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A Review-Optimization of Various Machine Process Parameters on the Surface Ruoghness in EDM

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Abstract*: In manufacturing industries the right selection of manufacturing condition is one of the most important aspects to take into consideration in the majority of process and particularly in processes related to Electric Discharge Machine (EDM). The EDM is a non-traditional machining process that involved a transient spark discharge through the fluid due to the different between the electrode and the work piece. Main aim of this project is optimization the various machine process parameters on surface roughness in EDM. The literature survey suggests that proper selection of input parameters will play a significant role in EDM also, obtain that pulse on time, pulse off time and discharge current have the highest impact on the surface roughness.

Keywords*: EDM, surface roughness, optimization.

I. INTRODUCTION

Electric Discharge Machine is one of the most accurate manufacturing and non-traditional machining process which is more efficient than traditional machining process due to ease of machining of difficult to machine material with difficult shapes and also electric energy is used to generate electric spark and material removal mainly occurs due to thermal energy of the spark. It can be used the machine complex geometries in least batches or even on job shop basis.

Principle of EDM

In the EDM process the metal is removing from the work piece due to erosion case by rapidly recurring spark discharge taking place between the tool and work piece. Show the mechanical set up and electrical set up and electrical circuit for electro discharge machining. A thin gap about 0.025mm is maintained between the tool and piece by a servo system in Fig.1. Both tool and work piece are submerged in a dielectric fluid. Kerosene/EDM oil/deionized water is very common type of liquid although gaseous dielectrics are also used in certain cases.

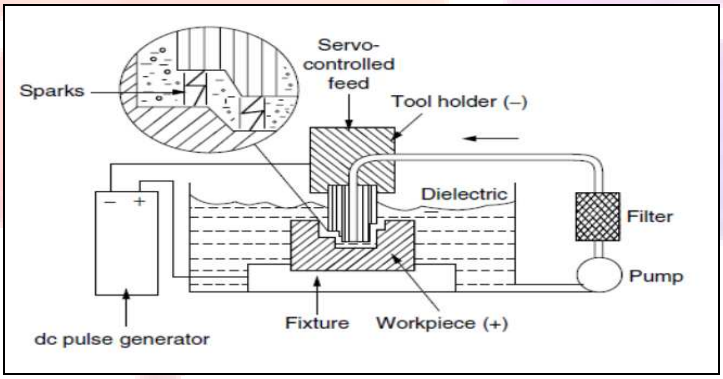

Fig-1 Diagram of Electric Discharge Machining

Such localized extreme rise in temperature leads to material removal. Material removal occurs due to instant vaporization of the material as well as due to melting. The molten metal is not removed completely but only partially.

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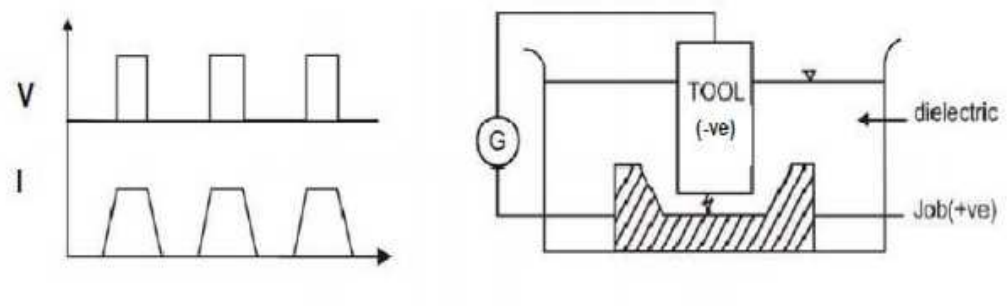

Fig-2 Working principle of EDM

As the potential difference is withdrawn as shown in Fig. 1.2, the plasma channel is no longer sustained. As the channel collapse, it generates pressure or shock waves, which evacuates the molten material forming a crater of removed material around the site of the spark.

