EVALUATION AN COMPARATIVE DESCRIBING THE OPITMIZATION OF INPUT MACHINING ATTRIBUTE IN MACHINING

Akhilesh Pandey [1], Dr.Dhananjay Yadav[2],
[1] Research Scholar, ME Dept. , SSSUTMS Sehore, Madhya Pradesh, India
[2] Professor, ME Dept. , SSSUTMS Sehore , Madhya Pradesh, India

ABSTRACT

The present scenario is the advancement of manufacturing industry, and it requires for alloy substances having high level hardness, impact resistance and toughness. The EDM is used in specific cutting complex contours which are complex to machine using traditional machining methods. It is a non-touching non-regular machining method which is used for better quality of product which is complex to achieve by using of contacting EDM processes. The current study on EDM is performed on EN-24and EN-42 with copper as electrode to establish the influence and compare the process factors on material removal rate, tool wear rate and surface roughness. The experimental outcomes resulted that the material removal rate, tool wear rate and surface roughness are majorly effected by peak current

Keyword : - *EDM.Machining,Cooloing*

1. INTRODUCTION

Electro Discharge Machining (EDM) process is generally an electrical-warm non-conventional material machining technique, which uses electrical energy to produce electrical spark and the material evacuation predominantly happens due to erosion caused by the heat energy of the spark.
EDM are generally applied to perform machining operation on hard substance which are not easy to machine and have more strength and are temperature contrary alloys. EDM may also be used for machining complex design in short batches or for on job-shop orient. Experimental substance which should be machined in EDM must be conductor of electricity

1.2 EDM Process

In EDM, generally a potential drop is tried across the electrode and substance. For this process, the tool and the experiment materialboth must good conductor of electricity and tool and working substance are submerged in a insulating environment to enhance the effectiveness of the process. Normally kerosene or deionizer water is providefor dielectric environmentbut in industries EDM oil is used. A spark clearance is occur in middle both of the electrode and the experimental substance. On Depending the provided potential drop across the electrodes and the clearance among the tool and work piece, there establishes an electric area. The working tool is attached to the minus polaritywhile the work substance is attached to plus polarity. When the electricity is supplied a field is produced, the unbounded electrons present upon the surface of the workingtool are aimed to electrostatic forces. If work task or the catching energy of the negative charge is less, electrons excitedtransferred from the tool (consider it would be attached with the minus polarity). Thistype of emission of negative chargeisknown as cold emission. The cold negative charge transferred and accelerate towards the job through the dielectric environment.. As the electrons obtain speed and energy, they start to transfer in direction of the work, there would be movement between the negative charge and insulating particles. Such movement result in formation of ion of the dielectric molecule based on the ionization energy of the non conductive molecule and the energy stored in the negative charge. Thus, negative charge get accelerated, more positive charge and electrons will generate a movement. Due to this increasing the constriction of negative charge and ions in the insulatingamong theelectrode and the work at the plasma clearance. The concentration would becomemore high that issue existing in that region known as “plasma”. There will be very less electrical contrary of such plasma channel.

Suddenly more electrons will transferredfrom electrode to work and charge from work to electrode. This is the avalanche movement of negative charge molecule and during such walking of negative charge and ions,it is seen by eye like spark. Here electrical energy is removed as spark in form of thermal energy.

