FABRICATION OF ELECTRIC DISCHARGE MACHINE WITH LOW COST DEVICES

R. Aditya[1], Ch. Hema latha[2], K. Nikhila[2], Sabana[2], K.V.S.S Divya[2]

1. Assistant Professor, Department of Mechanical Engineering, Vignan's Institute of Engineering for Women, Visakhapatnam, India
2. B.Tech. student, Vignan's Institute of Engineering for Women, Visakhapatnam, India.

Corresponding autor mail ID: adityavardhan158@gmail.com

AbstractThe key objective of our work is to fabricate a simple electric discharge machine. Electric discharge machining (EDM) is a thermoelectric author removal process extensively used for die manufacturing in the industry. It removes metal by discharging an electric current across a narrow, dielectric-filled gap between the tool and the workpiece. Basically, we are preparing a tabletop Electric discharge machine (EDM). The current machine is expected to be manufactured at a lower cost than other models. There are many machining parameters like discharge current, pulse duration, pulse interval, gap control, flushing rate, input power, etc. that are considered in EDM processes. It is not easy to consider all parameters to prepare a model, and based on this system, input parameters such as pulse on time, pulse off time, single point SS cutting tool, and circular SS rod cutting tool are considered for experimentation. In this model, the metal removal rate depends on the tool shape of the electrode. It is known that the MRR depends on the volume of material removed per unit of time. Due to this reason, the MRR is greater in circular SS rod. The system is user-friendly and home-made and can be easily operated by an average operator, which leads to less electrode wear, a better metal removal rate, and a good surface finish. This model is best suited for gap analysis, parameter experiments, etc.

1. Introduction

EDM is a proven processing method for the manufacturing of geometrically complicated and/or hard material parts, which by traditional machining methods are extremely difficult to operate. The company's production method for complex shapes and narrow apertures with high accuracy is one of the most popular and widely accepted methods. Kuniedaa and Kitamuraa [1] described about the gap phenomena of EDM in deionized water and oil were observed using a high-speed video camera. It was found that the discharge locations were dispersed more widely in water than in oil, and that the material removal volume per single pulse discharge was the same both in water and oil.

Thangaraj et al [2] described about EDM process is widely used for orthodontic technology and easily machined using titanium alloy. In the EDM process, the workpiece and tool electrode must be separated by a continuous air gap to generate discharge energy. The developed mechanical setup consists of a linear action movement with zero backlash along the X-axis, which can be controlled up to 0.03 mm. Kunieda and Kitamura [3] describes about an electrical discharge machining (EDM)

process, work-piece materials are gradually removed by thermal energies through a series of discharging pulses in a gap between electrode and work piece. The distance between the two is in proportion to gap servo-voltage, which is from a few micrometers up to tens of micrometer. A number of researches have shown that gap servo voltage is a crucial para-meter in machining rate and the most influential factor on sensitivity of EDM Tool.

Kumar et al. [4] gave details about the present work investigates the phenomenon of electrical discharge machining (EDM) process for different dielectric conditions. The results show that the conductive powder mixed EDM process is more stable and is able to generate better surface topography compared to other processes. The average interelectrode gap was measured as 0.05 mm, 0.1015 mm, and 0.1392 mm, and mean sizes of bubble diameter were observed as 0.1583 mm. Kitamura et al. [5] describes observation of the EDM gap phenomena through the transparent electrode from the direction normal to the discharge surface using a high-speed video camera. The image showed a brown area at the centre and blue area in the circumferential area, corresponding to the molten region in the transparent electrode and the plasma region, respectively. Yilmaz et al. [6] paper introduced a user-friendly intelligent system for the selection of electro discharge machining (EDM) parameters, based on expert rules obtained from experimental results and extracted from the knowledge of skilled operators. The system uses fuzzy-expert rules, triangular membership functions for fuzzification and centroid area method for defuzzification processes. Micro-electrical discharge machining (micro-EDM) is one the most efficient technologies among the nonconventional machining technologies for producing micro-components. Micro-EDM is able to machine tough die materials which cannot be machined by micro-milling. Hourmand et al. [7]. The micro-EDM method has the capability to machine electrical conductive materials with various hardness, strength, and temperature-resistant and complex shapes with accurate dimensions and fine surface roughness.

