International Journal of Scientific Research in Mechanical and Materials Engineering
© 2021 IJSRMME | ISSN : 2457-0435

A Review on Different Process Parameter in Wire Electric Discharge Machining

Dhananjay Verma[1], Lokesh Singh[2], Sushil Kumar Maurya[3]
Research Scholar[1], Assistant Professor[2, 3]
[1,2]RSR Rungta College of Engineering and Technology, Bhilai, Chhattisgarh, India
[3]Modern Institute of Technology and Research Centre, Alwar, Rajasthan, India

Article Info
Volume 5, Issue 2
Page Number : 39-43

Publication Issue :
March-April-2021

Article History
Accepted : 10 April 2021
Published : 15 April 2021

ABSTRACT

Non-traditional machining is a milestone in the manufacturing industries in today's machining process. Wire electrical discharge machining (WEDM) is one of the most advanced non-traditional manufacturing processes for machining difficult-to-machine materials. In precision manufacturing industries such as automobile, aerospace, and sheet metal, non-traditional machining processes such as electro discharge machining (EDM) and wire electric discharge machining (WEDM) play a critical role. Most of the time, the manufacturer's machine tool tables do not meet the machining requirements of a particular material. The purpose of this paper is to present an aggregated overview of various researchers contributions to the WEDM process. This review paper describe the WEDM process in relation between different input process parameter and different output measure like material removal rate, surface roughness, kerf width and wire wear ratio. In this paper is concluded by highlighting different wire material, wire diameter and discusses their role in WEDM process.

Keywords : WEDM, Material Removal Rate (MRR), Surface Roughness, Process parameter

I. INTRODUCTION

Wire-EDM has non -conventional machining process which widely used in the aerospace engineering, manufacture to tools, dies, molds, metal-workings and automotive industries because of wire EDM provides an effective solution for machining hard materials with intricate shapes. However, selection of cutting parameters for obtaining higher cutting efficiency or accuracy in wire-EDM. WEDM is a thermo-electrical process in which material is eroded by series of sparks between work piece and wire electrode. During process wire carries one side of an electrical charge and work piece carries the other side of the charge. When the wire gets close to the part, the attraction of electrical charges creates a controlled spark, melting and vaporizing microscopic particles of material. The spark also removes a miniscule chunk of the wire, so

after the wire travels through the work piece one time, the machine discards the used wire and automatically advances new wire. A continuously travelling wire electrode made thin copper, brass or tungsten of diameter 0.05-0.30 mm This paper mainly focuses on the major WEDM research activities which include the various process parameters such as wire material, wire diameter, pulse on time, pulse off time, peak current, and wire tension, wire feed rate, servo voltage, and dielectric fluid and flushing pressure. These process parameters have most influence on the performance measures like material removal rate, surface roughness, wire wear rate and kerf width.

