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Experimental Investigation And Determine The Influence Of Process Parameters On Surface Quality In Wire Cut Edm

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ABSTRACT:

Wire Cut Electric Discharge Machining process with a thin wire as an electrode transforms electrical energy to thermal energy for cutting materials. WEDM is considered as a unique adoption of the conventional EDM process, which uses an electrode to initialize the sparking process. However, WEDM utilizes a continuously travelling wire electrode made of thin copper, brass or tungsten of diameter 0.05-0.30 mm, which is capable of achieving very small corner radii. The wire is kept in tension using a mechanical tensioning device reducing the tendency of producing inaccurate parts. During the WEDM process, the material is eroded ahead of the wire and there is no direct contact between the work piece and the wire, eliminating the mechanical stresses during machining. Wire-cut Electrical Discharge Machining (WEDM) is extensively used in machining of conductive materials producing intricate shapes with high accuracy. This study exhibits that WEDM process parameters can be altered to achieve betterment of Material removal rate (MRR), Surface Roughness (SR) and Electrode Wear. The objective of our project is to investigate and optimize the potential process parameters influencing the SR and Electrode Wear while machining of aluminum alloys using WEDM process. This work involves study of the relation between the various input process parameters like Pulse-on time (Ton), Pulseoff time(Toff), Pulse Peak Current(IP), Wire material, Work piece material and process variables. Based on the chosen input parameters and performance measures L-9 orthogonal array is selected to optimize the best suited values for machining for aluminum alloys by WEDM

INTRODUCTION:

A machining methodology usually used for Non Ferrous metals, discharge Machining (commonly called "EDM Machining") makes it attainable to figure with metals that ancient machining techniques square measure ineffective. A vital purpose to recollect with EDM Machining is that it'll solely work with materials that square measure electrically semi conductive.

With smart EDM Machining instrumentality it's attainable to chop tiny odd-shaped angles, elaborated contours or cavities in hardened steel also as exotic metals like Ti, Haste alloy, Inconel, and inorganic compound.

The EDM method is usually utilized in the Tool and Die business for mold-making, but in recent years EDM has become a integral half for creating image and production elements. This is often seen within the part and natural philosophy industries wherever production quantities stay low.

When the gap between the 2 electrodes is reduced, the intensity of the electrical field within the volume between the electrodes becomes bigger than the strength of the insulator (at least in some points), that breaks, permitting current to flow between the 2 electrodes. As a result, material is off from each the electrodes. Once the present flow stops new liquid insulator is typically sent into the inter-electrode volume facultative the solid particles (debris) to be frenzied and also the insulating properties of the insulator to be restored. Adding new liquid insulator within the inter-electrode volume is usually stated as flushing. Also, when a current flow, a distinction of potential between the 2 electrodes is restored to what it absolutely was before the breakdown, so a brand new liquid Insulator breakdown will occur. The erosive result of electrical discharges was 1st noted in 1770 by English man of science

1.1 Die-sink EDM

Two Russian scientists, B. R. Lazarenko and N. I. Lazarenko, were tasked in 1943 to analyze ways that of preventing the erosion of W electrical contacts as a result of sparking. They failing during this task however found that the erosion was additional exactly controlled if the electrodes were immersed in an exceedingly insulator fluid. The Lazarenkos' machine is thought as Associate in Nursing R-C-type machine when the RC Circuit accustomed charge the electrodes

Simultaneously, however severally, Associate in Nursing yank team, Harold Stark, Victor President Harding, and Jack Beaver, developed Associate in Nursing EDM machine for removing broken drills and faucets from metallic element castings. Initial constructing their machines from feeble electric-etching tools, they weren't terribly winning. However additional powerful sparking units, combined with automatic spark repetition Associate in Nursingd fluid replacement with an magnetism device arrangement created sensible machines. Stark, Harding, and Beaver's machines were able

to manufacture sixty sparks per second. Later machines supported the Stark-Harding-Beaver style used electron tube circuits that were able to manufacture thousands of sparks per second, considerably increasing the speed of cutting.

