

International Multidisciplinary  
Research Journal

*Indian Streams  
Research Journal*

Executive Editor  
Ashok Yakkaldevi

Editor-in-Chief  
H.N.Jagtap

---

## Welcome to ISRJ

RNI MAHMUL/2011/38595

ISSN No.2230-7850

Indian Streams Research Journal is a multidisciplinary research journal, published monthly in English, Hindi & Marathi Language. All research papers submitted to the journal will be double - blind peer reviewed referred by members of the editorial board. Readers will include investigator in universities, research institutes government and industry with research interest in the general subjects.

### International Advisory Board

Flávio de São Pedro Filho  
Federal University of Rondonia, Brazil

Kamani Perera  
Regional Center For Strategic Studies, Sri Lanka

Janaki Sinnasamy  
Librarian, University of Malaya

Romona Mihaila  
Spiru Haret University, Romania

Delia Serbescu  
Spiru Haret University, Bucharest, Romania

Anurag Misra  
DBS College, Kanpur

Titus PopPhD, Partium Christian  
University, Oradea, Romania

Mohammad Hailat  
Dept. of Mathematical Sciences,  
University of South Carolina Aiken

Abdullah Sabbagh  
Engineering Studies, Sydney

Ecaterina Patrascu  
Spiru Haret University, Bucharest

Loredana Bosca  
Spiru Haret University, Romania

Fabricio Moraes de Almeida  
Federal University of Rondonia, Brazil

George - Calin SERITAN  
Faculty of Philosophy and Socio-Political  
Sciences Al. I. Cuza University, Iasi

Hasan Baktir  
English Language and Literature  
Department, Kayseri

Ghayoor Abbas Chotana  
Dept of Chemistry, Lahore University of  
Management Sciences[PK]

Anna Maria Constantinovici  
AL. I. Cuza University, Romania

Ilie Pinteau,  
Spiru Haret University, Romania

Xiaohua Yang  
PhD, USA

.....More

### Editorial Board

Pratap Vyamktrao Naikwade  
ASP College Devrukh, Ratnagiri, MS India Ex - VC. Solapur University, Solapur

R. R. Patil  
Head Geology Department Solapur  
University, Solapur

Rama Bhosale  
Prin. and Jt. Director Higher Education,  
Panvel

Salve R. N.  
Department of Sociology, Shivaji  
University, Kolhapur

Govind P. Shinde  
Bharati Vidyapeeth School of Distance  
Education Center, Navi Mumbai

Chakane Sanjay Dnyaneshwar  
Arts, Science & Commerce College,  
Indapur, Pune

Awadhesh Kumar Shirotriya  
Secretary, Play India Play, Meerut (U.P.)

Iresh Swami  
Ex - VC. Solapur University, Solapur

N.S. Dhaygude  
Ex. Prin. Dayanand College, Solapur

Narendra Kadu  
Jt. Director Higher Education, Pune

K. M. Bhandarkar  
Praful Patel College of Education, Gondia

Sonal Singh  
Vikram University, Ujjain

G. P. Patankar  
S. D. M. Degree College, Honavar, Karnataka

Maj. S. Bakhtiar Choudhary  
Director, Hyderabad AP India.

S. Parvathi Devi  
Ph.D.-University of Allahabad

Sonal Singh,  
Vikram University, Ujjain

Rajendra Shendge  
Director, B.C.U.D. Solapur University,  
Solapur

R. R. Yallickar  
Director Management Institute, Solapur

Umesh Rajderkar  
Head Humanities & Social Science  
YCMOU, Nashik

S. R. Pandya  
Head Education Dept. Mumbai University,  
Mumbai

Alka Darshan Shrivastava  
Shaskiya Snatkottar Mahavidyalaya, Dhar

Rahul Shriram Sudke  
Devi Ahilya Vishwavidyalaya, Indore

S.KANNAN  
Annamalai University, TN

Satish Kumar Kalhotra  
Maulana Azad National Urdu University

**PROCESS PARAMETER OPTIMIZATION IN ELECTRICAL DISCHARGE MACHINING(EDM) FOR MATERIAL REMOVAL RATE(MRR) AND SURFACE ROUGHNESS**



S. M. Rajmane  
M.E Guide, Solapur University, Solapur.

**Short Profile**

S. M. Rajmane is M.E Guide of Solapur University, Solapur.

**Co - Author Details :**

Nitin Vithalrao Shelar  
Student of ME Mechanica II BIGCE Solapur university, solapur.



