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Recent Un-conventional Investigation Improvement of Electric Discharge Machining (EDM) with tool Rotation: - A Review

Deepak, Department of Automobile Engineering,
G. B. Pant Institute of Technology, Delhi -20 (INDIA)
E-mail: ali10.sharma @gmail.com

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Abstract- Electrical discharge machining (EDM) process supreme universally used nonconventional precise material removal processes. Electrical discharge machining (EDM) is a process for affecting hard metals and forming deep multifarious shaped fleabags by arc erosion cutting-edge entirely kinds of electro conductive materials. Erosion pulse discharge transpires in a small gap between the work piece and the electrode. This eliminates the undesirable material from the parental metal finished melting and vaporizing trendy occurrence of dielectric fluid. In current centuries, EDM scholars ensure explored a number of techniques to improve EDM Process constraints such as Electrical parameters, Non-Electrical Parameters, tool Electrode based parameters & Powder based parameters. This advanced research shares the equivalent objectives of accomplishing more competent metal removal rate reduction in tool wear and improved surface quality. This paper reviews the research effort approved out from the foundation to the development of EDM with tool rotation, Water in EDM, dry EDM, and Powder mixed electric Discharge Machining. ***Key word***- Electrical Discharge Machining (EDM), MRR (Material removal rate), TWR (Tool wear rate) SR (Surface roughness), WR (Wear Ratio), HAZ (Heat affected Zone).

I. Introduction: -

The history of EDM Machining Techniques goes as far back as the 1770s when it was discovered by an English Scientist. However, Electrical Discharge Machining was not fully taken advantage of until 1943 when Russian scientists learned how the erosive effects of the technique could be controlled and used for machining purposes. When it was originally observed by Joseph Priestly in 1770, EDM Machining was very imprecise and riddled with failures. Commercially developed in the mid-1970s, wire EDM began to be a viable technique that helped shape the metal working industry we see today. In the mid-1980s.The EDM techniques were transferred to a machine tool. This migration made EDM more widely available and appealing over traditional machining processes. The new concept of manufacturing uses non-conventional energy sources like sound, light, mechanical, chemical, electrical,

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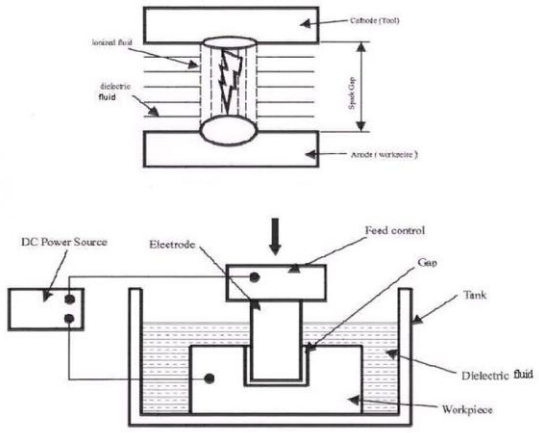
electrons and ions. With the industrial and technological growth,

1.1 Principle of EDM:-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. Both tool and work piece are submerged in a dielectric fluid .Kerosene/EDM oil/deionizer water is common type of liquid dielectric although gaseous dielectrics are also used in certain cases. Set up of Electric discharge machining shown the electric setup of the Electric discharge machining. The tool is cathode and work piece is anode.



