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A Critical Review on Optimization of WEDM Process Using Taguchi Array

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Abstract: ***Wire electrical release machining (WEDM) innovation has developed at special case rate since it was first applied over long term prior.WEDM is a widely recognized unconventional material cutting process used to manufacture components with complex shapes and profiles of hard materials. In this thermal erosion process, there is no physical contact between the wire tool and work materials. Wire Electrical Discharge Machining (WEDM) is getting more tasks in fields like dies, punches, aero and many more. It is the very difficult task to get optimum process parameters for higher cutting efficiency. In WEDM process rough machining gives lesser accuracy and finish machining gives fine surface finish, but it reduces the machining speed. This review involves process, principle, literature and applications of WEDM using Taguchi array.***
Keywords: WEDM; Materials; Machine; Cutting efficiency; Optimization process.

I. INTRODUCTION

Wire electrical release machining (WEDM) innovation has developed at special case rate since it was first applied over long term prior. In 1974, D.H Dule-bohn applied the optical-line supporter framework to naturally control the state of the segments to be machined by the WEDM cycle. By 1975, its ubiquity quickly expanded, as the cycle and its capacities were better perceived by the business. It was distinctly towards the finish of the 1970s, when PC mathematical (CNC) framework was started into WEDM, which achieved a significant advancement of the machining cycle [1]. The requests for composite material having high hardness, durability and effect opposition are expanding. These materials are hard to be machined by customary machining techniques. Henceforth, non-customary or un-traditional machining strategies including electrochemical machining, ultrasonic machining, and electrical releasing machine and so on are applied in machining such hard to machine materials.

A. Principle of WEDM process

WEDM is considered as an interesting reception for the customary EDM measure, which utilizes a cathode to instate the starting cycle. Notwithstanding, WEDM uses a ceaselessly voyaging wire anode made of conductive materials like copper, metal or tungsten of measurement 0.05-0.30mm. The wire is kept in pressure utilizing mechanical aides. During the WEDM cycle, the material is disintegrated in front of the wire and there is no immediate contact between the work piece and the wire. The WEDM machine device includes a fundamental worktable (X-Y) on which the work piece is braced a helper table (U-V) and wire drive component. The primary table moves along X and Y-hub and it is driven by the D.C servo engines. The X-Y regulator of the machine uproots the worktable conveying the work piece along a foreordained modified way. The voyaging wire is persistently taken care of from wire feed spool and gathered on wire spool which moves the work piece. The wire is upheld under pressure between a couples of wire guides situated at the contrary sides of the work piece. The lower wire manage is fixed whereas the upper wire guide can be dislodged transitionally along U and V-pivot regarding lower wire direct. The upper wire guide can likewise be situated vertically along Z-hub by moving the plume. A schematic graph of the fundamental guideline of WEDM measure is appeared in Fig 1.

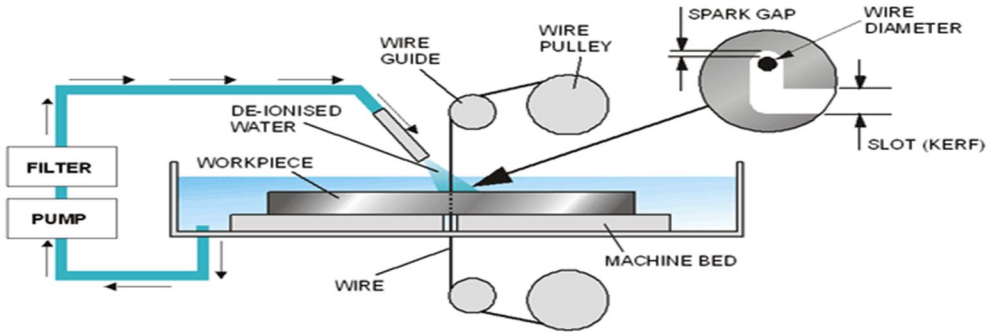


Fig.1: Schematic diagram of the basic principle of WEDM process

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A series of electrical pulses are generated by the pulse generator unit. These pulses are switched off and on during cutting process as shown in the Fig. 2. Electro erosion of the work piece material take place during the pulse on time period which is applied between work piece and traveling wire electrode. The machining zone continuously flushed with water passing through the nozzle on both sides of work piece. Water is used as a dielectric medium hence it is very necessary to deionize water continuously.