2. Fabrication of EDM

We are developing a low-cost EDM device that functions similarly to die-sinking EDM. This method is comparable to die-sinking EDM. A work piece and an electrode will be present. Dielectric fluid is poured over the work piece. The electrode and work piece will also have a power source. The electrode is connected to the negative terminal, and the workpiece is connected to the positive terminal. The connection causes a spark to form between the electrode and the workpiece when the electrode approaches it. Metal removal occurs as a result of that persistent spark.

Cut a piece of wood that is about 8 inches long, screw it to the centre of the drawer slide, measure the size of the end pieces of wood, drill a hole in the centre of each end cap, screw a wingnut

block to the end of the 8-inch block, and cut a piece of wood that is 4 inches long, screw it to the top of the 2 feet back piece. Thread the rod through the hole after attaching two nuts and two washers to it. To stop the threaded rod from moving up and down, lock the nuts together and tighten them against the top and bottom of the wood. One more piece of wood should be cut to eight inches and screwed.Cut another piece of wood eight inches long and screw it to cover the nylon nuts and act as a base to attach the working tool.The plastic storage container should be put beneath the EDM machine. Make a hole in the container's side with a drill. From the inside, insert a PVC elbow with the pointed end facing up. Cut a piece of PVC tubing that is long enough to extend past the bench's edge and insert it into the plastic container's elbow. Garden hoses should have the shutoff valve on one end and the water pump on the other. Put the nozzle on the valve's end. In the 5-gallon bucket, put the water pump, and fill the PVC with 4–5 gallons of distilled water.

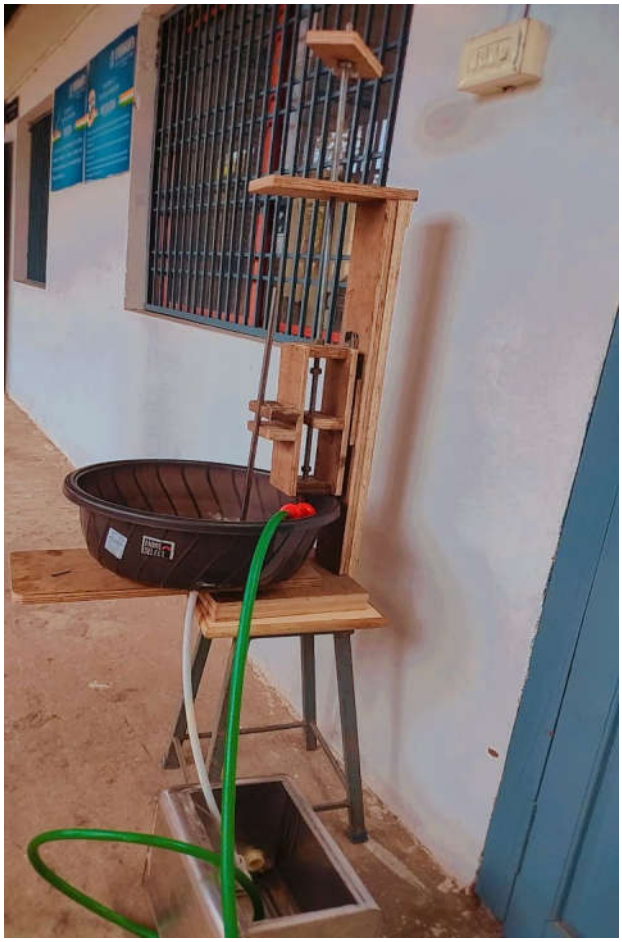

Fig. 1 Fabrication of Electric Discharge Machining

3. Conclusions

- EDM is fabricated to tabletop size with few components that are very cheap.

- The total cost of the machine is under 5000 Rupees.
- The machining process is tested and it is observed that operation is smooth with no stoppages.

References

1. Masanori Kuniedaa, Tomoo Kitamuraa, "Observation of difference of EDM gap phenomena in water and oil using transparent electrode". The University of Tokyo, 7-3-1, Hongo, Bunkyo-ku Tokyo 113-8656, JAPAN.

2. Muthuramalingam Thangaraj , Khaja Moiduddin, and Abdulrahman M. Al-Ahmari, School of Mechanical Engineering, Xijing University, Xi'an 710123, China, Advanced Manufacturing Institute, King Saud University, Riyadh 11421, Saudi Arabia; "Influence of Adaptive Gap Control Mechanism and Tool Electrodes on Machining Titanium (Ti-6Al-4V) Alloy in EDM Process".
3. Masanori Kunieda, Tomoo Kitamura, "Improving EDM performance by adapting gap servo-voltage to machining state".

