

# A review on optimization of process parameters of wirecut EDM with the application of taguchi method

A.Saravana Kumar , S.Sitharth ,P.Naveen, S.Santhosh Kumar

J.Sivasubramaniyan

Department of Mechanical Engineering

Saranathan College of Engineering

Trichy-12

Email id: masssant001@gmail.com

**Abstract** - Wire-cut electrical discharge machining is one of the most widely using un conventional machining processes for machining hard materials like titanium, stainless steel, tool steels. This project reviews the effect of various process parameters such as pulse on time, pulse of time, wire feed on different process response parameters such as surface roughness and kerf width. The design experiment is used to design the WEDM experiments .The various tools of D.O.E. are used to analyze the final results of the experiments with the help of graphs. The analyze is being done with the help of Minitab-17 software. The results of the experiments are the optimum values of SR (Surface roughness), KW (Kerf width).

**Keywords** – Optimization; EDM S/n.

## 1. INTRODUCTION

WEDM is a most popular modern manufacturing process in the present manufacturing industry[2010]. The mechanism of metal removal is similar to that of conventional EDM process, in which the erosion effect is produced by series of electrical sparks between work piece and wire electrodes which are surrounded by dielectric fluid. During wire electrical discharge machining a large amount of temperature of 8000 C -12000 C is developed in the form of thermal energy after applying voltage between wire electrode and work piece. When the discharge occurs, a small amount of material is melted and removed from the work piece surface. The continuously supplying di electric fluid flushes the derbies formed during machining.

## 2. LITERATURE SURVEY

**M. Geetha** [1] proposed modeling and analysis of performance characteristics of wire EDM of SS304 input parameters are pulse on time, pulse off time, wire tension, water pressure taken into consideration for the research. Experimental data obtained after conducting experiments as per the design of experiments. Later RSM is used to find the empirical models .Then the models were for its adequacy using ANOVA .The output response is MRR and surface roughness.

**V. Muthu kumar** [2]Optimization of the WEDM Parameters on Machining Incoloy 800 Super alloy with Multiple Quality Characteristics using combination of Grey Relational analysis and Taguchi method to achieve higher Material Removal Rate (MRR), lower surface roughness (Ra) and Kerf width (KW). Finally, the analysis of variance (ANOVA) and necessary confirmation tests were conducted to validate the experimental results The optimal ‘process parameters’ based on Grey Relational Analysis for the Wire-Cut EDM of Incoloy 800 include a 50 V Gap Voltage, 10  $\mu$ s pulse on-time, 6  $\mu$ s pulse off-time and 8mm/minute Wire Feed rate.

**A.Pratik** [3] Optimization of process parameters in wire-EDM response surface methodology. This research paper deals with Response Surface Methodology approach for maximizing the material removal rate in wire electrical discharge machining. The investigated machining parameters were wire tension, pulse on time and peak current. Machining was carried on AISI D2 cold work steel, which is widely used in die and mold making industries.After the experimentation, the effect of the parameters on MRR was determined by analysis of variance (ANOVA).

**R.Nagaraja** [4]. Optimization of process parameter for metal matrix composite in wire EDM, This paper presents an investigation on the optimization of machining parameters in WEDM of bronze-alumina MMC. The main objective is to find the optimum cutting parameters to achieve a low value of Surface roughness and high value of material removal rate (MRR). The cutting parameters considered in this experimental study are, pulse on time ( $T_{on}$ ), pulse off time ( $T_{off}$ ) and wire feed rate. The settings of cutting parameters were determined by using Taguchi experimental design method. An L9 orthogonal array was chosen. Signal to Noise ratio (S/N) and analysis of variance (ANOVA) was used to analyze the effect of the parameters on surface roughness and to identify the optimum cutting parameters. The contribution of each cutting parameters towards the surface roughness and MRR is also identified.

