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Examination Of Process Parameters On Wire-Electro-Discharge Machining Of Hastelloy

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Abstract: Existence a difficult-to-cut material, like nickel-based alloy suffers poor machinability for most cutting processes, especially the making slots, narrow shapes and micro-holes using traditional machining methods. Even though wire-electrical discharge machining (WEDM) is suitable for machining Nickel alloys, selection of machining parameters for higher machining rate and accuracy is a challenging task in machining complex shapes. The contemporary research attempts to enhance WEDM process parameters for machining Hatelloy. To verify the optimal WEDM process parameters settings, surface roughness, metal removal rate (MRR), is chosen as experiential performance measures. In accumulation, four independent parameters such as peak current, pulse-on time, pulse-off time, and flushing pressure, were adopted for evaluation by the Taguchi method to conduct the experiment. This study states the possible limits for machining the stated process parameters by using WEDM process.

1. INTRODUCTION

Optimization of process parameters is the essential stage in the Taguchi method to doing high class machining without increasing cost. Overall machining cost and cutting fluid consumption are taken as the main objectives in the optimization model, which are affected by process constraints peak current, pulse-on time, pulse-off time, and flushing pressure. In this regard optimization of process parameters can advance performance characteristics and the optimal process parameters found from the Taguchi method are insensitive to the variation of environmental conditions and other noise factors. The present work outlines a detailed experimental study to optimize the process parameters.

2. LITERATURE REVIEW

[1]Wang, Y. et al., 2018 in his work, they said that Ultrasonic vibration and magnetic field assisted techniques were employed separately and simultaneously with the conventional WEDMLS process to facilitate the evacuation of accumulated debris from the machining gap by ultrasonic vibration and magnetic driving force. Thus, a novel hybrid technique of WEDM-LS using assisted ultrasonic vibration and magnetic field is proposed to enhance the effect of machining exceeding thickness (50mm thickness) titanium-nickel based shape memory alloys (SMA) workpiece is essential. Also, the following conclusions have been drawn :(1) the principle and schematic diagram of the USV-MF complex assisted WEDM-LS machining setup are analyzed firstly. The discharge channel in MF assisted WEDM-LS has a larger expansion than in conventional WEDM-LS. Because the discharge channel becomes larger, the energy of discharge appears dispersive. The vibration state simulation analysis of wire electrode in USV assisted WEDM-LS and USV-MF complex assisted WEDM-LS under different machining parameters were carried out in the paper. Then the simulation analysis of distribution of the discharge points on wire electrode in USV-MF complex assisted WEDM-LS shows the distributions of discharging points become more uniform reducing the broken electrode wire caused by the concentration of the discharge point of the electrode wire. The establishment of process parameters (MRR and Ra) models is finished and verified by experiments. Comparison of the experimental results of only MF assisted, USV-MF complex assisted and conventional WEDM-LS reveals that when process parameters are selected in the appropriate range, USV-MF complex assisted can significantly improve the ratio of normal pulse discharge states, increase the machining efficiency and improve surface quality simultaneously, reducing Ra. The proposed USV-MF complex assisted WEDM-LS process presents enormous advantages and potential for applications in the practical machining and manufacturing field.

[2]Sonawane, S.A. & Kulkarni, M.L., 2018, in this paper they have discussed wire electrical discharge machining of Nimonic-75 alloy under different levels of machining parameters Settings. To carry out the experiments Taguchi's L27array is used and multi-objective optimization, PCA-based hybrid Taguchi method is presented. PCA eliminates vagueness and complication of engineers' judgment for assigning the weights to the quality characteristics which are associated with other techniques. PCA based technique take into consideration association between various quality output and converts this into uncorrelated components known as principal components. These principal components reduce the number of aspects and trims down the convolution of the multi-characteristic problems. The optimal settings of the machining parameters based on the principal component analysis for the WEDM of Nimonic-75 alloy obtained are pulse-on time 110 ms, pulse-off time 51 ms, servo voltage 40 volts, peak current 230 Amp., wire feed rate 5 m/min and cable tension 8 gram. From the results of confirmation experiments, it is found that there is an increase in the value of composite principal component from 1.2013 to 1.2443. From the ANOVA, it is found that pulse-on time (contributing 52.89%) is the major

influencing factor affecting the performance outputs. Microstructures of machined samples show micro-cracks, lump of debris, large sized craters and matt surface appearance on the machined surface at high discharge energy level. The only limitation of the PCA-based hybrid Taguchi method is the selection of composite quality indicator which depends upon the nature of problem and trial and error solution.

