A Review on Analysis of The Influence Of EDM Parameters On MRR, SR, And TWR, With Carbon Nano Tube.

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Abstract: Electric discharge machining is non conventional machining process used for machining of hard materials which cannot be machined by conventional machining process. Electric discharge machining is an electro sparking method of metal working involving an electric erosion effect. 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. Carbon nanotubes display unexpected strength and unique electrical and thermal properties. Multi-wall carbon nanotubes are therefore on purpose added to the dielectric used in the EDM process to improve its performance when machining the EN-31 tool steel, by means of Aluminium electrodes. Some EDM parameters such as material removal rate, surface roughness and tool wear ratio evaluated, here. Then compared the EDM performed without using nanotubes mixed to the dielectric. Full factorial experimental design was used to investigate the influence of EDM parameters.

Key words: Electrical discharge machining (EDM) .Carbon nanotubes (CNT). Material removal rate, surface roughness, tool wear ratio.full factorial method, Regression Analysis.

1.Inroduction: Electric discharge machining is a non conventional machining process and has found its wide application in making moulds, dies, and in aerospace products and in surgical equipments[1]. The process is based on removing material from a part by means of a series of repeated electrical discharges between tool called the electrode and the work piece in the presence of a dielectric fluid. The electrode is moved toward the work piece until the gap is small enough so that the impressed voltage is great enough to ionize the dielectric. [3] The material is removed with the erosive effect of the electrical discharges from tool and work piece. EDM does not make direct contact between the electrode and the work piece. [4] In this work, a study focused on the electric discharge machining of the EN-31 alloy steel, whose field of applications is in constant growth. Consequently, an analysis on the influence of current and pulse on, pulse off, over surface roughness, material removal rate, tool wear ratio will performed. [2]

2. Problem formulations & Purpose solution: Today in this comparative market the precession and cheap component is necessary to take the advantage for competitor high quality parts with shorter time period is demand from customer. So the unconventional machining mainly electro discharge machine is the key technology to manufacturing high quality component. In the EDM machine the quality of the parts is highly depends upon the various process parameters. For that, process parameter optimization of EDM process should be carried out. There are different methods of optimization of process parameter like factorial design, Taguchi method, central composite design; response surface methodology etc. So for evaluating the performance of Electro-Discharge Machining

(EDM) on materials with respect to various variables such as material removal rate, surface roughness, and tool wear ratio, to determine significant process parameters using full factorial technique.

3. Literature Review: Literature review is one of the scope studies. It works as guide to run this analysis. It will give part in order to get the information about electrical discharge machine (EDM) and will give idea to operate the test. From the early stage of the project, various literature studies have been done. Research journals, books, printed or online conference article were the main source in the project guides. This part will include almost operation including the test, history, machining properties and results. History of the electrical discharge machine (EDM) will be story little bit in this section. Literature review section work as reference, to give information and guide base on journal and other source in the media.

S.PRABHU, B.K VINAYAGAM they have work on Nano surface finish has become an important parameter in the semiconductor, optical, electrical and mechanical industries. The materials used in these industries are classified as difficult to machine materials such as ceramics, glasses and silicon wafers. Machining of these materials up to nano accuracy is a great challenge in the manufacturing industry. Finishing of micro components such as micro-moulds, micro-lenses and micro-holes need different processing techniques. Conventional finishing methods used so far become almost impossible or cumbersome. In this paper, a nano material especially multi wall carbon nano tube is used in the machining process like grinding to improve the surface characteristics from micro to nano level. They were obtained result as per table. [5]

Samples	Ra Values (μm)
Sample 1 (with no lubricant)	0·251
Sample 2 (with water soluble oil)	0·137
Sample 3 (with SAE20W-40)	0·096
Sample 4 (with SAE20W-40 + MWCNT)	0·057