**H.Singh** [5]. Effects of process parameters on material removal rate in WEDM. In this paper, the effects of various process parameters of WEDM like pulse on time (TON), pulse off time (TOFF), gap voltage (SV), peak current (IP), wire feed (WF) and wire tension (WT) have been investigated to reveal their impact on material removal rate of hot die steel (H-11) using one variable at a time approach. The optimal set of process parameters has also been predicted to maximize the material removal rate. The parameters wire feed (WF) and wire tension (WT) has no effect on the material removal rate. The pulse on time parameter has direct effect on the material removal rate, as we increase the pulse on time the material removal rate also increase.

**SauravDatta** [6]. Modeling, simulation and parametric optimization of wire EDM process using response surface methodology coupled with grey-Taguchi technique in the present work, quadratic mathematical models have been derived to represent the process behavior of wire electrical discharge machining (WEDM) operation. Experiments have been conducted with six process parameters: discharge current, pulse duration, pulse frequency, wire speed, wire tension and dielectric flow rate; to be varied in three different levels. Data related to the process responses viz. material removal rate (MRR), roughness value of the worked surface (a measure of surface finish, SF) and kerf have been measured for each of the experimental runs grey-Taguchi technique as multi-

objective optimizer in the field of wire EDM in D2 Tool steel.

**K. Kumar** [7]. Modeling and Optimization of Wire EDM Process The present work is aimed to optimize the parameters of wire electric discharge machining (WEDM) process by considering the effect of input parameters viz. Time On, Time Off, Wire Speed and Wire Feed. Experiments have been conducted with these parameters in three different levels data related to process responses viz. Metal removal rate, surface roughness (Ra) have been measured for each of the experimental run. These data have been utilized to fit a quadratic mathematical model (RSM) for each of the responses, which can be represented as a function of the process parameters in magnesium silicon carbide material. The optimal process parameters based on Grey Relational Analysis for the Wire Cut EDM of Mg SicP10% include (speed 1500 rpm), (feed 0.5 mm/min), (pulse on time 124  $\mu$ s), (pulse off time 44  $\mu$ s).

**S. Sarkar** [8]. Parametric optimization of wire electrical discharge machining of  $\gamma$  titanium aluminide alloy through an artificial neural network model The three most important parameters cutting speed, surface roughness and wire offset have been considered as measures of the process performance. The model is capable of predicting the response parameters as a function of six different control parameters, i.e. pulse on time, pulse off time, peak current, wire tension, dielectric flow rate and servo reference voltage. Experimental results demonstrate that the machining model is suitable and the optimization strategy satisfies practical requirements.

**S.S.Mahapatra** [9]. Optimization of wire electrical discharge machining process parameters using Taguchi method Rough cutting operation in WEDM is treated as a challenging one because improvement of more than one machining performance measure viz. metal removal rate (MRR), surface finish (SF) and cutting width (kerf) are sought to obtain a precision work. Using Taguchi's parameter design, significant machining parameters affecting the performance measures are identified as discharge current, pulse duration, pulse frequency, wire speed, wire tension, and dielectric flow. It has been observed that a combination of factors for optimization of each performance measure is different. In this study, the

relationship between control factors and responses like MRR, SF and kerf are established by means of nonlinear regression analysis, resulting in a valid mathematical model. Finally, genetic algorithm, a popular revolutionary approach, is employed to optimize the wire electrical discharge machining process with multiple objectives in aluminium silicon carbide.

**A. Manna** [10]. Suitable selection of machining parameters of CNC wire cut electrical discharge machining (EDM) process is necessary. This paper present a reliable set of parameters that demonstrate versatility, and numerous and diverse range based on experience and technology. We offer an experimental investigation to determine the parameters setting during the machining of aluminum-reinforced silicon carbide metal matrix composite (Al/Sic-MMC). The Taguchi method, a powerful tool for experimental design, is used to optimize the CNC-wire cut-EDM parameters. Mixed orthogonal array was used to determine the S/N ratio, and an analysis of variance (ANOVA) and the F-test values were used to indicate the significant machining parameters affecting the machining performance. From experimental results and through ANOVA and F-test values, the significant factors are determined for each machining performance criteria, such as the metal removal rate, surface roughness, gap current and spark gap (gap width).

