SYNTHESIS AND INHIBITOR ACTIVITY OF 2-AMINO-4-PHENYLTHIAZOLE AND ITS ANILS DERIVATIVE

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Abstract: The following Inhibitors 2-amino-4-phenylthiazole and its Anils derivative have been synthesised and used as inhibitors for corrosion of mild steel. The mild steel sheet used for the investigation the following composition C 0.14, Mn 0.35, Si 0.17, S 0.025, P 0.03 and rest Fe. Weight -loss method, Potentiostatic Polarisation Technique, AC Impedance Technique, Hydrogen Permeation Technique, Scanning Electron Microscopy and Auger Electron Microscopy were used for Characterization.

Keywords: 2-Amino-4-Phenylthiazole, Inhibitors, Corrosion

Introduction

A Perusal of literature [1,2] reveals the fact that most of the effective commercial inhibitor formulations include aldehydes and amines as their essential ingredients. Turbina et al [3] observed that condensation products of carbonyls and amines which are known as anils or Schiff's bases give higher inhibition efficiency than that of the constituent carbonyls and amines. Desai et al [4] have studied a few Schiff's bases as inhibitors for the corrosion of mild steel in hydrochloric acid. They found that the inhibition efficiency of the investigated Schiff's bases is much greater than that of corresponding amines and aldehydes. Recently in our laboratory a few anils have been synthesized by condensing a few substituted aminotriazoles and Salicylaldehyde and all the anils were found to be very effective acid corrosion inhibitors for mild steel [5]. The inhibition efficiency for all the compounds was found to be greater than that for the corresponding amines and salicylaldehyde. In the present investigation, the influence of a few anils synthesized in the laboratory by condensing 2-aminobenzo- thiazole and its substituted analogues with salicylaldehyde, has been studied as inhibitors for the corrosion of mild steel in 1N HCl and 1N H_2SO_4. Self-corrosion studies were conducted in 1N HC1 and 1N H_2SO_4, at different temperatures ranging from 40-60 °C, using 100-500 ppm concentrations of all the anils. Polarization experiments were carried out at 35 12 °C.

Materials Required

Test Specimen

The mild steel sheet used for the investigation had the following composition:

C	Mn	Si	S	P	Fe
0.14	0.35	0.17	0.025	0.03	rest

Test Solution

A.R. grade sulphuric and hydrochloric acids were used. Double distilled water was used to prepare all the solutions required for the experiments. 1-2% Ethanol was used to dissolve inhibitors.

Inhibitors Used

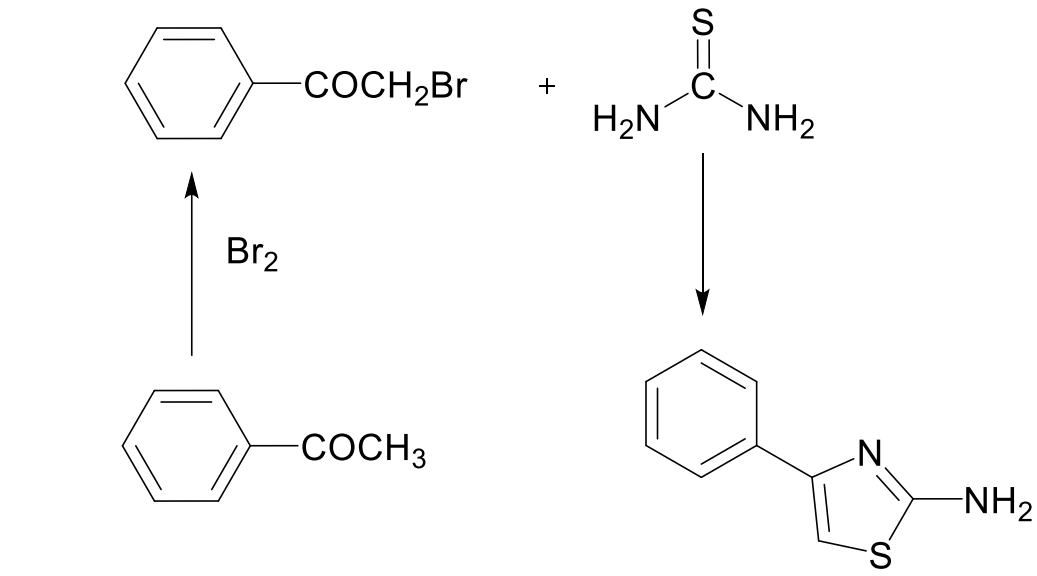
1. 2-amino-4-phenylthiazole (APT)
2. 2-cinnamalidene amino-4-phenylthiazole (CAPT)
3. 2-vanillideneamino-4-phenylthiazole (VAPT)
4. 2-salicylidene amino-4-phenylthiazole (SAPT)