II. EFFECT OF INPUT PARAMETRS

Based on the discharge phenomena, the effect of various input parameters on surface roughness(Ra) is discussed below.

Discharge current:

The discharge current (Id) is a measure of the power supplied to the discharge gap. A higher current leads to a higher pulse energy and formation of deeper discharge craters. This increase the surface roughness (Ra) value. Similarly effect on Ra is produced when the gap voltage is increased

Pulse-on time:

Machining takes place only during the pulse-on time (Ton). When the tool electrode is at negative potential, material removal from the anode (work piece) take place by bombardment of high energy ejected from the tool surface. At the same time positive ions move towards the cathode.

The whole machining process is carried out during one time. The spark gap is bridged, current is generated and the work is accomplished. The longer the spark is sustained more is the material removal. Consequently the resulting craters will be broader and deeper. Therefore, the surface finish will be rougher. Obviously with shorter duration of sparks the surface will be batter. With a positively charged wok piece the spark leaves the tool and strikes the work piece resulting in the machining. More sparks produces much more wear. Hence, this process behaves quite opposite to normal process in which the tool wears more during finishing than roughing.[9]

Pulse-off time:

A non-zero pulse off time a necessary requirement for EDM operation. Discharge between the electrodes leads to ionization of the spark gap. Before another spark can take place, the medium must de-ionize and regain its dielectric strength. This take place some finite time and power must be switched off during this time. Too low values of pulse-off time may lead to short.

Arc gap (or Gap):

The arc gap is distance between the electrode and work piece during the process of EDM. It may be called as spark gap. Spark gap can be maintained by servo system.

Duty cycle (τ):

It is a percentage of the on-time relative to the total cycle time. This parameter is calculated by dividing the on-time by the total cycle time (on-time pulse off-time).

$$\tau = \frac{Ton}{Ton + Toff}$$

Voltage (V):

It is a potential that can be measure by volt it is also effect to the material removal rate and allowed to per cycle. Voltage given by in this experiment is 50V.

Diameter of electrode (D):

It is an electrode of Cu-tube there are two different size of diameter 4mm and 6mm in this experiment. This tool is used not only as an electrode but also for internal flushing.

Over cut:

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It is a clearance per side between the electrode and the work piece after the machining operation.

III. MACHINING CHARACTERISTIC

This study investigates the machining characteristics such as surface roughness. These are the most common key indicators used by many manufacturers.

Surface Roughness (SR):

Surface roughness is usually defined as the deviation of a surface from an ideal level and is defined according to international standard (ISO 4287:1997). The arithmetic mean surface roughness Ra is defined as deviation of a surface from a theoretical center line (R_{mean}) over a measuring length Lm (Fig-3). Surface roughness is generally dependent on cutting tool geometry, tool material, work piece geometry, work piece material, cutting conditions, cutter run-out, machine-tool rigidity etc.

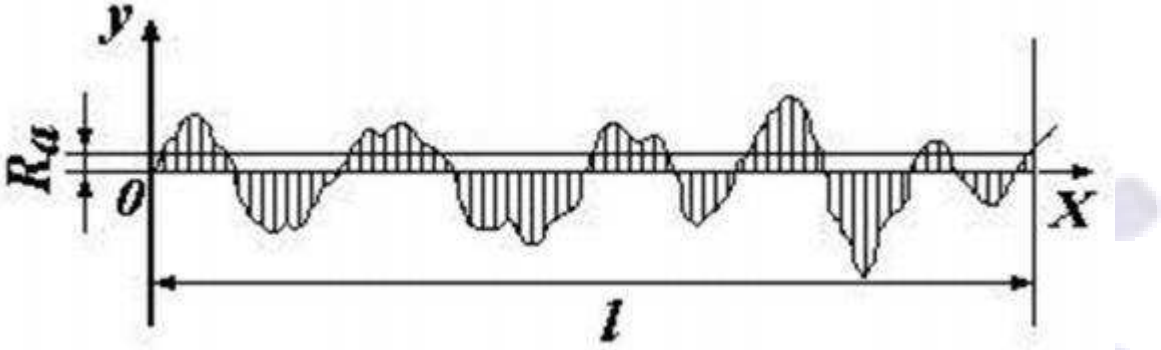


Fig-3 Arithmetic mean surface roughness Ra [1]

