© 2018 IJSRSET | Volume 4 | Issue 4 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section : Engineering and Technology

Process Parameter and Optimisation of Stainless Steel in Micro EDM

V. Bharathvajan[1], Dr. A. Parthiban[2]
[1]Post Graduates, Department of Mechanical Engineering, King College of Technology, Namakkal, Tamil Nadu,India
[2]Associate Professor, Department of Mechanical Engineering, King College of Technology, Nallur, Namakkal, TamilNadu, India

ABSTRACT

Electrical Discharge Machining (EDM) is one of the earliest non – traditional machining processes. EDM process is based on thermoelectric energy between work piece and an electrode. Material Removal Rate (MRR) is an important performance measure in EDM process. Since long, EDM researchers have explored a number of ways to improve and optimize the MRR including some unique experimental concepts that depart from the traditional EDM sparking phenomenon. Despite a range of different approaches, all the research work in this area shares the same objective of achieving more efficient removal coupled with a reduction in tool wear and improved surface quality. The paper reports research on EDM relating to improvement in MRR along with some insight into mechanism of material removal. In the end of the paper scope for future research work has been outlined. A micro electro – discharge machining (MEDM) technology is presented. It allows machining of micro holes and shafts as small as 5 μm, as well as a variety of complex shapes of equivalent accuracy. In the MEDM, machining for silicon with 10 -100 Ω - cm resistivity's is possible ; machining up to a depth of 10 times the electrode diameter is easy, and electrode wear is small.

Keywords: WJM,AJM,USM,LBM,PCM,TSDM,CHM,EDM,NICKEL TITANIUM SHAPE MEMORY ALLOY, MRR,TWR,OC,MT

I. INTRODUCTION

Micro Electrical Discharge machining is basically a non - conventional material Removal process which is widely used to produce dies, punches and moulds, finishing parts for the aerospace and automotive industry, and surgical components. This process can be successfully employed to machine electrically conductive parts irrespective of their hardness, Shape and toughness.

The review presented in this paper is on different techniques proposed and investigated by researchers in improvement in material removal rate in MEDM. Being an important performance measure, MRR improvement has always been a major area of focus for researchers and scrutiny of the published research work emphasized the need for such a review paper reporting all the available literature and suggesting the future direction for research.

The end of the paper identifies the major EDM academic research area and suggest future direction for the EDM research as a novel contribution to the archival literature.

1.1 PROBLEM IDENTIFICATION

Recent development in Micro – EDM have micromachining a crucial process in manufacturing microproducts. Micro – EDM is needed for a high precision machining where high precision machining is needed to produce microproducts that is essential in the future. In machining process there are countless problems that can reduce the quality of the product and that will affect the cost of the machining. In micro – EDM drilling, producing blind holes is stated as a problem because wear will constantly reduce the length of the electrode. Problems regarding the electrode wear will affect the erosion process where when eroding down to a fixed depth, the real depth of the hole will be significantly small. It becomes more complicated when machining complex 3D micro cavities. High wear rate will cause more frequent wire breaks. This is maximum tension the wire can take section of the micro wire therefore the micro-wire decreases, This will affect the spark gap where the spark gap area will change as the electrode moves down feeding in the Z – axis direction. The a absence of the dielectric flushing will result in low precision machining processes.

1.2 WORKING PRINCIPLE OF EDM

Electrical Discharge Machining (EDM) is a controlled metal removal process that is used to remove metal by means of electric spark erosion. In this process an electric spark is used as the cutting tool to cut the work piece to produce the finished part to the desired shape.

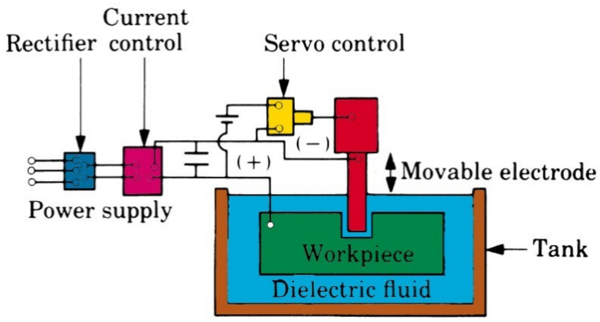

Figure 1

1.3 EDM PROCESS

EDM spark erosion is the same as having an electrical short that burns a small holes in a work piece of metal it contacts. With the EDM process both the work piece material and the electrode material must be conductors of electricity.

The EDM process can be used in two different way;

1. A reshaped or formed electrode (tool), usually from graphite or copper, is shaped to the form of the cavity it is to reproduce. The electrode is fed vertically down and the reverse shape of the electrode into the solid work piece.
2. A continuous travelling vertical wire electrode, the diameter of the small needle or less, is controlled by the computer to follow a programmed path to erode or cut a narrow slot through the work piece to produce the required shape.

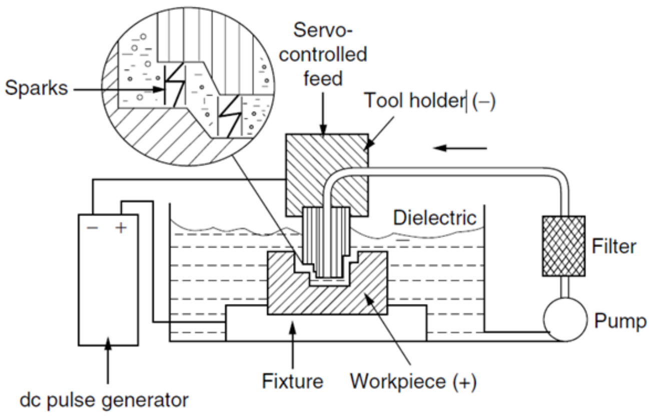

Figure 2. Schematic Diagram of Micro EDM Drilling

1.4 METHODOLOGY TO BE FOLLOWED

► Micro EDM performance are affected mostly by peak current (Ip) and pulse on time (T_{on})

► The experimental scheme has been designed based on nine rows corresponding to nine experimental runs based on two input factors, i.e., peak current (Ip) and pulse - on – time (T_{on}) each factor three levels, and the corresponding machining performance were recorded and used for analysis.