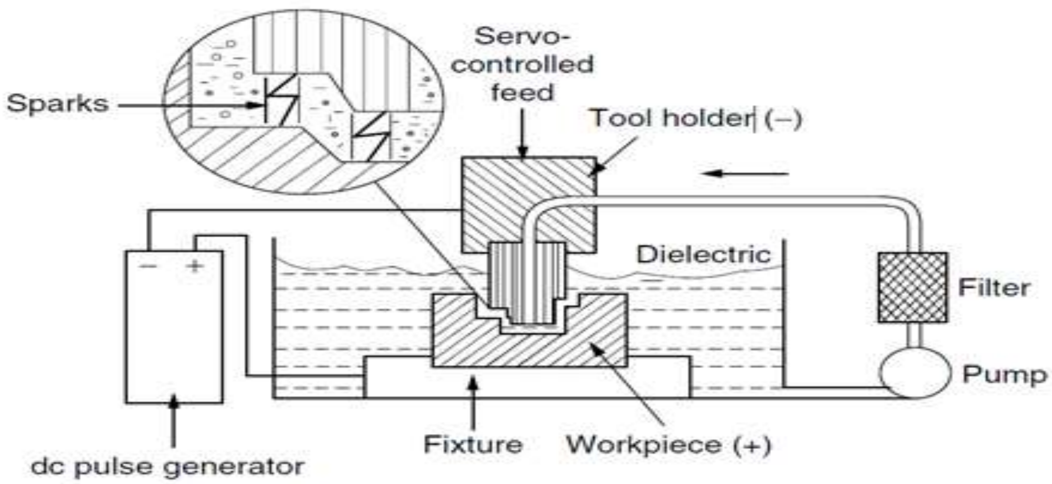

Figure 1.1 EDM Process

1.2 Conventional EDM

In the EDM process, continuous electric sparks are produced to machine the experimental substance, which acquires the shape different to that of the cutting electrode. The electrode and the experimental substance are both drown in a dielectric fluid to make the process more effective. A servomechanism is used to maintains a gap of low thickness between the tool and the work piece,resisting them from touching each other. This is called spark gap.
In EDM die-sink machining, a relatively soft copper or graphite electrode is used to machine hard material.The EDM process produces a cavity which is little bitlargerthan the feature of electrode because of the overcut or enlargement.

1.3 Wire EDM

The wire-cut EDM is aelectro discharge machine which useselectrode in form of wire togenerate thewanted contour or shape. It do not require a specific form of electrode, but it uses acontinuously traveling vertical electrode in form of wire in presence of tension as the electrode. In wire EDM process electrode is used about a thickness asminimumas a diameter of needle which produces the shape required.

1. 4 Dielectric Fluids - Conventional EDM

During the process EDM, the experimental substance and the electrode are drownin the nonconductive fluid, which is an insulator of electricity that provides a medium for controlled discharge of sparks. The dielectric fluid provides a means of flushing when pumped through the spark gap. This removes suspended debris particlesof work piece material and electrode from the spark gap.

1.5 The Servo Mechanism

Both of wire cut EDM and die-sinking EDM machines are equipped with a servo control mechanism which automatically maintains a constant spark clearance among the tool and the work piece. It is an important aspect for both machine types that there is no physical attachment between the electrode and the experimental substance, otherwise sparking may damage the work piece and the wire could break. The servomechanism serves the purpose of advancing the electrode into the work piece as the operation progresses and also senses the work-tool gap and controls it to maintain a proper spark gap which is necessary for a successful machining operation.
1.8Electrode Material
Electrode material used in the machining process that it have capacity of less tool wear when anode ion impact on tool.

Accordingly the climate danger will be few by fitting or appropriately picking its characteristics or notwithstanding the temperature increments, there would be less dissolving. Further, the dieted tempera vice ought to be effortlessly functional as perplexing form geometric figure are good machined in non conventional EDM.

2. LITERATURE REVIEW

D. K. Ojha et al. [1] conducted analysis with Taguchi approach and revealed that current significantly influences MRR, Dimensional Tolerance and surface roughness whereas TWR is mostly influenced by flow rate of the dielectric fluid used.

M M Sari et al. [2] by their experimental investigation foun that carbon nano-tubes give better surface finish as compared to the traditional EDM process. The thickness of recast layer is observed to be smaller when carbon nano-tubes are used. Tool Wear Rate and Material Removal Rate are enhanced and heat can be effectively absorbed by the carbon nano-tubes, if optimum machining parameters are set.

DeepuP.Nairet al. [3]conducted an experimental investigation for surface characteristics of M300 Steel and concluded that the parameter current was the most effective for surface roughness followed by the voltage and pulse on time. Another investigation conducted by

George et al. [4]to optimize the machining parameters, according to their relative significance, gap voltage, peak current were the main influencing parameters for the performance measures.

S. Ben Salem et al.[5]conducted experiments and found that a fewer number of experiments is required to optimize the surface roughness and it was found that the current intensity is the major dominating parameter for surface roughness.

In a research conducted by

V. Chandrasekaran et al. [6]through their investigation revealed that the MRR is highest for all compositions. As the percentage of nickel increases the thermal conductivity of the composition increases since the nickel material is easily removed from the surface of the parent material. Hence the MRR increases with increase in the percentage of nickel. It is also found that the surface roughness increases with current and flushing pressure and doesn’t depend on percentage of Ni. The optimum Ra values decreased with increasing electrode rotation.

