A study on improvement in surface finishing in case of EDM

Mr. Mahesh L. Toche 1, Prof. P.G.Patil 2, Prof. R.Y.Patil 3.

[1] **Mr. Mahesh L.** *Toche, Mechanical Department, S.G.D.College of Engg. Jalgaon, Maharashtra, India.*
[2] **Prof.P.G.Patil,** *Associate Professor Mechanical Department, S.G.D.College of Engg. Jalgaon,*
[3] **Prof.R.Y.Patil,** *,Associate Professor & H.O.D Mechanical Department, S.G.D.College of Engg. Jalgaon,*

ABSTRACT

. In the recent years, EDM researchers have explored a number of ways to improve the sparking efficiency including some unique experimental concepts that depart from the EDM traditional spark ing phenomenon. Despite a range of different approaches, this new research shares the same objectives of achieving more efficient metal removal coupled with a reduction in tool wear and improved surface quality.

Electro-discharge machining process can be controlled by parameters like pulse on time, voltage and current, spark gap. Surface finish is an important parameter to characterize the quality of machining process

Keyword: - *EDM, Surface finish, spark gap*

1. INTRODUCTION.

Conventional machining processes utilize the ability of the cutting tool to stress the material beyond the yield point to start the material removal process. This requires that the cutting tool material is harder than the work piece material.

New materials which are having high strength-to weight ratio, heat resistance and hardness, such as nimonic alloys, alloys with alloying elements such as tungsten, molybdenum, and columbium are difficult to machine by the traditional methods.

Machining of these materials by the conventional methods is very difficult as well as time consuming, since the material removal rate reduces with an increase in the work material hardness. Hence, there is the, need for development of non-traditional machining processes which utilize other methods for the material removal. As a result, these processes are termed as unconventional or non-traditional machining methods.

Non-Traditional machining processes are being used to achieve optimum metal removal rate, better surface finish and greater dimensional correctness, with a reduced amount of tool wear.

Electrical Discharge Machining, commonly known as EDM is a non-conventional machining method used to remove material by a number of repetitive electrical discharges of small duration and high current density between the work piece and the tool. EDM is an important and cost-effective method of machining extremely tough and brittle electrically conductive materials. In EDM, since there is no direct contact between the work piece and the electrode, hence there are no mechanical forces existing between them. Any type of conductive material can be machined using EDM irrespective of the hardness or toughness of the material.

In current experiment we have selected two types of electrodes having different shape, grade and observed electrode keeping all parameters like current, voltage, charge etc constant except spark gap. In this paper the discussion is made on effect of spark gap on surface roughness.

2. Literature Review.

EDM is an essential operation in several manufacturing processes in some industries, which gives importance to variety, precision and accuracy. Several researchers have attempted to improve the performance characteristics namely the surface roughness, cutting speed, dimensional accuracy and material removal rate. But the full potential utilization of this process is not completely solved because of its complex and stochastic nature and more number of variables involved in this operation (Spedding and Wang, 1997; Scott et al., 1991). Scott et. al. (1991) developed mathematical models to predict material removal rate and surface finish while machining D-2 tool steel at different machining conditions. It was found that there is no single combination of levels of the different factors that can be optimal under all circumstances. Tarng et. al. (1995) formulated a neural network model and simulated annealing algorithm in order to predict and optimize the surface roughness and cutting velocity of the EDM process in machining of SUS-304 stainless steel materials. Spedding and Wang (1997) attempted to model the cutting speed and surface roughness of EDM process through the response-surface methodology and artificial neural networks (ANNs). The authors attempted further to optimize the surface roughness, surface waviness and used the artificial neural networks to predict the process performance. Liao et. al. (1997) performed an experimental study using SKD11 alloy steel as the workpiece material and established mathematical models relating the machine performance like MRR, SR and gap width with various machining parameters and then determined the optimal parametric settings for EDM process applying feasible-direction method of non-linear programming. Spedding and Wang (1997) attempted to optimize the process parametric combinations by modeling the process using artificial neural networks (ANN) and characterizing the EDM machined surface through time series techniques. A feed-forward back-propagation neural network based on a central composite rotatable experimental design is developed to model the machining process. Optimal parametric combinations are selected for the process.

3. IMPORTANT PARAMETERS OF EDM .

Spark on-time (Ton): The duration of time (µs) the current is allowed to flow per cycle. . Material removal is directly proportional to the amount of energy applied during this on-time. This energy is really controlled by the peak current and the length of the on-time.

Spark off-time (Toff): the duration of time in between the sparks generated. During this time the molten material gets removed from the gap between the electrode and the work piece. This parameter is to affect the speed and the stability of the cut. Thus, if the off-time is too short, it will cause sparks to be unstable

Voltage (V): It is the potential difference applied between the electrode and the work piece. 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 is given by in this experiment is 50 V.