4. Amit Kumar1 & Amitava Mandal1 & Amit Rai Dixit1 & Deepak Kumar Mandal1, "Quantitative analysis of bubble size and electrodes gap at different dielectric conditions in powder mixed EDM process". Received: 16 June 2019 /Accepted: 9 March 2020 # Springer-Verlag London Ltd., part of Springer Nature 2020

5. T. Kitamuraa, M. Kuniedab*, K. Abec, "High-speed imaging of EDM gap phenomena using transparent Electrodes". The University of Tokyo, 7-3-1, Hongo, Bunkyo-ku Tokyo 113-8656, JAPAN Nippon Steel Materials Co., Ltd., 5319, Yohdo Torii-town Saitama 369-1201, JAPAN* Corresponding author. Tel.: +81-3-5841-6462; fax: +81-3-5841-1952.E-mail address: kunieda@edm.t.u-tokyo.ac.jps

6. Oguzhan Yilmaz a,b,∗, Omer Eyercioglu b, Nabil N.Z. Gindy, "A user-friendly fuzzy-based system for the selection of electro discharge machining process parameters". A School of Mechanical, Materials and Manufacturing Engineering, The University of Nottingham, University Park, Nottingham NG7 2RD, UK b Faculty of Engineering, Mechanical

Engineering Department, University of Gaziantep, 27310 Gaziantep, Turkey. Received 28 May 2005; accepted 26 September 2005

7. Mehdi Hourmand, Ahmed AD Sarhan, Mohd Sayuti, “Micro-electrode fabrication processes for micro-EDM”.

8. Y. Zhang, Z.C. Chen, L.M. Lin, Z. Yuan, The research on the neurofuzzy network control strategy for electrical discharge machining process, in: 5th International Conference on Progress Machining Technology (ICPMT 2000), Progress of Machining Technology—With Some Topics in Advanced Manufacturing Technology, September 16–20, 2000, pp. 440–445.

9. J.L. Lin, K.S. Wang, B.H. Yan, Y.S. Tarng, Optimization of the electrical discharge machining process based on the Taguchi method with fuzzy logic, J. Mater. Process. Technol. 102 (2000) 48–55.

10. O. Yilmaz, O. Eyercioglu, T. Dereli, A fuzzy expert system for selection of electro discharge machining parameters, in: 2nd International Conference on Design and Production of Dies and Molds, Kuasadasi, Turkey, 200.

11. Saito N, Kobayashi K (1967) Machining principle and characteristics of electric discharge machining. Mitsubishi Denki Giho 41(10):1222–1230. (In Japanese).

12. Leao, F. N., Pashby I. R, 2004. A review on the use of environmentally friendly dielectric fluids in electrical discharge machining. Journal of Materials Processing Technology, 149, 1-3. 341-346.

13. W.Konig, and R.Wertheim, "Material Removal and Energy Distribution in Electrical Discharge Machining", AImals CIRP, (1975)95-100

14. W.W.Fan,"EDM Characteristic of the SiC Particles Reinforce Aluminum Matrix Composite", Masters Thesis, National Centeal University, Taiwan, (1993).

15. Kitamura T., Kunieda M., 2015. Observation of relationship between bubbles and discharge locations in EDM using transparent electrodes. Precision Engineering, 40, 26-32

16. Y.Mukoyama, "The Mechanism of Electric-Discharge Machining", Bull JSPE, (1968)288-295.

17. Roy, A.K.; Kumar, K. Effect and Optimization of Machine Process Parameters on MRR for EN19 & EN41 Materials Using Taguchi. Procedia Technol. 2014, 14, 204–210.

18. Tang, L.; Du, Y.T. Experimental Study on Green Electrical Discharge Machining in Tap Water of Ti–6Al–4V and Parameters Optimization. Int. J. Adv. Manuf. Technol. 2013, 70, 469–475.

19. Selvarajan, L.; Narayanan, C.S.; Jeyapaul, R. Optimization of EDM Parameters on Machining Si3N4 -TiN Composite for Improving Circularity, Cylindricity, and Perpendicularity. Mater. Manuf. Process. 2016, 31, 405–412.

20. Peças P, Henriques E (2008) Effect of the powder concentration and dielectric flow in the surface morphology in electrical discharge machining with powder-mixed dielectric (PMD-EDM). Int J Adv Manuf Technol 37:1120–1132