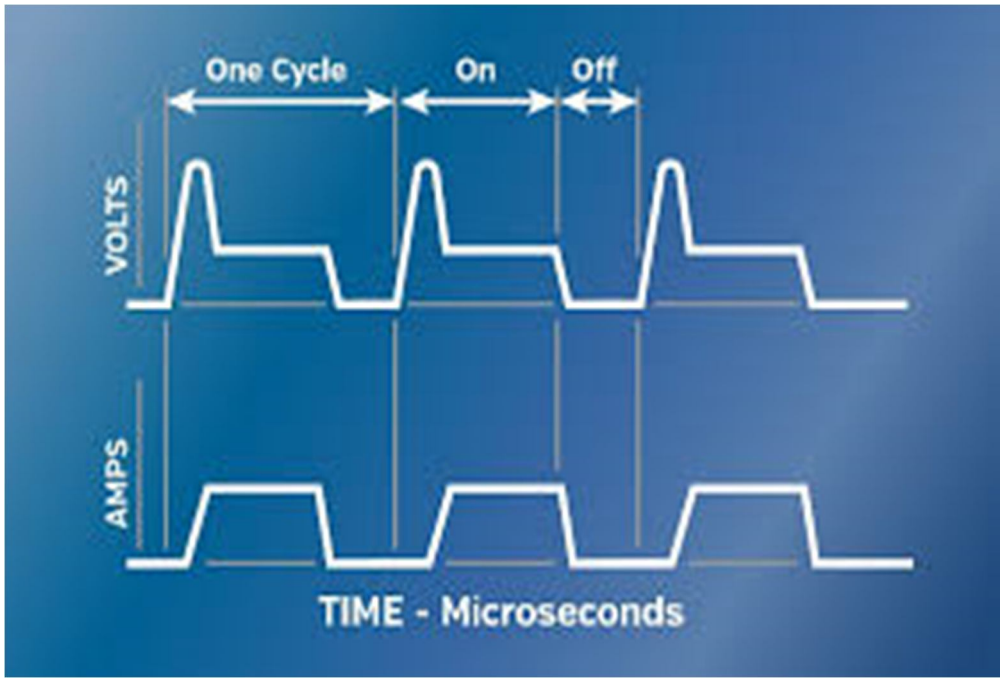


Fig. 2: Pulse generations

The conductivity of water in the dielectric conveyance framework is kept up by the deionization of water in a particle trade pitch. The total working arrangement of WEDM is appeared by the square outline in **fig. 3.**

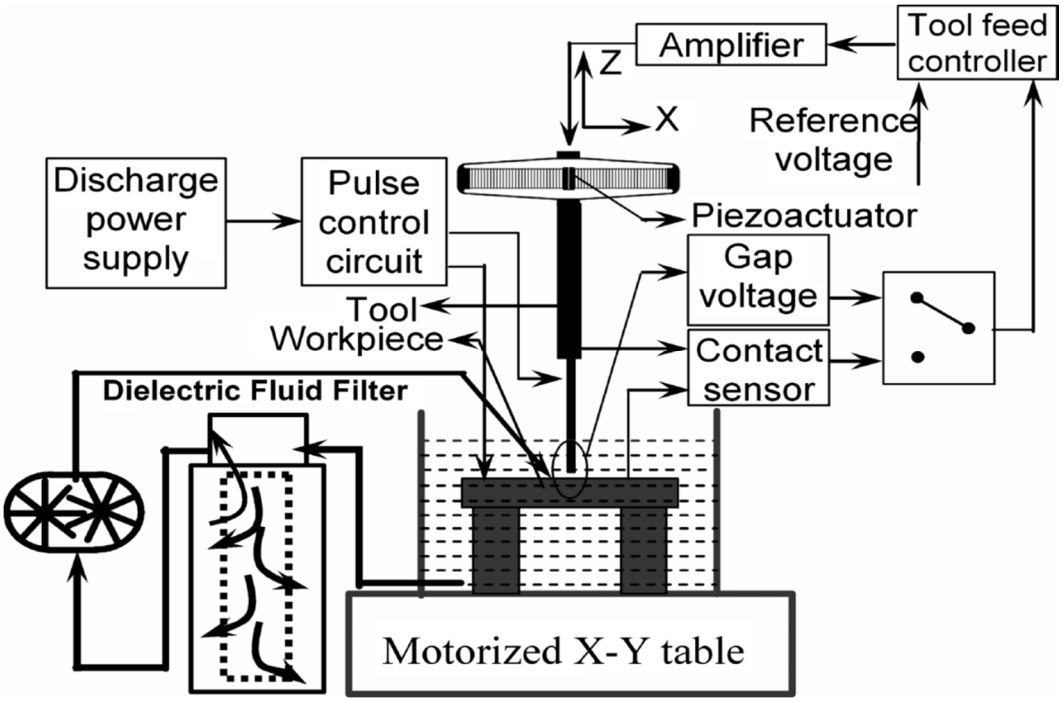


Fig. 3: Block diagram of WEDM.