II. Literature Survey: -

A large number of journals were referred on the subject of EDM. These dealt with the analysis of various machining parameters i.e. peak current, pulse on time, polarity of electrode, electrode material and tool rotation and output responses have been seen on MRR(Material removal rate), TWR (Tool wear rate) and SR(surface roughness). The various researchers have reported experimental results on different materials such as high carbon steel, EN8, EN31, AISI H13 tool steel, Mild steel, Inconel 718 etc**. K.H. Ho et. al (2003).** This paper reviews the research work carried out from the inception to the development of die sinking EDM within the past decade. It reports on the EDM research relating to improving performance measures, optimizing the process variables, monitoring and control the sparking process, simplifying the electrode design and manufacture. A range of EDM applications are highlighted together with the development of hybrid machining processes. The final part of the paper discusses these developments and outlines the trends for future EDM research **Vineet Srivastava et. al (2012)** -In this work the parametric study on EDM process using ultrasonic assisted cryogenically cooled Electrode (UACEDM) during machining of M2 grade high speed steel has been performed. Electrode wear ratio (EWR), material removal rate (MRR) and surface roughness (SR) was the three parameters observed. Discharge current, pulse on time, duty cycle and gap voltage were the controllable process variables. The effect of process variables on EWR, MRR and SR has been analyzed. The MRR, EWR and SR obtained in EDM process with normal electrode, cryogenically cooled electrode and ultrasonic assisted cryogenically cooled electrode have been compared. EWR and SR were found to be lower in UACEDM process as compared to conventional EDM for the same set of process parameters, while MRR was at par

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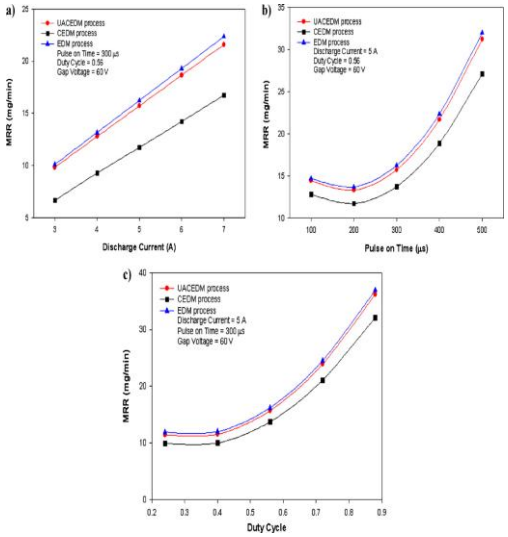
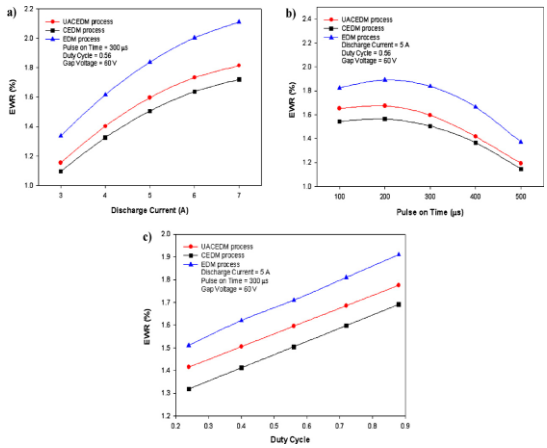
with conventional EDM process. The surface integrity of work piece machined by UACEDM process has



Variation of MRR with (a) discharge current, (b) pulse on time and (c) duty cycle.



Variation of EWR with (a) discharge current, (b) pulse on time and (c) duty cycle.

Yuna Yahagi et. al (2012) -This paper describes the machining characteristics of high spindle speed micro EDM using the electrostatic induction feeding method. In this technique, non-contact electric feeding allows the tool electrode to be rotated at a high speed of up to 50000rpm. In a previous study, it was shown that machining characteristics including material removal rate and accuracy can be improved by increasing the rotational speed. This is because rotation is effective in assisting flushing of debris particles from the gap and also cooling the tool electrode surface. This report investigates the influence of high spindle speeds on machining performance. As a result, it was found that much deeper micro-holes can be machined with better straightness. **Yanzhen Zhanget. al (2012)** - This paper reviews the current understanding of powder mixed electrical discharge machining (PMEDM), highlighting particularly the mechanisms proposed for PMEDM under the influence of additive of powders in the dielectric fluids. More investigations on the fundamental mechanism in power mixed EDM are highly desirable since it has not been understood clearly. In this paper, the traditional and some recent development technology for PMEDM is also reviewed. some novel variations that based on power mixed EDM, such as PMEDM combined with ultrasonic or abrasive, powder mixed near-dry EDM and powder mixed electrical chemical discharge machining (ECDM) were also developed. **Reza Teimouri et. al (2012)** -In this work, the effects of tool rotation and various intensities of external magnetic field on electrical discharge machining (EDM) performance have been studied. Experimental trials divided into three regimes of low energy regime, middle energy regime and high energy regime. Results indicated that the applying a rotational magnetic field around the