Synthesis of Inhibitors

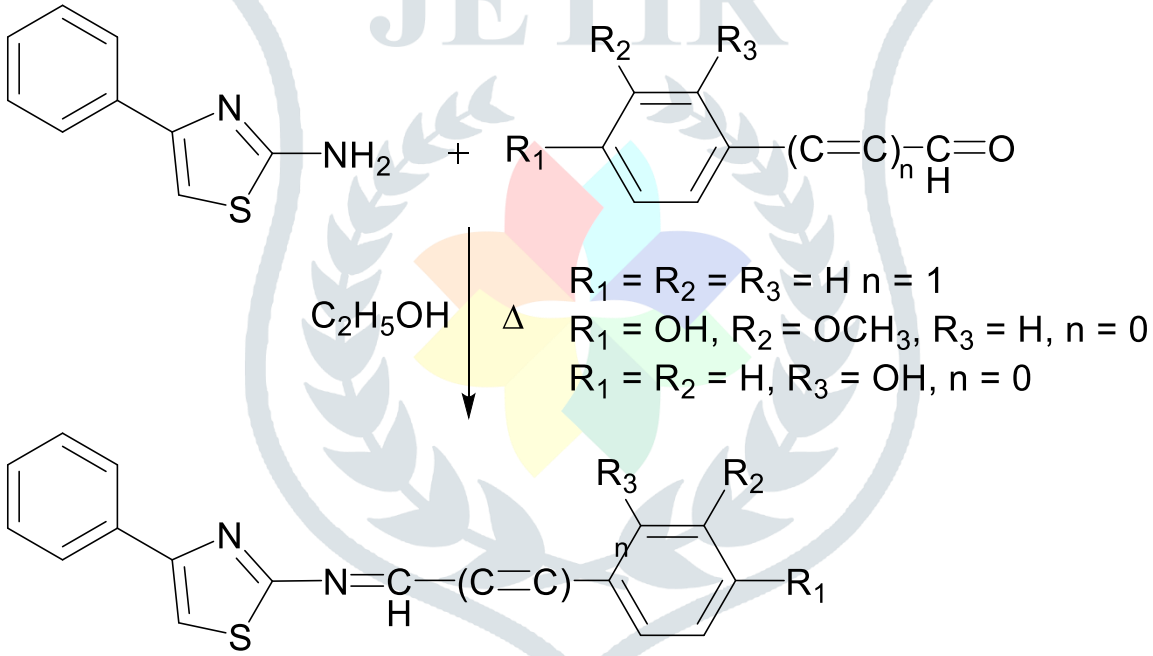
Synthesis of 2-amino-4-phenylthiazole and its Anils

Synthesis of 2-amino-4-phenylthiazole [6] (scheme-1): An equimolar mixture of phenacyl bromide and thiourea was refluxed on water bath in 50 ml of anhydrous ethanol for 5 hours. On cooling, a white precipitate was obtained. It was washed with dilute aqueous Na_2CO_3 solution and crystallized from ethanol: m.p. 125 °C.

Synthesis of Anils [7] (Scheme-2): An equimolar mixture (0.05 mol) of 2-amino-4-phenylthiazole and suitable aldehyde was dissolved in absolute alcohol, two drops of piperidine were added and refluxed on bath a water for 2-3 hours. The reaction mixture was poured in ice cold water, the solid thus separated was filtered and air dried. The anils thus prepared are 2-Cinnamalideneamino-4-phenylthiazole: m. P. 180 °C, 2-Vanillideneamino-4-phenylthiazole :160 °C, 2-Salicylidene amino-4-phenylthiazole :170 °C:



Scheme-1



Scheme-2

Technique Employed

The experimental work was carried out with the help of following techniques such as- Weight -loss method, Potentiostatic Polarisation Technique, AC Impedance Technique, Hydrogen Permeation Technique, Scanning Electron Microscopy and Auger Electron Microscopy for study of synergism of corrosion inhibitors for metals.