Hyun-seok TAK,Chang-seungHA, Ho-jun LEE had study on The characteristic evaluation of aluminum oxide (Al2O3)/carbon nanotubes (CNTs) hybrid composites for micro-electrical discharge machining (EDM) was described. Alumina matrix composites reinforced with CNTs were fabricated by a catalytic chemical vapor deposition method. Al2O3 composites with different CNT concentrations were synthesized. The electrical characteristic of Al2O3/CNTs composites was examined. These composites were machined by the EDM process according to the various EDM parameters, and the characteristics of machining were analyzed using field emission scanning electron microscope (FESEM). The electrical conductivity has a increasing tendency as the CNTs content is increased and has a critical point at 5% Al2O3 (volume fraction). In the machining accuracy, many tangles of CNT in Al2O3/CNTs composites cause violent spark. Thus, it causes the poor dimensional accuracy and circularity. The results show that conductivity of the materials and homogeneous distribution of CNTs in the matrix are important factors for micro-EDM of Al2O3/CNTs hybrid composites.[6]

C.Mai, Hong Hocheng, s.Huang has mention to improve surface roughness, and reduce machining time and tool wear. For that they have used different powder like Aluminiam, silicon, graphite and carbon nano tube mixed with dielectric fluid and experiment work on NAK 80 Steel using cu. Electrode. They have analyses three different parameter like effect of various powders mixed into dielectric on surface roughness, machining time and also on tool wear they have get three different graphs. They have conclude that improvement of the machining efficiency and the roughness of a machined surface by add CNT powder to the dielectric. The surface roughness of the work piece and

the machining efficiency of the EDM with powder mixed into the dielectric were improved by 70% and 66% respectively, compared with conventional EDM.CNTs demonstrate better achievement than other powder.[7]

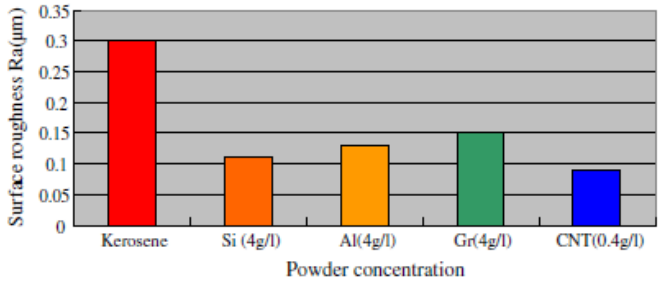


Fig.2.3(A) The influence of various powders mixed into the dielectric on the surface roughness

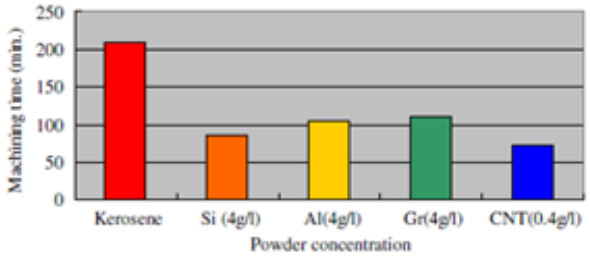


Fig.2.3(B) The influence of various powders mixed into the dielectric on the machining time

