

COOPERATIVE EFFECT OF 2-AMINO-6-CHLORO-BENZOTHAZOLE ON INHIBITIVE PERFORMANCE OF PROPARGYL ALCOHOL DURING CORROSION OF MILD STEEL

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Abstract: The inhibitive action of 2-amino-6-chlorobenzothiazole (ACLBT) and Propargyl alcohol (PA) and their mixture on corrosion of mild steel in 15% HCl under boiling condition has been studied by weight loss method. PA gave maximum IE 99.7% at a concentration of 5000 ppm and ACLBT gave maximum IE of 62% at 4000 ppm. The combination containing 2500 ppm of PA and 1000 ppm of ACLBT gave 99.3% IE. Electrochemical polarization studies reveal that PA, ACLBT and their optimum mixture act as mixed inhibitor.

Keywords: Mild steel, synergistic effect, 2-amino-6-chlorobenzothiazole.

Introduction

A perusal of literature [1-3] reveals that most of the organic compounds used as effective corrosion inhibitors during acidization include acetylenic compounds especially alcohols, α -alkenylphenones, aromatic α , β -unsaturated aldehydes, nitrogen and sulphur containing heterocyclic compounds, quaternary salts and condensation products of carbonyls and amines. Among various compounds available acetylenic alcohols are considered as excellent inhibitors for low-alloy carbon steels and are found in commercial formulations [4-6]. The vapours of acetylenic alcohols are toxic and they retard the corrosion of steel only at higher concentrations (> 1.0%) [7]. Several attempts were made to synergise PA with organic compounds [8-10].

In the present work we have studied the effect of 2-amino-6-chlorobenzothiazole (ACLBT) on inhibitive performance of propargyl alcohol (PA) on mild steel corrosion in 15% HCl which is normally employed in acidization under boiling condition.

Experimental

Materials and test solutions

Mild steel (AISI 1079) coupons of size 2 x 2 x 0.6 cm having composition C=0.14%, Mn=0.35%, Si=0.17%, P=0.03% and remainder Fe, were used for weight loss measurements. The experiments were performed in a 500 ml three neck borosil round bottom flask using a condenser for half an hour at 378.2 K. All the experiments were performed as per ASTM G 1-72 and G 31-72 [11]. For potentiodynamic polarization studies, mild steel strips of

the same composition embedded in araldite with an exposed area of 1.0 cm² were used and the experiments were carried out at constant temperature of 308.2 K as per G 3-74 and G 5-87 [11]. AR grade HCl (MERCK) and double distilled water were used for preparing test solution of 15% HCl for all the experiments. AR grade propargyl alcohol (PA) (MERCK) was used and 2-amino-6-chloro-benzothiazole (ACLBT) was synthesized in the laboratory following the procedure reported elsewhere [12].

The potentiodynamic polarization studies were carried out using EG & G PARC Potentiostat/Galvanostat (model 173), Universal programmer (model 175) and with X-Y recorder (model RE 0089). A platinum foil of 3 x 3 cm and a saturated calomel electrode (SCE) were used as auxiliary and reference electrodes, respectively.

Results and Discussion

Weight loss measurements

The values of corrosion rates and percent inhibition efficiencies obtained from weight loss measurements for different concentrations of propargyl alcohol, ACLBT and their mixture in 15% boiling HCl. It has been found that percent inhibition efficiency increases with the increase in concentration of propargyl alcohol in 15% boiling HCl. PA gives maximum inhibition efficiency of 99.7% at 5000 ppm and ACLBT shows maximum inhibition (62.4%) at 4000 ppm. The mixture of 2500 ppm of PA and 1000 ppm of ACLBT gave 99.3% inhibition efficiency.

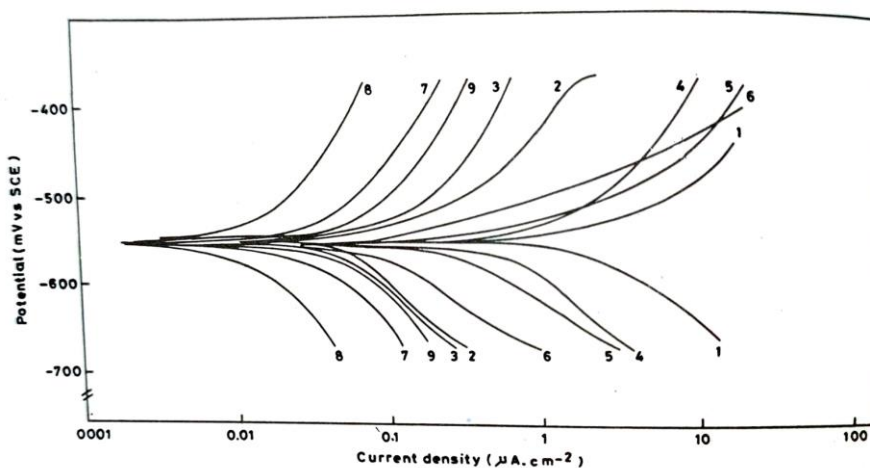


Figure 1. Potentiodynamic polarisation curves for mild steel in 15% HCl in the absence and presence of various concentrations of inhibitors 1. 15% HCl (Blank) 2. 250 ppm PA 3. 500 ppm PA 4. 250 ppm ACLBT 5. 500 ppm ACLBT 6. 250 ppm PA + 250 ppm ACLBT 7. 250 ppm PA + 500 ppm ACLBT 8. 500 ppm PA + 250 ppm ACLBT 9. 500 ppm PA + 500 ppm ACLBT

Potentiodynamic polarization studies

Potentiodynamic polarization studies were carried out in 15% HCl without and with different concentrations of both the inhibitors alone and in combinations. The various electrochemical parameters calculated from Tafel plots (Fig. 1) that the I_{corr} values decrease significantly in presence of the inhibitors. At optimum concentrations ACLBT and PA give inhibition efficiency of 88.57% and 98.29% respectively. The best synergistic combination comprises 500 ppm of PA and 250 ppm of ACLBT which provides the maximum protection (99.71%) to mild steel in 15% HCl solution. The E_{corr} values are almost unchanged in the presence of inhibitors suggesting that

these inhibitors inhibit the corrosion of mild steel in 15% HCl by controlling both the anodic and cathodic reactions. Inhibitors of this type are known as mixed type inhibitors.

The plausible mechanism of the inhibition of corrosion of mild steel in 15% HCl by PA and ACLBT may be explained on the basis of adsorption of inhibitor molecules on the metal surface. It is reported in the literature that PA inhibits corrosion by forming a polymeric film in the metal surface [13,14] ACLBT can adsorb on the metal surface either as protonated species or through electrons of the heterocyclic ring [15]. Thus the inhibition mechanism of mild steel in HCl in presence of a combination of PA-ACLBT may be attributed to both polymerisation and adsorption mechanism.

Conclusion

The inhibitive action of 2-amino-6-chlorobenzothiazole (ACLBT) and Propargyl alcohol (PA) and their mixture on corrosion of mild steel has been studied and observations shows that the mixture of ACLBT and PA may be used as a less toxic alternative for PA during acidizing process.

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