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Parameteric Optimization on Graphite Plate By WEDM

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ABSTRACT

WEDM is an emerging technology in the field of machining to very complex micro products. WEDM is a very complex process involving the different process parameters. In the present investigation an optimization of WEDM has been carried out using suitable method. The parameters involved are current, pulse on time, pulse of time, and wire speed. MRR and surface roughness are taken as the response criteria. Experimental investigation has been carried out in multi-process Micro-EDM machine. WEDM process is a highly complex, time varying & stochastic process. This is used in the fields of dies, moulds; precision manufacturing and contour cutting etc. any complex shape can be generated with high grade of accuracy and surface finish using CNC WEDM. The output of the process is affected by large no of input variables. Hence suitable selection of input variables for the WEDM process depends heavily on the operator's technology & experience. However optimum process and its parameter can be utilized to overcome irregularities to a great extent. Integrated to better surface finish and the surface roughness and metal removal rate, the selection of proper combination of machining variables is required. This paper presents an experimental study on Graphite plate. Response surface methodology (RSM) technique has been applied to optimize the machining parameters for minimum surface roughness and maximum MRR. The design of experiments (DOE) is done in tag chi L18 orthogonal array (OA)

Keywords **— DOE, RSM ,WEDM.**

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I. INTRODUCTION

Wire electrical discharge machining (WEDM) is one of the important nontraditional machining processes which are used for machining difficult to machine materials like composites There are various material having high hardness that can be easily machined by generating sparks every few microseconds. There is Sparking mechanism which generates the spark between wire electrode and work piece, where the temperature reaches to approximately 12,000_C.Their is dielectric fluid is act as medium for passing of spark current from electrode to work piece. Typically the gap between wire and work piece for wire EDM varies from 0.025 to 0.05 mm and this gap is constantly monitored by a computer controlled system. Now a day the numerical control is mainly produced according to the customer requirement for machining. Recently it is widely used in the aerospace and automotive industries. However, selection of cutting parameters for obtaining higher cutting efficiency or accuracy in wire EDM is still not fully solved, even with the most up-to-date CNC WEDM machine. Main aim to optimize the process parameter to overcome irregularities and to achieve the surface roughness and metal removal rate.

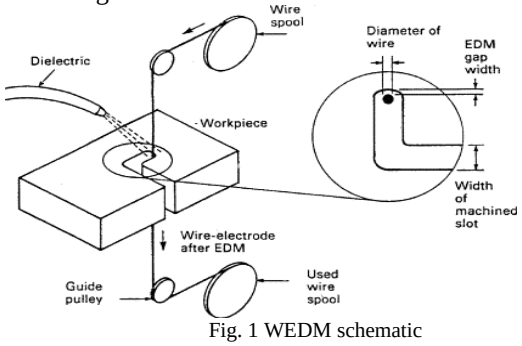

Fig. 1 WEDM schematic

Process Parameters.
Pulse duration

It is also known as pulse on time,it's unit is in microseconds As soon as we apply voltage it will produce discharge current As we increase pulse on time in short higher the pulse on time, higher will be the energy applied it will generate more amount of heat energy . MRR depend upon the application of energy applied during pulse on time.

Pulse Interval
It is also called pulse off time in short it is pause time in which the removed material is flushed away upto next discharge .if we reduce time there may be increase in cutting speed but it will make adverse effect on wire, it can overload the wire, causing wire breakage.

Servo Voltage
To control the wire advances and retracts motion servo voltage can be consider as reference voltage. If the mean machining voltage is higher than the set servo voltage level, the wire advances, and if it is lower, the wire retracts. When we set smaller value it leads to increase in no. of electric spark which leads to higher machining rate

Peak Current
The amount of power consumed during machining is pick current. It is indicated by surface area of cut.

