A REVIEW ON GOVERNING PARAMETERS OF ELECTROCHEMICAL MACHINING

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Abstract

Electrochemical machining is an advanced machining technique that possess an ability to machine complex shapes and also very difficult to machine surfaces. The processparameters in ECM play an important role in obtaining higher Material removal rate. In this present review paper, the parameter that governs the electrochemical machining process has been regarded as the topic of interest and also their effect on Material removal rate.

Keywords- Electrochemical machining, Electrolyte concentration, electrochemical micromachining, Material removal rate, tool vibration, Voltage, Current density.

1. Introduction

In today's era, there is the advancement in the technology and due to advancement in the technology; the manufacturing sector is rapidly growing and hence now the complex designs and products can thus be easily manufactured. The drawbacks or disadvantages of the conventional manufacturing techniques are now overcome by means of the non-conventional manufacturing techniques. The Electrochemical machining technique is one of the non-conventional manufacturing techniques. The ECM technique is generally the reverse of the electroplating. It is based on the controlled anodic dissolution of the work piece and this anodic dissolution is governed by means of the Faraday's law of electrolysis. This technique is able to overcome the disadvantages of the conventional manufacturing techniques as in ECM technique there is no direct contact in between the tool and the work piece rather there is small gap which is always maintained between the tool and the work piece during the feed. The stresses generated due to the direct contact in case of the conventional manufacturing techniques can easily be overcome by this technique. Also the problem of the tool wear can also be overcome by means of this non conventional technique.The papers reviewed are shown in Table 1.

S.No	Publication	Reported by	Study presented in the papers	Conclusion

1.	**ELSEVIER**	J. Munda [1]	**Influence of tool vibration on machining performance in electrochemical micromachining of coppe[i]r**	• It was found that by introducing the tool vibration in Hertz range, improves the MRR and better accuracy in machining a work piece surface could be achieved.
2.	**IJESRTInternational Journal of engineering sciences and research technology**	Gaurav Soni [2]	**Effect of various process parameters on MRR on Mild Steel in ECM**	• As the electrolyte concentration increases, the MRR also increases. • Out of stainless steel, copper and aluminium as the tool, the copper electrode is found out to be giving good results. • In the experiment it has been found that by increasing the current density the MRR also increases.

3.	**World congress on engineering (conference paper) WCE 2009, July 1-3, London,UK**	Dr. I.K. Chopade [3]	**Effect of voltage Variation on MRR for Stainless steel EN series 58A (AISI 302B)in Electrochemical Machining**	• The inter- electrode gap and machining voltage was taken into consideration to study the effect on MRR considering other parameters constant. • It was found that keeping the inter electrode gap constant when the voltage was increased then the MRR also increased. • The experimental result i.e. machining voltage equivalent to 45 volts gave an appreciable amount of MRR.

4.	**IJMMME International Journal of Mining, Metallurgy & Mechanical Engineering**	Andi Sudiarso [4]	**MRR on Electrochemical machining of brass, Stainless Steel and Aluminium using Brass Electrodes**	• It was found that as the diameter of the tool electrode was increased; the average steady current increased and hence MRR also increased. **Experimental values:** • **For 2mm brass electrode the MRR of the Stainless steel and aluminium is 2.54*10^-4g/s and 7.9*10^-5 g/s respectively.** • **For 6mm brass electrode the MRR of the SS and Aluminium is found to be 5.74*10^-4 g/s and 2.53*10^-4 g/s respectively.**
5.	**International Journal of Applied Science and Engineering**	G. Ganesan [5]	**Influence of input Parameters on Characteristics of Electrochemical Machining Process**	• Due to increase in the parameters such as tool feed rate and applied voltage; the current density increased that resulted in an increase in **Material removal rate.** • Also with the increased electrolyte concentration and flow rate; there is the increase in the mobile ions due to which the speed of the chemical reaction increases and hence leading to increased **Material removal rate.**
6.	**Chinese Journal of Aeronautics**	Qu Ningsong [6]	**Wire Electrochemical machining with axial electrolyte flushing for titanium alloy**	• WECM with the axial electrolyte flushing is favourable machining process for fabrication of titanium alloy. • The most important machining parameters for wire ECM with axial electrolyte flushing are the wire feed rate, working voltage, electrolyte concentration, nozzle-work piece distance and electrolyte flow rate. The optimized values for above parameters for machining are **2.5% Nacl+ 2.5% $Nano_3$, 5mm nozzle-work piece distance, 87 m/s electrolyte flow rate, 18V working voltage and 1.8 mm/min wire feed rate**. • The multi wire ECM could increase the machining productivity of the wire ECM.

7.	**Chinese journal of Aeronautics**	Zhu Di [7]	**Experimental Research on Electrochemical machining of titanium alloy Ti60 for a blisk**	• The frequency of the pulsed power supply and the temperature of the electrolyte are the two parameters that tend to affect the surface roughness during the ECM of the Ti60 titanium alloy**.** • At frequencies above 400Hz; the surface finish being achieved is better and hence realizing the advantage of the pulsed ECM. • At an electrolyte temperature of more than 50^0C ; the surface quality of the titanium alloy tends to deteriorate and hence leading to higher surface roughness. • The optimized parameters obtained for the ECM of the titanium alloy are: Nacl conc. -13wt% Voltage- 20V Frequency- 0.4Khz Duty cycle -0.3 Temperature- 23^0C Feed rate-0.5mm/min **Above optimized parameters can Yield a better surface finish up to 0.912 micrometer**. • The optimized parameter has led to the successful manufacturing of the blades of the Ti60 alloy blisk, managing a surface roughness of 1.019 micrometer (approx.).

8.	**ELSEVIER**	Peng Qin [8]	**Electrochemical machining of high temperature titanium alloy Ti60**	• When the anodic polarization curve and the open circuit potential of Ti60 Using the **sodium nitrate** and **sodium chloride** electrolyte was obtained; it was found that sodium chloride electrolyte possessed more active ions that can chemically interact with the oxide layer. Hence, the electrochemical machinability obtained was better. • It was seen that **electrolyte concentration** and **temperature** are also an important factors. • The electrolyte concentration tends to affect the **dissolution voltage and transpassive behaviour.** • A high concentration of the electrolyte is essential in **order to remove or destroy the oxide layer effectively and hence stabilizing the dissolution.** • Maintaining the electrolyte temperature under 30^{o} C; the **Dissolution potential (E_{Diss}) increases**. • It was also found that the current density more than at least 20 A/cm^2 was required in order to obtain a good stability, Efficiency & quality. • The machining rate is more than **1.2mm/min** for the channel ECM and the machining accuracy of the blade profile is **0.05-0.07mm** with the surface roughness equal to **0.6 micrometer**.

CONCLUSION

Primarily it was found by the researches that the electrolyte concentration influenced the material removal rate. Hence, by obtaining the favourable concentration of the electrolyte one can easily achieve the higher MRR.The parameters such as tool feed rate and the applied voltage also plays a vital role in increasing the MRR.

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