Review on Optimization of Electrical Discharge Machining Process Parameters

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Abstract— Electrical discharge machining is the non-traditional machining process. In this machining the material removal is done by using electrical spark generated between tool and work piece. The objective of this review is to study the effect of process parameters such as current, voltage, pulse on time, pulse off time, spark gap on material removal rate and surface roughness. This study gives idea to find optimum solution for process parameters in EDM by using Taguchi Method in Design of Experiments.

Key words: EDM, DOE, Taguchi Technique, SR, MRR

I. INTRODUCTION

Electrical discharge machining is non-traditional, thermo electric machining process. It is used to achieve complex shape jobs such as moulds and dies. The material removal is done by the spark produce with the help of electric current. The spark is generated between electrode and work piece. When the voltage between the two electrodes is increased, the intensity of the electric field in the volume between the electrodes becomes greater than the strength of the dielectric, which breaks down, allowing current to flow between the two electrodes. The performance of EDM is influenced by different electrical parameters such as current, voltage, pulse on time, pulse off time, polarity, spark gap, flushing pressure. All these parameters affect the output parameters such as material removal rate, surface roughness, tool wear rate. It is very difficult to obtain optimal process parameters in EDM. In manufacturing industries there is need of high productivity and good surface finishing. To obtain high productivity with good surface finishing we need to optimize the input process parameters.

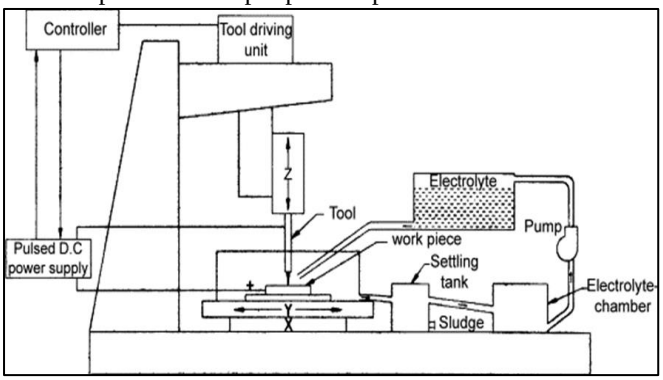

Fig. 1: Electrical Discharge Machine

II. LITERATURE REVIEW

In this paper few selected research paper related to Electrical Discharge Machining with input parameters current, voltage, pulse on time, pulse off time, spark gap and its influence on material removal rate (MRR), Tool wear rate (TWR) and surface roughness (SR) have been discussed.

M.A. Razak et al. [1] conducted experiment on electrical discharge machine. They studied influence of input parameters peak current, voltage, pulse on time, pulse off time on output parameter SR. Experiment were carried out using L9 orthogonal array. Work piece material was magnesium alloy and copper tool was used. Taguchi method was used for optimization. Pulse on time was the parameter having most influence on SR.

Chandramouli S et al. [2] conducted experiment on electrical discharge machine. They studied influence of input parameters peak current, pulse on time, pulse off time on output parameter MRR, TWR. Experiment were carried out using L9 orthogonal array. Work piece material was RENE80 nickel super alloy and Aluminium tool was used. ANOVA method was used for optimization. In result, current was the parameter having most influence on MRR and TWR.

Jadi Laxman and Kotakonda Guru Raj [3] conducted experiment on electrical discharge machine. They studied influence of input parameters peak current, pulse on time, pulse off time, Tool lift time on output parameter MRR, TWR, SR. Experiment were carried out using L27 orthogonal array. Work piece material was Titanium super alloy and copper tool was used. Taguchi method was used for optimization. In result MRR, TWR, SR increase with increase in current and decrease with increase in tool lift time.

Saeed Dhaneshmand et al. [4] conducted experiment on electrical discharge machine. They studied influence of input parameters peak current, pulse on time, pulse off time, voltage on output parameter MRR, SR. Experiment were carried out using L9 orthogonal array. Work piece material was nickel titanium (NiTi). Taguchi method was used for optimization. In result, current was the parameter having most influence on MRR and pulse on time was the parameter having most influence on SR.

Santanu Dey, Dr. D.C. Roy [5] conducted experiment on electrical discharge machine. They studied influence of input parameters Impulse and spark gap, current on output parameter MRR. Experiment were carried out using L9 orthogonal array. Work piece material was mild steel and copper and graphite tool was used. Regression analysis method was used for optimization. In result it is seen that graphite electrodes are the best suitable for lower values of parameters and copper electrodes are suitable for high metal removal process where finish requirements are not significant.

Jesudas T and Arunachalam RM [6] conducted experiment on micro-EDM. They studied influence of input parameters voltage, capacitance, spark gap on output parameter MRR. Experiment were carried out using L27 orthogonal array. Work piece material was stainless steel. In conclusion, it is found that the MRR gets increased with increase in voltage and capacitance. With simultaneous increase in capacitance and spark gap, highest MRR could be achieved.

N. Radhika et al. [7] conducted experiment on electrical discharge machine. They studied influence of input parameters peak current, pulse on time, flushing pressure on output parameter MRR, TWR. Experiment were carried out using L27 orthogonal array. Work piece material was Mg alloy. ANOVA method was used for optimization. In result, current was the parameter having most influence on MRR and TWR.

Dr. M. Janardhan [8] conducted experiment on electrical discharge machine. He studied influence of input parameters peak current, Electrode rotation, voltage, spark gap on output parameter MRR, SR. Experiment were carried out using L27 orthogonal array. Work piece material was AISI D2 and copper tool was used. Taguchi method was used for optimization. In result, current was the parameter having most influence on MRR and SR and spark gap was the parameter having least influence on MRR and SR.

Mao-yong LIN et al. [9] conducted experiment on micro milling electrical discharge machine. They studied influence of input parameters peak current, pulse on time, pulse off time, spark gap on output parameter MRR, Electrode wear, woeking gap. Experiment were carried out using L9 orthogonal array. Work piece material was Inconel 718 alloy. Grey-Taguchi method was used for optimization. In result it is seen that current and spark gap were two important factors to achieve optimum result.

Mary george et al. [10] conducted experiment on electrical discharge machine. They studied influence of input parameters peak current, voltage, spark gap on output parameter SR. Experiment were carried out using L9 orthogonal array. Work piece material was SS304 and Cu, Wcu, graphite tool was used. ANOVA method was used for optimization. In result, current was the parameter having most influence on SR.

Kansal, Sehijpal Singh, P. Kumar [11] conducted an experiment in 2006. In this experiment Peak current, pulse duration, duty cycle and powder concentration were considered as input process parameters. The output parameters were MRR, SR and TWR. The concentration of silicon powder added in dielectric fluid. For optimization they used Taguchi method and utility concept. In conclusion, it is seen that and peak current was the most influenced process parameter for tool wear rate, material removal rate and surface roughness.

Mohd Amri et al. [12] conducted an experiment on work piece of Tungsten Carbide. The material of electrose was graphite. They studied the implementation of Taguchi method on Electrical discharge machining. The process parameters that are taken for consideration are current, voltage, pulse-on-time and pulse-off-time. MRR, EWR and SR were output parameters. In the conclusion it is found that current is the most influential parameter. Optimization of process parameters can be easily done by using Taguchi method.

III. Conclusion

From all above analysis with different process parameters it is seen that Current and Pulse on Time are the most influential process parameters and spark gap, Flushing pressure are the least influential process parameters that affect MRR, TWR, SR. It is easier to Design experiment by using orthogonal array and to optimize process parameters by using Taguchi method.

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