II. LITERATURE REVIEW

Ashish Srivastava, Amit Rai Dixit,Sandeep Tiwari [1] performed associate degree experimental study on composite of Al2024 bolstered with attack.They select three levels of each parameters like current ,pulse on time and reinforcement proportion on surface finish and MRR.Response surface methodology (RSM) technique has been applied to optimize the machining parameters for minimum surface roughness and most MRR.It was determined thatSurface roughness is can increase with the increase in peak current.and pulse on time . Material removal rate is hyperbolic with the increase in Peak current.and pulse on time .Adeel Ikram1,, Nadeem Ahmad Mufti, Muhammad Qaiser Saleem and Ahmed Raza Khan[2] highlighted Associate in Nursing improvement of eight management factors on material removal rate (MRR), surface roughness and kerf in wire discharge machining (WEDM) technique for steel D2. it\\\'s been found that pulse on-time is that the foremost vital parameter on surface roughness, kerf and material removal rate.Neeraj Sharma & Rajesh Khanna &Rahul Dev Gupta & Renu Sharma [3] complete that the aim of this the aim of this study is to analysis the impact of parameters on cutting speed and dimensional deviation for WEDM exploitation HSLA High-strength low-alloy steel HSLA.RSM is utilized to optimize the strategy parameter. it\\\'s seen that the foremost distinguished issue for cutting speed pulse-on time. Pragya Shandilya, P.K.Jain, N.K. Jain[4] optimize the strategy parameters throughout machining of SiCp/6061 Al metal matrix composite (MMC) Four .input technique parameters of WEDM (namely servo voltage (V), pulse-on time (TON), pulse-off time (TOFF) and wire feed rate (WF)) on the cutting dimension (kerf) .RSM methodology is utilized. ANOVA results that voltage and wire feed rate ar very vital parameters and pulse-off time could be a smaller quantity vital. M. Durairaj, D. Sudharsunb, N. Swamynathan[5] investigation on stainless-steel (SS304).They use brass wire of zero.25mm as conductor .from this paper it\'s conclude that optimized input parameter combos to urge the minimum surface roughness square measure 40V gap voltage, 2mm/min wire feed, six µs pulse on time, 10 µs pulse off time and equally optimized conditions to urge the minimum kerf breadth square measure 50V gap voltage, 2mm/min Wire Feed, four µs pulse on time, six µs pulse off time.Chengmao Zhang [6] highlighted the investigataion on TiN/Si3N4 ceramic The dependence of surface texture, surface roughness, and materials removal rate square measure take into consideration as output parameter. From this paper it\\\'s finished that the material removal rate to boot can increase with increase in power semiconductor numbers, plenty of pulse off-time finish in lower material removal rate.R. Bagherian Azhiri & R. Teimouri & M. Ghasemi Baboly &Z. Leseman [7] had given the work experimental investigation,intelligent modeling and multi-characteristics improvement of dry WEDM technique whereas machining of Al/SiC metal matrix composite. throughout this Taguchi L27 orthogonal array to analysis effects of pulse on time, pulse off time, gap voltage, discharge current, wire tension and wire make the most of cutting speed and surface roughness
Ravindranadh Bobbili, V. Madhu, and A. K Gogia [8] renowned the influence of machining parameters on surface roughness (SR) and material removal rate (MRR) of high strength armor steel. pulse-on time,pulse-off time, wire feed, flushing pressure, spark voltage, and wire tension. Results show that pulse-on time, pulse-off time, and spark voltage square measure vital variables to MRR and surface roughness (SR).G. Rajyalakshmi & P. Venkata Ramaiah [9] taguchi technique has been applied to experimental results of wire cut discharge machining (WEDM) on Inconel 825. grey relative is to boot used to verify the the only technique parameters that optimize the response measures.from result conclude that it square measure usually all over that the Taguchi technique is most ideal and applicable for the constant improvement of the wire cut EDM technique, once exploitation the multiple performance characteristics like MRR, surface roughness, and spark gap, for machining the Inconel 825.Yongfeng Guo1, Pengju Hou1, Dongxiang Shao1, Zongfeng Li1, Li Wang1, and Maya Lin Tang1[10] high-speed wire discharge machining (HS-WEDM) of insulating oxide. The characteristics of this HS-WEDM technique supported the novel aiding conductor square measure investigated, that embrace the study of the results of pulse-on time on machining speed.Ibrahem Maher & Ahmed A. D. Sarhan & M. Hamdi [12] targeted on the evolving technologies of EDM wire electrodes from exploitation copper to the wide used brass wire electrodes and from brass to the latest coated wire electrodes, that square measure developed and assist user demand and wishes in terms of most productivity and quantity.Special wire electrodes were introduced as abrasive, hot dip electrical, and porous wire electrodes. The copper wire conductor was replaced by brass as a result of the low material removal rate and low wear or erosion resistance.B.

Kuriachen & K. P. Somashekhar & Jose Mathew[11] investigated throughout this paper gap voltage, capacitance, feed rate, and wire tension on metal alloy (Ti-6AL-4V). Analysis of variance (ANOVA) is performed to identify the numerous factors.From this paper it\\\'s everywhere that formal logic system with response surface techniqueologyology is best method.It is found that if we tend to want max. MRR and minimum surface roughness need to be the input parameters ar gap voltage (113 V), capacitance (0.26 μF), feed rate (9 μm/s), and wire tension (10 gm).Ramakrishnana,,L. Karunamoorthyb [13] highlighted the WEDM applications in many areas like metal 718 by CNC WEDM processIt was determined that the with Taguchi's parameter vogue is also a simple, systematic, reliable and extra economical tool for optimizing multiple performance characteristics of WEDM technique parameters. The results of varied machining parameter like pulse on time, wire feed speed, delay time and ignition current were studied whereas machining of metal 718.