[3]Majumder, H. & Maity, K., 2018. In the experimental study, four WEDM responses were investigated using five key input parameters for Ni-Ti shape memory alloy. The proposed GRNN model perceived approximately ±5% error, which revealed the fitness of GRNN model to foresee the WEDM outputs for Ni-Ti shape memory alloy. The optimal parameter setting is perceived based on the hybrid multivariate approach VIKOR-Fuzzy. Subsequently, the input parameter combination of TON= 10 s, I = 12 A, WT = 12 N, WS = 150 mm/s and FP = 6 bar, were establish to provide the favored results. The proposed VIKOR-Fuzzy method can efficiently support the decision makers in the manufacturing industry to define the optimal input parameter combination for the WEDM operation for Ni-Ti shape memory alloy under different conflicting response criteria. Analysis of variance results indicated that, for WEDM responses, the pulse on time was the most important process parameter. The recommended GRNN model and hybrid VIKOR-Fuzzy multivariate method can be applied to other WEDM responses like MRR, kerf width, etc. It can also be used for different conventional manufacturing processes like welding, casting, turning, milling, etc. and also for different non-conventional manufacturing processes like LBM, AJM, USM, etc.

[4]Gowd, G.H. et al., 2014 said that the selection of right combination of input parameters in WEDM is difficult as the process involves a large number of control variables. The effects of input parameters pulse-on time, pulse-off time, wire tension and water pressure on surface roughness, metal removal rate while machining the stainless steel 304 material were analyzed. The multiple regression coefficients (R) for Ra and MRR were found to be 0.888 and 0.966, respectively. This shows that the second-order model can explain the variation in the Ra and the MRR up to the extent of 89% and 97%, respectively. Pulse on time and Pulse off time were found to be the most significant factors influencing all responses investigated for both the experiment sets. Increased value of pulse on time leads to the low quality of machining responses such as surface finish. The optimal values obtained by the proposed methodology could serve as a ready reckoner to operate the machine with great ease to achieve the quality and the production rate demanded by the consumers. In summary, the proposed work enables the manufacturing engineers to select the optimal value depending on the production requirements and as a consequence, automation of the process could be done based on the optimal values

[5]Lodhi, B.K. & Agarwal, S., 2014. This paper described the optimization of the WEDM process using parametric design of Taguchi methodology. It was observed that the Taguchi's parameter design is a simple, systematic, reliable, and more efficient tool for optimization of the machining parameters. The effect of various machining parameter such as pulse-on time, pulse off time, peak current and wire feed has been studied though machining of AISI D3 steel. It was identified that the pulse on time and current have influenced more than the other parameters considered in this study. The confirmation experiment has been conducted. Result shows that the error associated with SR is only 3.042 %. The selection of optimum values is essential for the process automation and implementation of a computer integrated manufacturing system. Thus, the optimized condition, not only makes the WEDM a more commercially viable process for industrial applications, but also turns a spotlight on WEDM process as a promising field for further advancements.

[6]Alhadeff, L.L. et al., 2018. said that in terms of white layer, the rough-cut parameter set is significant, but an aggressive rough cut combined with a smaller offset achieves a desirable thickness. Regarding surface finish, rough cut parameters set is insignificant within the bounds investigated, which allows a fast (or more aggressive) rough cut parameter set to be used and speeds up machining time. The tool path radius of the wire had an effect on the surface finish, thus parameter control is required such that pulse energy is reduced in these areas. Using the premise that wire offset and finish cut parameters have the most significance when determining surface roughness and recast layer thickness, it is possible to have a fast-rough cut while minimizing these so that machining rate is higher and quality is adequate.

