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SRB-cidal properties of some Cu-Mn alloys

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Three different copper-maganese alloys have been fabricated and tested for their antifouling properties in SRB cultures under static condition. Among the alloys experimented, the Cu-Mn alloy containing misch metal and gallium, besides being excellent antifoulant, acts as an efficient SRB-cide as well.

Key words: Microfouling, microbial corrosion, SRB-cide

INTRODUCTION

The ethic belief on the antifouling properties of copper and its alloys becomes quite controversial [1,2]. Hence the formulation and evaluation of newer and better antifouling alloys are being attempted for microfouling control. In general, the efficiency of an antifoulant is in proportion to its dissolution rate. The greater the dissolution, the greater will be the antifouling property. In contrast, the new alloys formulated, show good antifouling as well as SRB-cidal tendencies at very low rates of dissolution.

EXPERIMENTAL

Bacterial magnitude and metabolic activities like sulfide production and shifting of pH as well as potential have been monitored as already described [2]. Since there are some criticisms on the usage of culture media for microbial corrosion studies [3], the work has been carried out in 10% Postgate's (B) medium (in 90% seawater). Impedance behaviour of these alloys in sterile and SRB inoculated media has been studied with time using PARC Electrochemical system, Model No. 273. Composition of the alloys are presented in Table I.

TABLE–I: Composition of alloys

Alloy No.	Composition			Ga
	Cu	Mn	Misch metal	
No. 1	70	30.0	0	0
No. 2	70	29.0	1	0
No. 3	70	28.5	1	0.5

RESULTS AND DISCUSSION

Table II shows the changes in potential in mV, dissolution in mg, bacterigenic sulfide production in ppm and pH of the cells inoculated with SRB. It is clear that alloy No. 3 dissolves more quickly and reveals more negative potential in contrast to mild steel. In the case of mild steel, in sea water, negative shift in potential is directly proportional to the bacterial magnitude [4]. But as indicated in Table III, there is no bacteria surviving in the cells with alloy No. 3. It is remarkable that the alloy No. 2 shows almost a similar shift in potential (550 mV approximately) from the initial value, in which the bacterial magnitude is 10^3/ml. This result clearly exemplifies that besides microfouling, some other factors are also in operation in the shifting of OCP. Lack of pH shift towards alkaline side and comparatively little sulfide production in the case of alloy No. 3, which are well pronounced in other cases with a bacterial magnitude of 30^3/ml, clearly supports the SRB-cidal nature of the copper-maganese alloy with misch metal and gallium. The weight loss data receives support from the impedance value (R_p) of these alloys (Table IV). While comparing the R_p values of the alloys 1 and 3 in sterile medium, it is clear that the dissolution of the last alloy is least and that of the first alloy is the highest and a similar trend is observed in the cells with bacteria also.

TABLE–II: Changes in potential, pH, bacterigenic sulfide production in SRB inoculated cells with time

Alloy	OCP vs SCE (mV)		Dissolution (mg)	pH			Sulfide (ppm)	
	0hrs.	24 hrs.	30 days	4 hours	24 hours	120 hours	4 hours	24 hours
No. 1	-132	-540	0.06	7.0	7.4	7.8	Trace	64
No. 2	- 47	-600	0.60	7.0	7.2	7.7	Trace	58
No. 3	-122	-670	0.70	7.0	7.1	7.1	Trace	24

CONCLUSION

(i) In terms of the antifouling property, the results arrange

TABLE-III: Changes in the bacterial magnitude (Cells/ml)

Duration (hrs)	Alloy No.			
	Blank	1	2	3
4	10^1	10^1	10^1	10^1
6	10^1	10^1	10^1	10^1
24	10^3	10^3	10^3	10^0

these alloys in the Cu:Mn:Misch metal:Ga > Cu:Mn:Misch metal > Cu:Mn. (ii) The Cu-Mn alloy with misch metal and gallium is SRB-cidal in nature. (iii) The above said alloy brings about microbial mortality at very low dissolution rate.

TABLE-IV: Impedance behaviour of alloy in sterile and SRB inoculated media with time (in ohms)

Alloy No.	In sterile 10% Postgate (B) medium - instantaneous (R_p)	In 10% postgate (B) with 10^1 SRB/ml -instantaneous (R_p)	In 10% Postgate (B) with 10^1 SRB/ml -After 24 hours (R_p)
1	110	187	187
2	75	125	110
3	50	78	112

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