

Effect of sulfide ions on the corrosion behaviour of marine alloys in synthetic sea water

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The corrosion behaviour of 90 Cu-10 Ni, 70 Cu-30 Ni and monel in the presence of sulfide ions (10 ppm to 100 ppm) in synthetic sea water has been studied by DC polarisation method. In the case of 70 Cu-30 Ni and 90 Cu-10 Ni alloy, the corrosion rate is found to increase for sulfide concentrations greater than 10 ppm. But for monel, the presence of 10 ppm sulfide is found to increase the corrosion rate by 10 times. These studies have shown that there exists a critical concentration of sulfide ion for each alloy.

Key words: copper-nickel alloys, sea water corrosion, sulphide

INTRODUCTION

Copper-nickel alloys containing 10 or 30% nickel have been used extensively as condenser material. The Cu-Ni alloys have been found to have excellent corrosion resistance and have good resistance to biofouling [1]. However, most of the copper alloys undergo accelerated corrosion in the presence of sulfide or ammonia. Several recent surveys and reports [2-5] show the adverse effect of dissolved sulfide on copper alloy tubing and piping in service. In this present investigation, the corrosion behaviour of 70 Cu-30 Ni, 90 Cu-10 Ni and monel in synthetic sea water in presence of sulfide ion has been studied.

EXPERIMENTAL

Cu-Ni electrodes of 1 cm × 1 cm with stem exposing an area of 2 cm² were used. The stem was masked with araldite. The electrodes were polished with 120 emery wheel and degreased with trichloroethylene. Potentiodynamic polarisation measurements were carried out in a three electrode cell at a sweep rate of 1

mV/sec using potentiostat (PAR 173, USA), Universal Programmer (PAR 175, USA) and X-Y recorder (HP 7004B, USA). The potential of the electrode was measured with respect to SCE and platinum was used as an auxiliary electrode. Synthetic sea water and sulfide solutions were prepared using ANALAR chemicals in distilled water.

RESULTS AND DISCUSSION

Corrosion rates of Cu-Ni alloys have been obtained in the absence and presence of sulfide ion concentrations of 0 to 100 ppm in synthetic sea water by Tafel extrapolation methods. The results are given in the Table I. It can be seen that the corrosion potential is shifted towards more active direction for all Cu-Ni alloys with increase of sulfide ion concentrations. It indicates that addition of sulfide ion enhances the corrosion of copper alloy. It can also be seen from the Table that the corrosion rates of 90 Cu-10 Ni and 70 Cu-30 Ni increase with the increase in sulfide ion concentrations beyond 10 ppm. But in the case of monel, the corrosion rate is found to increase by 10 fold even in the presence of 10 ppm of sulfide ions.

TABLE-I: Effect of sulfide ions on corrosion of Cu-Ni alloys in synthetic sea water

Sl. No.	Sulfide ion concn. ppm	90 Cu-10 Ni		70 Cu-30 Ni		Monel	
		E_{corr} mV vs SCE	Corr. rate mppy	E_{corr} mV vs SCE	Corr. rate mppy	E_{corr} mV vs SCE	Corr. rate mppy
1.	0	-240	0.0443	-198	0.003706	-130	0.00239
2.	10	-242	0.05	-203	0.004633	-315	0.02415
3.	25	-265	0.0599	-317	0.003706	-325	0.02316
4.	50	-255	0.065	-323	0.003706	-365	0.01247
5.	100	-245	0.096	-430	0.003706	-390	0.02474

The addition of sulfide ion increases the corrosion rate of 90 Cu-10 Ni, 70 Cu-30 Ni alloys and monel. This may be due to the formation of cuprous sulfide film at the metal surface as a porous nonprotective corrosion product [2].

CONCLUSION

The presence of sulfide ion increases the corrosion rate of 90 Cu-10 Ni, 70 Cu-30 Ni alloys and monel markedly.

REFERENCES

1. T Gilbert, *Mat Perf*, **21**–2 (1982) 47
2. L E Eiselstein, B C Syrett, S S Wing and R D Caligimi, *Corr Sci*, **23** (1983) 223
3. E Francis, *Brit Corr J*, **20** (1985) 167 and 175
4. I P Gudas and H P Hack, *Corr*, **35** (1979) 259
5. M Eashwar, G Subramanian and P Chandrasekar, *Proc. Int. Seminar on SRB*, Feb. 20-22 (1988), Bombay