Discharge Current (Ip): It is the current flowing through the electrode and is measured in amp. Current is measured in amp Allowed to per cycle. Discharge current is directly proportional to the Material removal rate.

Duty cycle (τ): It is the ratio of Ton divided by total cycle time (Ton+Toff). 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).

$\tau = Ton / (Ton + Toff)$

Arc gap (or gap): The Arc gap is distance between the electrode and workpiece during the process of EDM. It may be called as spark gap. Spark gap can be maintained by servo system.

Diameter of electrode (D): It is the 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 – It is a clearance per side between the electrode and the workpiece after the marching operation.

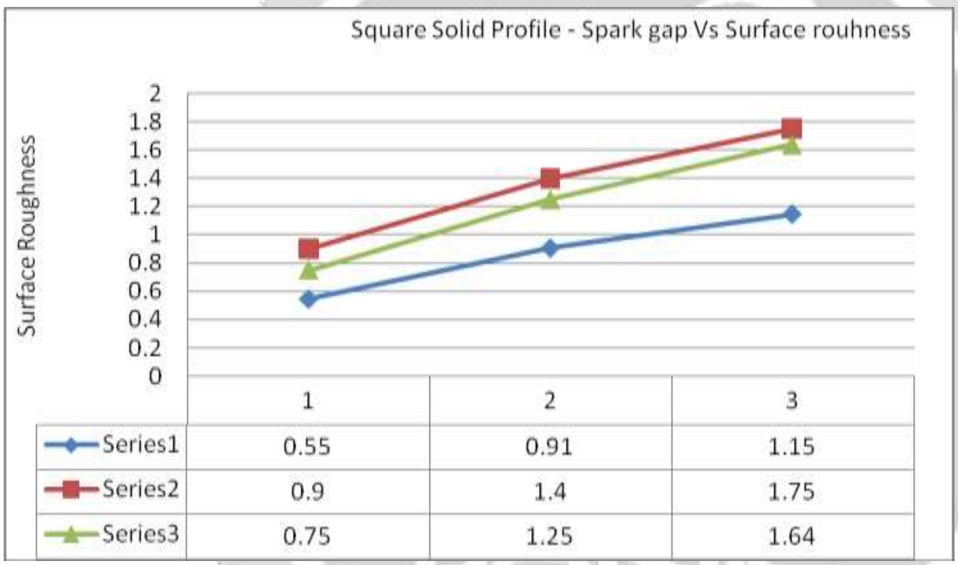
Electrode Specification

Electrode type	HK - 1	HK - 2	HK - 75
Size (mm)	311x622x 1245	311x622x 622	311x622x 622
Sp. gravity	1.85	1.82	1.82
Sp. Resistance (µΩm)	11	13.5	16.5
Flexural Strength (Mpa)	50	63.7	65.7
Shore Hardness	58	64	72
Avg. grain size (µm)	11	7	4
Surface finish (VDI)	30	24	20

4. CONCLUSIONS

4.1 Table 1: Square Solid profile graphite electrode trial analysis report

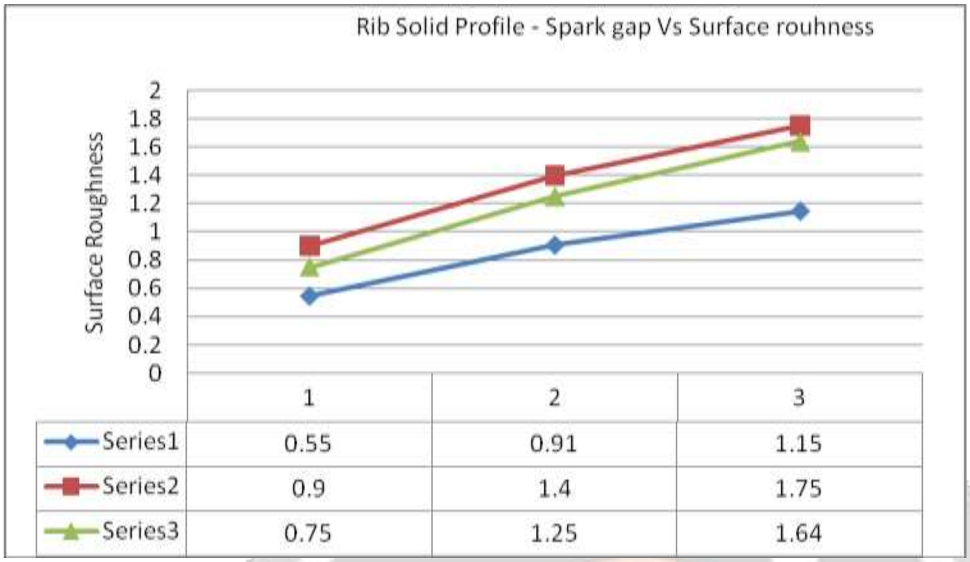
Square Solid Profile Electrode Type	Spark Gap	Surface Roughness
HK 1	0.1	0.8
	0.2	1.3
	0.3	1.69
HK 2	0.1	0.95
	0.2	1.45
	0.3	1.8
HK 75	0.1	0.7
	0.2	0.96
	0.3	1.2



Graph 1: Square Solid profile graphite electrode Surface roughness Vs Spark gap.

