Experimental Investigation of PMEDM on AISI 1045

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Abstract— The EDM is a non-traditional machining process that involved a transient spark discharges through the fluid due to the difference between the electrode and the work piece. In PMEDM process Powder of different material is being suspended in dielectric during machining, numerous research results show that PMEDM process improve the MRR, surface roughness and surface quality. In the present work, it is aimed to perform Powder mixed electro discharge machining of Al 1045 material of specified depth using electrode made from copper material while Graphite powder of varied concentration is suspended in dielectric. Taguchi orthogonal array has been used for present experimentation. Discharge current (Ip), Gap voltage (Vg), Pulse-on time (ton).

Key words: PMEDM, Process Parameter, Response Surface Methodology

I. INTRODUCTION

Electrical Discharge Machining (EDM) is a 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 electrical energy is used to generate electrical 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.

In the 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.

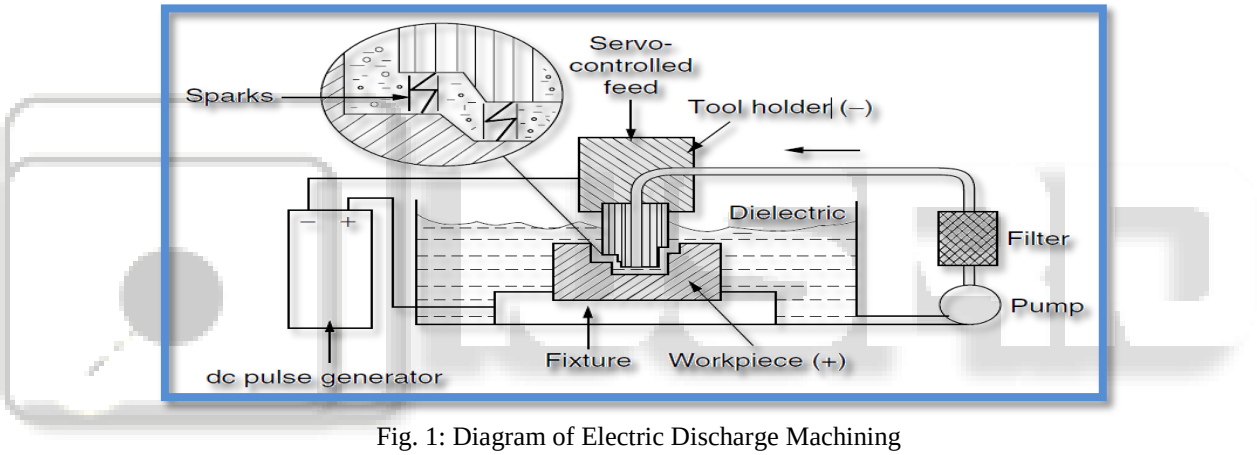

Fig. 1: Diagram of Electric Discharge Machining

Work Piece Material Before Experiment

Copper Electrode

II. DESIGN OF EXPERIMENT

With the help of literature review, findings from the literature and gaps identified from the literature, the present work is focused on the effect of different processing parameters such as Discharge current, gap voltage, Pulse on time on machine response characteristics such as MRR, TWR and Overcut using copper electrode. The (statistical) Design of Experiments (DOE) is an efficient procedure for planning experiments so that the data obtained can be analyses to yield valid and objective conclusions. the structural shape of rim makes a difficulty

A. Phase of Design of Experiment

- Planning
- Screening
- Optimization
- Verification

B. Response Surface Methodology

Response surface methods are used to examine the relationship between one or more response variables and a set of quantitative experimental variables or factors. These methods are often employed after you have identified the

important controllable factors and you want to find the factor setting that optimizes the response.

