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Edm technique analysis using tag chi technique And Process Parameters

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Abstract- As a part of EDM, various techniques are put in to improve the material removal rate (MRR), surface roughness (SR) and tool wear rate (TWR) by using different electrode combinations, material thickness with respect to different values of discharge current and pulse on duration. However, machining parameters are stillvery effective while machining.For surface Roughness values [Ra] data, we've found that at high pulse on time and lowdischarge current, the surface roughness is good but as we increase the discharge current to get more MRR, the SR decreases, so we have to set parameters at optimum value to get significant values/throughput of MRR, TWR and SR.

I. INTRODUCTION

Electro Discharge Machining is a non-traditional or non-conventional machining process for machining hard materials that are difficult to machine using regular machining methods. EDM is difficult for machining challenging cavities and curves. Dies and moulds, parts for the aerospace and automotive industries, and surgical components are all types of goods that can be manufactured with high precision and good surface quality utilizing EDM.

EDM is a heat and electricity-based method. When the tool and the work piece move together, sparks form between the tool electrode and the work piece. During this procedure, it does not come into contact with the work piece or the tool electrode. Both the tool electrode and the work piece must be capable of carrying electricity in order for this to be possible. It is referred to as an electrode since it is the cutting tool used in the EDM process. The electrode's form slices the work piece. The electrode and the work piece are linked item. When these two conductors get near enough, there will be a spark. The heat from the spark takes material from the work piece, and this process continues until the shape of the electrode is carved into the work piece. The essential components of an Electric Discharge Machine are electrodes, work piece, dielectric fluid, power supply, and servomechanism. There are various types of electrodes are used in research work such as copper, brass, tungsten etc. The work pieces used for research work are Stainless Steel, Die Steel, Carbide, Inconel etc. Kerosene, EDM oil is generally used as dielectric fluid in EDM. A servomechanism maintains a space of about the thickness of a human hair between the electrode and the work, preventing them from contacting each other.

II.RESEARCH METHODOLOGY

1.Taguchi Design Technique

Dr. Genichi Taguchi is considered to be the leading advocator of vigorous specification design. It involves basically three design optimization criteria, (i) Larger is Better; (ii) Nominal is Better (iii) Smaller is Better. Taguchi technique is a step by step procedure for designing a process or product that aims at optimizing signal to noise ratios as per above three design criterion. Taguchi design analysis give a very successful, effective and powerful design criterion, that can take design criterion least affected by noise or disturbances in the products and services. Taguchi experimental design consideration also called DOE (Design of Experiment). It involves factorial design of two, three, four or five and mixed level design. It finds best parameters which can make design robust least effected by noise or disturbances.

2. MINITAB-19 for Taguchi's Design of Experiment

In this project MINITAB-19 S/w is used for Taguchi's Design of Experiment (DOE). This software helps in analyzing various experimental values obtained in DOE and design data matrix as per designThe objective is to find the optimal design quality which is at a same level and the findings of different controlling parameters to obtained vigorous parameters against disturbances (noise). By utilizing Minitab-19, data for response variable can be evaluated and also S/N ratios are also calculated for optimization of Design Quality Characteristic as per Largest is Better (LB) for finding optimum rate of material removal (MRR), Smaller is Better (SB) for finding optimal criterial for having lower rate of tool wear (TWR) and finally finding S/N ratios for Smaller is Better (SB) optimal Design characteristic for having lowest surface roughness (SR) that is better smooth surface. Also give various plots Area plot and interaction plots.

Table 1 Response Table

Exp. Run	Thickness(mm)	Ip(A)	Ton(µs)	MRR (mm/cm^{3})	TWR (Gm/mt.)	SR (Ra)µm	SR (Rz)µm	Depth of Slot(mm)
R1	6	4	20	5.8992	0.0024	4.299	23.483	0.475
R2	6	4	20	5.8120	0.0002	4.474	22.821	0.275
R3	6	4	20	1.6855	0.0007	5.138	24.971	0.240
R4	6	5	25	2.5573	0.0047	4.660	20.001	0.435
R5	6	5	25	2.5282	0.0009	4.632	24.961	0.500
R6	6	5	25	0.1453	0.0004	5.003	26.651	0.365
R7	6	6	30	0.0291	0.0007	4.342	23.314	0.215
R8	6	6	30	3.8069	0.0002	5.097	23.488	0.180
R9	6	6	30	6.2189	0.0007	5.979	32.635	1.100
R10	8	4	20	2.8479	0.0002	5.041	26.311	0.395
R11	8	4	20	5.4633	0.0013	5.348	27.019	0.980
R12	8	4	20	4.1846	0.0002	5.186	25.717	0.585
R13	8	5	25	1.1915	0.0002	4.918	26.073	0.225
R14	8	5	25	1.1624	0.0004	4.798	25.887	0.155
R15	8	5	25	0.2325	0.0011	5.115	24.221	0.840
R16	8	6	30	6.2189	0.0002	4.446	25.104	0.525
R17	8	6	30	7.5556	0.0004	7.328	30.975	1.490
R18	8	6	30	6.3351	0.0024	6.396	35.779	0.910

1. S/N Analysis of effect on MRR

The ratio S/N is called Signal to Noise ratio. For optimizing (maximizing) the rate of material removal in the machining of HCHCr, for each experimental run from R1 to R18, S/N ratios are evaluated by using equation (4.1) written below. To analyze the data obtained via feedback of output operational variables, Larger is Better (LB) design criteria based on Taguchi technique.