**ABSTRACT:**

This paper postulates the analysis of an process parameter optimization in electrical discharge machining for material removal rate and surface roughness. I have considered AISI D3 material for experiment and parameters are discharge current,spark on time ,spark off time and spark gap.The Taguchi method is used for Design of experiment. The analysis is done using Minitab software.

**KEYWORDS**

*Material removal rate, surface roughness, Taguchi method.*

## I. INTRODUCTION

Electric discharge machining is a thermo-electric non-traditional machining process. Material is removed from the work piece through localized melting and vaporization of material. Electric sparks are generated between two electrodes when the electrodes are held at a small distance from each other in a dielectric medium and a high potential difference is applied across them. Localized regions of high temperatures are formed due to the sparks occurring between the two electrode surfaces. Work piece material in this localized zone melts and vaporizes. Most of the molten and vaporized material is carried away from the inter-electrode gap by the dielectric flow in the form of debris particles. To prevent excessive heating, electric power is supplied in the form of short pulses. Spark occurs wherever the gap between the tool and the work piece surface is smallest. After material is removed due to a spark, this gap increases and the location of the next spark shifts to a different point on the work piece surface.

## II. OBJECTIVE

The aim of this project is to optimize the machining parameters for MRR and surface roughness in EDM. The objective of this Dissertation is to maximize the material removal rate and minimize surface roughness of EDM. This will reduce the time required for machining the work piece and will improve the surface quality.

It is found that, much work has been done on MRR and SR for various materials like AISI 302, D2, EN but very little work has been done on MRR and SR for AISI D3 material. In this Dissertation work I have considered this material. Also, very few researchers have taken the process parameters as discharge current ( $I_p$ ), spark on time ( $T_{on}$ ), spark off time ( $T_{off}$ ), and spark gap (SG). So I considered these parameters in this Dissertation work to maximize MRR and minimize surface roughness in EDM.

o Taguchi method is used for Design of experiment. The analysis is done using Minitab software.

o Mathematical models are developed for MRR and surface roughness (SR) using regression analysis.

o Optimum values of process parameters are obtained using grey relational analysis method.

## III. EXPERIMENTAL SET UP

For this experiment, the whole work is done by using Electric Discharge Machine, model ELECTRONICA- ELECTRAPULS PS 50ZNC (die-sinking type), having provision of programming in the Z-vertical axis and manually operated X and Y axes. The tool is made of cathode and the work piece as anode. Commercial grade EDM oil (specific gravity= 0.763 kg/ m<sup>3</sup>), freezing point= 94°C) was used as dielectric fluid with lateral flushing (pressure of 0.3 kgf/cm<sup>2</sup>) system for effective flushing of machining debris from working gap region. The pulsed discharge current was applied in various steps in positive mode. The EDM consists of following major parts -

- Dielectric reservoir, pump and circulation system.
- Power generator and control unit.
- Working tank with work holding device.

- X-Y table accommodating the working table.
- The tool holder.
- The servo system to feed the tool.



Fig. Experimental Set up

#### IV. EXPERIMENTAL ANALYSIS

The various levels of the selected parameters are listed in the table no.3.1. I have consulted to Simran Spark Industry, they told the range of the levels of the process parameters which is favorable to the selected work piece materials and dimensions.

Parameters	Notation	Units	Levels			
			1	2	3	4
Discharge current	Ip	Ampere	3	7	11	15
Pulse on time	Ton	μs	40	50	60	70
Pulse off time	Toff	μs	5	6	7	8
Spark gap	SG	mm	0.05	0.1	0.15	0.2

The number of selected parameters and their levels are four so the number of experiments must be 256 (4<sup>4</sup>), but according to Taguchi method the Orthogonal Array for this case is L16.Hence design of experiment provides us the minimum number of experiments required for experimentation purpose.

The material removal rate (MRR) is expressed as the ratio of the difference of weight of the work

piece before and after machining to the machining time and density of the material.