Francesco Modica et al. [7]investigation throw light on relation between the material removal technique, identified during the evaluation of MRR and TWR. The selected parameters were voltage, discharge current, pulse width and frequency,so as to experimentally quantify the waste of material produced and optimize the technological process in order to decrease it.

Kumar Sandeep et al. [8]investigated surface quality and metal removal rate which are the utmost important factors for selecting the optimum condition of processes and also the economical aspects. The research reported the trend of research in EDM.

Lau et al. [9] established the feasibility of using Electrical Discharge Machining for machining carbon fiber composite materials. Parameters selected were currents, pulse durations, tool materials and polarities and it concluded that it is totally feasible for EDM to machine carbon fiber composite. Copper is found to be better than graphite electrodes for tool wear and surface finish. They suggested that positive polarity must be opted for machining carbon fiber composite materials so as to achieve low tool wear ratio.

Navdeep Malhotra et al. [10]conducted experiments on EN-31 and found that surface roughness of EN-31 Die Steel was majorly influenced by the current and pulse on time. Lower the value of current better the surface finish and same effect in case of pulse on time.

H.T. Lee et al. [11] found the relationship between the EDM parameters and surface cracks formation on the basis of discharge current and pulse on time parameters for EDM machining of D2 and H13 tool steel and concluded that surface roughness increases when pulse on time and pulse current increases. He also found that increased pulse-on duration will increase both the average white layer thickness and also the induced stress which promote crack formation.

Pravin R. Kubade et al. [12]studied the dominance of EDM parameters on tool wear rate, material removal rate and radial overcut of AISI D3 using acopper electrode. The results revealed that MRR is mainly dominated by peak current while other factors were less effective. Tool wear rate is majorly influenced by both peak current and pulse on time, while duty cycle and gap voltage were very less effective on it. Peak currentalso has the major influence on radial overcut followed by duty cycle and pulse on time while almost very less influence was observed by gap voltage.

Harpuneet et al. [13]Investigating the Effect of Copper Chromium and Aluminum Electrodes on EN-31 Die Steel and concluded that Metal removal rate is better for copper chromium except at 6A current when compared to brass electrode. Maximum MRR was achieved at 12A for both brass and copper chromium.

Singh et al. [14]through their study found that the negative polarity of tool is esential for minimizing the surface roughness and increasing the pulse on time produces more rough surfaces. Addition of powder particles in dielectric fluid will decreases the level surface roughness of EDMed specimen while higher peak currents offers more rough surfaces.

Ojha et al. [15]reviewed for MRR improvement in Electrical Discharge Machining and found that the basis of controlling and improving MRR mostly relies on empirical methods. This is majorly because of the stochastic nature of the sparking phenomenon that involves both electrical and non-electrical process parameters. They also concluded that MRR has been getting overwhelming research potential from the invention of EDM process, and it requires more experimentation in future.

3.1 MATERIALS AND METHODS

The following steps are undertaken while using formulation of parameter of the Taguchi principle for optimizing a process with many performance properties:

- Identifying the performance properties and then selecting the process attribute to be formulated.
- Identify the number of stages for the operation alternative and accessible similarity among the process alternative.
- Selecting much close taguchi orthogonal array and assigning the operation alternatives to the orthogonal array.
- Conducting the operation on the basis of the orthogonal array.
- Analyzing the operational results by applying ANOVA. and optimal signal to noise ratio methods.
- Selecting the optimal level of process parameters by the S/N ratio and ANOVA.
- Verifying the optimum level process parameters by conducting confirmation experiment.

3.2 PROCEEDURES OF TAGUCHI APPROACH

The brief structure of taguchi Approach is as follows

- Identifying the objective
- Selecting the factors
- Identifying factors which is not in control and running experiment conditions
- Selecting of stagesfor controllable and uncontrollable factors
- Calculating the allDOF (degree of freedom)
- Choosing suitable orthogonal array
- Selecting factors to column
- Executing experiments as per the trial conditions in array
- Analyzing the obtained results
- Confirming the results

3.3 APPLICATION OF S/N RATIO

The change in the product's quality characteristics which is during inspection, in answerable to a alternative identifiedin design of experiment is basically the signal of wanted effect. Although, when experimentsshould be done, there may be numerous external parameters which are not designed into the experiment and mayeffect the outcome of the experiments. Usually the noise factors are these external agentand their influence on the results of the properties of attributes under experiment is known as noise. The signal to noise ratio is the source of measuring the sensitivity of the quality attributeswhich is obtained in a controlled environment, to those external dominating agent (known as noise factors) which are out of control. The fact of S/N ratio was produced in the electrical engineering Area. This approach effectively applied this theory to achieve the optimum level of parameters from the experiments.

