International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 02 | Feb 2021 www.irjet.net p-ISSN: 2395-0072

OPTIMIZATION OF CONVENTIONAL EDM MACHINE PROCESS PARAMETERS FOR STAINLESS STEEL 430 BY USING TAGUCHI METHOD WITH COPPER TUNGSTEN ELECTRODE

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Abstract: *Since the research on the materials have been started, there are many advancements in the materials had occurred. Along with the research on the materials, the material handling processes had been developed immensely. Out of the conventional manufacturing methods, unconventional manufacturing methods are showing good results for metal properties. Electrical Discharge Machining (EDM) is one of the best unconventional method for material removal process. So, the objective of the present project work is to investigate the effects of the various EDM process parameters of metals. The work piece and electrode materials used for machining are stainless steel 304 and copper tungsten.*

Introduction

Two Russian scientists, b. r. lazarenko and n. i. lazarenko, proposed that electrical discharge machining (edm) was not completely in use benefit of this method until 1943. And, when established up then erosive properties of the method could be employed and make use of machining functions. later one among them was discovered by joseph priestly in 1770, in the middle of 1980s machining process on edm were converted to a production instrument. The effective movement through Electrical Discharge Machining makes it more commonly offered and also engaging above out dated machining procedures till then. At earlier days EDM form it produces arc which is harmful for machining processes. Each spark energy is discrete and controlled enough to melt and vaporize within a thin gap from the work piece surface.

Working Principle Of EDM

Electrical discharge machining process is a unconventional machining process works on the basic principle of spark generation and metal will be removed by spark erosion through an electrode. EDM spark which burn a small amount of hole in a piece of metal through which it contacts for erosion. The spark generated by this process produces high amount of heat, which removes metal on respective product by erosion and evaporation. In this unconventional machining process both the work piece and tool must be made by conductive material process was actually inaccurate plus damaged. It had been Commercially established in the mid-1970s, the wire edm machining originated to be a feasible practice that facilitated to run- through the metallic operational industry we have seen nowadays. Die Sinker EDM Machining process, first and foremost the two electrodes are fitted on their places on the machine parts which is work bench and tool holder. Both the electrodes are electrically conductive in nature. Subsequently as both the electrodes are immersed in an insulating liquid dielectric with the help of pump. The dielectric in this is EDM oil/ kerosene / transformer oil. Then set the machining parameters on the CNC controller for machining on the work piece to get the required shape and size.

SURFACE ROUGHNESS

Surface roughness is in real nothing but roughness, which is an important property for many real time applications in mechanical field. Roughness plays an important role in calculating or exterminating how a real object will interact with its environment. In tribology, rough surfaces usually loss its life more quickly and have higher friction coefficients than smooth surfaces. Roughness is a good predictor of the performance of a mechanical component, since indiscretions on the surface may form nucleation sites for cracks or corrosion. On the other hand, roughness may promote adhesion.

Material Removal Rate (MRR):

This is one of the performance measures. Material Removal Rate of the work piece is the volume of the material removed per minute. It is usually measured in the unit as mm3 /min.

Maximum of MRR is an important indicator of the efficiency and the cost effectiveness of the EDM process.

LITERATURE REVIEW

[1] J. Jeevamalar Department of Mechanical Engineering, gave a review, E.G.S. Pillay Engineering College, Nagapattina Electrical Discharge Machining is of an Electrical energy based Unconventional Machining Technique as trending. The electrical energy is directly used to remove material or cut the metals on object. It's also called as Spark Erosion Machining or Electro Erosion Machining in mechanical field. The metal will be removed by electrical spark discharge Between tool (Cathode) and work piece (Anode). Electrical Discharge Machining is immensely used in mould and die making industries, Automobile industries and also making of Aerospace components as well. Current Advanced Research Development of Electric Discharge Machining (EDM) has become an interesting thing.

Objective

The main motto of the current work is to investigate the Optimal Process Parameters of EDM machine. Stainless steel 304 is selected as a base work piece material with Copper tungsten as a conductive Tool (Electrode) Material. The Parameters which we are giving as parameters such as peak Current (A), Pulse on Time (TON) & Pulse off Time (TOFF) are selected for the experimental work in process. Effects of these Input Parameters on Output Response as surface roughness and Material Removal Rate (MRR) are studied respectively. Analysis is carried out using Taguchi Technique and an attempt has been made to estimate the optimum machining conditions to get the best possible response within the experimental constraints.

Methodology

Taguchi's strategy is an operative method to perform a brilliant framework. It gives productive and orderly way to deal with improved plans for execution and quality. Moreover, Taguchi parameter configuration can lessen the change of framework execution. The experiment is governed by the following steps such as:

- Select the appropriate orthogonal array and assign these parameters to the orthogonal array.
- Perform the experiments based on the arrangement of orthogonal array.
- Analyze the experimental results using TAGUCHI and S/N Ratios

EXPERIMENTAL SETUP

The experiments were conducted using a Die- sinking EDM machine, model ZNC25 manufactured by KRUSHI ENGINEERS HYD India.