III GAP IDENTIFICATION

Many researcher had worked on composite material such as aluminium MMC ,alloy, basic material concluding that few few work had been takes place on graphite material. Response surface methodology is seem to be optimum method and which is rarely used .So main aim is to optimize input parameter and achieve better output parameter.

IV EXPERIMENTAL DETAILS

A. Materials and Experimental setup

A WEDM machine, developed by ITRI (Industrial Technology Research Institute) and CHMER company Taiwan, was used for the experiment. Brass wire with graphite Work-piece specimens having thicknesses 6 mm is used and square pieces of 10 mm a side were cut by WEDM

Fig. 2 WEDM Machine

Specification of WEDMThe work material specification electrode and the other machining conditions were taken as follows:

TABLE I

work piece (anode)	Graphite Plate
electrode (cathode)	00.25 mm brass wire
Dielectric fluid	Distilled water
X,Y axis mm	400*300
U,V,Z TRAVEL	60*60*220
maximum size of work piece (w *d*h)mm	720*600*215
Motor	AC servo motor
wire dia.mm	0.15-0.3
Max. wire feed	300
wire tension (Gm)	300-2500

According to the taguchi design method L9 Orthogonal array was chosen for the optimization of the process.
Four control factors were chosen at three levels-
I. Current
II. Pulse on time
III. Pulse of time
IV. Wire Tension
Two response parameters measured were-
I Surface Roughness
II MRR

Input process parameters and their levels.

TABLE II

Process Parameter	Units	Level
Current	A	5,10,15
Ton	Ms	3,5,7
Toff	Ms	20,25,30
Wire tension	GM	8,10,12

B. Design of Experiment:

L9 orthogonal array is prepared

TABLE IIII

No of runs	Current (a)	T on	Toff	Wire Tension
1	5	3	20	8
2	5	5	25	10
3	5	7	30	12
4	10	3	20	12
5	10	5	25	10
6	10	7	30	8
7	15	3	20	8
8	15	5	25	12
9	15	7	30	10

V ACTUAL EXPERIMENTATION

From above array or sequence experimentation is carried out

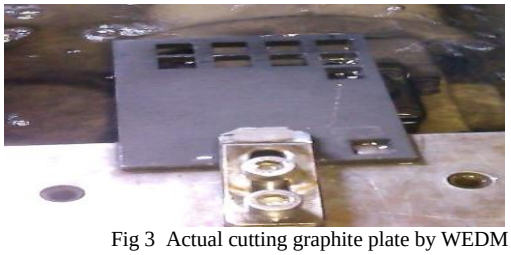

Fig 3 Actual cutting graphite plate by WEDM

TABLE IIIV
Measurement of Response

	curre Nt	To n	To ff	wire tension	MRR	Surface roughness
1	5	3	20	8	5.475	16.8
2	5	5	25	10	6.78	13.2
3	5	7	30	12	7.183	14.1
4	10	3	20	12	9.794	14.5
5	10	5	25	10	7.966	18.5
6	10	7	30	8	4.853	12.4
7	15	3	20	8	6.381	13.3
8	15	5	25	12	7.246	16.2
9	15	7	30	10	7.335	14.5

V METHODOLOGY

Wire EDM Machining and Response Surface Methodology (RSM) is used to describes the effect of parameters on graphite Material.

Response Surface Methodology (RSM)

Response Surface Methodology is combination of mathematical and statistical technique, used to develop the mathematical model for analysis and optimization**.**By conducting experiment trails and applying the regression analysis, the output responses can be expressed in terms of input machining parameters namely table speed, depth of cut and spindle speed. The major steps in Response Surface Methodology are:

1. Identification of predominate factors which influences the surface roughness.
2. Developing the experimental design matrix, conducting the experiments as per the above design matrix.
3. Developing the mathematical model.
4. Determination of constant coefficients of the developed model.
5. Testing the significance of the coefficients.
6. Adequacy test for the developed model by using analysis of variance (ANNOVA).
7. Analyzing the effect of input machining parameters on output responses, surface roughness and MRR.

IV. CONCLUSION

From the experiments and literature review we will discuss expected result and impact of assorted method parameter on the machining of graphite plate by calculative signal to noise magnitude relation. it\'s been noticed that MRR will increase once Ton is exaggerated and reduces once nob exaggerated. it\'s attributed to higher thermal power with increase in Ton resulting in a quicker cutting rate. MRR is directly proportional to the facility provided throughout this Ton. because the knob is faded, a lot of sparks are generated. This diode to improvement in MRR. it\'s unconcealed from totally different analysis that on increasing Pulse on time & Peak current, MRR will increase however at a similar time Surface roughness of piece of work conjointly will increase, it\'s a degree of concern. It is discovered by experimental results that on increasing Pulse off time & Servo-voltage surface end become higher. Wire Tension has not vital impact on MRR and Surface roughness. a lot of experimental work is needed to supply a piece of work that has sensible surface end, this could be done by setting low periodic current & little pulse length

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