- MRR, TWR, Overcut
- Duty cycle
- Discharge current
- Diameter of electrode
- Powder Concentration
- Pulse on time
- Voltage
- Pulse of time
- Arc gap

C. EDM Process Parameters and Levels:

Minitab - Untitled

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Session

Results for: Worksheet 2

Box-Behnken Design

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Factors:        3      Replicates:      1
Base runs:     15      Total runs:     15
Base blocks:    1      Total blocks:    1

Center points: 3
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Worksheet 2 ***

	C1	C2	C3	C4	C5	C6	C7
	StdOrder	RunOrder	PtType	Blocks	Discharge Current	Gap Voltage	Pulse On Time
1	14	1	0	1	17	40	240
2	11	2	2	1	17	25	280
3	2	3	2	1	25	25	240
4	6	4	2	1	25	40	200
5	3	5	2	1	9	55	240
6	13	6	0	1	17	40	240
7	15	7	0	1	17	40	240
8	9	8	2	1	17	25	200
9	7	9	2	1	9	40	280
10	12	10	2	1	17	55	280
11	4	11	2	1	25	55	240
12	1	12	2	1	9	25	240
13	8	13	2	1	25	40	280
14	10	14	2	1	17	55	200
15	5	15	2	1	9	40	200

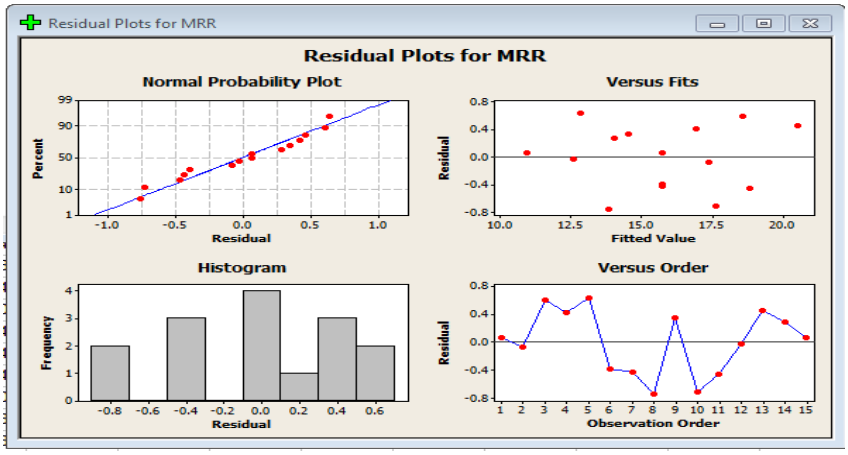
D. Experimental Result:

