EXPERIMENTAL ANALYSIS AND OPTIMIZTION OF PROCESS PARAMETER OF EDM FOR EN47

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ABSTRACT: **The aims of this research work to identify parameters of EN47 spring steel material on EDM machine by applying Copper, Graphite, & Tungsten Carbide Coated Copper electrodes. And pursue the influence of four design factors pulse on (Ton), pulse off (Ton), current (I), and voltage (V), which are the most connected parameters to be controlled by the EDM process over machining specifications such as material removal rate (MRR) and tool wear rate (TWR) and characteristics of surface integrity such as average surface roughness (Ra) and also to quantify them.**
In this paper the experiments have been conducted by using Taguchi Methodology with the DOE techniques and developed a mathematical model to predict material removal rate & average surface roughness using input parameters such as pulse on(Ton), pulse off (Toff) , current (I), voltage (V).

Keywords: **EDM, MRR, TWR, Surface Roughness.**

INTRODUCTION:

Now - a - days due to need for high strength materials in sophisticated industries and patronaged by the advances in the field of Materials science, there has been an increase in the availability and use of different machining of materials. EDM is one such process which is widely used to machine electrically conductive materials. EDM is a thermo-electric process in which material remotion takes place through the process of controlled spark generation. It is one of the most popular non-traditional machining processes being used in the industries. [1]

EDM is a thermo-electric process in which material removal takes place through the process of controlled spark generation. It is one of the most popular non-traditional machining processes being used in the industries. EDM is generally used for mould and Die making industry and in manufacturing automotive, aerospace and surgical components. Since there is no mechanical contact between the tool and work piece, therefore frail components can be machined without the risk of damage. [1]

The Surface Roughness plays a very important role for any manufacturing work in order to identify the extent of the surface finish with reference to time and cost. A number of experimental works has been carried out till date for the investigation of the effect of the different parameters over the surface roughness value for different materials. [2]

PRINCIPLEOFEDM

Inthisprocessthemetalisremoving fromtheworkpieceduetoerosioncaseby rapidlyrecurringsparkdischargetaking placebetweenthetoolandworkpiece.Show the mechanicalsetupandelectricalsetupandelectrical circuitforelectrodischargemachining.A thin gap about0.025mmismaintainedbetweenthetoolandworkpiecebyaservosystem shown in fig.1Both tool and work piece are submerged in a dielectric fluid .Kerosene/EDMoil/deionizedwateris verycommon type of liquid dielectric although gaseousdielectricsarealsousedincertaincases.

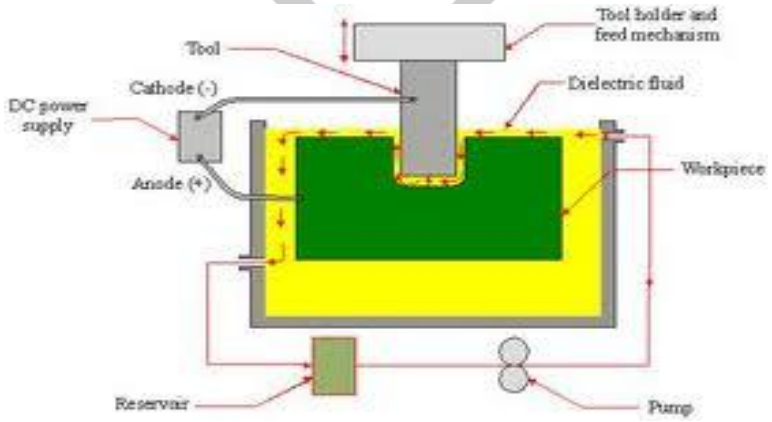


Fig.1 setupof Electricdischargemachining

The tool is ofcathode andworkpieceisanode. When the voltage acrossthegapbecomessufficientlyhighitdischarges through thegapintheformofthesparkin intervaloffrom10ofmicroseconds.

EXPERIMENTAL SET-UP

A. **Selection of the Work Material:** EN 47 Spring Steel of 160 mm dia and 12mm thickness.

Electro Discharge Machining is able to do machining of hard material component such as heat treated tool steels, composites, super alloys, ceramics, carbides, heat resistant steels etc with Electro Discharge Machining process. EN 47 steel is medium tensile steel which is supplied in the black hot rolled or it can be in normalized condition..

EN 47 steel has good weld ability and machinability in normalized as well as the hot rolled condition. EN 47 is having huge industrial applications such as gear manufacturing, Leaf spring, train Shockers which requiring more wear resistance and strength.

B. Selection of the Electrode Material:

1) Copper :Size : 10mm dia , 1 Inch length
2) Graphite : Size: Size : 10mm dia , 1 Inch length
3) Tungsten Carbide Coated Copper: Size: 10mm dia, 1 Inch length.
4)

Tungsten Carbide Powder	
Elements	**Percentage %**
Boron	3
Carbon	0.8
Chromium	15
Iron	3.5
Nickel	56.4
Tungsten	17.3
Silicon	4

Table no. 3.1 Specification of Electrode

Fig.2 EDM Electrode

It is capable of machining geometrically complex or hard material components, super alloys,ceramics,carbides,heatresistant steelsetc. There are different types of tool material are using the EDM method. And the tool steel containscarbonandalloysteelsthatareparticularlywell-suitedtobemadeinto tools.