[7]Singh, T., Misra, J. & Singh, B., 2017. The present study illustrates the MRR of Al 6063 alloy by WEDM process. The experimental study has been carried out after designing it with the help of Box-Behnken design technique of response surface methodology and this technique is used to explore the effects of input process parameters on measure of process performance. Based on the experimentation and analysis, it can be concluded that pulse-on time, pulse-off time, and servo voltage have significant effect on response parameter while, the effect of peak current is found insignificant. It was found that MRR increases with increasing pulse-on time, whereas the response parameter decreases with increasing pulse-off time and servo voltage. An empirical model has been developed to provide a guideline to the potential users of WEDM of Al 6063 alloy. Confirmation experiments have been also conducted to validate the analytical study. It is observed that the developed model is quite capable in predicting the value of response parameters. The future research work could consider the study of changes in metallurgical and tribological properties of workpiece material.

[8]Sreenivasa Rao, M., Venkata Naresh Babu, A. & Venkaiah, N., 2018.said that Flower pollination algorithm, one of the global optimization algorithms, was found to outperform some popular algorithms such as GA and PSO.

However, there is a need to further improve the FPA with regard to its accuracy and speed. A modified FPA has been proposed in the present work to estimate the global optimal response value accurately. The proposed method has been successfully tested on standard bench-mark problems for its robustness before applying it on the WEDM data. The proposed algorithm was found to be accurate and fast as compared to existing FPA and RSM methods. The proposed method is able to perform better than the existing FPA technique in terms of accuracy and speed because of the novel two-stage initialization concept introduced in this work. Since the best strings, after the first generation, are grouped and further search is made around these solutions, the convergence rate is much faster. Though the proposed algorithm has been applied for optimizing the WEDM process, it can also be used for other applications. Furthermore, an attempt has been made in this work to study the machining behavior for Inconel-690 using WEDM. By conducting the trial experiments, feasible ranges for process parameters have been identified for the material in order to avoid problems such as wire breakage and wire short. A face centered central composite design of RSM was used for the experimental design. Effects of process parameters and their interaction effects on performance measures such as MRR and SR have been investigated. Percentage contributions of each process parameter on various responses have been estimated using ANOVA. MRR and SR values are significantly influenced by Ton, Ip and their interaction. Though the process or mechanism is same for any work material, experiments are conducted on Inconel-690 and machining data is generated for this process material combination and this data provides the industry a basis for further research in this direction.

[9]Banerjee, S., Panja, B. & Mitra, S., 2018. In the present study, Taguchi orthogonal array is successfully used to optimize the process parameters viz. Ton, Toff, WF, V of WEDM in order to maximize the MRR of EN47 spring steel. ANOVA analysis is done to investigate the significance of the process parameters and their interactions. Finally, confirmation test is performed to validate the results through optimization. Optimal combination of process parameters for maximum MRR is Ton3Toff1WF2V1 i.e. higher level of pulse on time, middle level of wire feed along with lower level of pulse of time and gap voltage. The ANOVA result indicates that pulse-on time (Ton) is the most influencing parameter whereas pulse off time (Toff) and gap voltage (V) is found to be quite remarkable parameters to control the MRR. The confirmation test reveals that MRR of EN47 spring steel developed at optimal condition is 26% greater than that developed with the initial condition.

[10]Gnanavelbabu, A. et al., 2018 said that in this research, Kerf geometry, microstructural analysis and material removal rate (MRR) of Ti-6Al-4V were investigated using Wire cut electrical discharge machining. Kerf Geometry shows that kerf taper angle gets narrower with an increase in pulse on time TON, server voltage and decreases with an increase in pulse off time TOFF. This is due to abrasive particles hitting of jet target to produce a narrower slot. Kerf taper ratio varies for increasing pulse off time and lowest kerf taper of 0.0124° was obtained for higher pulse off time TOFF (10 µs). Microstructural analysis reveals that micro holes and patchy rough cuts are seen when the process parameters like pulse on time TON and pulse off time TOFF are increased. And also, it is observed that the machined surface contains tiny craters and black patches at higher values of process parameters during machining. From these results it is recommended that the lower or medium values of process parameters will give enhanced surface quality than the highest values of process parameters. Material Removal Rate (MRR) analysis shows that MRR increases when pulse on rate TON is high (6 µs) and servo gap voltage (55 V) is low. MRR decreases, when servo gap voltage (65 V) is high with an increase in wire feed rate.