1.2 Wire-cut EDM

The wire-cut kind of machine arose within the Nineteen Sixties for the aim of creating tools (dies) from hardened steel. The tool conductor in wire EDM is solely a wire. To avoid the erosion of fabric from the wire inflicting it to interrupt, the wire is wound between 2 spools so the active a part of the wire is continually dynamical. The earliest numerical controlled (NC) machines were conversions of punched-tape vertical edge machines. The primary commercially on the market Tar Heel State machine designed as a wire-cut EDM machine was factory-made within the Russia in 1967. Machines that would optically follow lines on a master drawing were developed by David H. Dulebohn's cluster within the Nineteen Sixties at Saint Andrew Engineering Company for edge and grinding machines. Master drawings were later created by pc numerical controlled (CNC) plotters for bigger accuracy. A wire-cut EDM machine mistreatment the CNC drawing plotter and optical line follower techniques was created in 1974. Dulebohn later used an equivalent plotter CNC program to directly management the EDM machine, and also the 1st CNC EDM machine was created in 1976.

WIRE CUT EDM MACHINE

Electrical discharge machining could be a machining methodology primarily used for onerous metals or people who would be terribly troublesome to machine with ancient techniques. EDM usually works with materials that square measure electrically semi conductive, though strategies for machining insulating ceramics with EDM have additionally been planned. EDM will cut complex contours or cavities in pre-hardened steel while not the requirement for warmth treatment to melt and re-harden them. This methodology is used with the other metal or metal alloy like Ti,hastelloy, kovar, and metal. Also, applications of this method to form crystalline diamond tools are according.

EDM is usually enclosed within the 'non-traditional' or 'non-conventional' cluster of machining strategies alongside processes like chemistry machining (ECM), water jet cutting(WJ, AWJ), optical maser cutting and opposite to the 'conventional' cluster (turning, milling, grinding, drilling and the other method whose material removal mechanism is actually supported mechanical forces).

Ideally, EDM is seen as a series of breakdown and restoration of the liquid insulator intermediate the electrodes. However, caution ought to be exerted in considering such a statement as a result of it is and perfect model of the method, introduced to explain the elemental concepts underlying the method. Yet, any usage involves several aspects that will additionally have to be compelled to be thought-about. For example, the removal of the rubble from the interelectrode volume is probably going to be continuously partial. So the electrical proprieties of the insulator within the inter-electrodes volume is completely different from their nominal values and may even vary with time. The inter-electrode distance, usually additionally stated as sparkgap, is that the ending of the management algorithms of the precise machine used. The management of such a distance seems logically to be central to the present method. Also, not all of the present between the Insulator is of the perfect sort delineated above: the spark-gap is shortcircuited by the rubble. The system of the conductor could fail to react quickly enough to stop the 2 electrodes (tool and work piece) from returning into contact, with a sequent short. This is often unwanted as a result of a brief circuit contributes to material removal otherwise from the perfect case. The flushing action is inadequate to revive the insulating properties of the insulator so the present continuously happens within the purpose of the inter-electrode volume (this is stated as arcing), with a sequent unwanted amendment of form (damage) of the tool-electrode and work

2.LITERATURE REVIEW:

Evaluation of Optimal Parameters for machining with Wire cut EDM Using GreyTaguchi Method by S V Subrahmanyam, M. M. M. Sarcar[1] The main objective of this work is to demonstrate the optimization of Wire Electrical Discharge Machining process parameters for the machining of H13 HOT DIE STEEL, with multiple responses Material Removal Rate (MRR), surface roughness (Ra) based on the Grey–Taguchi Method. taguchi'sL27(21x38) Orthogonal Array was used to conduct experiments, which correspond to randomly chosen different combinations of process parameter setting, with eight process parameters: TON, TOFF, IP, SV WF, WT, SF, WP each to be varied in three different levels. Data related to the each response viz. material removal rate (MRR), surface roughness (Ra) have been measured for each experimental run; With Grey Relational Analysis Optimal levels of process parameters were identified. The relatively significant parameters were determined by Analysis of Variance. The variation of output

responses with process parameters were mathematically modeled by using non-linear regression analysis. The models were checked for their adequacy. Result of confirmation experiments showed that the established mathematical models can predict the output responses with reasonable accuracy. Performance Analysis of Wire Electric Discharge Machining (W-EDM) by ATUL KUMAR, DR.D.K.SINGH[2] In this present study variation of cutting performance with pulse on time, pulse off time, open voltage, feed rate over ride, wire feed, servo voltage, wire tension and flushing pressure were experimentally investigated in wire electric discharge machining (WEDM) process. Brass wire with 0.25mm diameter and Skd 61 alloy steel with 10mm thickness were used as tool and work materials in the experiments. The cutting performance outputs considered in this study were material removal rate (MRR) and surface roughness. Experimentation has been completed by using Taguchi L18 (21 different conditions of parameters. Optimal combinations of parameters were obtained by this technique. The study shows that with the minimum number of experiments the complete problem can be solved when compared to full factorial design. The results obtained are analyzed for the selection of an optimal combination of WEDM parameters for proper machining of Skd 61 alloy to achieve better surface finish. In addition the importance of the cutting parameters on the cutting performance outputs is determined by using analysis of variance (ANOVA). x37 orthogonal array.

