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REVIEW ARTICLE

THEORETICAL ANALYSIS AT ELECTROCHEMICAL MACHINING WHAT THE CURRENT REQUIRED WHEN WE KNOW THE MATERIAL REMOVAL RATE

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ABSTRACT

This study shows that the behavior of a Electrochemical metal cutting in electrochemical machining process. Study find out the a particular current required for a given Material Removal Rate. The Simple CNC PROGRAM makes the machine semi -automatic.

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INTRODUCTION

In Electrochemical machining when we use the computer numeric control machine, we use the following computer program to give the material, material removal rate valency, density of the material the machine set directly on a particular current in Ampere. Here we remove the metal therefore for metal all valences are positive. Other parameters like chemical solution depends on metal material which want to cut. The temperature of the chemical solution is depends on the current supplied therefore the current is very important parameter to adjust for metal cutting process in electrochemical machining process. Here we take different material like Fe, Al, Mg, Cu, Ag, Au . we know the atomic number valency and density of that material they are fixed in Mendsleaf Periodic table.

Theory- For metal cutting in Electro chemical machining the metal removal rate is depends on atomic number , current , velency , and density

We know that MRR = A X I/ F X D X V

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Where MRR = material removal rate

A= Atomic number of the material

I = current supply to the solution from the electro chemical machine

V = valency of the metal

D= density of the metal

F= faraday constant = 96500

In our study we want to calculate the current therefore we adjust the formula like

I = MRR X F X D XV/ A

We know that for every metal the valency , atomic number and density are constant .Some metal shows two valences. Here we take both in my analysis.

Results and calculation-For above we take one by one of these material and study

1st material Iron (Fe)

Atomic number = 56, valency= 2, 3 Density = 7.5 gm/cc

Faraday number = 96500, MRR = material removal rate
Formula used

I = MRR X F X D XV/ A

When valency = 2

Then revised formula is

I = MRR X 96500X 7.5 X2/ 56 = (1447500/56) X MRR

I = 25848.22X MRR

When valency = 3

I = (96500 X 7.5 X3 / 56) X MRR

= 38772.32 X MRR

Table 1. Calculation of current For Iron (Fe 2,3)

S.no	Material removal rate (cc/sec)	Valency 2 Current Required (Amp)	Valency 3 Current Required (Amp)
1	$1 X 10^{-3}$	25.84	38.77
2	$5 X10^{-3}$	129.24	193.86
3	$10 X10^{-3}$	258.48	387.72
4	$15 X10^{-3}$	387.72	581.59
5	$20X10^{-3}$	516.97	775.45
6	$25X 10^{-3}$	646.21	969.31
7	$30 X 10^{-3}$	775.45	1163.17
8	$35 X10^{-3}$	904.69	1357.03
9	$40 X 10^{-3}$	1033.93	1550.89
10	$45 X 10^{-3}$	1163.17	1744.76

Result- Here we set different material removal rate in cubic centimeter per second for Iron have valences 2 and 3 From table we conclude that

- We see that if we increase 2 times MRR the current is also Increase 2 times e.g $20X10^{-3}$ /10 $X10^{-3}$ = 2 and 516.97/258.48 =2
- If valency ratio is 1.5 then current is also increase by 1.5 times

2nd For Aluminum (AL)

Atomic number = 13, valency= 3 Density = 2.7 gm/cc
Faraday number = 96500, MRR = material removal rate

I = (96500 X 2.7 X3 / 13) X MRR

= 60126.92 X MRR

Table 2. calculation of current For Aluminum(Al 3)

S.No.	Material removal rate (cc/sec)	Valency 3 Current Required (Amp)
1	0.001	60.126
2	0.005	300.64
3	0.010	601.27
4	0.015	901.90
5	0.020	1202.54
6	0.025	1503.17
7	0.030	1803.8
8	0.035	2104.44
9	0.040	2405.077
10	0.045	2705.71

Result-Here we set different material removal rate in cubic centimeter per second for Aluminum have valencey 3 From table we conclude that we see that if we increase 2 times MRR the current is also Increase 2 times e.g $20X10^{-3}$ /10 $X10^{-3}$ = 2 and 1202.54/601.27 =2

3rd For Magnesium (Mg)

Atomic number = 12, valency= 2 Density = 1.74 gm/cc
Faraday number = 96500, MRR = material removal rate

I = (96500 X 1.74 X2 / 12) X MRR

=27985 X MRR

Table 3. Calculation of current For Magnesium (Mg2)