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II. LITERATURE REVIEW

WEDM is a recently introduced in manufacturing industries. Its use is widely increasing as it is a revolution in automation. These days its applications are so large because of its accuracy and capability in cutting complex job. Still its full utilization due to its complexity is not achieved.

1) Sinha et al. [2], concluded that wire lag as the major cause of inaccuracy in WEDM and for preventing the wire lag phenomenon he proposed over travel method by considering the static deflection and vibration of wire.
2) Devies et al.[3], reviewed several temperature measurement methods and used them in temperature monitoring during material removal in WEDM. Their study outline the physics of each method, detailing the source and evaluation of uncertainty. Finally, using critical criteria in measuring material removal rate, methods were compared and the results were presented in guide format for participants in this field of work.
3) Puri and Bhattacharya et al. [4], presented an analytical approach for the solution of the wire-tool vibrations in WEDM. They further considered multiple spark discharge for investigate the effect of wire vibrations.
4) Kinoshita et al.[5], observed the problems in steep “taper-cutting”. These problems were rectified by designing a new guide for electrode wire resulting in better stability of electrical discharge machining (EDM) process.
5) Scott et al. [6], showed that material removal rate and wire wear ratio were highly affected by pulse on time and pulse off time. They concluded that the surface finish increases with increases in discharge current, pulse duration and wire speed. However they did not provide a single combination of input levels of pulse on time, wire feed, wire tension.
6) Hascahk&Caydas et al. [7], investigated the surface roughness and tool life based on the parameter design by Taguchi method in the optimization of turning operation. They suggested that tool life is strongly affected by cutting speed and surface roughness by feed rate.
7) Quet al. [8], suggested a mathematical model for calculating material removal rate (MRR) of a cylindrical WEDM process. They applied this model to eliminate the ire vulgarities obtained during machining of cylindrical shape objects. They further designed two experimental configurations to find the maximum material removal rate in cylindrical wire EDM.
8) Hsue et al.[9], performed the work on corner cutting. The concept of discharge angle was introduced by studying the geometric properties of WEDM. A mathematical expression was derived for the same by analytical geometry of WEDM.
9) Katz &Tibbles et al. [10], proposed a micro EDM model along with computer simulation for the channel expansion velocity as a function of spark duration. The establishment of a possible process model was aimed at relating input/output parameters. The simulation was linked to dimensionless groups, which was related to micro electro discharges and their effect on metal removal.
10) Bannerjee et al.[11],developed a simple computational model to estimate the temperatures for varying magnitudes of parameters. They used this distribution to predict the wire failures.

III. MATERIAL REMOVAL IN WEDM PROCESS

The metal evacuation in WEDM includes the way toward liquefying and vaporization brought about by the electric flash release created by athrobbing direct flow power flexibly between the terminals. In WEDM, negative terminal is a ceaselessly moving wire and the positive anode is the work piece. The sparkles are created between two firmly dispersed anodes under the weight of dielectric fluid. Water is utilized as dielectric in WEDM, in view of its quick cooling rate. The temperature of terminals locally ascends to high esteem and high vitality thickness disintegrates a piece of material. The vitality thickness delivered by the WEDM relies on different machine boundaries. These boundaries must be advanced for the productive material expulsion rate.

IV. APPLICATION OF WEDM PROCESS

In the metal cutting industry WEDM has huge potential in accomplishing a significant dimensional exactness, surface completion and form age highlights on items. The troubles experienced in the kick the bucket sinking EDM are maintained a strategic distance from by WEDM, in light of the fact that intricate plan device is supplanted by moving conductive wire and relative development of wire guides. Besides, WEDM is fit for creating a fine, exact, erosion and wear safe surface. The different utilizations of WEDM measure in confounded shapes are appeared in Fig. 4. Which likewise incorporate form, instrument and bite the dust making ventures. The machine capacity to work unattended for quite a long time or even days further expands the appeal of the cycle. Machining thick segments of material, as thick as 200 mmin expansion to utilizing PC to precisely scale the size of the part, make this cycle particularly significant for the creation of different sorts of bites the dust. The machining of press stepping bites the dust is improved on the grounds that the punch, pass on, punch plate and stripper, all can be machined from a typical CNC program. Without WEDM, the manufacture cycle requires numerous long periods of manual crushing and cleaning.