Result And Discussion

The inhibition efficiency values for APT and different Anils in 1N HCl and 1N H_2SO_4, at 40 °C follows the order: CAPT > VAPT > SAPT > APT. The excellent performance of CAPT in both the acids can be explained as it

possesses additional conjugate π-electrons through which it interacts with the metal surface. This favours more adsorption of this compound on the metal surface leading to more inhibition, and lone pair of electrons present on nitrogen and sulphur atoms may also lead to more interaction with the metal surface leading to more adsorption, thereby more inhibition.

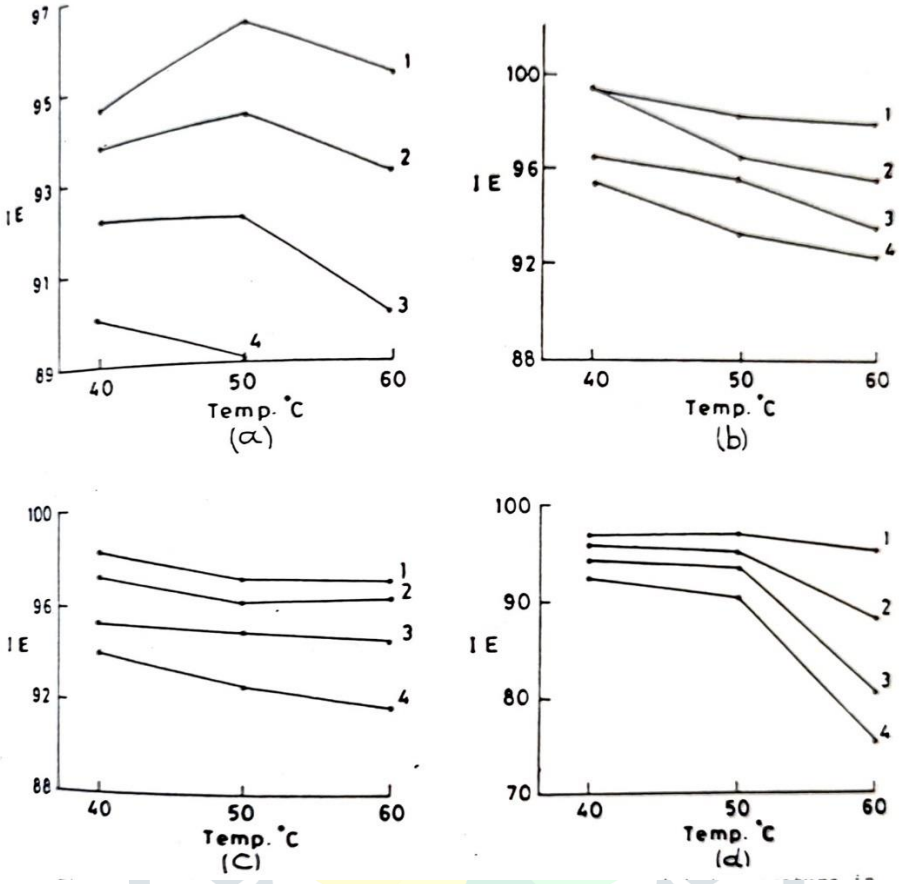


Figure 1. The variation of Inhibition Efficiencies with temperature in 1N HCl,
For APT: 1, 500 ppm; 2, 400 ppm; 3, 300 ppm; 4, 200 ppm. For Anils: 1, 300 ppm; 2, 200 ppm; 3, 100 ppm; 4, 50 ppm. a, APT; b, CAPT; c, VAPT; d, SAPT.

VAPT gives better inhibition efficiency than that for SAPT because it contains -OCH, group which is absent in the case of SAPT. Methoxy group makes the compound as a hard base which forms a strong bond with ferrous and ferric ions and gets strongly adsorbed on the metal surface leading to a high value of inhibition efficiency. SAPT inhibits the corrosion of mild steel in both the acids due to the following interactions with the metal surface. (i) Π-electrons of the benzene, thiazole ring and azomethine (C-N-) group. (ii) Lone pair of electrons of nitrogen and sulphur atoms of the thiazole ring. (iii) The electron releasing inductive effect of -OH group attached with benzene ring of this compound also leads to adsorption and thereby the inhibition of corrosion.