S. No.	Material removal rate (cc/sec)	Valency 2 Current Required (Amp)
1	0.001	27.99
2	0.005	139.93
3	0.010	279.85
4	0.015	419.78
5	0.020	559.7
6	0.025	699.63
7	0.030	839.55
8	0.035	979.48
9	0.040	1119.4
10	0.045	1259.33

Result-Here we set different material removal rate in cubic centimeter per second for Aluminum have valencey 3 From table we conclude that we see that if we increase 2 times MRR the current is also Increase 2 times e.g $20X10^{-3}$ /10 $X10^{-3}$ = 2 and 559.7/279.85 =2

4Th For copper (Cu)

Atomic number = 29, valency= 1, 2 Density = 8.96 gm/cc

Faraday number = 96500, MRR = material removal rate

When valency =1

I = (96500 X 8.96 X1 / 29) X MRR

= 29815.17 X MRR

When valency =2

I = (96500 X 8.96 X2 / 29) X MRR

= 59630.344 X MRR

Table 4 calculation of current For copper(Cu1, 2)

S. No.	Material removal rate (cc/sec)	Valency 1 Current Required (Amp)	Valency 2 Current Required (Amp)
1	0.001	29.82	59.63
2	0.005	149.08	298.15
3	0.010	298.15	596.30
4	0.015	447.22	894.46
5	0.020	596.30	1192.61
6	0.025	745.38	1490.76
7	0.030	894.46	1788.91
8	0.035	1043.53	2087.06
9	0.040	1192.61	2385.21
10	0.045	1341.68	2683.36

Result- Here we set different material removal rate in cubic centimeter per second for copper Cu have valences 1 and 2 From table we conclude that

- We see that if we increase 2 times MRR the current is also Increase 2 times e.g $20X10^{-3} /10 X10^{-3}$ = 2 and 596.30/298.1 =2
- If valency ratio is 2 then current is also increase by 2 times

5th For silver (Ag)

Atomic number = 47, valency = 1 Density = 10.49 gm/cc Faraday number

= 96500, MRR
= material removal rate
I = (96500 X 10.49 X1 / 47) X MRR
=21537.98 X MRR

Table 5. Calculation of current for silver (Ag 1)

S. No.	Material removal rate (cc/sec)	Valency 1 Current Required (Amp)
1	0.001	21.54
2	0.005	107.69
3	0.010	215.38
4	0.015	323.07
5	0.020	430.76
6	0.025	538.45
7	0.030	646.14
8	0.035	753.83
9	0.040	861.52
10	0.045	969.21

Result- Here we set different material removal rate in cubic centimeter per second for Silver Ag have valences 1 From table we conclude that

- we see that if we increase 2 times MRR the current is also Increase 2 times e.g

$20X10^{-3} /10 X10^{-3}$ = 2 and
430.76/215.38 =2

6Th For gold (Au)

Atomic number = 79, valency= 1,3 Density = 19.32 gm/cc

Faraday number = 96500, MRR = material removal rate
When valency = 1

I = (96500 X 19.32 X1 / 79) X MRR =23599.75 X MRR

When valency = 1

I = (96500 X 19.32 X2 / 79) X MRR =47199.5 X MRR

Table 6. Calculation of current Fo Gold (Au 1,2)

S. No.	Material removal rate (cc/sec)	Valency 1 Current Required (Amp)	Valency 2 Current Required (Amp)
1	0.001	23.6	47.2
2	0.005	118	236
3	0.010	236	472
4	0.015	354	708
5	0.020	472	944
6	0.025	590	1179.99
7	0.030	708	1415.99
8	0.035	826	1651.99
9	0.040	944	1887.98
10	0.045	1061.99	2123.98

Result- Here we set different material removal rate in cubic centimeter per second for Gold Au have valences 1 and 2 From table we conclude that

- we see that if we increase 2 times MRR the current is also Increase 2 times e.g $20X10^{-3} /10 X10^{-3}$ = 2 and 472/236 =2
- If valency ratio is 2 then current is also increase by 2 times

Conclusion- We conclude that

- if we increase the MRR double the Current required for electrochemical metal cutting is absolutely double.
- If for same metal cutting the current increase rate is same as we increase the valency
- Future scope we tested in practically in the electrochemical metal cutting and then make a simplified computer program (CNC) . then if we give the MRR to Computer numeric control Electrochemical machine, the machine adjust automatically current and cutting take place properly.

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