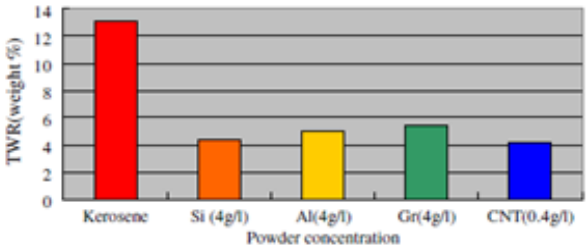
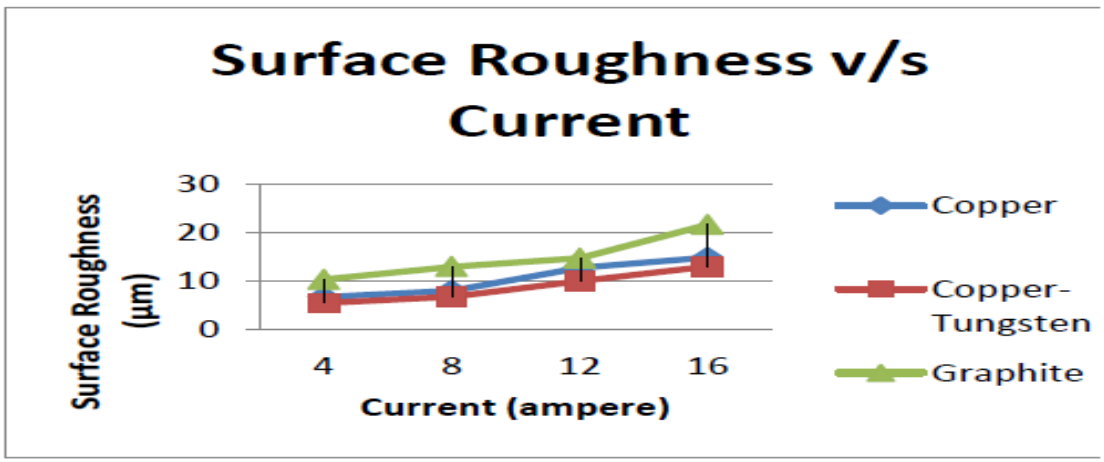


Fig.2.3(c) The influence of various powders mixed into the dielectric on the machining time

Gautam Kocher , Karan chopara etc. In this paper the microstructure of D3 tool steel is observed before and after heat treatment and surface roughness in D3 is investigated after EDM. For this set of experiments three different tool electrodes are taken and the result shows the variation of Ra value with respect to discharge current. They have observed that Copper-Tungsten is giving good quality surface as compare to copper electrode and graphite electrode. Graphite is recommended for roughing and copper electrode is recommended for semi finishing process but Copper –Tungsten is best for finishing process. Copper –Tungsten is costly than copper. But it gives good surface finish.[8]



S Velusamy, U.O Bidwai had studied an Effect of Titanium Carbide particle addition in the aluminum composite on EDM process parameters with aluminum composite electrode and used Titanium Carbide (Tic) as a work piece. They have used Taguchi method as research methodology for finding out different outputs such as MRR, EWR, SR. As a result they found that MRR is found to increase with increasing values of discharge current, MRR decreases as the percent of titanium carbide particle in the composite increases due to the shielding effect of titanium carbide particle in the composites. MRR increases with increasing pulse on time initially and after an optimum value is reached no visible improvement in the MRR Increase in discharge current has a moderate effect on TWR up to an optimum value and thereafter a significant rise in the wear rate is associated with higher thermal loading Increasing the duration of pulse increases the tool wear during the initial period. However, as the pulse on time reaches an optimum value a gradual reduction in the tool wear is noticed which is the combined effect of an increase in the flushing pressure particle crater formation due to longer pulse duration. A sudden drop in the tool wear rate has been noticed when machining Al-2.5% TiC composites at very high pulse on time value [9].

P. Janmanee , A. Muttamara had worked on performance of difference electrode materials in EDM of Tungsten carbide using electrodes such as Graphite , Copper – Graphite, Copper – tungsten & used Tungsten carbide as a work piece. They have used ANOVA analysis as research methodology for finding out different outputs like MRR, EWR, SR with the help of different inputs like Pulse off time, Open – circuit voltage, Electrode polarity (Negative), Discharge Current, and Pulse on time. As a result they found that Negative polarity graphite electrode has the most MRR 11% & both powder electrodes give the better MRR and EWR more than solid electrode & increased current have influence to increasing of MRR. [10]