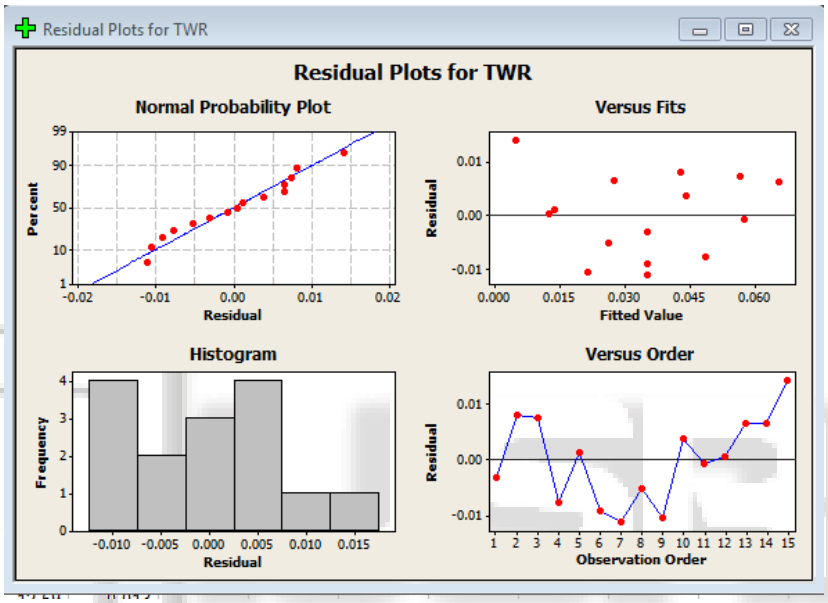
Worksheet 2 ***

→	C5	C6	C7	C8	C9
	Discharge Current	Gap Voltage	Pulse On Time	MRR	TWR
1	17	40	240	15.80	0.032
2	17	25	280	17.32	0.051
3	25	25	240	19.21	0.064
4	25	40	200	17.36	0.041
5	9	55	240	13.50	0.015
6	17	40	240	15.34	0.026
7	17	40	240	15.30	0.024
8	17	25	200	13.07	0.021
9	9	40	280	14.87	0.011
10	17	55	280	16.92	0.048
11	25	55	240	18.38	0.057
12	9	25	240	12.59	0.013
13	25	40	280	20.97	0.072
14	17	55	200	14.35	0.034
15	9	40	200	11.02	0.019

1) Using Minitab 16.0

- Residual Plots For MRR & TWR





III. CONCLUSION

When the current 25A, Pulse on time 280 µs and Gap Voltage 40µs the. Also conclude that the when the pulse on time 200 µs the tool wear rate is better as compare to other machining parameters

As conclused that the machining process of electric discharge machine influence the machine performance

REFERENCES

[1] Kozak, Rajurkar, K.P,—Hybrid machining processes, Evaluation and development‖, Proceedings of 2nd International Conference on Machining and measurement of sculptured surfaces, Krakow, pp.501-536, 2001

[2] Ho, K.H., Newman, S.T.,—State of the art electrical discharge machining (EDM)‖, International Journal of Machine Tools & Manufacture, 2003, Vol. 43, p.p. 1287–1300.

[3] Kansal, H. K., Singh, S., Kumar, P., —Effect of silicon powder mixed EDM on machining rate of AISI D2 die steel‖, Journal of Manufacturing Processes, Vol. 9, part 1, p.p. 13–22, 2007

[4] Luttervelt, C.A., —On the selection of manufacturing methods illustrated by an overview of separation techniques for sheet materials‖, Annals CIRP 38, Vol. 2, p.p. 587, 1989

[5] Konig, W., Dauw, D., Levy, G., Panten, U., —EDM—future step towards the machining of ceramics‖, Annals CIRP 37, Vol. 2, p.p. 623, 1988

[6] Mohri, N., Saito, N., Higashi, M., —A new process of finish machining on free surface by EDM methods‖, Ann. CIRP. 40, Vol. 1, p.p. 207-210, 1991

[7] Kansal, H. K., Singh, S., Kumar, P., —Numerical simulation of powder mixed electricaldischarge machining (PMEDM) using finite element method‖., Mathematical andComputer Modeling,Vol. 47, p.p. 1217–37, 2008

[8] Zhao, W. S., Meng, Q. G., Wang, Z. L.,"The application ofresearch on powder mixed EDM in rough machining‖. J Material Process Technol, Vol. 129, p.p. 30–33, 2002

[9] Furutani, K., Saneto, A., Takezawa, H., Mohri, N., Miyake, H.,—Accretion of titanium carbide by electrical dischargemachining with powder suspended in working fluid‖. PrecisEngg, Vol. 25, p.p. 138–144, 2001

[10] Peças, P., &Henriques, E., —Effect of the powder concentration and dielectric flow in the surface morphology in electrical discharge machining with powder-mixed dielectric (PMD-EDM)‖Int J AdvManufTechnol, Vol. 37, p.p. 1120-1132, 2008