[11]Phate, M.R. & Toney, S.B., 2018. In the present work, DA and ANN based predicted models for the surface roughness and the material removal rate was formulated in the WEDM of AlSiCp MMC. The Material removal rate and the surface roughness increases with the increase in the pulse on time and the thermal conductivity. Material removal rate and the surface roughness decreases with the increase in the composition of SiC. Out of all the process parameters, the pulse on time (TON) was found to be most influencing parameter followed by the current and wire feed rate. DA and ANN models are capable to predict the responses. On the basis of results obtained from the DA and ANN model. The ANN approach is very superior to the DA approach.

[12]Ramanujam, R. et al., 2018. Said that Successful WEDM machining of as-cast composite material was achieved, characterization of as-cast composite materials and DOE analysis indicates, Wire feed rate was found to be most influential factor in roughness of surface. More feed rate lead to poor surface roughness. Macroscopic images confirm the fact as indication of marks on the surface are visible. Influence of presence of disorganized particulates in machining path lead to poor surface roughness with crater formation. Uniform dispersion of particulate will avoid any sever material removal giving rise to uniform surface roughness decreasing peaks. Recast layer is found to be reduced as presence of particulates with low thermal conductivity and high specific heat absorb much of the temperature allowing matrix material to solidify early. Wire wear rate is also found to be influenced for composite materials due to presence of agglomerates. The particulates when removed from matrix material flow through the wire path and damage the wire. Thus, wire modification may be required to increase tool life.

[13]Cheong, H.G., Kim, Y.S. & Chu, C.N., 2019. This research confirmed that the reverse current caused by oscillation when using an RC circuit worsens the relative wear ratio (RWR) of the tool. The reverse current was therefore removed and the RWR reduced by connecting a

MOSFET to an RC circuit. The MOSFET, to which pulse voltage is applied, cuts off the current before the reverse current is generated. Although tool wear remains a significant problem for precision and efficiency in electrical discharge machining, RWR and material removal rate (MRR) are improved by eliminating the reverse current of the RC circuit. Also, the addition of the MOSFET helped maintain geometrical accuracy in DI water with low resistivity, leading to additionally reduced RWR. Preventing reverse current reduced the RWR in micro-electric discharge milling. Under various machining conditions, connecting a MOSFET to the RC circuit reduced RWR. However, the effects of the MOSFET decreased at small circuit capacity and small open gap voltage because the discharge energy induced by the reverse current in those conditions was small. The frequency of the voltage applied to the MOSFET and the depth of cut were not dominant values for the reduction rate of the RWR caused by the MOSFET. When the resistivity of the DI water being used as dielectric fluid was decreased, the MOSFET's effect on the RWR increased. The reason for this is that prevention of the reverse current removed not only thermal wear but also the chemical wear that is induced by the reverse current. However, excessively low resistivity decreased the effect of the MOSFET because the channel was then mostly machined by the chemical dissolution. In DI water with resistivity of 5 kΩ-m, the RWR was reduced the most (56%). In the normal RC circuit, geometrical accuracy of the machined channel was maintained at resistivities over 5 kΩ-m. On the other hand, in the RC circuit with added MOSFET, geometrical accuracy was retained at resistivity's over 1 kΩ-m. In terms of the edge radius, taper angle, and machining gap, the MOSFET circuit provided better results, but surface roughness was better when using the normal RC circuit. In comparing the RWR at the same edge radius, it was possible to further reduce it by 67%.

