Experimental Investigation of Machining Parameter in Electrochemical Machining

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Abstract -. *Electrochemical Machining (ECM) is a non-traditional machining process belonging to electrochemical category. Electrochemical machining is a metal machining technology based on electrolysis where the product is processed without contact and thermal influence. The present work has been undertaken to search out the optimum material removal rate, surface roughness and overcut by chemical dissolution of an anodically work piece (Aluminum) with a copper conductor of the hexagonal shape cross section tool. Experiments were conducted to analyze the influence of machining parameters like feed rate, voltage and current, flow pressure. It's discovered that the voltage is the most important part of material removal rate and surface roughness. The results of the experiment show the material removal rate will increase with increasing voltage and reduced the initial gap. The results of the experiment also show the optimum material removal rate.*

Key Words: Electrochemical Machining (ECM), Material removal rate (MRR), Surface roughness.

1. INTRODUCTION

Electrochemical machining is a special type of non-traditional machining process. Electrochemical machining (ECM) is a method based on electrical & a chemical procedure for removing metals in mass productions. Electrochemical Machine is developed for hard material, although any character of fabric can be machined. Electrochemical machining is an electrochemical process it is a combination of electrical and chemical process. It's a basic phenomenon of electrolysis, whose law was made by Faraday in1833.In 1950 there was first incident is occurring ECM obtained for shaping high strength alloys. At that time of 1990s, ECM employed in many ways. The working principle is anodic dissolution in which the work piece as the anode and the tool as cathode. Conventionally positively charged particles are attracted move to the cathode and negative particles are attached towards to the anode. And thus the flow of current is initiated in the electrolyte. Both electrodes are immersed in the electrolyte and electrical applied to these electrodes. The electrical conduction is achieved through the movements of ions between the anode and cathode through the electrolyte. The current is passed through the system of arrangements will cause the dissolution of a node. This process of electrolysis is working based on Faradays law of electrolysis. The aim of the present work is to find the responses, their interaction with input variables, and to find a combination of input variables to find the optimum value of the response variables using hexagonal shape electrode on aluminum as work piece in sodium nitrate. Experiments are to be conducted to understand the influence of the various ECM parameters on MRR. This research mainly concentrates on finding optimum ECM process parameters to achieve maximum MRR. The parameters subjected to the study are 1) Machining Voltage, 2) Machining Current, 3) Flow Pressure, and 4) Feed Rate.

Table -1: Machining Parameters and their levels

Parameter	Range
Voltage	0-25V
Current	5-300A
Feed Rate	(0-99) x0.03 mm/min
Flow Pressure	0-100%

2. EXPERIMENTAL WORK

In our experiments we have taken constant parameter like machining time are 10 minutes & electrolyte concentration 25%/liter.

Sr. No	Voltage	Current	Feed Rate	Pressure	MRR	Cut (Z)
1	20	150	0.15	80	0.40	0.856
2	20	150	0.15	70	0.40	0.821
3	20	150	0.15	60	0.40	0.845
4	18	150	0.15	80	0.06	0.854
5	22	150	0.15	80	0.04	0.772
6	24	150	0.15	80	0.6	0.842
7	22	160	0.15	80	0.31	0.794
8	22	170	0.15	80	0.26	0.844
9	22	200	0.15	80	0.14	0.740
10	22	230	0.15	80	0.16	0.742
11	22	260	0.15	80	0.10	0.702
12	22	290	0.15	80	0.20	0.819
13	24	250	0.3	95	0.32	1.620
14	24	250	0.45	98	0.51	3.287

15	25	290	0.36	100	0.29	2.378
16	24	220	0.15	100	0.08	0.265
17	25	280	0.24	100	0.20	1.419
18	10	50	0.06	80	0.04	0.21

3. RESULT AND DICUSSION

3.1 EFFECT ON MRR

The machining of ECM depends on the electrical conductivity of the electrolyte, feed rate of tool, inter electrode gap (IEG) and electrolyte flow rate. The tool feed rate has an enormous effect on MRR and it increases with increase in feed rate. This result was obtained because the material removal rate increases with feed rate because the machining time decreases.