**Chandramouli.S** , **Eswaraiah K.**[11]Electrical Discharge Machining is a thermo-electric process and one of the advanced methods of machining. In the present study, the optimal setting of the process parameters on Electric Discharge Machining (EDM) was determined. The important process parameters that have been selected are peak current, pulse on time, pulse off time and tool lift time with output response as Material Removal Rate (MRR) and Surface Roughness (SR). Taguchi experimental design (L27 orthogonal array) was used to formulate the experimental layout and experiments were conducted on 17-4 Precipitation Hardening Stainless Steel (PH Steel) machined with copper tungsten electrode.

**Ho and Newman (2003)**[12]presented the review of vast research work carried out from the inception to the development of die-sinking EDM within the past decade. It reports the EDM research

relating to improving performance measures, optimizing the process variables, monitoring and control of sparking process, simplifying the electrode design and manufacturing. A range of EDM applications were highlighted together with the development of hybrid machining processes.

## REFERENCES

- (1). M. Geetha, A.K.M. Asif Iqbal , Influence of Process parameters on Electrical Discharge Machined Job Surface Integrity, American J. of Engineering and Applied Sciences (2): 396-402, 2010 ISSN 1941-7020.
- (2). V. Muthu kumar , Nihat Tosuna, A study on kerf and material removal rate in WEDM based on Taguchi method, Journal of Matrerials Processing technology 152 (2004) 316-322.
- (3). A.Pratik,D. V.S.S.S.V. Prasad, A. Gopala Krishna, Analysis of performance characteristics of wire electrical discharge machining, Journal of manufacturing, 2009, Vol.4, Issue.3, pp 205-211.
- (4). R.Nagaraja, Modelling the machining parameters of wire electrical discharge machining of Inconel 601 using RSM , Journal of Materials processing Technology 169 (2005) 328-336.
- (5). H.Singh, S.S.Mahapatra, and A.Patnaik ,Optimization of wire electrical discharge machining (WEDM) process parameters using Taguchi method, International Journal of Advanced Manufacturing Technol.,34, 911–925 (2007).
- (6). SauravDatta, Gokler, Mustafa Ilhan, Ozanozgu, Alp Mitha-Experimental investigation of effects of cutting parameters on surface roughness in the WEDM process, International Journal of Machine Tools and Manufacture, Volume 40, Issue 13, Pages 1831-1848, October 2000.
- (7). K. Kumar, M.T. Antar, S.L. Soo, D.K. Aspinwall, D. Jones and R.- Productivity and Workpiece Surface Integrity When WEDM Aerospace Alloys Using Coated Wires, Proceedings Engineering, Volume 19, Pages 3-8, 2011.
- (8). S. Sarkar , V. Janardhan, G.L. Samuel, “Pulse train data analysis to investigate the effect of machining parameters on the performance of wire electro discharge turning (WEDT) process” International journal of machine tools and manufacture., Vol. 50, Jun. 2010, pp. 775-788.
- (9). S.S.Mahapatra, S. Babu and Venkatasamy R, “Optimization of the WEDM Parameters on Machining Incoloy800 Super alloy with Multiple Quality

Characteristics,” International Journal of Engineering Science and Technology., Vol. 2, Jun. 2010, pp. 1538-1547.

(10). A. Manna, Mr. kuo-Wei Lin, Optimizing Multiple Quality Characteristics of Wire Electrical Discharge Machining via Taguchi method-based Gray analysis for Magnesium Alloy. Journal of C.C.I.T., VOL.39, NO.1, May 2010.

(11). Chandramouli.S ,Eswaraiah.K ,A.K.M. Nurul Amin The Implementation of Taguchi Method on EDM Process of Tungsten Carbide. European Journal of Scientific Research, ISSN 1450-216X Vol.26 No.4 (2009), pp.609-617.

(12). Ho and Newman , S.B. Prajapati and N.S. Patel, Effect of process parameters on performance measure of wire EDM for AISI A2 tool steel, International journal of Computational Research, Vol 03, Issue 4, 2013.