productivity of the EDM process is solved instantaneously obtain the quality and output of EDM operation. As part of this technique the four input operational variables are chosen are: current on time (Ton), distance between the electrodes, spark voltage (V), spark current (Ip). In three different stages various performance variables are analyzed. For each experimental run as per Taguchi's DOE performance of SR and MRR, TWR was evaluated. Main Focus is on maximization of MRR (to boost productivity), minimizing surface ruggedness and also minimization of TWR. Taguchi's S / N ratio and GRA techniques are used to optimized TWR, SR and MRR of stainless steel-316 job material by means of EDM system.

DalgobindMahto and Narinder Singh [10] (2016) This paper summarizes and based on review findings the research work conducted to enhance performance steps, optimal response variables, find and maintain the discharging activity in EDM. It also describes how we simplify the production and designing of tool electrode. The major goal of this research is related to find maximized value of material removal rate, surface roughness and overcut with copper tool of AISI304SS. Current was observed to be most influencing followed by current on time and the least relevant was the current off time for the Material tool wear rate and material removal rate of the instrument as confirmed by the experimental analysis. is the biggest influencing factor along with current on time and last by current off time.

ShantisagarBiradar, et al [11] (2016) This research paper examined optimum collection of operational variables like current on time, applied voltage, spark current in EDM to find changes in output response variables like rate of material removal in the machining of HCHCr die steel and electrode wear rate during machining by titanium nitride-coated copper electrode. Study was carried out using Grey Relational Study (GRA), based on experiments performed using factorial technique. GRA is an important strategy for dealing with the issue of multi- objective optimization. Final conclusion is 1. The optimal mixture of operational variables rate of material removal and minimizing TWR is V=45 volt and Ton=200 µs and Ip=10 ampere. If optimal criteria is applied TWR value is 0.02099 g/min and MRR value is 0.1579 g/min 3. Current has been found to be the most powerful parameter for the copper electrode coated with titanium nitride, which has a strong effect on both TWR and MRR after that second most factor is Ton¬.

Marshal Noel Paik and Rahul Davis, et al. [12] (2016) The paper analyzed that when HCHCrworkpiece is machined by EDM with copper as tool electrode then how the output operation variables like MRR is affected as a result of changes in input variables by Taguchi optimization technique. Collection of data during experiments were used to provide responses with respect to the rate of material removal (MRR). In this analysis chosen input variables are such as spark gap, flushing rate, current on time, and spark current. In the machining of HCHCR by copper tool on EDM, the final result is that the cutting combination obtained for the optimum parameter levels was spark current, then flushing rate and finally Ton.

ArindamMukhuti, et al [13] (2016) Experimental work investigates the effect on workpiece INCONEL-600 when machined by WEDM with chosen operational variables like current on time, voltage, feed rate of wire, current on time. In the application where high temperature and corrosion tolerance is required INCONEL-600 is mostly preferred which is alloy of nickel and chromium. The experiment was performed using an orthogonal array of Taguchi's L9. MOORA method is used to find various results by analyzing S/N ratio. The optimal values of various performing operational variables are current on time is 18 µs, feed rate of wire is 12, current off time is 18 µs and regulating voltage is 35 volts in order to get optimal output result.

Naveen Kumar, et.al [14] (2016) Studies have been made in this present work related to machining of HCHCrworkpiece by using powder mixed electric discharge machining (PMEDM). The addition of optimum amount of powder in EDM's dielectric fluid increases the MRR and decreases the TWR. As per Taguchi technique L9 OA was decided and experiment planning and study is carried out as per DOE. HCHCr is used as work piece, the effect of PMEDM with tungsten copper electrode and silicon powder in dielectric EDM oil was investigated in this research.

III.CONCLUSION

This review paper includes a study on how to optimise several machining parameters on an EDM. A lot of work is done on various types of work items that cannot be machined using traditional machines. There are electrodes constructed of copper, aluminium, and other metals. When striving to improve things, for example, the Taguchi optimization is frequently applied. However, there are various techniques for doing so, such as Grey Relational Analysis, Surface Response Methodology, and so on. So, based on the aforementioned literature review, it can be concluded that materials that cannot be machined using traditional machining methods can be machined using non-

traditional machining methods, such as the Electro Discharge Machining technique.

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