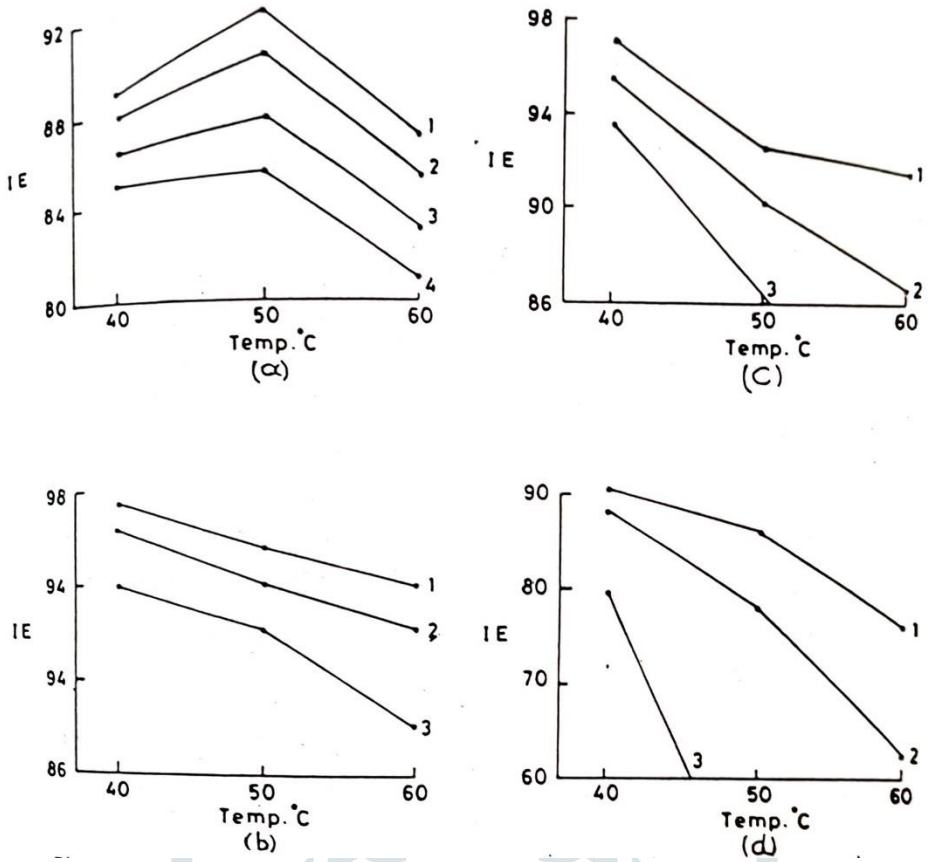


Figure 2. The variation of Inhibition Efficiencies with temperature in 1N H_2SO_4,
For APT: 1, 500 ppm; 2, 400 ppm; 3, 300 ppm; 4, 200 ppm. For Anils: 1, 300 ppm; 2, 200 ppm; 3, 100 ppm; 4, 50 ppm. a, APT; b, CAPT; c, VAPT; d, SAPT.

The presence of an extra benzene ring and -OH group in SAPT makes it more effective in corrosion inhibition than APT. The absence of methoxy group in this compound makes it less inhibitive than VAPT. The adsorption of APT on the metal surface occurs due to the following factors. Π-electrons in the benzene ring and thiazole ring inter- acts with the positively charged metal surface leading to adsorption and inhibition. Lone pair of electrons of the nitrogen and sulphur atoms also leads to the interaction with the positively charged metal surface, which causes the adsorption of the compound on the metal surface and inhibition. -NH_2 group of this compound can form protonated species in acidic solutions which interacts with the negatively charged metal surface, and leads to adsorption and corrosion inhibition. The plots of surface coverage (θ) versus log c for all the inhibitors at 40 °C are shown in Figure 3. Almost a straight line is obtained indicating that all the compounds follow Temkin's adsorption isotherm.