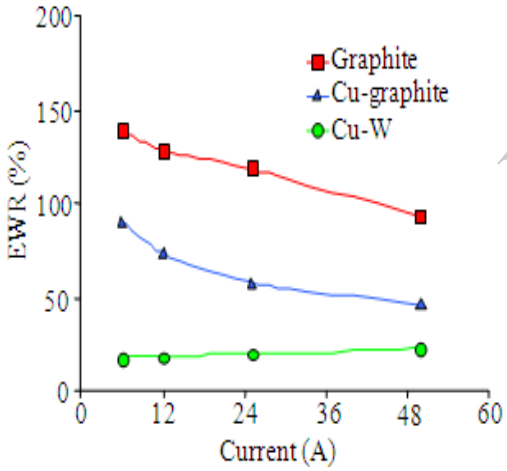


Fig. 2.5: Variation of EWR with Discharge current

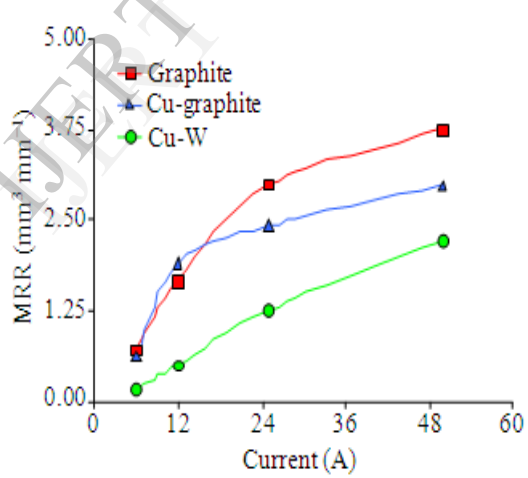


Fig 2.5: Variation of discharge current with MRR

A. A. Khan had worked on Electrode wear and MRR during EDM of aluminum and mild steel using copper and brass electrodes. They used electrodes like copper and brass electrodes & aluminum and mild steel as a work piece. for finding out different outputs like MRR, EWR, SR with the help of different input like Thermal conductivity, Melting point ,Electrical resistivity, Specific heat capacity & as a result they found that during machining of mild steel, electrodes undergo more wear than during machining of aluminum. This is due to the fact that the thermal conductivity of aluminum is higher that of mild steel, which causes comparatively more heat energy to dissipate into the electrode during machining of mild steel. The WR increases with increase in current and gap voltage Vg. The highest wear ratio was found during machining of steel using a brass electrode. The MRR increases sharply with increase in current. In the present study, the highest MRR was obtained during machining of aluminum using a brass

electrode. That means, though a higher current causes more removal of work material and the electrode, but comparatively more material is removed from the electrode Also at low Ip, the MRR is very low, but with increase in Ip, the MRR [12].

Y.S.Wong, J. & Y.H.Fuh had worked on EDM performance of TIC/Copper based Sintered electrode like Copper based Sintered (Copper tungsten, tungsten brass, copper) & Titanium Carbide (TiC) material as a work piece. They have used peak current, pulse duration, machining time, arc voltage, reaction time, machining time for find out output like MRR, EWR, SR As a result they found that 1. Electrodes with 15% Tic show the highest relative density, lowest electrical resistivity, and good EDM performance. Lowest TWR and highest MRR at low current, and the best surface finish not only at low current, but also at high current [15].

Yan-Cherng et.al have investigated The effects of the machining parameters (MRR, TWR and SR) in EDM on the machining characteristics of **SKH 57** high-speed steel Experimental design was used to reduce the total number of experiments. Parts of the experiment were conducted with the L18 orthogonal array based on the Taguchi method. Moreover, the signal-to-noise ratios associated with the observed values in the experiments were determined by ANOVA and F -test. The relationship of MRR and SR with pulse duration graph in different peak current. During the experiment MRR increases with peak current MRR initially increased to a peak at around 100 μs, and then fell.[16]