The meaning of different terms used in the above equation are: yi = denotes the data obtained through experimental run, in ith observed experimental value, S/N means ratio of signal to noise (disturbances), η = value of calculated S/N ratio by utilizing above equation, n =1 to 18 is the total number of investigation planned through various run as per Taguchi's DOE. In this project L-18 OA is, planned, so total 18 runs are performed to collect required data Effect on TWR Vs Ip Ton is shown in Figure 1 is called surface Graph and Surface Graph of TWR Vs Ton and Th is shown in Figur 2 below. These plots clearly predict the effect of parametrs on TWR. Graph in Figure 30 shows TWR is mostlty influenced by Ip, and the Ton and least by copper electrode thickness (t).

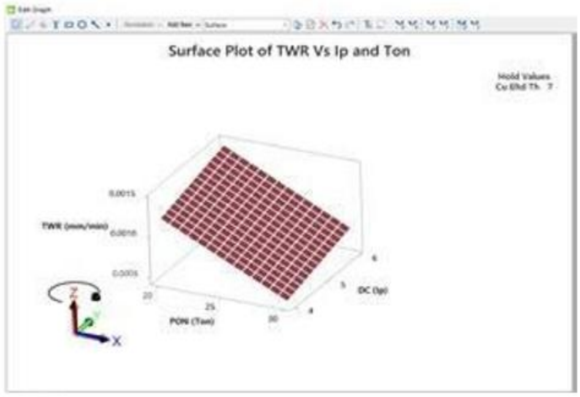

Figure 1: Surface Graph of TWR Vs Ip& Ton

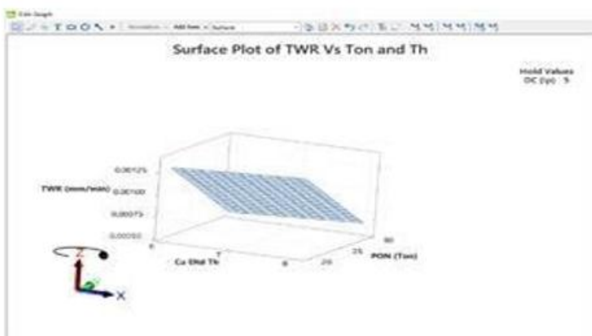

Figure 2 Surface Graph of TWR Vs Ton &Th

2. S/N Analysis of SR (based on [Ra] Values of Surface Roughness)

In the signal /Noise (S/N) analysis of Surface Roughness based on [Ra] values.The S/N ratios for SR are calculated by usign Taguchi Design Criteria based on Smaller is Better (SB), and the equation is used which is written below. To get the optimized value of Surface Roughness as per Smaller is Better Taguchi design criteria, different values of S/N ratios of surface roughness is evaluated and a S/N plot of SR with respect to changing input parameters like thickness (t) of copper tool electrode, pulse on duration (Ton) and Discharge current (Ip) is plotted which clearly depicts that optimal value of SR is 7.328 µm in terms of [Ra] values, when the value of Ton = 30 µs; Ip = 6A and t = 6 mm. This is also confirmed by the ANOVA analysis as results are written in Table No.2

Table 2 ANOVA analysis as results.

[ANOVA]AN anlysis-Of-Variance			Basedon	ForSUURFACEROUGHNESSValues[Ra]			
RegressionEqn. SR	1.42+0.0799Ton+0.497Ip - 0.111(Thickness'x')						
DesignParameters	DOF	Sequential Sum ofSquares	Contribution	Adjusted Sum ofSquares	Adjusted Mean Squares	Fact orF-value	P-value Probability
Regression	3	5.1024	50.71%	5.1024	1.7008	4.8	0.017
Pulseon(Ton) (µs)	1	1.9164	19.05%	1.9164	1.9164	5.41	0.036

Table 3: Calculation of ANOVA for determining S/N ratios for SR

Discg.Curr(Ip) (µs)	1	2.9641	29.46%	2.9641	2.9641	8.37	0.012
CopperElectrode thickness(mm)	1	0.2219	2.21%	0.2219	0.2219	0.63	0.442
Error	14	4.9599	49.29%	4.9599	0.3543		
Total	17	10.0623	100.00%				