MRR also increases with a larger diameter of the tool; however, the effect is less than the feed rate on MRR. The electrolyte flow rate and conductivity have very little effect on MRR and doesn't give any conclusive evidence of any impact on MRR.

3.1.1 EFFECT OF FLOW RATE ON MRR

This effect represents the MRR during changing the electrolyte flow rate or pump pressure during the operation. During the operation we have constant parameters like voltage, current; machining time, feed rate, the electrolyte flow rate has very little effect on MRR and doesn't give any conclusive evidence of any impact on MRR. Below the graph represents the effect on MRR.

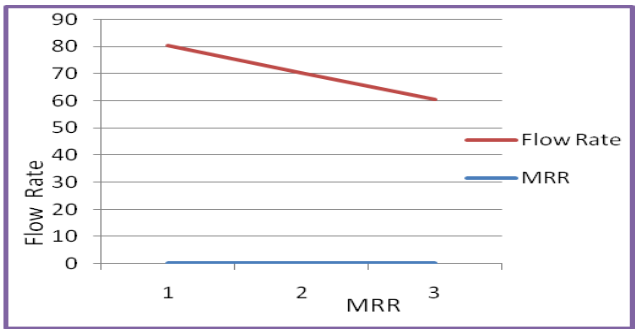

Chart-1: Effect of flow rate on MRR

3.1.2 EFFECT OF VOLTAGE ON MRR

This effect represents the MRR during changing the voltage during the operation. During the operation we have constant parameters like flow rate, current, machining time, feed rate, The voltage has very major effect on MRR and give conclusive evidence of impact on MRR. Below the graph represents the effect on MRR.

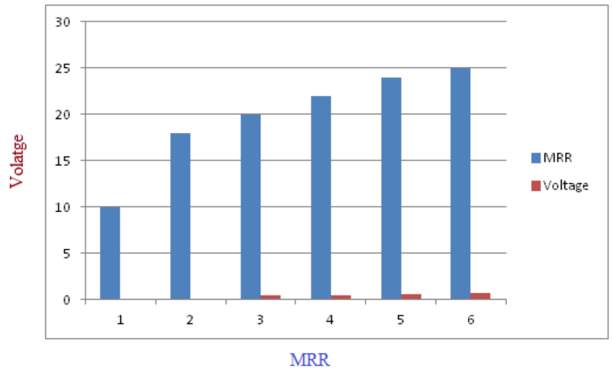

Chart-2: Effect of Voltage on MRR

3.1.3 EFFECT OF CURRENT ON MRR

This effect represents the MRR during changing the current during the operation. During the operation we have constant parameters like voltage, flow rate, machining time, and feed rate. The current has very little effect on MRR and doesn't give some approximately conclusive evidence of any impact on MRR. Below the graph represents the effect on MRR.

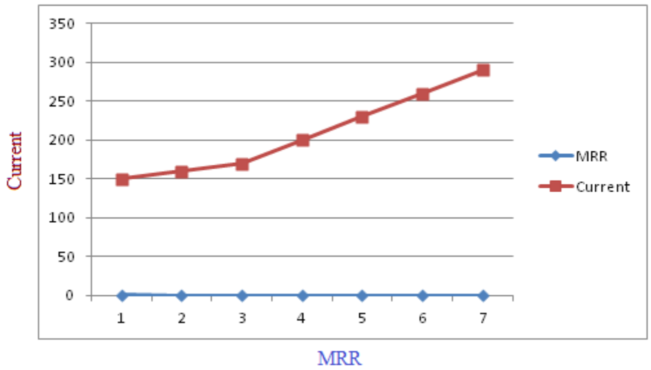

Chart-3: Effect of current on MRR

3.1.4 EFFECT OF FEED RATE ON MRR

This effect represents the MRR during changing the feed rate during the operation. During the operation we have constant parameters like voltage, flow rate, machining time, and current. The feed rate has very grater effect on MRR and because it works to increase with time so it give major conclusive evidence of impact on MRR. Below the graph represents the effect on MRR.