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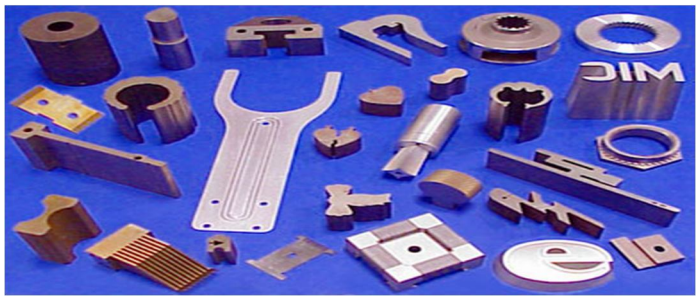


Fig. 4: Components manufactured by WEDM

V. WEDM PROCESS

Wire electrical discharge machining (WEDM) is a non-conventional machining process used for hard to cut conductive material. Wire EDM finds many applications; for instance, in the manufacturing of various press tools, dies and even electrodes used in other areas of EDM.

Wire EDM machining (Electrical Discharge Machining) is an electro thermal production process where a thin single strand metal wire, along with de-ionised water (used to conduct electricity) allows the wire to cut through metal by the use of heat from electrical sparks, while preventing rust.

VI. CONCLUSION

Wire electrical discharge machining is extensively used in machining of conductive materials. The WEDM process has the ability to machine complex shapes and hard electrically conductive metal components precisely. The main goal of wire electrical discharge machine manufacturers and users are to achieve a better stability and high productivity of the process with desired accuracy and minimum surface damage. The main objectives of the present research are to experimentally study the effect of various process parameters like pulse on time, pulse off time, wire feed, and wire tension on the performance measures like material removal rate, surface roughness and wire wear ratio. WEDM is a widely recognized unconventional material cutting process used to manufacture components with complex shapes and profiles of hard materials. In this research work, we are presenting the development of WEDEM process using various pre define parameters using Taguchi method.

REFERENCES

[1] Ashwini Karpe and Hanmant Shete (2021),"Surface roughness and material removal rate in wire electro discharge machining of hard materials: a review", International Journal of Engineering Research & Technology (IJERT) Vol. 10 Issue 11, Pages 162-166

[2] S.Dinesh Kumara , Ravichandran, S.V.Alagarsamy, M.Meignanamoorthy and S.Sakthivelu (2020) " Effect of EDM process parameters on material removal rate and surface roughness of metal matrix composites: A review" , Material today procedding, Volume 21, Part 1, 2020, Pages 616-618

[3] D. Deepak and Beedu Rajendra (2019), Investigation of the effect of process parameters on material removal rate in machining of is 5986 fe 410 steel by wire-EDM: The optimization and regression modeling, International Journal of Mechanical and Production Engineering Research and Development, Vol. 10 Issue 11, Pages 162-166

[4] Kuldeep Singh, Khushdeep Goyal and Deepak Kumar Goyal (2018), "Effects of Process Parameters on Material Removal Rate and Surface Roughness in Wedm of H-13 Die Tool Steel", Advanced Engineering Forum, Volume 28, Pages 55-66

[5] Mahesh kumar B. Patil1, G. R. Naik and P.G. Naik (2018), "Analysis of process parameters in wire edm with stainless steel 410 using topsis method", Journal of Emerging Technologies and Innovative Research (JETIR), vol, 05.