Analysis of Process Parameters in Wire EDM with Stainless Steel Using Single Objective Taguchi Method and Multi Objective Grey Relational Grade by M. Durairaja, D.Sudharsunb, N. Swamynathan[3] With the increasing demands of high surface finish and machining of complex shape geometries, conventional machining process are now being replaced by non-traditional machining processes. Wire EDM is one of the non-traditional machining processes. Surface roughness and kerf width are of crucial importance in the field of machining processes. This paper summarizes the Grey relational theory and Taguchi optimization technique, in order to optimize the cutting parameters in Wire EDM for SS304. In this present study stainless steel 304 is used as a work piece, brass wire of 0.25 mm diameter used as a tool and distilled water is used as a dielectric fluid. For experimentation Taguchi's L16, orthogonal array has been used. The input parameters selected for optimization are gap voltage, wire feed, pulse on time, and pulse off

time. Dielectric fluid pressure, wire speed, wire tension, resistance and cutting length are taken as fixed parameters. For each experiment surface roughness and kerf width was determined by using contact type surf coder and video measuring system respectively. By using multi – objective optimization technique grey relational theory, the optimal value is obtained for surface roughness and kerf width and by using Taguchi optimization technique, optimized value is obtained separately. Additionally, the analysis of variance (ANOVA) is too useful to identify the most important factor.

OPTIMIZATION OF PROCESS PARAMETERS OF MICRO WIRE EDM by Ricky Agarwal [4] Wire electrical discharge machining process is a highly complex, time varying & stochastic process. The process output is affected by large no of input variables. Therefore a suitable selection of input variables for the wire electrical discharge machining (WEDM) process relies heavily on the operaton technology & experience because of their numerous & diverse range. WEDM is extensively used in machining of conductive materials when precision is of prime importance. Rough cutting operation in wire EDM is treated as challenging one because improvement of more than one performance measures viz. Metal removal rate (MRR), surface finish & cutting width (kerf) are sought to obtain precision work. In this paper an approach to determine parameters setting is proposed. Using Taguchi's parameter design, significant machining parameters affecting the performance measures are identified as pulse peak current, pulse on time, and duty factor.

A Study to Achieve a Fine Surface Finish in Wire-EDM by J.T. Huang*, Y.S. Liao** and Y.H. Chen*[5] Many Wire-EDM machines have adopted the pulse generating circuit using low power for ignition and high power for machining. However it is not suitable for finishing process since the energy generated by the high voltage sub-circuit is too high to obtain a desired fine surface, no matter how short the pulse on time is assigned. For the machine used in this research, the best surface roughness Ra after finishing process is about 0.7µm.

Experimental investigation of MRR, surface roughness and overcut of AISI304 Stainless steel in EDM by AYUSH PODDAR , Under the Guidance of Dr. C.K. BISWAS [6] EDM has become an important and cost-effective method of machining extremely tough and brittle electrically conductive materials. It is widely used in the process of making moulds and dies and sections of complex geometry and intricate

shapes. The work piece material selected in this experiment is AISI 304Stainless steel taking into account its wide usage in industrial applications. In today's world 304stainless steel contributes to almost half of the world's production and consumption for industrial purposes. The input variable parameters are current, pulse on time and duty cycle. Taguchi method is applied to create an L27 orthogonal array of input variables using the Design of Experiments (DOE). The effect of the variable parameters mentioned above upon machining characteristics such as Material Removal Rate (MRR), Surface Roughness (SR) and Overcut (OC) is studied and investigated. The tool material is copper. The results obtained showed that current was the most significant parameter followed by pulse on time and the least significant was the duty cycle for the entire three responses namely Material removal rate, Surface roughness and overcut. With the increase in current and duty cycle MRR increased but for pulse on time it increased only up to 100 µs and then started to decrease. SR increased significantly with the increase in current; for pulse on time it increased up to 100 µs and after that there was no significant increase; and in case of duty cycle SR increased up to 70% and then started to decrease. OC increased with the increase in current and pulse on time but in different fashion and in case of duty cycle, OC increased up to 70% and then started decreasing. A review based paper on investigation of process parameters and optimization in EDM by Ritesh Kumar Hui*, Chandrabhanu Malla[7] Among the thermal mode of machining, electrical discharge machining (spark erosion machining) is mainly a method for the manufacturing of a multitude of ever changing geometries very often produced as unit job or in small batches. The basic concept of Electrical Discharge Machining (EDM) process is creating out of metals affected by the sudden stoppage of the electron beam by the solid metal surfaces of the anode. The portion of the anode facing the direct electrical pulse reaches the boiling point. Even in case of medium long pulse the rate of temperature increases in tens of millions of degree per second which means dealing with an explosion process. In the present work, a combined optimization approach is used for the estimation of maximum metal removal rate (MRR) and minimum tool wear rate (TWR), surface roughness (SR) and overcut(OC) of produced in electrical discharge machining. The important input parameters current (I), pulse on time (Ton), pulse off time (Toff) and voltage (V) are considered.

