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Influence of Corrosion Inhibition by Surfactants

[1]M. Manivannan and [2]P. Patric Raymond,
[1]Department of Chemistry, Chettinad College of Engg & Tech, Karur, TamilNadu, India
[2]Department of Science, GHS, Dindigul, Tamil Nadu, India

Abstract– The Influence of N-cetyl-N, N, N-trimethylammonium bromide (CTAB) and sodium dodecylsulphate (SDS) on Inhibition efficiency (IE) and Ethylenediaminetetraacetic acid (EDTA) in controlling corrosion of carbon steel in natural sea water in the absence and presence of Zn (II) ion has been evaluated by biocidal study. The formulation consists of 250 ppm of EDTA, 50 ppm of Zn (II) and 50 ppm of CTAB shows IE 98% and 100 % biocidal efficiency (BE). The formulation consists of 250 ppm of EDTA, 50 ppm of Zn (II) and 50 ppm of SDS shows IE 97% and 100 % BE.

Keywords – *CTAB; SDS; EDTA; sea water*

I. INTRODUCTION

Microbial colonization of metals and alloys of industrial usage takes place through the formation of biofilms made of bacteria, extracellular polymeric substances (EPS) and mainly water. These biological deposits can drastically modify the corrosion behavior of structural metals and alloys enhancing localized alterations in the type and concentrations of ions, pH, and oxygen levels. However, biofilms also facilitate the formation of diffusion barriers to the exchange of chemical species from and towards the metal/solution interface. The problems due to biocorrosion and biofouling of industrial systems range from heavy microbiological contamination with consequent energy and efficiency losses to structural failures owing to corrosion. It must be emphasized that this assessment should be made for each industrial system, considering its previous history, present operational conditions, physicochemical composition of the intake water and the number and identity of microbial contaminants [1].

Zhao Kaili [2] investigated that the pipelines during and after hydro testing are vulnerable to microbiologically influenced corrosion (MIC), which can result in severe pinhole leaks. Rongjun Zuo [3] summarized the review on recent progress in microbial corrosion control using beneficial bacteria biofilms. Rajendran et al. [4] have evaluated the IE of sodium dodecylsulphate (SDS) in controlling corrosion of carbon steel immersed in the chloride environment. Sharma et al. [5] investigated that the inhibitive effect of N-cetyl, N,N,N-trimethylammonium bromide (CTAB) on acid corrosion of mild steel in sulphuric acid at different temperatures. Shanthy et al. [6] evaluated the IE of CTAB – Zn (II) system in controlling corrosion of carbon steel in well water. Jizhou Duan [7] has characterized the bacteria in the anaerobic biofilm on rusted carbon steel immersed in natural seawater by culturing and molecular biology techniques. The aim of the present study is to study the influence of biocides such as CTAB and SDS on IE of EDTA – Zn (II) system.

II. EXPERIMENTAL

A. Preparation of the carbon steel specimens

The carbon steel specimens (0.026% S, 0.06% P, 0.4% Mn, 0.1% C and rest is Fe) of the dimensions 4.0 x 1.0 x 0.2 cm were polished to a mirror finish and degreased with trichloroethylene.

B. Zobell medium

The Zobell medium was prepared by dissolving 5 g of peptone, 1 g of yeast extract, 0.1 g of potassium dihydrogen phosphate and 15 g of agar-agar in 1 L of double distilled water. The medium was sterilized by applying 15 pounds per square inch for 15 minutes in an autoclave.

C. Biocidal efficiency of the system

The EDTA – Zn (II) formulation that offered the best IE was selected. The BE of biocides such as CTAB and SDS was determined. The various concentrations of CTAB and SDS namely 50 ppm, 100 ppm, 150 ppm, 200 ppm and 250 ppm were added to the formulation consists of the inhibitor system. Polished and degreased carbon steel specimens in triplicate were immersed in these environments for a period of three days. After three days 1 mL each of test solutions from the environments was pipetted out into sterile Petri dishes containing about 20 mL of the sterilized zobell medium kept in a sterilized environment inside the laminar flow system fabricated and supplied by CEERI – Pilani. The Petri dishes were then kept for 48 hours. The total viable heterotropic bacterial colonies were counted using bacterial colony counter.

III. RESULTS AND DISCUSSION

A. Influence of CTAB on IE of EDTA– Zn^{2+} system

CTAB is a cationic surfactant. It is a biocide [8, 9]. The IE and BE of EDTA – Zn^{2+} – CTAB system is given in Table V.1.7. It is observed from the results that 50 ppm of CTAB in combination with EDTA – Zn^{2+} system has increased IE from 96% to 98%. However a decrease in IE of EDTA – Zn^{2+} system is noticed when the CTAB concentration increases from 100 ppm to 250 ppm. This is due to the formation of micelles at higher concentration of surfactant. The BE of EDTA – Zn^{2+} system in the absence of CTAB is found to be 96% and the number of colony forming units (CFU)/mL is 1 x 10^5, which is objectionable. When 50 ppm of CTAB is added, nil CFU/mL is obtained with BE 100%. Hence the optimum concentration of CTAB is > 50 ppm. Thus it is observed that the effective synergistic formulation consists of 250 ppm of EDTA, 50 ppm of Zn^{2+} and 50 ppm of CTAB shows IE 98% and 100 % BE [11-12].