[11] Bhattacharya, A., Batish, A., Singh, G., Singla, V. K.,―Optimal parameter settings for rough and finish machiningof die steels in powder-mixed EDM‖.Int J AdvManufTechnol, Vol. 61, p.p. 537–548, 2012
[12] Klocke, F., Schwade, M., Klink, A., Veselovac, D., ―Analysis of material removal rate and electrode wear in sinking EDM roughing strategies using different graphite grades‖ Procedia CIRP, Vol. 6, pp. 163–167, 2013
[13] Padhee, S., Nayak, N., Panda, S. K., Dhal, P. R., Mahapatra, S. S., ―Multi-objective parametric optimization of powder mixed electro-discharge machining using response surfacemethodology and non-dominated sorting genetic algorithm.‖ Sadhana, Vol. 37, Part 2, p.p. 223–240, 2012
[14] Hu, F. Q., Cao, F. Y., Song, B. Y., Hou, P. J., Zhang, Y., Chen, K., Wei, J. Q., ―Surface properties of SiCp/Al composite by powder-mixed EDM‖,Procedia CIRP, Vol. 6,p.p. 101 – 106, 2013
[15] Ojha, K., Garg, R. K., Singh, K. K., ―Parametric Optimization of PMEDM Process using Chromium Powder Mixed Dielectric and Triangular Shape Electrodes‖, Journal of Minerals & Materials Characterization & Engineering, Vol. 10, No.11, p.p.1087-1102, 2011
[16] Furutani, K., Sato, H., Suzuki, M., ―Influence of electrical conditions on performance of electrical discharge machining with powder suspended in working oilfor titanium carbide deposition process‖, Int J AdvManufTechnol, Vol. 40, p.p. 1093–1101, 2009
[17] Kung, K. Y., Horng, J., Chiang, K., ―Material removal rate and electrode wear ratio studyon the powder mixed electrical discharge machiningof cobalt-bonded tungsten carbide‖, Int J AdvManufTechnol, Vol. 40, p.p. 95–104, 2009
[18] Ozgedik, A., Cogun, C., ―An experimental investigation of tool wear in electrical discharge machining‖, Int J AdvManufTechnol Vol. 27, pp. 488-500, 2006
[19] Singh, S. and Pandey, A., ―Some studies into electrical discharge machining of Nimonic 75 super alloy using rotary copper disk electrode‖, JMEPEG Vol. 22, pp. 1290-1303, 2013
[20] C H CHE HARON, B. MD DEROS, "Investigation on the influence of machining parameters when machining tool steel using EDM". Journal of Material processing technology (2001) 84-87.
[21] C J Luis, I. Puertas, "MRR and EW study on the EDM of Silicon carbide" Journal of Material processing technology (2005) 889-896.
[22] S.H Tomadi, M.A Hussain, "Analysis of influence of EDM Parameters on Surface quality, MRR, EWR on Tungsten carbide". IMECS, (2009).
[23] Y.S.Wong, Y.H. Fuh, "EDM performance of TIC/Copper based Sintered electrode". Material & Design (2001) 669-678.
[24] SAMEH S. HABIB, "Study of the parameters in electrical discharge machining through response surface methodology approach". Applied Mathematical Modelling.33 (2009) 4397–4407
[25] M M RAHMAN, M.A.R.KHAN, "Experimental investigation into EDM of stainless steel 304". Journal of applied sciences (2011) 549-554.
[26] P. Janmanee and A. Muttamara, "Performance of Difference Electrode Materials in Electrical Discharge Machining of Tungsten Carbide". Energy Research Journal 1 (2): 87-90, 2010
[27] HARPUNEET SINGH, "Investigating the Effect of Copper Chromium and Aluminum Electrodes on EN-31 Die Steel on EDM Using Positive Polarity". Proceedings of the World Congress on Engineering 2012 Vol III WCE 2012, July 4 - 6, 2012, London, U.K.

Websites

[28] [w-1] http://en.wikipedia.org/wiki/Electrical_discharge_machining
[29] [w-2] www.sciencedirect.com
[30] [w-3] www.googleschlore.com

Books

[31] [B1] Mishra P.K., Non-conventional machining processes, 3rd reprint, Nasora publishing house, 2005, page No. 1 - 7, 86 - 107.
[32] [B2]M.J. Dudas, Trends in EDM Wire, Am. Machinist (Aug.) (1988)
[33] MINITAB SOFTWARE 16.0