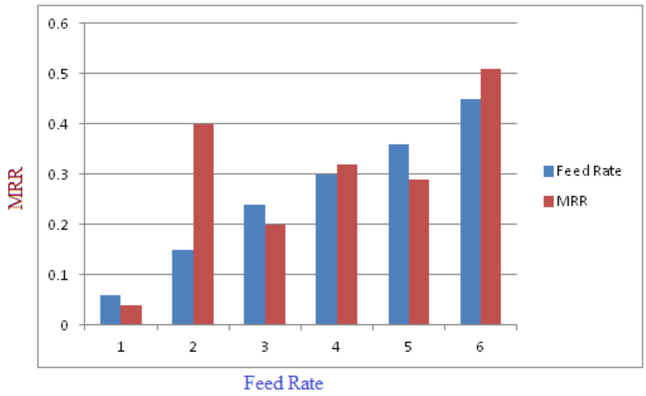

Chart-4: Effect of feed rate on MRR

3.1.5 OPTIMUM MRR

This graph is plotted on the optimum MRR. In the varying parameters give better surface finish and gives more MRR.

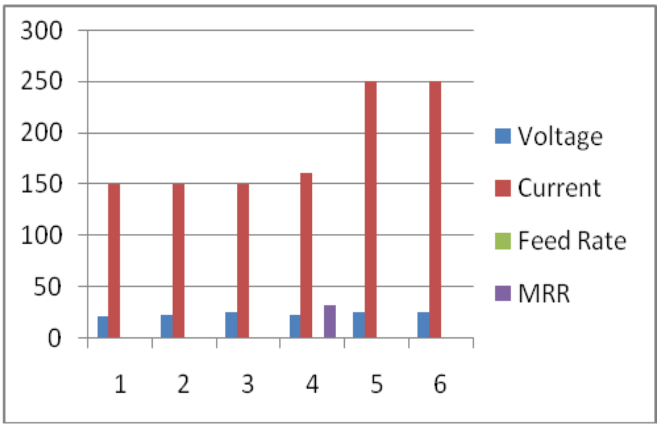

Chart-5: Optimum MRR

Optimum Parameters are

Voltage = 22V

Current=250A

Feed Rate = 0.45 mm/min

Flow Rate = 80%

3.2 CHEMICAL EFFECT

While machining the chemical effect is the most and common problems on the ECM. In the running condition of the machine the outer material will be chemically affected through the electrolyte.

Fig-1: Chemical effect during machining

Fig-2: Chemical effect after machining

Fig-3: Chemical effects after machining on clamping

3.2.1 PREVENTION OF CHEMICAL EFFECT

- ✓ Before every operation check the clamping is proper. And always use tight clamping.
- ✓ The electrolyte will be heating up use exhaust in electrolyte chamber it will cool down.
- ✓ Suddenly we give the input parameter in the machine means the parameter that we are given in the machine they are proportionate.

- ✓ Check the tool before use and cleanup it outer and inner part because every tool has groove it was affected by moisture.
- ✓ Always use proportional parameters in the machine.

4. CONCLUSION & FUTURE SCOPE

The surface roughness are affected by tool feed rate to the greater extent followed by electrolyte flow rate and applied voltage. At low feed rates, irregular removal of material is more likely to occur to affect surfaces. It is unknown what methodology to be used and which electrolyte should be used for a particular metal choice with researchers focusing only on one metal or alloy to determine ideal machining parameters. If a new material were to be machined, extensive research to establish a suitable electrolyte along with appropriate machining parameters to be done. At present, there is no scientifically based methodology to justify the use of the specific electrolyte solution, IEG distance and machining conditions, especially for the needs of the micro manufacturing application of ECM technology. It was also found that suitable voltage selection is important for achieving effective results in electrochemical machining. The results represent machined depth increased and the material removal rate also increased by using an acidic electrolyte and a high voltage. Gas bubbles generated in a small gap between the electrodes is a barrier to the current flow is preferred for better accuracy and precision.

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