Optimization of the Process Parameters of Wire Cut EDM – A Review

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Abstract— The objective of this paper is to study the effect of different process parameter of wire electrical discharge machine (WEDM) process on the performance measures such as material removal rate (MRR), surface roughness, dimensional accuracy and kerf width. It is necessary to evaluate the factors that affect the productivity and efficiency of WEDM process. It will directly contribute to increase cutting speed and dimensional accuracy.

Key words: WEDM, Optimization, Surface finish, Taguchi, MRR

I. INTRODUCTION

Wire-electrical discharge machining is a form of EDM in the category of non-conventional machining process. In this process, this is similar to contour cutting with a band saw, a moving wire travels along a prescribed path, cutting the workpiece with a number of repetitive electrical discharge sparks acting like cutting teeth. The process is widely use in the die manufacturing industry, automobile industry, aerospace, medical. Irrespective of hardness of material, any type of conductive material can be cut with wire EDM process.

II. BASIC PRINCIPLE OF WEDM PROCESS

Wire cut EDM process is non-traditional type machining process in which the material is removed by thermo-electric spark erosion process. The spark is generated between the workpiece and wire. The wire does not touch the workpiece but certain gap is maintained between wire and workpiece, the material removed is flushed out of the gap with the flowing dielectric fluid, which is made to flow through the gap constantly.

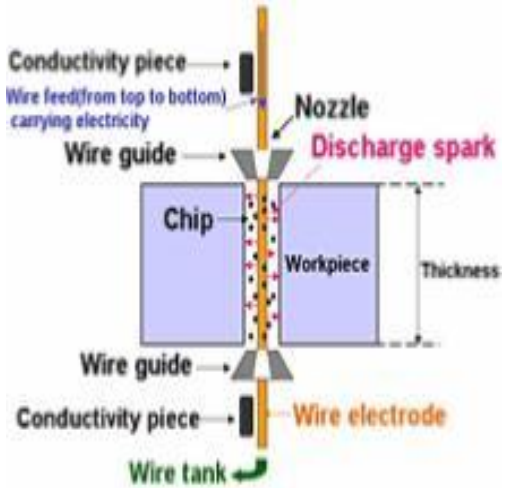

Fig. 1: Mechanism of material removal of WEDM [1]

An extremely high temperature generates in the region where discharge occurs causing melting and removal of workpiece surface. In WEDM process a thin wire is used which is continuous feeding through the workpiece. A small gap is between wire and workpiece. There is no direct contact between wire and workpiece. The conductive material of any hardness can be cut.

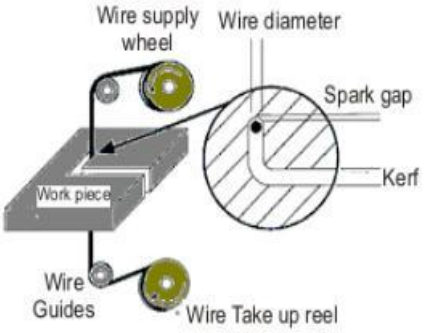

Fig. 2: Details of WEDM gap [2]

III. LITERATURE REVIEW

In this part, the literature review regarding the optimization of the process parameters of WEDM process is carried out. Optimum utilization of the capabilities of WEDM process requires the selection of an appropriate set of machining parameter.

Sonu Dhiman, Ravinder Chaudhary, V. K. Pandey [1], In this paper, the effect various process parameters like, pulse on time, pulse of time, servo voltage, peak current, wire feed, wire tension on cutting rate of S7 steel is studied. One factor at a time (OFAT) approach is used. Cutting rate is increase with increase in pulse on time, peak current and cutting rate is decrease with increase of pulse duration and servo gap voltage. Finally the range of control factors is selected. Lokeswara Rao T. and N. Selvaraj [2], In their paper they have selected Taguchi's orthogonal array (OA) under different condition of process parameters and regression equation is developed for the VMRR & Ra. Optimal combination of parameters is obtain for VMRR & Ra. Kuriachen Basil, Dr. Josephkunju Paul, Dr. Jeoju M. Issac [3], This study investigates the effect of voltage, dielectric process, pulse on time and pulse off time on spark gap of Ti6Al4V alloy. Full factorial method is used. The pulse on time, pulse off time, the interaction of dielectric pressure & pulse off time and interaction of pulse on time & pulse off time are the significant parameters for spark gap.

Aniza Alias, Bulan Abdullah, Norliana Mohd Abbas [4], The objective of this paper is to find influence of different machine feed rates with constant current (6A) on Ti6Al4V. If machine feed rate is increase, the MRR and Kerf width increases. Smoother surface roughness is obtain with low machine feed rate. Surface topography of each experiment is also examined by using microscope. Manoj Malik, Rakesh Kumar Yadav, Deepak Sharma, Manoj [5], In this paper, pulse on time, duty factor and pulse peak current have been taken for optimization of MRR, electrode wear rate and surface roughness using zinc coated brass wire. Grey based Taguchi method is used for the Design of Experiment (DoE). Danial Ghodsiyeh, Mohammadreza Askaripour Lahiji, Mahdi Ghanbari, Mostafa Rezazadeh Shirdar, Abolfazl Golshan [6], In this paper, Taguchi

method is used. The behavior of control parameters pulse on time, pulse off time and peak current on the performance measures like material removal rate (MRR) and surface roughness is studied using ANOVA. Also, mathematical relationship between responses and variables is generated by response surface methodology (RSM). The most significant factor for MRR and surface roughness is peak current. The optimal condition for each parameter is found out. M. T. Antar, S.L. Soo, D. k. Aspinwall, D. Jones, R. Perez [7], this study investigates the effect on productivity and surface integrity with the use of coated wires and uncoated wires. Comparison between Cu core coated wires and uncoated brass wire for two workpiece materials Udimet 720 nickel based super alloy and Ti-6Al-2Sn-4Zr-6Mo titanium alloy is given. The productivity of both workpiece material increase significantly with the use of coated wires. The variation in surface roughness is due to the imperfect sparks generated due to erosion of the wire, leads to wider machining gap. C V S Parmeswara Rao and M M M Sarcar [8], In this paper, the effect of discharge current, voltage at rated wire speed and tension on MRR, surface roughness, cutting speed and spark gap is studied. Workpiece is cut with different wire composition of Cu and Zn. Mathematical relations are developed for cutting speed & workpiece thickness and for spark gap & workpiece thickness which are useful to estimate cutting time. R. Venkata Rao and V. D. Kalyankar [9], This paper review, a newly developed advanced algorithm named teaching – learning – based optimization (TLBO) is applied to the ultrasonic machining (USM), abrasive jet machining (AJM) and wire EDM process. In TLBO technique two phases are there, known as teacher and learner phase. The comparison of other optimization techniques with this TLBO technique is carried out. By this technique, result can be obtain in the less iteration compared to other optimization techniques. Nihat Tosun and Can Cogun [10], this paper investigates the effect of cutting parameter on wire electrode wear. The process parameters selected are pulse duration, open circuit voltage, wire speed and dielectric fluid pressure. ANOVA is also used in this study. It is found that by increasing open circuit voltage and pulse duration, wire wear rate increases. WWR can be decrease by increasing the dielectic fluid pressure & wire speed

IV. CONCLUSION

Cutting rate is increases with increase in pulse on time and peak current. If the machine feed rate increases then MRR & kerf width increases. Taguchi method and ANOVA is helpful to find optimal result. Mathematical relationship is also helpful for the same, some modern approaches of optimization like TLBO and genetic algorithm (GA) is efficient to use. The use of wire material also affects the performance measurers. WWR is also affect by changing the process parameters.

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