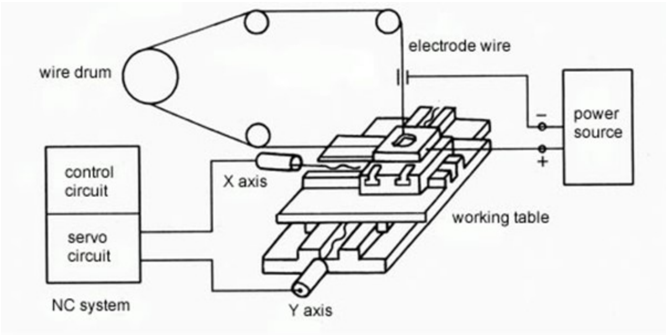

Figure 3. Machine Specification

1.5 MATERIAL REMOVAL RATE (MRR)

► In the present investigation, the MRR in grams per seconds and TWR in grams per seconds are used to evaluate the machining performance, which are expressed as,

$$MRR = \frac{WRM}{MT}$$

Where,

WRM – work piece removal mass (grams)   v - Volume of the machined hole (m^3)

h - Thickness of the work piece (m^3)   r - Radius of the exit hole (m^3)

MT - Machining time (seconds)   R - Radius of the entry hole (m^3)

ρ - Density of the work piece (Kg/m^3)

1.6 TOOL WEAR RATE (TWR)

► TWR in grams per seconds are used to evaluate the machining performance ,

Where

TWM – tool wear mass (grams)   v - Volume of the tool (m^3)

MT - Machining time (seconds)   ρ - Density of the tool (Kg/m^3)

d - Diameter of the tool (m)   l - tool wear per hole (m)

The first serious attempt of providing a physical explanation of the material removal during electrical discharge machining is that of Dijck. In the Ph.D , thesis he presented physic mathematical analysis of the process, He presented a thermal model together with a computational simulation to explain the phenomena between the electrode during electric discharge machining.

1.7 EDM OPARATION

1. Flushing   MRR – Material removal rate
2. Electrode   TWR – Tool wear rate

1.8 MATERIAL

STAINLESS STEEL

AK steel type 304 is a variation of the basic 18-8 grade, Type 302. With a high ferrochromium and lower carbon content. Lower carbon minimizes chromium carbide precipitation due to welding and its susceptibility to intergranular corrosion. In many instances, it can be used in the as – welded condition. While type 302 must be annealed in order to retain adequate corrosion resistance. Type 304L is an extra low carbon variation of Type 304 with a 0.03%maximum carbon content that eliminates carbide precipitation due to welding.

1.9 AVAILABLE FORMS

AK steel produces type 304 stainless steel in thickness from 0.01" to 0.25" (0.025 to 6.35 mm) max. And widths up to 48 (1219 mm). For other thickness and widths, inquire.

MECHANICAL PROPERTIES OF STAINLESS STEEL

Table 1

Stainless steel type	UTS ksi (MPa)	0.2 % YS ksi (MPa)	Elongation %in 2" (50.8 mm)	Hardness Rockwell
Type 304	90 (621)	42 (290)	55	B 82

The proposed work for the Phase II is to carry out the above mentioned methodology for performing the MRR, TWR, OC, MT and Taper. During micro hole drilling in micro EDM on 304 stainless steel material using graphite and tungsten copper electrode and using de – ionized water as dielectric.

II. RESULT

The project was tested and parameters were chosen from the factor involved in the process and the impact of the factor on the final result was taken to account and the results were taken for regression and analysis.

Table 2. factor and range

FACTOR	RANGE
Spindle speed (rpm)	3000 – 12000 rpm
Feed rate mm/teeth	600 – 1800 mm/s
Depth of cut mm	0.40 – 1.00 mm

Table 3. Array with values of Ra and MRR

Speed rpm	Feed mm/s	Depth of cut mm	Ra (mm x 10*-5)	MRR mm^2/s)
3000	1800	0.2	1.57	84.9256
3000	1200	0.3	1.24	161.2903
3000	1200	0.1	1.32	50.5055
3000	600	0.2	1.26	105.8201
7500	1800	0.3	0.93	215.0558
7500	1200	0.1	0.24	277.7778
7500	600	0.2	0.68	196.0784
7500	600	0.2	0.34	588.2353
12000	1800	0.1	0.21	317.4608
12000	1200	0.2	0.63	211.6402

III. CONCLUSION

Thus the comparative investigation of machining characteristics such as MRR, TWR, OC, MT, and taper during micro drilling in micro EDM on stainless steel material using graphite and tungsten copper and using De- ionized water as dielectric founded by the process parameter and optimisation of stainless steel in micro EDM.

IV. REFERENCES

[1]. W.Koenig, D.F Dauw, G.Levy, U.Panten EDM future steps towards the maching of ceramics, Ann, CIRP (1998)

[2]. Kibra G,Sarker B. R,Pradhan B, compatative study of different for micro EDM performance during micro hole machining od Ti-6A1-4V alloys

[3]. A.Erden effect of material on the mechanism of electric discharge machining trans ASME (1983)

[4]. Masuzawa .T, Tanaka.k, Nakamura.Y water based dielectric solution for EDM CRIP anals manufacturing technology

[5]. J.S Soni materisl migration during EDM of die steel.