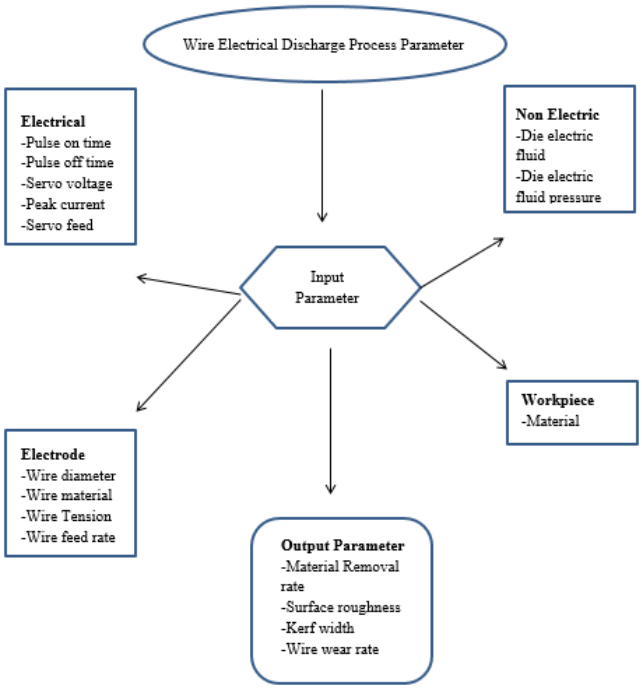

Fig.1: WEDM process and respond parameter

II. LITERATURE REVIEW

Literature review section provides information about WEDM process machining parameter and its characteristics also provide information related to machining of latest composite material used in the aerospace industries, automobile section and tooling section and tooling section. **Mohan et al.** have investigated the machining characteristics of SiC/6025 Al composite using rotary electro-discharge machining (EDM) with a tube electrode. Brass was used as the electrode material to EDM SiC/6025 Al composites. Three observed values: MRR, electrode wear rate (EWR) and SR are adopted to evaluate the machinability. Peak current, polarity, volume fraction of SiC reinforced particles, pulse duration, hole diameter of the tube electrode, and speed of electrode rotation were used as the input variables to assess the machinability. **Yuan-Feng Chen et al.** have investigated how machining characteristics and surface modifications affect low-carbon steel (S15C) during EDM processes with semi-sintered electrodes. **Pradhan et al.** have attempted the optimization micro-EDM process parameters for machining Ti-6Al-4V super alloy. To verify the optimal micro-EDM process parameters settings, metal removal rate (MRR), tool- wear rate (TWR), over cut (OC) and taper were chosen as observed performance criteria. **Abhang et al.** have presented the optimization of machining parameters in steel turning operation by Taguchi method. In their study the experimental work was carried out by turning EN-31 steel alloy by using tungsten carbide inserts. **Periyanan et al.** have focused on the Taguchi technique for the optimization in micro-wire electro discharge grinding process to achieve maximum MRR considering the feed rate, capacitance and voltage as the cutting parameters. **Milan Kumar Das et al.** the objective is to find out the combination of process parameters for optimum surface roughness and material removal rate (MRR) in electro discharge machining (EDM) of EN31 tool steel. **Pujari Srinivasa Rao et al.** study the effect of wire EDM parameters on aluminum alloy because of its growing applications in various industries. In the present research, parametric analysis of wire EDM parameters was performed by Taguchi method on surface roughness (SR) and material removal rate (MRR). **Muthu Kumar et al.** have demonstrated optimization of WEDM process parameters of Inconel800 super alloy based on Grey-Taguchi

method. They have chosen gap voltage, Pulse On – time, Pulse Off-time and wire feed as process parameters with multiple performance characteristics such as MRR, SR and kerf. **Hsien–Ching Chen et al.** have projected optimization of WEDM parameters on machining Ti-6Al-4V with multiple quality characteristics using the Taguchi method and grey relational analysis by choosing discharge current, open voltage, pulse duration and duty factor as process parameters and electrode wear ratio, material removal rate and surface roughness as performance characteristics. **Janardhan et al.** have investigated the effect of machining parameters on the performance of wire electro discharge turning process. **Venkata Ramaiah et al.** have objective of their study is to obtain improved material removal rate, surface roughness, and spark gap. They adopted grey relational theory to determine the best process parameters that optimize the response measures.

III. DISCUSSION AND FUTURE TRENDS

After a through investigation of the published works in this field, the following conclusions can be drawn:-