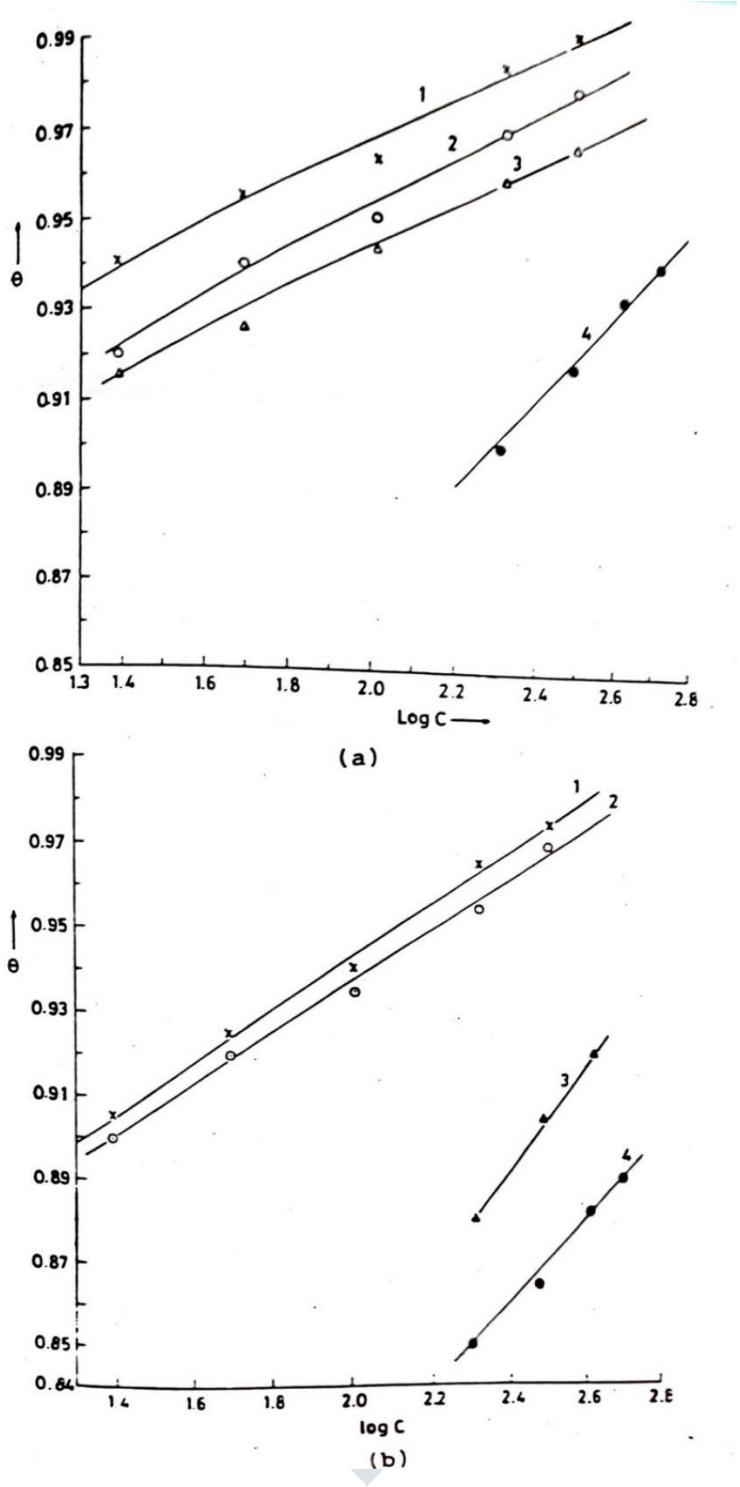


Figure 3. The Temkin Isotherm Plots from 1N HCl and 1N H_2SO_4 at 40 °C
a, 1N HCl; b, 1N H_2SO_4. 1, CAPT; 2, VAPT; 3, SAPT; 4, APT.

Conclusion

The 2-amino-4-phenylthiazole (APT) and different Anils have been found to perform well in both sulphuric and hydrochloric acids. The inhibition efficiency of all the anils have been found to be better than APT. The performance of all the inhibitors has been found to be better in hydrochloric acid. The mechanism of the inhibition of the corrosion of mild steel in presence of these compounds in both IN HCl and IN HSO is found to be under

mixed control. All these compounds have been found to inhibit the corrosion of mild steel in acidic solution by getting adsorbed on the metal surface through lone pair of electrons of N and S atoms, π-electrons and the protonated species. The adsorption of APT and different anils on the mild steel surface from both the acids obey Temkin's adsorption isotherm.

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