[6] Gurpreet Singh and P.S. Satsang (2017), "Effects of wedm on the performance characteristics in various classes of work material: A review" Research Cell: An International Journal of Engineering Sciences, Vol. 25, Pages 266-272

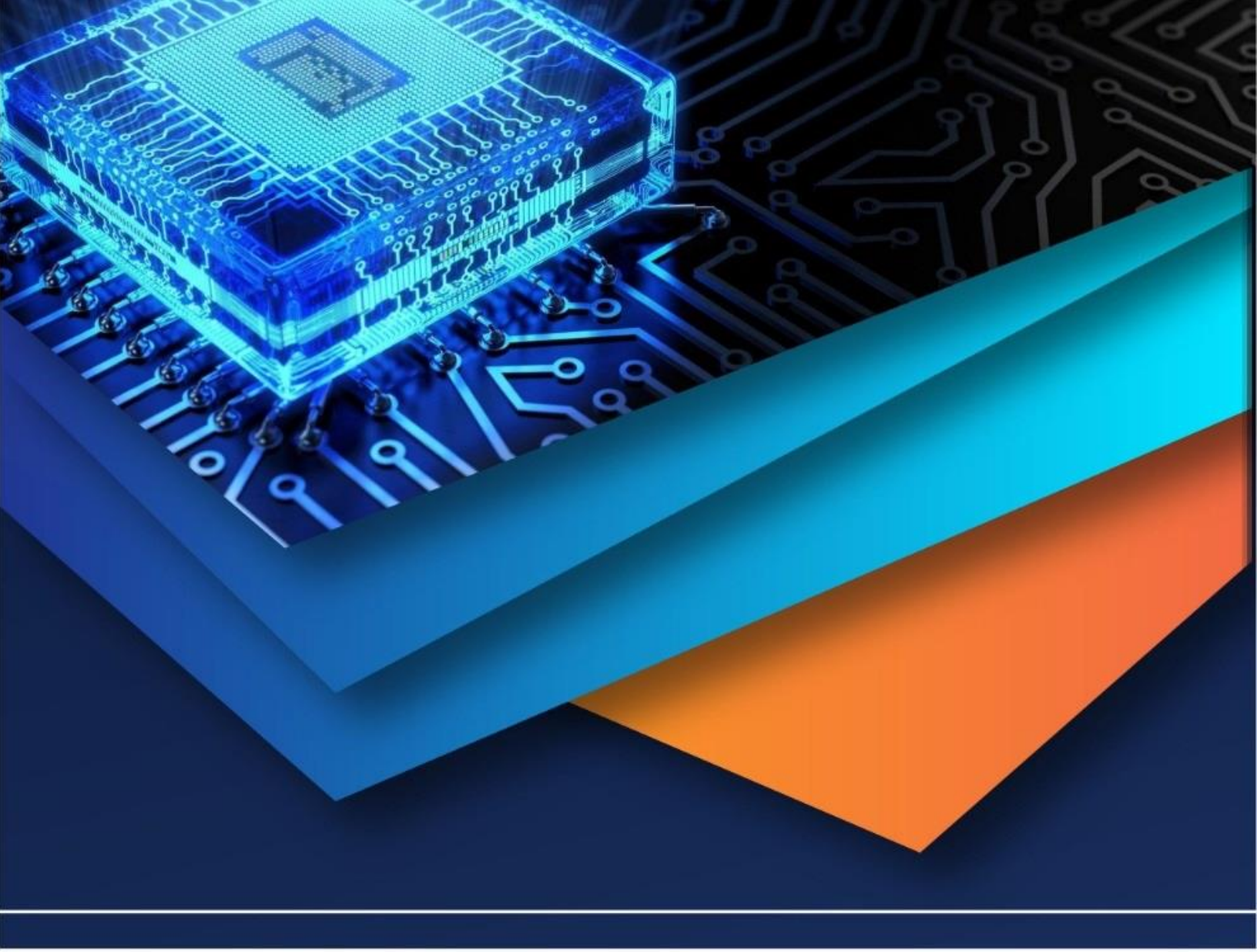
[7] S.B.Prajapati and N.S. Patel (2013), Effect of process parameters on performance measure of wire edm for AISI A2 tool steel, International journal of Computational Engineering Reseacrh, vol, 03.

[8] Anish Kumar, Vinod Kumar, and Jatinder Kumar (2013), "Multi-response optimization of process parameters based on response surface methodology for pure titanium using WEDM process", International journal of Advance Manufacturing Technology

[9] Manoj malik, Rakesh, Nitesh ,Deepak and Manoj (2012), Optimization of process parameters of Wire edm using zinc coated brass wire, International Journal of Advanced Technology and Engineering Research.

[10] PragyaShandilya, P.K. Jain, and N.K. Jain (2012), "On wire breakage and microstructure in WEDC of SiCp/6061 aluminum metal matrix composites", International Journal of Advance Manufacturing Technology.

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