Various electrode materials used are graphite, copper, copper graphite, brass, zinc alloys, steel, copper tungsten, silver tungsten, tungsten etc., classification of different electrode materials used in Electro Discharge Machining Process. Copper is selected as a tool material of present experimental work.

EXPERIMENTAL WORK

This experimental setup is used for machining of different materials regardless of their hardness. For this experiment the whole work will be carried out on Electric Discharge Machine, model Joemars Machine (die-sinking type) with servo-head (constant gap). Experiments will be conducted using copper and graphite electrodes.

The EDM consists of following major parts:

a) Dielectric reservoir, pump and circulation system.
b) Power generator and control unit.
c) Working tank with work holding device.
d) X-Y table accommodating the working table.
e) The tool holder.
f) The servo system to feed the tool.

Machine Specification

Model: Joemars AZ 50 Machine

Table no. 1. Specification of JOEMARS AZ50 EDM machine

SPECIFICATION	SIZE	UNIT
X TRAVEL	200	Mm
Y TRAVEL	350	Mm
Z TRAVEL	160	Mm
TANK CAPACITY	200	Ltrs
MOTOR FOR PUMP	1	H.P.
POSITIONING RESOLUTION	1	micron

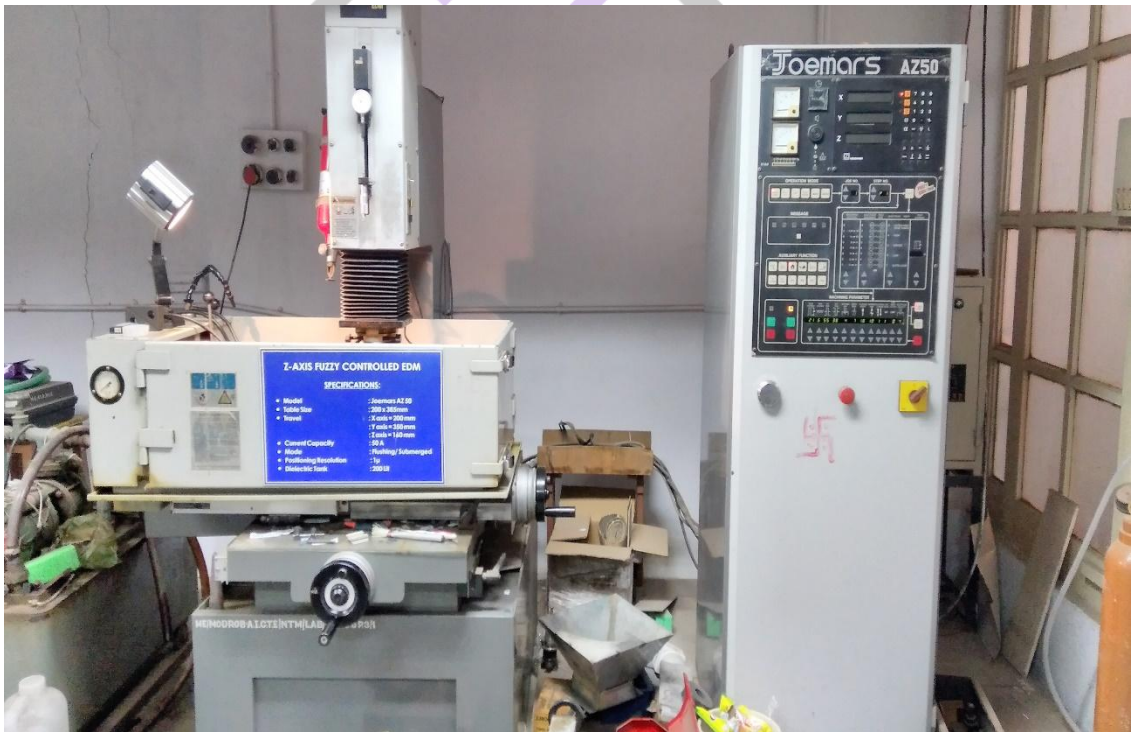


Fig.3 EDM Machine setup

PLAN OF EXPERIMENT

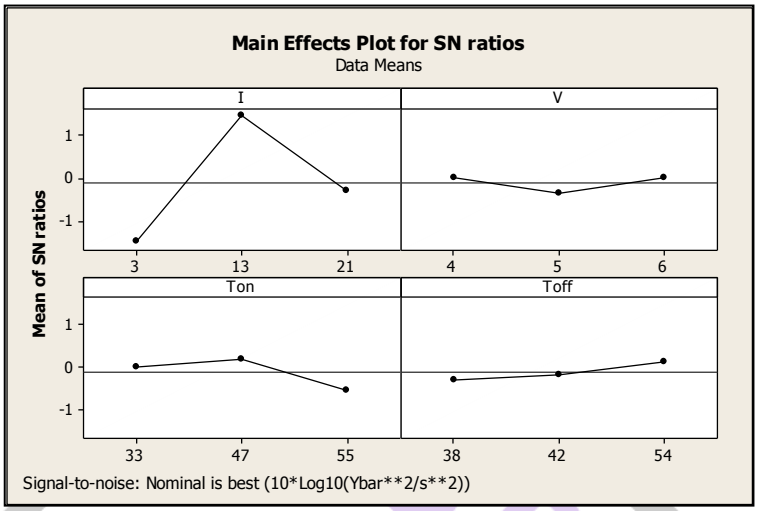
Through this dissertation, effect of different process parameters such as Pulse Duration (Ton) & (Toff), Discharge current (Ip) & Spark Gap (Vg) their effect on machine response characteristics such as Material Removal Rate, Tool Wear Rate and Surface Rouhness on EN 47 Spring Steel work piece material using copper, graphite & tungsten carbide coated copper electrode will be investigated.