[14]Kumar, R. & Singh, I., 2019 In the present experimental investigation, the process performance of electric discharge drilling by using electrodes featured with inclined through holes (pathways) has been analyzed. Blind holes were drilled in Ti6Al4V workpiece to evaluate the effectiveness of the designed electrodes. The effect of pathway angle, pathway diameter and tool speed on MRR and whole aspect ratio was evaluated. The following conclusions can be drawn from the present experimental investigation; The idea of using an inclined pathway within the tool electrode, for the easy evacuation of debris during EDD process, was found to be successful. The bubbles and the debris easily move through the featured pathway eliminating the occurrence of arcing and short circuiting. As the debris move through the featured pathway and not through the side gap, there is very less or no side sparking during the process resulting in the straight holes. Machining depth of more than 9.8 mm in Ti6Al4V can be achieved using the proposed electrode (type III) which is the highest depth ever reported in the literature using electric discharge drilling. The proposed electrode completely eliminates the need of flushing and acts as a self-flushing electrode. The proposed electrode lowers the capital, running and maintenance cost of the EDM machine (by eliminating the need of flushing pump). The proposed electrode can be fabricated on the EDM machine itself, without the requirement of any special attachment. An electrode with a length of 4 mm (diameter 0.8 mm) can be fabricated in a much less time of 22 min. This is the lowest electrode fabrication time ever reported in the literature in the category of shaped tool electrodes.

[15]Jeykrishnan, J. et al., 2018. Said that This work mainly deals with the optimization of input parameters such as applied current, pulse on time and pulse off time to obtain optimal MRR value and has been obtained on machining Inconel 625 alloy in EDM by using Taguchi technique in Minitab software. The effect of individual process parameters has also been found out by using ANOVA table. It has been derived that, the current plays an important role in affecting the MRR, followed by pulse on time and pulse off time.

[16]Reddy, D., Soni, H. & Narendranath, S., 2018 said the detailed experimental investigation of the Wire Electron Discharge machining of Ti50Ni48Co2 Shape memory alloy has been done. The effect of various process parameters such as pulse on time, pulse off time and servo voltage on material removal rate (MRR) and surface roughness (MR) has been discussed. The optimum process parameters for simultaneous maximum MRR and minimum SR was found to be Pulse on Time (Ton) =125µs, Pulse off Time (Toff) =35µs, Servo Voltage (SV) =40V. Micro globules, blowholes, craters, and cracks have been noticed during the microstructural analysis. Harder surface found near machined cutting edge of machined components.

[17]Nayak, B.B. & Mahapatra, S.S., 2016. In this work, a hybrid approach is proposed for optimization of various machining parameters during taper cutting in WEDM process using deep cryo-treated coated Bronco cut-W wire electrode and Inconel 718 as the work piece material. The effect of input parameters on various performance characteristics such as angular error, surface roughness and cutting speed is also analyzed individually after taper cutting operation in deep cryotreated Inconel 718. In order to optimize, multiple performance characteristics simultaneously, maximum deviation theory is used to convert multiple performance characteristics into a single equivalent performance characteristic. As the process is a complex one, the functional relationship between the process parameters and performance characteristic during taper cutting process in WEDM process has been developed using BPNN. For faster training of ANN, Leven berg–Marquardt algorithm is used. The suggested process model can be used in any taper cutting operation for prediction of various performance characteristics before experimentation because a high degree of correlation is obtained. A latest evolutionary algorithm known as bat algorithm has been successfully used to predict the optimal parameter setting so as to produce the optimal result in the process. Although the

approach is applied in taper cutting using WEDM, the approach is quite generic and can be applied in any complex machining situation for developing the process model.

[18]Srinivasarao, G. & Suneel, D., 2018. This work presents the experimental study on wire electrical discharge machining of titanium alloy. The following observations are made: From the surface roughness model, it can be observed that the surface roughness increases with an increase in pulse on time and decreases with increase in peak current and servo voltage. The individual effect of pulse off time and wire feed rate has no significant effect on surface roughness, but their interaction is identified. The effect of peak current is dominating on material removal rate followed by servo voltage, pulse off time and pulse on time. Material removal rate is increasing with peak current and decreases with increase in servo voltage and pulse off time. Wire feed has no significant effect on material removal rate individually, but it's interaction with other parameters has been identified as significant effect on material removal rate individually, but it's interaction with other parameters has been identifies as significant effect on material removal rate. The second order polynomial model developed based on CCF (5) design has better accuracy due to presence of quadratic effects and anti-synergistic interactions. Using desirability function, a scale-free quantity called desirability had been obtained for two performance characteristics to optimize multi-performance characteristics, i.e., MRR and SR. Corresponding to highest desirability, the optimal combination of discharge parameters was pulse on time: 108µs, pulse-off time: 51µs, peak current: 12A, servo voltage: 51V and wire feed: 15m/min.