3.4 ROLE OF ANOVA

Taguchi approach is used for replacement of full factorial experiment method with a lean, low cost, quicker, partial factorial experiment. Taguchi's approach for the partial factorial is depend on specially developed OA's. Since the partial practical is just a replica of the full setof experiment, the study of the partial experiment must be included byan calculation of the confidence that must take place the results. Study of Variance is routinely used that provides a measure of confidence. This approach does not work does not indirectly analyze the data, but instead determine the difference in data. The confidence is generally measure from difference.

Table 3.1: Process Parameters and their levels

S.No.	Parameters	Units	Level 1	Level 2	Level 3
1	Current	A	2	5	8
2	Pulse-on-time	μsec	20	40	60
3	Pulse duty Factor		5	6	7

Table 3.2: Experimentation L9 Orthogonal Array

S.No.	Ip	Ton	T	M/c Time for EN-24	M/c Time for EN-42
1	2	20	5	8.38	9.32
2	2	40	6	6.5	6.48
3	2	60	7	6.22	5.54
4	5	20	6	2.1	2.05
5	5	40	7	1.38	1.33
6	5	60	5	1.08	1.01
7	8	20	7	3.48	3.47
8	8	40	5	1.04	1.03
9	8	60	6	1	1

4.1EXPERIMENTATAL SETUP

ELECTRONICAEDM machine was used for experimental runs of the samples. The machine is shown in the figureon next page. It is a non-conventional machining method. Basically in EDM, machining is achieved by sparks erosion seen as a chain of breakdown and restoration of the liquid insulating dielectric in-between the electrodes. This machine was provided by Dilawar Engineering Works, Kaiserbagh, Lucknow.

Table 4.1 Technical Specifications of EDM

Sr. No.	Specification	Value
1	Model	ZNC
2	Dielectric Fluid	EDM Oil
3	Input Power Supply	Three phase AC 415 V, 4 wire system,50 Hz
4	Electrode used	Copper
5	H X W X D machine size	1750 X 1060 X 525 mm
6	Maximum Load Lift	750 kg
7	Pulse on time	0.5 to 4000

8	Pulse frequency	0.1 to 500
9	Main Table Traverse (X,Y)	1100 X 650 mm

4.2 CALCULATION FOR MRR

For estimation of MRR, first We estimated the weight of specimen before and after each running operation by electronic weight measurement machine. The difference of weight gives the amount of material transferred during machining which is noted down as weight loss. Time of machining is also noted down for each run to calculate MRR. Material transfer rate is a capacity to measure that gives the productivity of process. Material removal rate can be estimated by dividing loss in weight of work piece (in grams) to the product of work piece density (gm/cc) and the time consume during machining. Using the relation we can get the values of MRR

Material Removal Rate= (Workpiece weight loss (gm)×1000)/(Density of workpiece (gm/cc)×Machining Time(min))

4.3 Calculation of S/N ratio for MRR

The S/N ratio, which condenses the multiple data points within a trial, depends on the type of characteristics being evaluated. For calculation of S/N ratio for material removal rate LARGER IS BETTER condition is opted. The equation for the calculation of S/N ratio for material removal rate is:

$$S/N_{LB} = -10 \log \left(\Sigma \left(1/y_i^2\right) \right)$$

Table 4.2 Estimation of S/N ratio for MRR

S.No	MRR(mm³/min) of EN-24	S/N ratio (EN-24)	MRR(mm³/min) of EN-42	S/N ratio (EN-42)
1	0.459	-6.7637	0.401	-7.9371
2	0.592	-4.5536	0.636	-3.9309
3	0.824	-1.6815	0.863	-1.2798
4	1.832	5.2585	1.835	5.2727
5	2.787	8.9027	2.385	7.5498
6	4.748	13.5302	3.635	11.2101
7	1.474	3.3699	1.467	3.3286
8	3.698	11.3593	2.545	8.1138
9	5.128	14.1990	5.089	14.1326