Table no. 2. Processing Parameters and Machine Responses

Input parameter	Output parameter
Discharge Current	Material Removal Rate (mm^3/min)
Spark Gap (Vg)	Tool Wear Rate (mm^3/min)

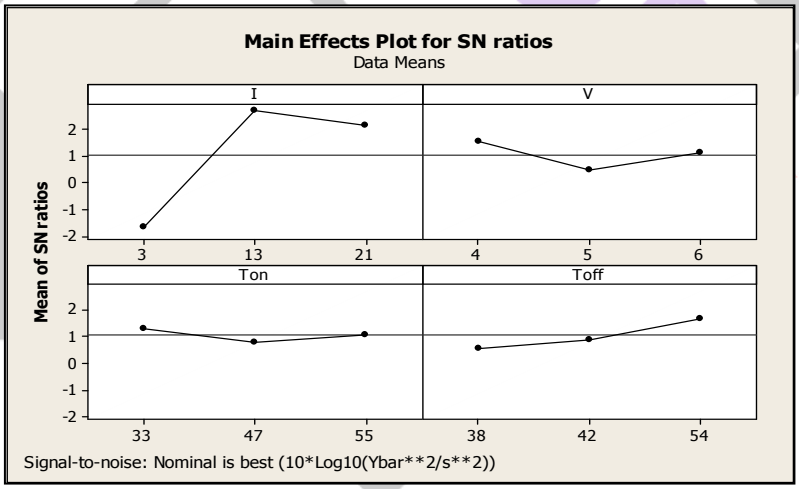
Pulse Duration (Ton)	Surface Roughness (µm)
Pulse Duration (Toff)	

Analysis of **Observation OfEn 47 By Copper Electrode:**

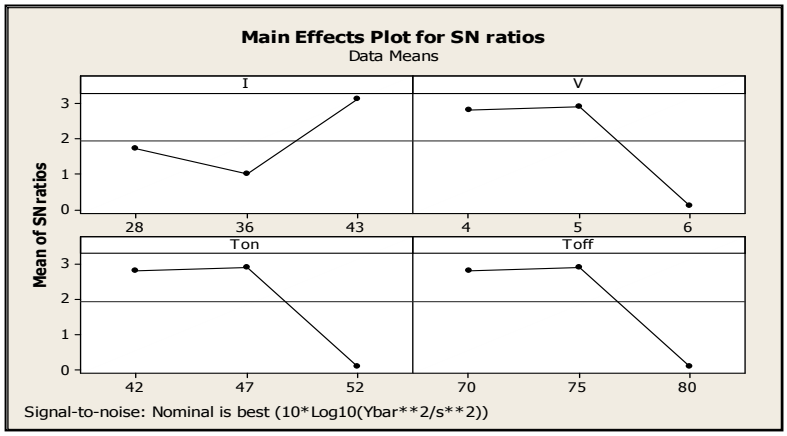


Nominal is best (10*Log10(Ybar**2/s**2))

Analysis of **Observation OfEn 47 By Graphite Electrode:**



Analysis of **Observation OfEn 47 By Tungsten Coated Copper Electrode:**



Optimization Of Grey Relational Analysis:

SR NO.	Electrode	MRR (mm^3/min)	TWR (mm^3/min)	Ra (µm)	Grey Relational Grade	Rank
1	Copper	32.511	4.058	9.12	0.5190	1
2	Graphite	12.352	7.005	6.208	0.4308	1
3	Tungsten Carbide Copper	8.205	3.018	12.125	0.3654	1

Conclusion:

- From the experimentation we found that the Copper Electrode is having higher material removal rate (MRR) 40.49 mm^3/min than of the graphite electrode MRR is 30.457 mm^3/min& for tungsten carbide coated copper electrode MRR is 13.629 mm^3/min.
- Low Tool wear rate of Graphite & Copper Electrode, TWR of both the electrode are same are 0.029 mm^3/min.
- Machining from the Graphite electrode obtain better Surface Roughness (Ra) is 2.25 µm, than the Copper (Ra is 2.33 µm) & Tungsten Carbide Coated Copper Electrode (Ra is 7.81 µm).
- Based on the experiment, the effect of selected input parameter on the output parameter like
- MRR, TWR, Ra are studied.

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