[19]Majumder, H. & Maity, K., 2018. In this research, an experimental study was executed to Investigate the WEDM responses for nitinol. Responses were validated through the outcomes of GRNN. Following findings may be drawn from this study: The estimated errors in the proposed GRNN model observed nearly ± 10%, which shown the suitability of GRNN model to predict the WEDM responses for nitinol in this research, an experimental study was executed to investigate the WEDM responses for nitinol. Responses were validated through the outcomes of GRNN. Following findings may be drawn from this study: The estimated errors in the proposed GRNN model observed nearly ± 10%, which shown the suitability of GRNN model to predict the WEDM responses for nitinol. The proposed GRNN model can be used as a reliable method to predict WEDM responses. The optimum level of the input process parameters is recognized based on the hybrid MOORA-Fuzzy MCDM approach. Consequently, the process parameter setting of TONS= 12 µs, I = 10 A, WT = 12 N, WS = 150 mm/s. and FP = 8 Bar, were found to yield the preferred results. ANOVA results showed that the discharge current is the most significant input parameter for all the responses. The confirmation result shows improvement in quality characteristics. The proposed hybrid MCDM approach can effectively support the decision makers to determine the optimum process parameter setting for the WEDM process for nitinol under multi-response criteria. The varied nature of process parameters considered in the current investigation were found to be effective in altering the responses to a great extent. However, this might be limited to the studied range of machining variables and selected cutting conditions. The FESEM micrographs revealed that lump of debris, pockmarks, recast layer and micro cracks are more prominent at optimum setting machined surface. The proposed GRNN model can be used as a reliable method to predict WEDM responses. The optimum level of the input process parameters is recognized based on the hybrid MOORA-Fuzzy MCDM approach. Consequently, the process parameter setting of TONS= 12 µs, I = 10 A, WT = 12 N, WS = 150 mm/s. and FP = 8 Bar, were found to yield the preferred results. ANOVA results showed that the discharge current is the most significant input parameter for all the responses. The confirmation result shows improvement in quality characteristics. The proposed hybrid MCDM approach can effectively support the decision makers to determine the optimum process parameter setting for the WEDM process for nitinol under multi-response criteria. The varied nature of process parameters considered in the current investigation were found to be effective in altering the responses to a great extent. However, this might be limited to the studied range of machining variables and selected cutting conditions. The FESEM micrographs revealed that lump of debris, pockmarks, recast layer and micro cracks are more prominent at optimum setting machined surface.

[20]Singh Nain, S., Garg, D. & Kumar, S., 2017.said that Based on experimental result it is find out that MRR increase with increase in pulse-on-time, wire tension and peak current and decrease with increase in servo voltage, pulse-off-time and wire feed. Surface roughness increase with increase in pulse-on-time, peak current and wire tension significantly and surface roughness decrease with increase in servo voltage and pulse-off-time. Waviness increase with increase in pulse-on-time and wire feed significantly and decrease with increase in servo voltage and pulse-off-time significantly. The entire three models are significant for surface roughness, waviness and material removal rates of WEDM on Udimet-L605. But linear regression and ANN-linear regression model presents better result in contrast to the nonlinear regression model. Overall the linear regression model presents better result in contrast to ANN-linear regression model. The best value of R2, co-relation coefficient, MSE and RMSE for MRR are 0.9432, 0.9712, 0.7103 and 0.8428 respectively given by ANN-linear regression model. The best value for R2, co-relation coefficient, MSE and RMSE for SR are 0.93, 0.966, 0.024 and 0.154 respectively given by the linear regression model. The best value for R2, co-relation coefficient, MSE and RMSE for waviness are 0.76, 0.874, 0.016 and 0.126 respectively given by the linear regression model.