Influence of process parameters in machining the Hybrid Aluminum metal matrix

composites in wire cut EDM-An Experimental investigation by G.Ramesh a, V.C.Uvarajab , M.S.Sampathkumarc[8] The composite materials are extensively used globally in major industries. It is very difficult to machine the metal matrix composite materials impeded with reinforcement by conventional machining methods. Hence non conventional machining techniques are employed to overcome these difficulties. Wire Electrical discharge machining (WEDM) shows higher capability for cutting complex shapes with high precision for these materials. In this present work the effect of process parameter of Wire Electrical discharge machining such as Voltage, Pulse on-time , pulse -off time and current were studied for the reinforced metal matrix composite and hybrid aluminum metal matrix composites(HAMMCs). Aluminum 7075 reinforced with Silicon carbide (SiC) and boron carbide (B4C) are fabricated using stir casting process and machining was done in WEDM using design of experiments approach. Also the microstructure, Surface roughness, and hardness evaluation were made for the fabricated specimen and results were analyzed. It has been observed that the metal removal rate decreases when the weight fraction of reinforcement increases and surface roughness increases.

Experimental investigation of MRR and surface roughness of EN-18 Steel in ECM by K SAYAN KUMAR (109ME0595) Under The Guidance of Prof. C.K.Biswas [9] Electrochemical machining (ECM) is one of the important non-traditional machining process for machining hard materials which are difficult to cut, high strength and heat resistant materials into complex shape. Electrochemical machining has vast application in Automotive, Aircrafts, Aerospace, textile industries etc. Its industrial applications has extended to drilling, deburring, grinding and polishing so studies on Material Removal Rate (MRR) and surface roughness is extremely important. Use of optimal process parameters can significantly reduce the ECM operating, tooling and maintenance cost and will produce components of higher accuracy. This paper investigates the effect and parametric optimization of process parameters for ECM of EN-18 steel alloy. The process parameter considered as applied voltage and Feed rate are optimized for getting high MRR and good surface finish by using Taguchi approach.

Study of the Effect of EDM Parameters based on Tool Overcut using Stainless Steel (SS 304 Grade) by T.Roy, R.K.Dutta [10] The effect of process parameters on an EDM namely pulse on time (TON), duty cycle (DC), discharge

current (I) and gap voltage (V) were studied based on Tool Overcut (TOC). Taguchi's L9 orthogonal array was selected for conducting the experiments. Optimization was carried out using Signal to Noise ratios (SNR) and the main effects plot based on SNR. Duty cycle was found to be the most significant parameter that effected TOC followed by discharge current and pulse on time. Gap voltage had the least effect on TOC.

Experimental Investigation and Optimization of Machining Parameters in Electrical Discharge Machining by Indhu Sekaran. N, Arun Pothilingam S [11]This experimental aims at achieving the integrated approach to solve the optimization problem of EDM process. At any stage, the dominance factor of the input variables and output variables contained in the constraints and objective functions can be computed. Electric discharge machining is categorized as a thermoelectric process in which heat energy of spark is used to remove material from the work piece. The present work is aimed at characterizing the electric discharge machining of HCHCR steels on EDM. Since an electrode with micro features is employed to cut its mirror image in the work piece, it is necessary to investigate the machining efficiency of the electrodes used. Further more to improve the machining efficiency. The combination of gap voltage, Ampere setting were new line considered for maximum Material Removal Rate (MRR), Surface Roughness (SR), constrained circularity error and overcut. The experiments were carried out as per L9 orthogonal array with each experiment performed under different conditions of such as Ampere rating, sparking voltage while machining.