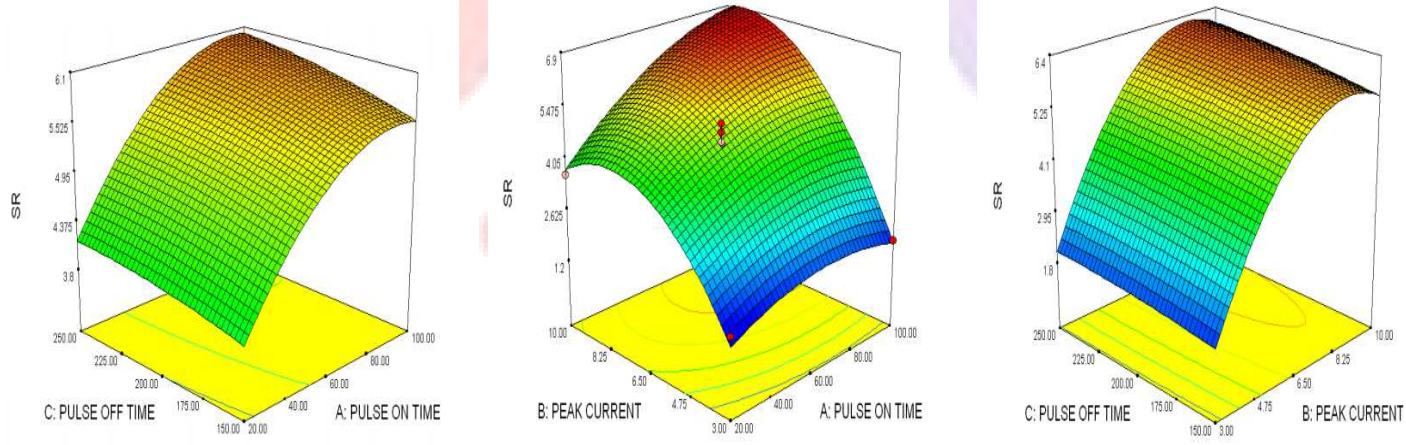
Surface roughness most commonly refers to the variations in the height of the surface relative to a reference plane. It is measured either along a single line profile or along a set of parallel profiles (surface maps). It is usually characterized by one of the two statistical height descriptors advocated by the American National Standards Institute (ANSI) and the International Standardization Organization (ISO) (Anonymous, 1975, 1985). There is Ra, CLA (center line average).

IV. LITRETURE REVIEW

Vikas at al (2014)[1],They have find out the effect of different input parameters over the surface roughness in EDM using the Grey-Taguchi method and also found that current had larger impact over the SR and also the experimental and predicted value was much closed to each other for an EN 41 material. In this paper finding the various surface roughness like Ra, Rq, Rsk,Rku and Rsm.

Shashikant at al (2014)[2], evaluated the effect of pulse-on time, pulse-off time, discharge current and voltage on surface roughness of EDM with an EN19 material due to molybdenum and chromium. The experiment conducted as per L31 orthogonal array based on Response Surface Method (RSM). They observed that for Ra value of peak current and pulse-on time was most significant feature. Ra value decrease with a decrease in peak current as well as pulse on time.

N.Annamalai at al (2014) [3] has presented the mathematical modeling of EDM with AISI 4340 steel. The effect of MRR and SR with process parameters taken in to consideration were the pulse-on time, pulse-off time and peak current. The three level full factorial design was choosing. Finally the significant of the models were checked using the ANOVA. When the pulse-on time increase the roughness average values also increase so, batter surface roughness, the pulse-on time must be optimum. There is no change in Ra value when pulse-off time is increase.