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3. EXPERIMENTAL SETUP

Fig. 1 Work piece-Al-1100

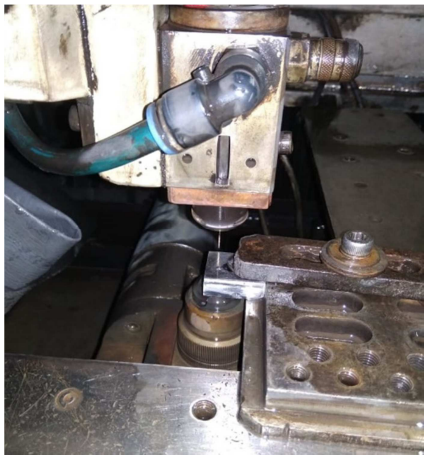

Fig. 2 Cutting process

Fig. 3 WEDM

The experimentation is carried out through the based-on literature review. By taking same group of metals as a reference, conducted the experiment. In the initial trail the values which are taken pulse-on-time 120, pulse-off-time 55, peak current 60 and plush pressure or dielectric fluid flow as a 50. In this trail experimentation the machine taken around one hour thirty minutes to cut 5mm length. Even the surface roughness is as expected also, these parameters are not viable. In the second trail the values which are taken as taken pulse-on-time 120, pulse-off-time 55, peak current 100 and plush pressure or dielectric fluid flow as a 50. In this trail experimentation the machine taken around one hour five minutes to cut 3.5mm length. Even the surface roughness is as expected also, these parameters are not viable. In the last trail we have taken pulse-on-time 120, pulse-off-time 55, peak current 150 and plush pressure. In this trail experimentation the machine taken around one hour five minutes to cut 3.5mm length. Even the surface roughness is as expected also, these parameters are not viable. In the last trail we have taken pulse-on-time 120, pulse-off-time 55, peak current 150 and plush pressure or dielectric fluid flow as 8. In this trail experimentation the machine taken around two minutes thirty seconds to cut total length of the work piece.

4. RESULTS AND DISCUSSION

Trail No	A	B	C	D
1	1	1	1	1
2	1	2	2	2
3	1	3	3	3
4	2	1	2	3
5	2	2	3	1
6	2	3	1	2
7	3	1	3	2
8	3	2	1	3
9	3	3	2	1

Table No 1

Trail No	T on time	T off time	water pressure	current
1	110	50	6	100
2	110	55	8	150
3	110	60	10	200
4	120	50	8	200
5	120	55	10	100
6	120	60	6	150
7	130	50	10	150
8	130	55	6	200
9	130	60	8	100

Table No 2

After completing three trails we have observed that, the trail three parameters are near by the optimal parameters. So that by making these parameters as a middle level, the levels are fixed and shown in the table no 1. With this level by considering all four factors by adopting taguchi method trails are framed. Table no 2 shows the machining trails. In this work, finally fixed matching operations for WEDM on Hatelloy with l9 orthogonal array.

5. CONCLUSION

This work mainly concentrated on selecting suitable levels for performing the machining operations on Hastelloy. In initial trail the values which are taken as taken pulse-on-time 120, pulse-off-time 55, peak current 60 and plush pressure or dielectric fluid flow as a 50. In this trail experimentation the machine taken around one hour thirty minutes to cut 5mm length. Even the surface roughness is as expected also, these parameters are not viable. In the second trail the values which are taken as taken pulse-on-time 120, pulse-off-time 55, peak current 100 and plush pressure or dielectric fluid flow as a 50. In this trail experimentation the

machine taken around one hour five minutes to cut 3.5mm length. Even the surface roughness is as expected also, these parameters are not viable. In the last trail we have taken pulse-on-time 120, pulse-off-time 55, peak current 150 and plush pressure. By taking this process parameters we can get optimum parameters to perform the machining operation. In the future study we can plan to perform machining operations with levels and parameters by adding one or two responses we can fix the optimum parameters. Also, by using some analyzing softwares we can confirm the results and observe the significance of these parameters.

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