J. Simao et al was developed the surface modification using by EDM, details are given of operations involving powder metallurgy (PM) tool electrodes and the use of powders suspended
in the dielectric fluid, typically aluminum, nickel, titanium, etc. experimental results are presented on the surface alloying of **AISI H13** hot work tool steel during a die sink operation using partially sintered WC / Co electrodes operating in a hydrocarbon oil dielectric. An L8 fractional factorial Taguchi experiment was used to identify the effect of key operating factors on output measures (electrode wear, workpiece surface hardness, etc.). With respect to micro hardness, the percentage contribution ratios (PCR) for peak current, electrode polarity and pulse on time. Even so, the very low error PCR value (for micro hardness ~6%) implies that all the major effects were taken into account.[17]

Khalid Hussain SYED et. In this paper presents the experimental investigations on addition of aluminium metal powder to dielectric fluid in electric discharge machining (EDM). They uses distilled water mixed with aluminium powder as dielectric fluid instead of conventional hydrocarbon-based oils. The work piece and electrode materials chosen for the investigation are W300 die-steel and electrolytic copper, respectively. Taguchi design of experiments is used to conduct experiments by varying the parameters peak current, pulse on-time, concentration of the powder, and polarity. The process performance is measured in terms of material removal rate (MRR), electrode wear ratio (EWR), average surface roughness (Ra), and white layer thickness (WLT). The experimental results indicate that the polarity significantly affects the machining performance. Signal-to-noise (S/N) ratio and the analysis of variance (ANOVA) are employed to find the optimal levels for the process parameters to achieve maximum MRR, low EWR, Ra, and WLT values.[18]

4. Full factorial design for optimization

S H Tomadi, M A Hussain had worked on Analysis of influence of EDM Parameters on Surface quality, MRR, EWR on Tungsten carbide using copper tungsten electrode & used tungsten carbide as work piece. They have used

ANOVA analysis as research methodology & full factorial as a DOE for finding out different outputs like MRR, EWR, SR with the help of different inputs such as duty cycle, intensity, off time, on time, Polarity, pulse duration, power supply voltage, peak current, Arc Gap. As a result they found that higher Pulse On time will gives the higher value of MRR of Tungsten carbide. Increasing of pulse off time, will decrease the MRR when the voltage is increased, the MRR & EW will increase when the peak current is increased, MRR & electrode will increase when the pulse on time increased, and the EW will also increase [13].

C J Luis, I. Puertas had worked on MRR and EW study on the EDM of Silicon carbide using Silicon carbide electrodes & Silicon carbide as a work piece. They have followed Fractional factorial design analysis as research methodology for finding out different outputs MRR, EWR, SR with the help of different inputs such as pulse time, duty cycle, open circuit voltage, die electric flushing pressure. As a result they they found that MRR greatly increases when intensity and open-circuit voltage is increased. EW decreases when intensity is increased when flushing pressure is increase improve the wear on the electrode. [14]

Puertas and Luis has define the optimization of machining parameter for EDM of **Boron carbide** of conductive ceramic materials. It is these conditions that determine such important characteristics as surface roughness, electrode wear, and MRR. In this article, a review of the state of art of the die-sinking EDM processes for conductive ceramic materials, as well as a description of the equipment used for carrying out the experiments, are presented. Also, a series of mathematical models will be devised using design of experiments techniques combined with multiple linear regression, which will allow us, while only performing a small number of experiments, to select the optimal machining conditions for the finishing stage of the EDM process.[19]

5. Conclusion: From the above reviews we can conclude that full factorial design is versatile tool for process design optimization. The full factorial design is most effective to get the contribution of each parameter and to determine significant parameters which affect the performance characteristic respectively. There are different optimization methods but as shown in above reviews researchers got better results with full factorial design because of it can be provide systematic, efficient and simplification of experimental plan. The regression technique is an important tool for representing the relation between machining characteristic and EDM process input parameters, and the obtained mathematical models, indicate this correlation perfectly.

6. Referance

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