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machining gap improves the MRR and SR. Combination of rotational magnetic field and rotary electrode increases the machining performance, in comparison of previous conditions. This is due to better flushing debris from machining gap. This work introduces a new method for improving the machining performance, in cost and time points of view. **K.P. Rajurkara et. al (2013)** - Electrochemical and electro-discharge machining processes are the two major electro-machining processes with unique capabilities. Electrical Discharge Machining (EDM) and Electrochemical Machining (ECM) offer a better alternative or sometimes the only alternative in generating accurate 3-D complex shaped macro, micro and nano features and components of difficult–to-machine materials. Technological advances reported in electrochemical and electro discharge machining processes, which reflect the state of the art in academic and industrial research and applications, are briefly reviewed in this paper. **Samad Dadvandipour et. al (2013)** - Evaluating customer demands to link with manufacturer may have the most important role introducing parts with utmost preciseness. Replacing traditional manufacturing process with modern and advanced process technology has already been an important alternative in competitive world market, which may fulfill the customer satisfaction in long term. Different kind of tool electrode materials like graphite, copper and Brass. The effective parameters of electric discharge machining and outputs (response variables) of working material were defined as follows: Open circuit voltage (V), Peak current(Ic), Pulse on time (Ton), Tool wear ratio(TWR), Surface roughness (Ra), Material removal rate(MRR), and Electrode wear ratio (EWR). **Nibu Mathewet. al (2014)** - Electric Discharge Machining (EDM) is a non-traditional machining process that involved a momentary spark discharges through the fluid due to the potential difference between the electrode and the work piece. In EDM, This is due to material removal rate characteristics. Less material removal rate (MRR) needs more time for machining process and become waste which is not good for peak current, gap voltage, and duty cycle on material removal rate of H11 steel are experimentally investigated. A L18 Taguchi's standard orthogonal array issued for experimental design. Conventional Copper (Cu) and powder metallurgy (PM) copper tungsten (CuW) are used as tool materials. It was found that conventional copper tool electrode gives maximum MRR and best parametric setting for maximum MRR was found at, Cu (99% Cu) tool electrode, 9 ampere current, 50 volts gap voltage and 0.92 duty cycles. ie. A1B2C2D3. **Shaaz Abulaiset. al (2014)** - Electrical discharge machining (EDM) is one of the earliest non-traditional machining processes. EDM process is based on thermoelectric energy between the work piece and an electrode. A pulse discharge occurs in a small gap between the work piece and the electrode and removes the unwanted material from the parent metal through melting and vaporizing. The electrode and the work piece must have there are various types of products which