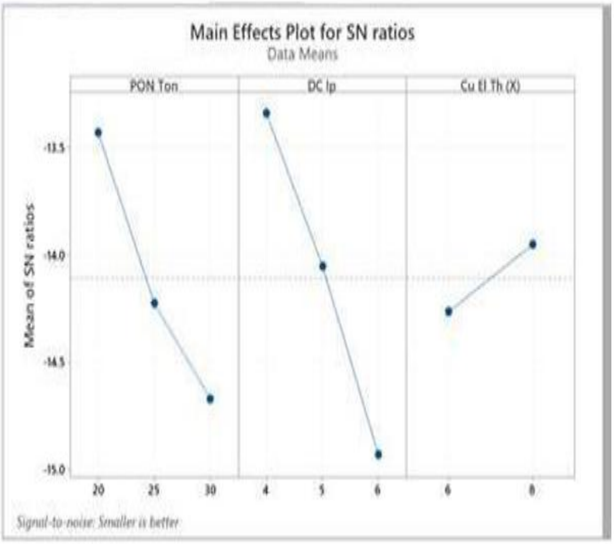

Figure 3: Major aftereffect Graph for SN ratios (SR)

In the Figure 3 above, which is the plot of S/N ratio against Ton, Ip, and Thickness (t). As per S/N ratio Smaller is Better criteria. It is shown that Surface Roughness is better at when the Ip in the range of 5A to 6A and Ton in the range of 25 µs and tool thickness is less at 6 mm. Surface Plot: SR is best at low values of discharge current and pulse on time. When Ip rises up SR decreases and when Ton rises up SR decreases. This can be seen in the Figure 3 which shows the surface plot of surface roughness (SR) Vs Ton and Ip- varying two values and one value kept constant. At low values of electrode thickness SR is good but at high value it decreases.

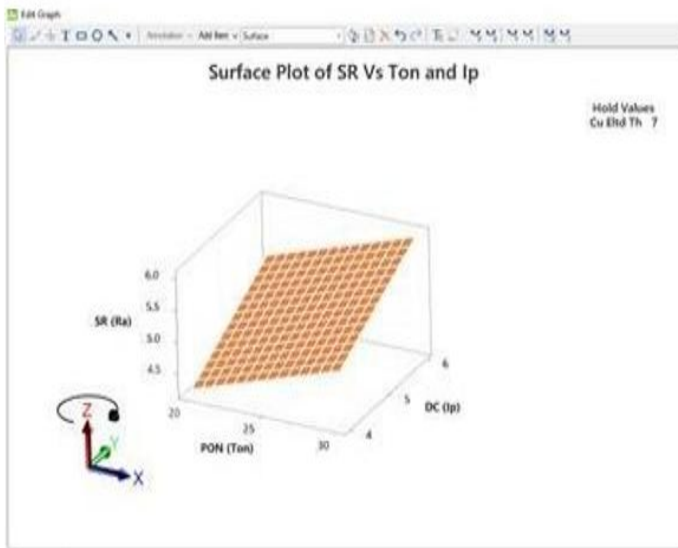

Figure 4 Surface Plot of SR Vs Ton and Ip when Hold Values for Cu electrode.

Interdependence graph for SR also called as Ineractionplot is shown in below Figure 4. In this graph ineraction of SR values with respect to input parametrs Ton, Ip, thickness (Th) is represented. These plots clearly indicate that at low values of Ip and Ton surface Roughness (SR) is good but as we incrsse to higher values surface roughness (SR) is poor.

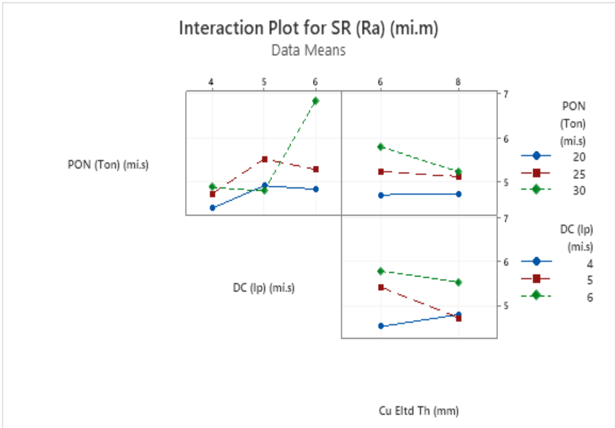

Figure 4 Interaction Plot for Surface Roughness (Ra) with Ton, Ip, and Th. (x)

III.CONCLUSION

The current study relates to machining of HCH Cr (D2) by Die Sinking EDM and investigates to find the optimal values of out put process parameters with respect to changing input response variables and finding various data related as per DOE based on Taguchi techniques. The effect of machining responses is then analyzed for MRR, TWR and SR in Minitab-19Software and final conclusions related to MRR, TWR and SR are drawn. Below are the conclusions: Conclusion related to MRR: As per Taguchi's Design Criteria Larger is Better S/Nratio. It is finally concluded that optimal value of MRR is found to be6.3351mm^3/min.whichisfoundatRun-18whentheoptimumcombinationofinputparameters is copper tool electrode thickness is (t) = 8 mm, and pulse on duration Ton= 30 µs and Discharge Current Ip= 6A. Further itis also concluded that value of discharge current (Ip) is most dominating parameter and after that pulse on duration (Ton) is most contributing factor and the thickness of electrode is least influencing parameter.

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