Selection of Material: Work Piece Material-Stainless steel 304s

Electrode Material- Copper Tungsten

Stainless steel 304

Type 304S is a low carbon, non-hardening version of Type 304 stainless steel. This general- purpose stainless steel remains soft and ductile even when it is quickly cooled. Other key benefits of Type 304S include:

- Weldable by most normal techniques
- Good resistance to oxidation
- Continuous services up to 1300°F (705°C)

COPPER TUNGSTEN

Copper–tungsten (tungsten–copper, CuW, or WCu) is a combination of copper and tungsten. As copper and tungsten are not mutually soluble, the material is composed of distinct particles of one metal dispersed in a matrix of the other one.

This material mixes the properties of both metals, resulting in a material that is heat- resistant, ablation-resistant, highly thermally and electrically conductive and easy to machine.

Levels	PULSE TIME ON	PULSE TIME OFF	PEAK CURRENT
Level 1	100	200	7
Level 2	200	500	15
Level 3	500	900	22

The L9 orthogonal array for input parameters Pulse on time, pulse off time and peak current is shown in table below:

EXPERIMENTS	TIME		Peak current(IP)
	On	off	
1	100	200	7
2	100	500	15
3	100	900	22
4	200	200	15
5	200	500	22
6	200	900	7
7	500	200	22
8	500	500	7
9	500	900	15

Experiments have been performed in order to investigate the effects of one or more factors of the process parameters on the surface finish of the die sink machined surface.

The main aim of the project is to determine the influence of time on, time off, wire feed and input power. The investigation is based on surface roughness during machining of stainless steel 304s

Input parameters

Fig: die sink EDM process

Fig: Final work piece

SURFACE ROUGHNESS RESULTS

In this project most important output performances in DEDM such as Surface Roughness (Ra) is considered for optimizing machining parameters. The surface finish value (in µm) was obtained by measuring the Volume VI, Issue XI, November/2019 mean absolute deviation, Ra (surface roughness) from the average surface level using a Computer controlled surface roughness tester.

EXPERIMENTS	TIME		Peak current(IP)	Surface Roughness **(Ra)**
	On	off		
1	100	200	7	5.12
2	100	500	15	6.22
3	100	900	22	7.18
4	200	200	15	5.60
5	200	500	22	6.81
6	200	900	7	7.72
7	500	200	22	6.32
8	500	500	7	7.52
9	500	900	15	8.52

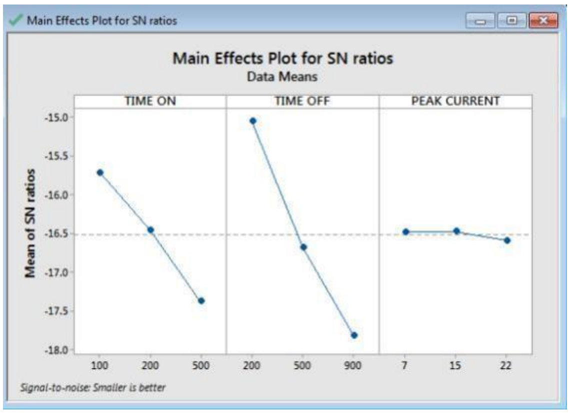
Material Removal Rate

EXPERIMENTS	TIME		Peak current(IP)	MRR (mm^3/min)
	On	off		
1	100	200	7	0.1875
2	100	500	15	0.2875
3	100	900	22	0.15
4	200	200	15	0.125
5	200	500	22	0.075
6	200	900	7	0.25
7	500	200	22	0.275
8	500	500	7	0.1
9	500	900	15	0.1125

INTRODUCTION TO TAGUCHI TECHNIQUE

Taguchi defines Quality Level of a product because the Total Loss incurred with the aid of society due to failure of a product to carry out as preferred once it deviates from the delivered target performance ranges.

This includes charges related to negative overall performance, in operation expenses (which modifications as a product a while) and any in addition prices because of dangerous issue effects of the products in use.



Graph: Effect of parameters surface roughness for S/N ratio

Graph: Effect of parameters MRR for S/N ratio

CONCLUSION

The objective of the present work is to investigate the effects of the various DEDM 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 ss 304s.

The process parameters considered are Pulse Time on, Pulse Time off, and peak current. The range of values varied are Time on – 100μsec, 200 μsec and 500 μsec, Time off – 200 μsec, 500 μsec, 900 μsec, Input power –7amp, 15amp, 22amp.. 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 - 200 μsec, and Peak current-15amp to get better surface finish values. By observing the MRR Volume VI, Issue XI, November/2019 results, to get better MRR values at Time on -100 μsec, Time off – 500 μsec and Input power-15amp.

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