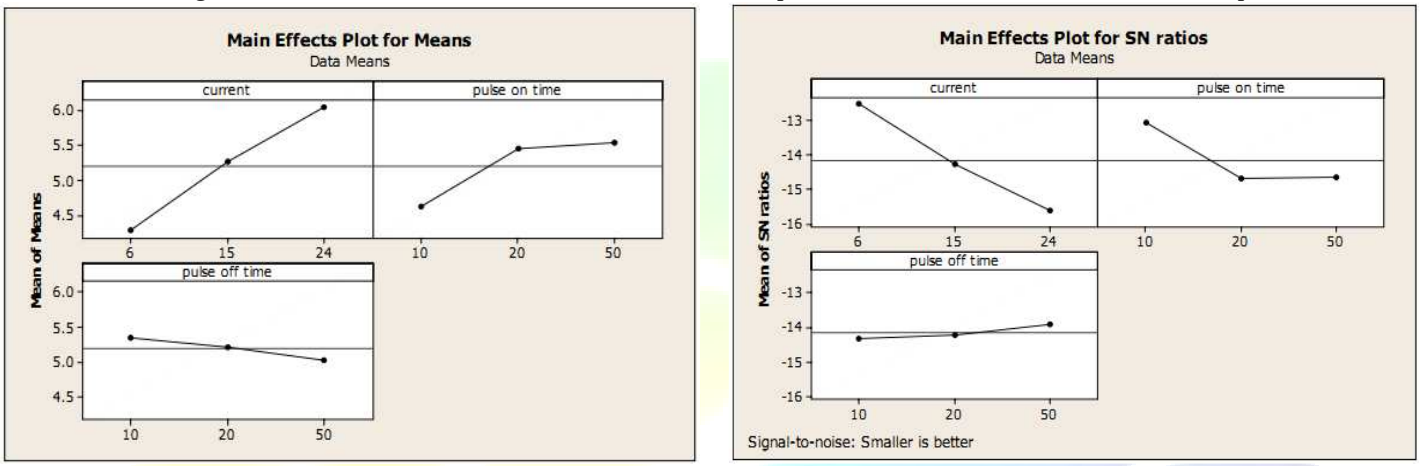


(a) (b) (c)

Fig-4 (a) Effect an pulse on time surface roughness, (b) Effect an peak current on surface roughness and (c) Effect an pulse off time on surface roughness.

Milan kumar Das at al (2014)[4], evaluation the effect of the EDM on such process parameters like as pulse-on time, pulse=off time, discharge current and voltage of MRR and SR of EN 31 steel tool. For a experimental plan central composite design (CCD) was used. Experiment result shows that with an increase in current and pulse–on time. Surface roughness value increase in the experimental regime.

Chandramauli at al (2014)[5], they have optimize the optimal process parameters of EDM a RENE 80 nickel steel alloy material. For current 60A, pulse on time 6µs and pulse off time value is 50µs. The surface finish is better than other value which shoes that in the fig. The SR value is increase with increases current and pulse on time but increase with increase in pulse off time.



(a) (b)

Fig-5 (a) Main effect plot of mean value for SR, (b) Main effect plot of S/N ratio for SR.

Saeed Daneshmand at al (2013) [6], have defined that MRR, Tool Wear Rate and Surface Roughness for NiTi alloy. When the increase of pulse current in NiTi alloy, SR value increase. To obtain the least amount of SR, the least value of pulse current and pulse on time should be chosen and the off time between two pulses should be increase.

V. CONCLUSION

After the literature survey concluded that effects of machining characteristics on electric discharge machine using different materials. An also conclude that the machining process of electric discharge machine influence the machining performance.

The surface roughness (SR) value will result in batter machining process parameters like a pulse on time, pulse off time and discharge current. EN21 is a work material which is a 3% steel nickel steel is used to capable of being heat treated to produce an excellent resistance to shock combined with a tensile strength.

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