4.2 Table 2: Rib Solid profile graphite electrode trial analysis report.

Rib Solid Profile Electrode Type	Spark Gap	Surface Roughness
HK 1	0.1	0.95
	0.2	1.35
	0.3	1.71
HK 2	0.1	0.75
	0.2	0.9
	0.3	1.35
HK 75	0.1	0.65
	0.2	0.8
	0.3	1.25

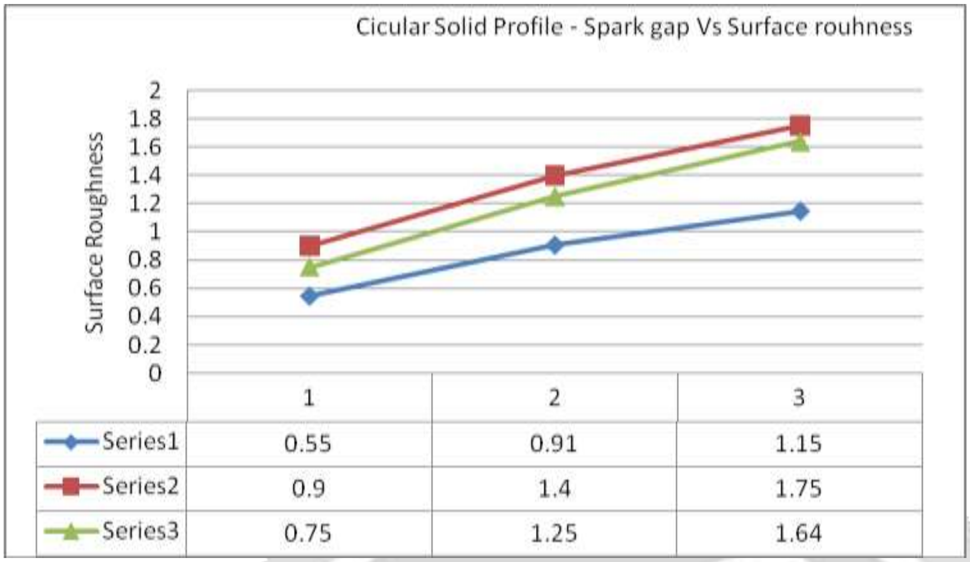


Graph 2: Rib Solid profile graphite electrode Surface roughness Vs Spark gap.

4.3 Table 3: Circular Solid profile graphite electrode trial analysis report.

Circular Solid Profile Electrode Type	Spark Gap	Surface Roughness
HK 1	0.1	0.75
	0.2	1.25
	0.3	1.64
HK 2	0.1	0.9
	0.2	1.4
	0.3	1.75
HK 75	0.1	0.55
	0.2	0.91
	0.3	1.15

Graph 3 Circular Solid profile graphite electrode Surface roughness Vs Spark gap.



In the current experiment by keeping all the parameter constant except spark gap and observed its effect on surface roughness of the workpiece material.

As shown in table 1 the spark gap in case of square electrode is increased by 0.1 mm in each reading and the value of surface roughness varies with the gap.

In table 2 the spark gap in case of rib section electrode is increased by 0.06 to 0.07 in each reading and the value of surface roughness varies with gap.

Thus, from the readings and graphs it is clear that, the surface roughness is directly proportional to the value of spark gap. Hence high grade of surface finish can achieve by reducing spark gap.

5. REFERENCES

1) Spedding, T. A., Wang, Z.Q. (1997), "Parametric optimization and surface characterization of wire electrical discharge machining process", Precision Engineering, 20(1), 5-15.

2) Spedding, T. A., Wang, Z.Q. (1997), "Study on modeling of wire EDM process", Journal of Materials Processing Technology, 69, 8- 28.

3) Scott, D., Boyina, S., Rajurkar, K.P. (1991), "Analysis and optimization of Parameter Combination in Wire Electrical Discharge Machining", International Journal of Production Research, 29, 2189-2207.

4) Tarng, Y. S., Ma, S. C., Chung, L. K. (1995), "Determination Of optimal cutting parameters in wire electrical discharge machining", International Journal of Machine Tools and Manufacture, 35, 1693-170

5) Yan, M.T., Liao, Y.S., Chang, C.C. (2001), "On-line estimation of workpiece height by using neural networks and hierarchical adaptive control of EDM", International Journal of Advanced Manufacturing Technology, 18, 884–891.