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can be produced using EDM such as dies and molds Parts of aerospace. **Vikas et. al (2014) -** The article presents an idea about the effect of the various input process parameters like Pulse ON time, Pulse OFF time, Discharge Current and Voltage over the Surface Roughness for an EN41 material. Here, 5 different output parameters concerned with surface roughness like Ra, Rq, Rsk, Rku and Rsm are taken and optimized accordingly, using the Grey-Taguchi method. The Grey-Taguchi method used in the article considers an L27 orthogonal array, which uses a different combination of the 4-input parameters to obtain an optimized value of the surface roughness for EN41 material. The 5 different output values of the surface roughness are calibrated into a single value (i.e. Grade) by calculating their normalized, Δ and ξ values .On the basis of their Grade, the S/N ratio is obtained and accordingly the ANOVA table is generated. It was found that the Current had larger impact over the Surface Roughness value, followed by the Voltage. The experimental results thus, obtained were compared with the theoretical results and they were found very close to one another. **Nishant Kumar Singhet. al (2015)** -The electrical discharge machining (EDM) is unitary of the widely used unconventional machining because of its ability to cut very hard material engendering high dimensional accuracy as well. In thermo-electric process, control sparks generation between electrodes causes material removal; however, application of hydrocarbon oil based dielectric is an issuance of environmental disruption. To rectify this problem, replacement of dielectric is main concerns in EDM research. This paper highlights Dry-EDM, Near-Dry EDM and EDM in water, which is conceived as an environment amiable alteration in the oil EDM process. The work gives a thorough review of Dry, near-dry EDM and EDM in water as a process, where the target is to endeavor dielectric fluids that can be substituted bypassing hydrocarbon oil. It is perceived that water and gas based dielectrics could take over oil-based fluids in die sink applications. Novel technological advances in dry EDM machining processes, which deliberate the relatively advanced stage of a technology in to the area of academic and industrial research is briefly reviewed. An outline of the prospective trend of reviewing is intimate in the last fragment. **T. Muthuramalingam et. al (2015)-** Since the thermal energy produced in electrical discharge machining process is due to the applied electrical energy, it is very important to enhance the electrical process parameters to improve the process efficiency. The present study discusses about having an overview of the EDM process, modeling of process parameters, and influence of process parameters such as input electrical variables, pulse shape, and discharge energy on performance measures such as material removal rate, surface roughness and electrode wear rate. This study also discusses about controlling the electrical process parameters, and empirical relationships between process parameters and optimization of process parameters in EDM process. **Yingmou Zhu et. al (2016)-** An optimized long aspect radio micro rotary

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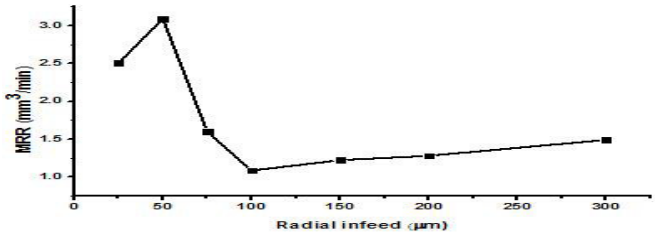
parts machining process was proposed based on common wire EDM machine. By adding a precise rotary spindle to a conventional three axis CNC wire EDM machine, A single factor experiment was conducted to investigate the influence of the radial infeed on MRR. The experimental results showed that the maximum MRR can reach up to 3.09 mm3/min when the radial infeed was 50□m.

Radial feed (cm)	25	50	75	100	150	200	300
MRR(mm 3/min)	2.5 07	3.0 91	1.6 03	1.0 87	1.2 26	1.2 82	1.4 95

At last, a feedback rod and a group of pin electrodes were machined by applying optimized parameters and following the new feeding strategy.



Influence of radial in feed on MRR

The achieved maximum aspect ratio was more than 60 among these pin electrodes.

III. Conclusion Remark: -

The objectives of the study on EDM are as follows:-•to investigate the effect of different input process parameters on MRR, TWR and SR. To study the effect of rotation of tool electrode on MRR, TWR and SR. A critical remark on various research works is presented and the following observations are made based on this review work. • In this review paper collection of EDM research publications in the field of optimization technique which used in the manufacturing process area to arrive for the best manufacturing conditions, which is an essential need for industries towards manufacturing of quality products at lower cost.• For each and every method introduced and employed in EDM process, the objectives are the same: to enhance the capability of machining performance, to get better output product, to develop technique to machine new materials and to have better working conditions.• Through the latest optimization technique used in the EDM processes Maximize the MRR, reduced the TWR or EWR, improve the SR &Surface quality.

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