Study of influence of process parameters on surface roughness of AMMCS in wire electrical discharge machine by B. Naga Raju1, K. Ramji2, P. Srinivasa Rao3 and V. S. R. K. Prasad4 [12] The usage of composite materials has been increasing globally in all manufacturing industries. Non-Traditional machining methods like Wire Electrical Discharge Machining (WEDM) plays important role in precision manufacturing. In this study, an attempt is made to study the influence of process parameters like pulse-on time, pulse-off time and peak current on surface roughness of Aluminum Metal Matrix Composites (AMMCs). The composite material containing aluminum alloy as matrix, silicon carbide as reinforcement is produced by stir casting technique. Experiments are conducted based on design of experiments. The results show that the machined Surface quality improves with increase in pulse-off time, while the pulse-

on time produces poor surface quality. Higher peak current leads an inferior surface finish. The pulse duration has also an important and overbearing effect on surface roughness. Finally, Prediction of Surface Roughness (Ra) in terms of the process parameters using Artificial Neural Networks (ANN) is performed and the predicted values were compared with experimental data by varying the number of neurons in the intermediate hidden layers (i.e 5, 6, 7 neurons). Based on the analysis carried out, it was observed that the neural network structure with 3 layers and 7 neurons was best in predicting the surface roughness.

Electrical Discharge Machining Characteristics of Aluminum Metal Matrix Composites by P. Srikanth1, Ch. Pranay Kumar2[13] Electrical Discharge Machining (EDM) is the process of machining electrically conductive materials by using precisely controlled sparks that occur between an electrode and the work piece in the presence of a dielectric fluid. Aluminum Metal Matrix Composites (AMMC's) are new generation engineering materials that possess superior physical and mechanical properties compared to non-reinforced alloys. This makes them attractive for wider range of applications in automotive, aerospace and defense industries. These materials have desirable qualities such as high strength to weight ratio, high toughness and low value of coefficient of thermal stability. It is very difficult to cut the complex shapes by using Conventional Machining. High tool wear and high cost of tooling is also a limitation in Conventional Machining, Unconventional Machining offers an alternative solution to this problem. This paper presents a review of research work done on AMMC's on EDM, Wire EDM, Powder Mixed EDM, EDM in Water, Micro EDM. The paper also discusses the future trends of research work in the same area.

Experimental investigations on machining characteristics of Al 6061 hybrid metal matrix composites processed by electrical discharge machining by C. Velmurugan1*, R.Subramanian2, S.Thirugnanam3,B.Ananadave [14] Metal matrix composites, in particular, Aluminum Matrix Composites are gaining increasing attention for applications in aerospace, defence and automobile industries. The use of nonconventional machining techniques in shaping aluminum metal matrix composites has generated considerable interest as the manufacturing of complicated contours such as dies. Electrical discharge machining (EDM) appears to be a promising technique for machining metal matrix composites. The

objective of this work is to investigate the effect of parameters like Current(I), Pulse on time(T), Voltage(V) and Flushing pressure(P) on metal removal rate (MRR),tool wear rate(TWR) as well as surface roughness(SR) on the machining of hybrid Al6061 metal matrix composites reinforced with 10% SiC and 4%graphite particles. Composite was fabricated using stir casting process. A central composite rotatable design was selected for conducting experiments. Mathematical models were developed using the MINITAB R14 software. The method of least squares technique was used to calculate the regression coefficients and Analysis of Variance (ANOVA) technique was used to check the significance of the models developed. Scanning Electron Microscope (SEM) analysis was done to study the surface characteristics of the machined specimens and correlated with the models developed

CONCLUSION:

The objective of the present work is to investigate the effects of the various Wire cut EDM process parameters on the machining quality and obtain the optimal sets of process parameters so that the quality of machined parts can be optimized. Experiments are conducted on the pieces varying parameters. The materials used for machining are Aluminum alloy. The process parameters considered are Pulse Time on, Pulse Time off, Input Power, Wire Feed, Servo Voltage and Wire Tension. The range of values varied are Time on – 105 µsec, 107 µsec and 109 µsec, Time off – 52 µsec, 56 µsec, 60 µsec, Input power –210amp, 220amp, 230amp. Wire feed, wire tension and servo voltage are kept constant. The optimization is done by using Taguchi technique by considering L9 orthogonal array. Optimization is done using Minitab software. We can conclude that at Time on -109 µsec, Time off – 52 µsec and Input power-210amp to get better surface finish values.

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