- WEDM process is a very precise manufacturing process and it is capable to produce complex shapes in any conductive material regardless its hardness.
- The development of economical wire electrodes with high conductivity and toughness for high material removal rate.
- It very less effort has been made to identify electrode materials view their thermal properties from the perspective of cutting speed.
- Not many studies have been conducted on the machining of composite material by using assisting electrodes to facilitate sparking of highly electrically resistive materials.
- This technique can be successfully utilized for cutting, turning, step turning, taper turning, grinding and gear cutting operations and having huge potential to replace conventional processes.
- It is observed that in WEDM the input process parameters: pulse-on time, pulse-off time, servo voltage, peak current, wire feed rate, wire tension, wire offset, water pressure, servo feed, wire material are having significant influence on process performance characteristics namely surface roughness, material removal rate, kerf width, wire wear rate, surface integrity aspects, etc.
- A number of optimization and modelling techniques are attempted to improve the process capability.
- Not many studied has been effect of wire diameter and wire material on material removal rate and surface roughness.
- More research is required to enhance high performance wire electrodes with high conductivity alloy materials for high speed cutting applications which used for automobile parts and die manufacturing.

IV. CONCLUSION

The focus of this paper was to developing technologies of wire EDM wire electrodes tool from using molybdenum wire because of its high thermal conductivity and low melting point which have been developed and assist user demand that need of maximum productivity and quantity. Aluminium silicon carbide composite (Al/SiCp) using with increasing silicon carbide lead to increased cutting speed and material removal rate. It has been observed that most of the researchers concentrated on few number of process parameters at the time to optimize various responses. There is a lot of scope for effective multi objective optimization. In present study, we highlight the influences of input process parameters namely such

as wire feed, wire speed, pulse time on and pulse time off. etc. on process performances characteristics. For optimizing the process parameters for these composites, the authors aced by WEDM manufacturers is to continuously in the area of developing wire EDM wire electrodes that have high conductivity are environmental friendly and can undergo machining operations.

V. REFERENCES

[1]. Benedict, G.F., 1987, 'Electrical discharge wire cutting, non-traditional manufacturing processes', 234-235.

[2]. Lin, JL, Wang, KS, Yan, BH & Tarng, YS 2000, 'Optimization of the electrical discharge machining process based on the Taguchi method with fuzzy Logics', Journal of Materials Processing Technology, vol.102, pp.48-55.

[3]. Mohan, B., Rajadurai, A. & Satyanarayana, K.G. 2004, 'Electric Discharge machining of Al/Sicp Metal Matrix Composites Using Rotary Tube Electrode', Journal of Material Processing Technology, vol.153-154, pp.978-985.

[4]. Tosun, N., Cogun, C., 2004, 'A study on kerf and material removal rate in wire electrical discharge machining based on Taguchi method, Journal of material Processing Technology',152,316-322.

[5]. Chiang, K. T., & Chang, F.P. 2006, 'Optimization of the WEDM process of particle –reinforced material with multiple performance characteristics using grey relational analysis', Journal of Materials processing Technology, 180, 96-101.

[6]. Han, F., Yu, D., 2007, 'Influence of machining parameters on surface roughness in finish cut of WEDM', International Journal of Advanced Manufacturing Technology,34(5-6), 538-546.

[7]. Dubey, A.K., 2008, 'Multi-performance modeling and optimization control strategies for electro-chemical honing: a critical evaluation', International Journal of Advanced Manufacturing Technology, DOI: 1007/soo170-008-1477.

[8]. Manoj Singla, Lakhvir Singh & Vikas Chawla, 2009, 'Study of wear properties of al-sic composites', International Journal of advances in engineering and technology, vol. 8, no.10, pp.613-639.

[9]. Ali Riza Motorcu, 2010, 'The Optimization of Machining Parameters Using the Taguchi Method for Surface Roughness of AISI 8660 Hardened Alloy Steel', Journal of Mechanical Engineering, vol.56, issue 6, pp.391-401.

[10]. Muthu Kumar, V., Suresh Babu, A. & Venkatasamy, R., 2010, 'Optimization of the WEDM Parameters on Machining Inconel800 Super alloy with Multiple Quality Characteristcs', International Journal of Engineering Science and Technology, vol.2, no. 6, pp.1538-1547.