$$MRR = \frac{W_{jb} - W_{ja}}{t \times \rho}$$

Where,

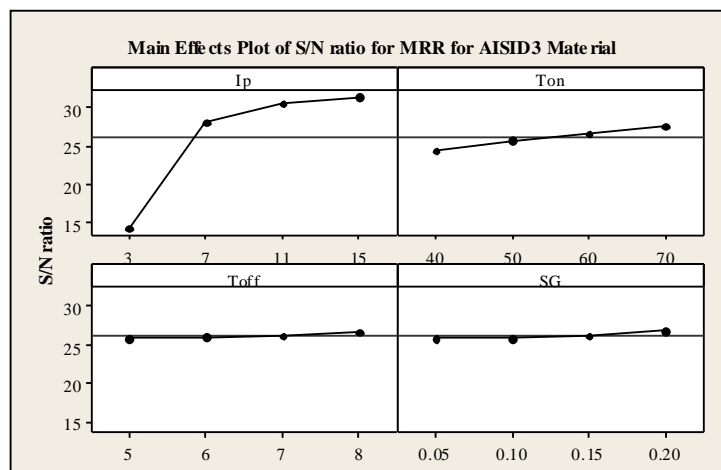
W<sub>jb</sub> = Weight of work piece before machining.

W<sub>ja</sub> = Weight of work piece after machining.

t = Machining time = 5 Minutes

ρ = Density of the tool steel material

From the experimental results, the effects of process parameters on MRR are plotted by using MINITAB software as shown below.



Optimal values of process parameters:

Process parameters	units	Optimum values
Discharge current (Ip)	A	15
Spark on time (Ton)	μs	70
Spark off time (Toff)	μs	8
Spark gap (SG)	mm	0.2

## V. CONCLUSION

In the present study ,the effect of machining parameters on MRR and surface roughness (Ra) for material AISI D3 using the cylindrical shaped copper tool with side flushing system have investigated for EDM process.

The experiments were conducted under various parameters setting of Discharge Current (Ip), Pulse On time (Ton), Pulse Off time (Toff) and Spark gap (SG)

Design of experiment by Taguchi methodology was used for experimentation.

MINITAB software was used for DOE and analysis of the experimental result and the response was validated experimentally.

Discharge current and Spark on time are the most influencing factors.

MRR increases with the increase in discharge current (Ip) and Spark on time.

The choice of the electrical parameters of the EDM process depends largely on the material combination of the electrode and the work piece and the EDM manufactures only supply these parameters for a limited amount of material combinations.

While machining the material AISI D3, the industrialist can directly use the optimum values so that the material removal rate will be maximum and Ra value will be minimum.

## REFERENCE

- [1] Md. Ashikur Rahman Khan, M.M. Rahman<sup>1</sup>, K. Kadirgama<sup>1</sup>, M.A. Maleque and M. Ishak. Prediction Of Surface Roughness Of Ti-6al-4v In Electrical Discharge Machining. A Regression Model Journal of Mechanical Engineering and Sciences (JMES) e-ISSN: 2231-8380; Volume 1, pp. 16-24, December 2011.
- [2] Pichai Janmanee and Apiwat Muttamara. Optimization of Electrical Discharge Machining of Composite 90WC-10Co Base on Taguchi Approach, European Journal of Scientific Research ISSN 1450-216X Vol.64 No.3 (2011), pp. 426-436 © EuroJournals Publishing, Inc. 2011
- [3] S. Murugesan and K. Balamurugan,. Study on EDM of Al-15%SiC MMC using Solid and Multihole Electrodes- A Taguchi Approach,European Journal of Scientific Research ISSN 1450-216X Vol.68 No.2 (2012), pp. 161-171 © EuroJournals Publishing, Inc. 2012
- [4] Prof.B. R. Jadhav and Prof.M.V.Kavade,. Experimental Study Of Ai-Si Alloy Plate On Electric Discharge Machining Using Tungsten Electrode, International Journal of Advanced Engineering Research and Studies E-ISSN2249– 8974

# Publish Research Article

## International Level Multidisciplinary Research Journal For All Subjects

Dear Sir/Mam,

We invite unpublished Research Paper, Summary of Research Project, Theses, Books and Book Review for publication, you will be pleased to know that our journals are

### Associated and Indexed, India

- ★ International Scientific Journal Consortium
- ★ OPEN J-GATE

### Associated and Indexed, USA

- Google Scholar
- EBSCO
- DOAJ
- Index Copernicus
- Publication Index
- Academic Journal Database
- Contemporary Research Index
- Academic Paper Database
- Digital Journals Database
- Current Index to Scholarly Journals
- Elite Scientific Journal Archive
- Directory Of Academic Resources
- Scholar Journal Index
- Recent Science Index
- Scientific Resources Database
- Directory Of Research Journal Indexing

Indian Streams Research Journal  
258/34 Raviwar Peth Solapur-413005, Maharashtra  
Contact-9595359435  
E-Mail-ayisrj@yahoo.in/ayisrj2011@gmail.com  
Website : www.isrj.org