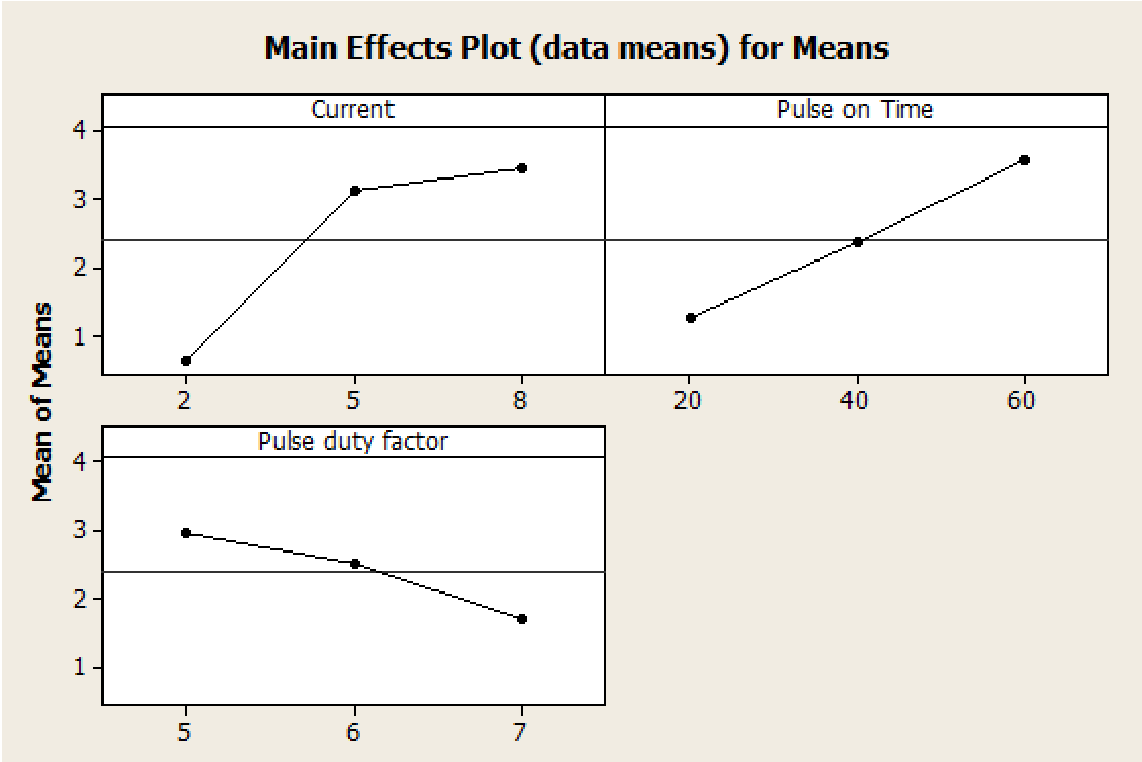

Figure 4.1: Main effect plot for MRR for EN-24

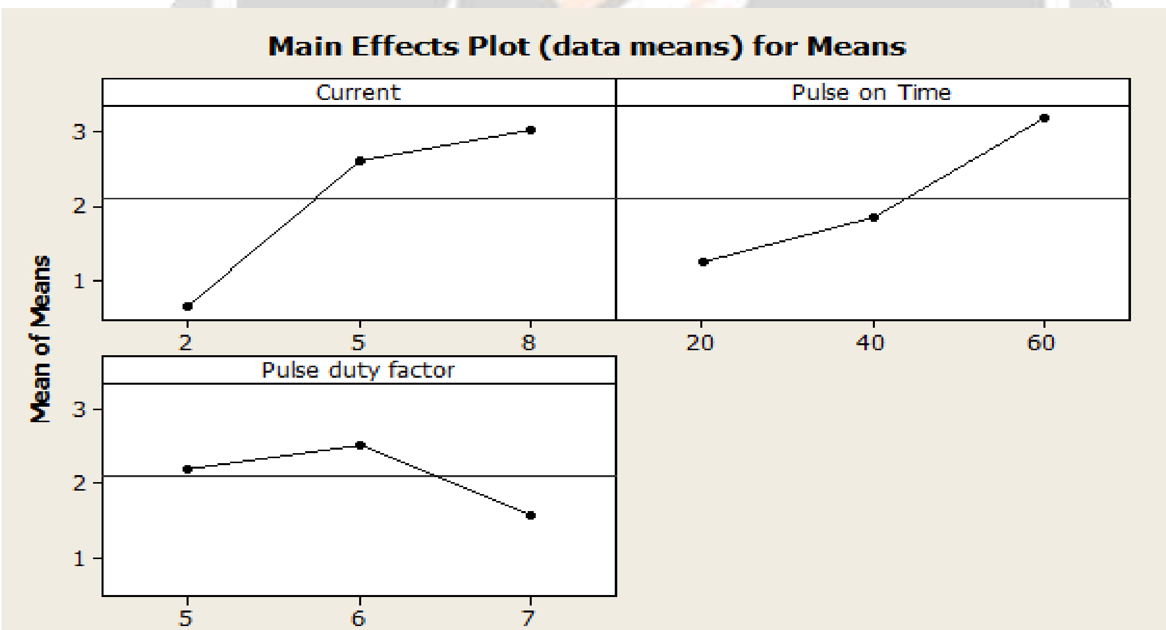

Figure 4.2: Main effect plot for MRR for EN-42

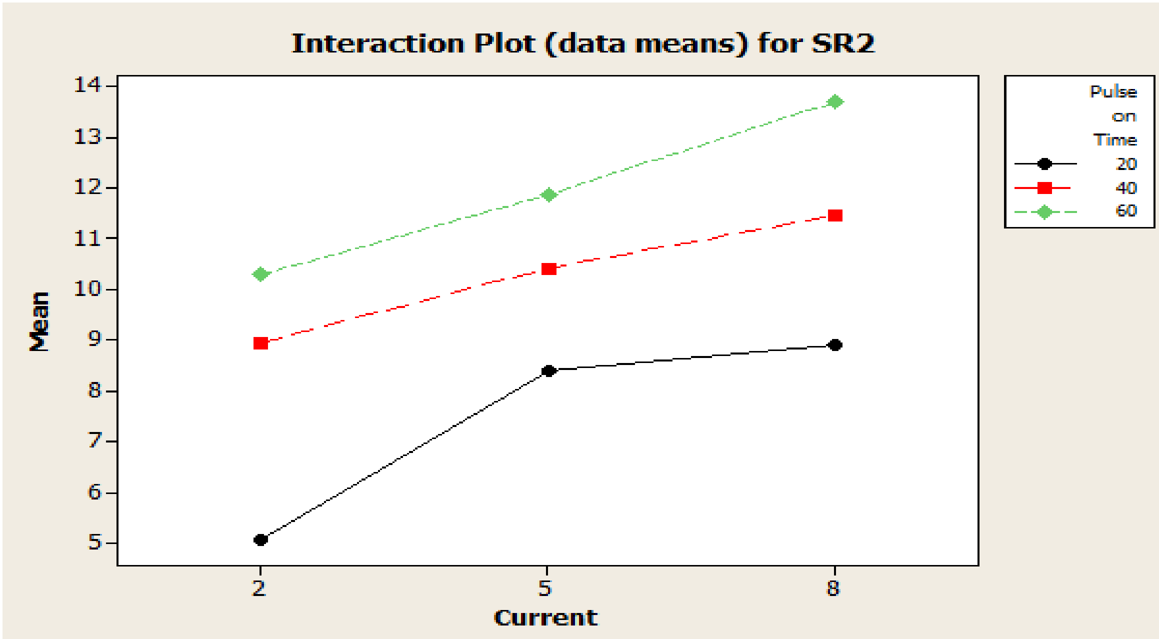

Figure 4.3: Interaction plot for parameters and SR of EN-24

5. 1 CONCLUSIONS

- Both Ip and Ton are the major influencing alternatives and have direct influence on MRR for both materials.
- MRR shows and increasing trend with Ip and Ton for both EN-24 and EN-42 because at top level of Ip and Ton, the intensity of spark is high and hence large amount of material transfer from upper layer of workpiece is noticed..
- Ip and Ton approximately similar influence on MRR for both the materials.
- Pulse duty factor is found to be the least influencing parameter for MRR in both the cases
- Both Ip and Ton are the major influencing alternatives and have direct influence on TWR for both materials. It is seen that TWR follows an increasing trend with pulse on time for both EN-24 and EN-42. This is because at top level of pulse on time, the intensity of spark is high. This produce in outcome in form of large transfer of material from the surface of the tool and hence higher MRR is obtained at higher level of Ton.

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