[11]. Garg R. K., Singh, K. K., Ojha K., & Singh S., 2010, 'Review of research work in EDM and WEDM on metal matrix composite materials' International Journal of manufacturing Technology, 50, 611-625.

[12]. Jong Hyuk Jung & Won Tae Kwon 2010, 'Optimization of EDM process for multiple performance characteristics using Taguchi method and Grey relational analysis', Journal of Mechanical Science and Technology, vol.24, issue 5, pp.1083-1090.

[13]. Kao, J.Y. 2010, 'Optimization of the EDM parameters on machining Ti-6Al-4V with multiple quality characteristics', International Journal of Advanced manufacturing Technology, vol.47, issue 1-4, pp.395-402.

[14]. Hsien–Ching Chen, Jen–Chang Lin, Yung-Kuang Yang & Chin–Hung Tsai, 2010, 'Optimization of wire electrical discharge machining for pure tungsten using a neural network integrated simulated annealing approach', Expert Systems with Applications, vol.37, issue 10, pp.7147-7153.

[15]. Chakradhar, D & Venu Gopal, A 2011, 'Multi-Objective Optimization of Electrochemical machining of EN31 steel by Grey Relational Analysis', International Journal of Modeling and Optimization, vol.1, no.2, pp.113-117.

[16]. Satish Kumar, D., Anburaj, R. &Arul, H., 2011, 'Investigation of wire electrical discharge machining characteristics of Al6063/SiCp Composites', International Journal of Advanced Manufacturing Technology, 56(9-12), 975-986.

[17]. Adarsh Kumar, K., 2012, 'Optimization of Surface Roughness in Face Turning Operation in Machining of EN-8', International Journal of Engineering Science & Advanced Technology', vol.2, issue 4, pp.807-812.

[18]. Ashok Kumar Sahoo, Arun Kumar Rout, 2012, 'Multi-Objective Optimization and Predictive Modeling of Surface Roughness and Material Removal Rate in Turning Using Grey Relational and Regression Analysis'. International Journal of Engineering, vol.4, issue 7, pp 45-58.

[19]. Boopathi, S., & Sivakumar, K. 2013. Experimental investigation and parameter optimization of wire-cut electrical discharge machining using multi-objective. International Journal of Advanced Manufacturing Technology,67, 2639-2655.

[20]. Garg, M.P., Jain, A., Bhushan, G., 2013. Multi-objective optimiztin of process parameters in wire electric discharge machining of Ti-6-2-4-2 Alloy, Arabian Journal for Science and engineering, 39, 1465-1476.

[21]. Nourbakhsh, F., Cao, J.2013. Wire electro discharge machining of titanium alloy. Procedia CIRP, 5, 13-18.

[22]. Goswami, A & Kumar, J. 2014. Investigation of surface integrity, material removal rate and wire wear ratio for WEDM of Nimonic 80A alloy using GRA and Taguchi method. Engineering Science and Technology, An international Journal, 17, 173-184.

[23]. Zhang, Z., Chen, Z. & Huang, Y., 2015, Optimization of process parameters on surface integrity in wire electrical discharge machining of tungsten tool YG15. The International Journal of Advanced Manufacturing Technology.

[24]. Dabade, U. A.,& Karidkar, S.S.,2016. Analysis of response variables in WEDM of Inconel 718 using taguchi technique. Procedia CIRP, 41,886-891.

[25]. Singh, T., Mishra, J.P., 2016, Experimental investigation of influence of process parameters on MRR during WEDM of Al6063 alloy. Materials Today: Proceedings.

Cite this article as :

Dhananjay Verma, Lokesh Singh, Sushil Kumar Maurya, "A Review on Different Process Parameter in Wire Electric Discharge Machining",International Journal of Scientific Research in Mechanical and Materials Engineering (IJSRMME), ISSN : 2457-0435, Volume 5 Issue 2, pp. 39-43, March-April 2021. URL : https://ijsrmme.com/IJSRMME21524