Table 1: Influence of CTAB on IE % of carbon steel immersed in sea water

EDTA ppm	Zn^{2+} ppm	CTAB ppm	CR mmpy	IE%	CFU/mL	BE %
0	0	0	0.1124	-	1 x 10^6	-
250	50	0	0.0045	96	1 x 10^5	90
250	50	50	0.0022	98	Nil	100
250	50	100	0.0022	98	Nil	100
250	50	150	0.0033	97	Nil	100
250	50	200	0.0056	95	Nil	100
250	50	250	0.0089	92	Nil	100

B. Influence of SDS on IE of EDTA– Zn^{2+} system

SDS is an anionic surfactant. It is a biocide. The IE and biocidal efficiency (BE) of EDTA – Zn^{2+} – SDS system is given in Table V.1.8. It is found that when 50 ppm of SDS is added with EDTA – Zn^{2+} system, the IE increases from 96% to 97%. Also a decrease in IE of EDTA – Zn^{2+} system is noticed when the SDS concentration increases from 100 ppm to 250 ppm. This may be due to the formation of micelle by SDS. The BE of EDTA – Zn^{2+} system in the absence of SDS is found to be 96% and the number of colony forming units (CFU)/mL is 9 x 10^4, which is objectionable. When 50 ppm of SDS is added, nil CFU/mL is obtained with BE 100%. Hence the optimum concentration of SDS is > 50 ppm. Thus it is observed that the effective synergistic formulation consists of 250 ppm of EDTA, 50 ppm of Zn^{2+} and 50 ppm of SDS shows IE 97% and 100 % BE [13, 14].

Table 2: Influence of SDS on IE % of carbon steel immersed in sea water

EDTA ppm	Zn^{2+} ppm	SDS ppm	CR mmpy	IE %	CFU/mL	BE %
0	0	0	0.1124	-	1 x 10^6	-
250	50	0	0.0045	96	9 x 10^4	91
250	50	50	0.0033	97	Nil	100
250	50	100	0.0078	93	Nil	100
250	50	150	0.0101	91	Nil	100
250	50	200	0.0112	90	Nil	100
250	50	250	0.0134	88	Nil	100

CONCLUSION

The present study leads to the following conclusions. The IE and BE of the biocides such as CTAB and SDS for EDTA – Zn (II) system has been studied. The addition of CTAB enhances the IE at lower concentration, but decreases at higher concentration. The addition of SDS enhances the IE at lower concentration, but decreases at higher concentration.

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References

[1] H.A Videla, Int. Biodeterioration and Biodegradation, 49 (2002) 259.
[2] Zhao Kaili, Dissertation: "Investigation of Microbiologically Influenced Corrosion (MIC) and Biocide Treatment on Anaerobic Salt Water and Development of a Mechanistic MIC model", Ohio Univ., Chem. Engg., (2008).
[3] Rongjun Zuo, Appl. Microbiology and BioTech., 76 (2007) 1245.
[4] S. Rajendran, S.M. Reenkala, N. Anthony and R. Ramaraj, Corr. Sci., 44 (2002) 2243.
[5] M. Sharma, J. Chawla & G. Singh, Indian J. Chem. Tech., 16 (2009) 339.
[6] P. Shanthy, P. Rengan, A. Thamarai Chelvan, K. Rathika and S. Rajendran, Indian J. Chem. Tech., 16 (2009) 328.
[7] J. Duan, S. Wu, X. Zhang, G. Huang, M. Du and B. Hou, Electro. Acta, 54 (2008) 22.
[8] R.S. Chaudhary, D.K.Tyagi & A.Kumar, J.Scient. Indus. Res., 66 (2007) 835.
[9] M. Sharma, J. Chawla and G. Singh, Indian J. Chem.Tech., 16 (2009) 339.
[10] J. Arockia Selvi, S. Rajendran, V. Ganga Sri, A. John Amalraj and B. Narayanasamy, Portugaliae Electro. Acta, 27 (2009) 1.
[11] S. Ramesh, S. Rajeswari & S. Maruthamuthu, Mater. Let., 57 (2003) 4547.
[12] R. Amini and A.A. Sarabi, Appl. Surface Sci., 257 (2011) 7134.
[13] R. Guo, T. Liu and X.Wei, Colloids and Surfaces A: Physicochem. and Engg. Aspects, 209 (2002) 37.
[14] S. Rajendran, S.P.S. Devi, N. Anthony, A.J. Amalraj and M. Sundaravadivelu, Anti-Corr. Meth. and Mater., 52 (2005) 102.