SYNTHESIS OF 2-SALICYLIDENEAMINOBENZOTHIAZOLE AND ITS 6-SUBSTITUTED AND ITS INHIBITOR ACTIVITY FOR METAL COROSSION

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Abstract: The following inhibitors 2-salicylideneaminobenzothiazole and its 6-substituted analogues 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-Salicylideneaminobenzothiazole, Inhibitors, Corrosion

Introduction

A wide range of heterocyclic compounds contain a potential class of corrosion inhibitors. There is a wide consideration in the literature regarding corrosion inhibition studies by nitrogen containing heterocyclics [1-3). On the contrary, investigations on heterocyclics bearing N and S atoms in t ring have received a little attention. 2-mercaptobenzothiozole has been reported as an effective corrosion inhibitor the same for copper and its alloys in different corrosive environments [4,5]. A few salicylideneaminobenzothiazole were synthesized and evaluated as acid corrosion inhibitors. Survey of literature reveals that 2-Salicylideneaminobenzothiazole and its 6-substituted have not been studied as acid corrosion inhibitors. This study deals with the influence of 2-Salicylideneaminobenzothiazole and its derivatives on corrosion of mild-steel in 1N HC1 and 1N H_2SO_4. The weight loss measurements were conducted in both the acids at different temperatures (40-60 °C) using 100-500 ppm concentrations for all the inhibitors. Polarization experiments have been performed at (35 ± 2°C) to understand the behaviour of these compounds as corrosion inhibitors. Hydrogen permeation experiments were also carried out to study the effect of these compounds on the permeation of hydrogen through the steel surface. The surface coverage values (θ) were evaluated using values of inhibition efficiency.

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

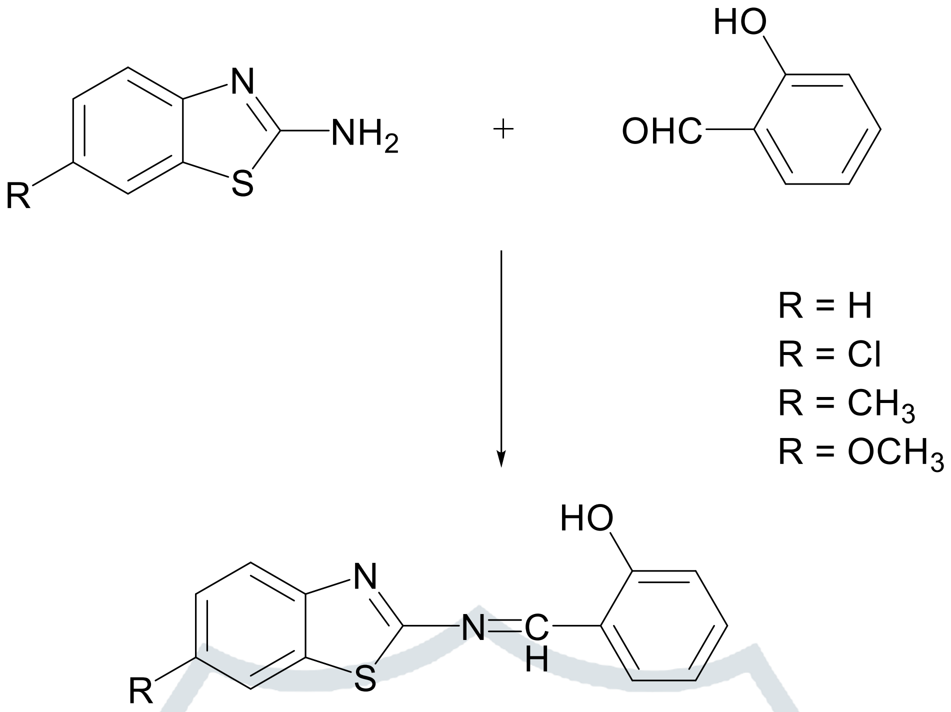
A.R. grade sulphuric and hydrochloric acids were used. Double distilled water was used to prepare all the solutions required for the experiments. 1-2% Ethanol was used to dissolve inhibitors.

Inhibitors Used

1. 2-salicylideneaminobenzothiazole (SABT)
2. 2-salicylideneamino-6-chlorobenzothiazole (SACLBT)
3. 2-salicylidene amino-6-methoxybenzothiazole (SAMEOBT)
4. 2-salicylideneamino-6-methylbenzothiazole (SAMEBT)

Synthesis of Inhibitors

Synthesis of 2-salicylideneaminobenzothiazole and Its 6-Substituted Analogues [6] (Scheme-2) Salicylaldehyde (0.1 mole) was added to 0.1 mole of 2-aminobenzothiazole dissolved in 100 ml of benzene. The solution was refluxed on a water bath for an hour. The water produced during the reaction was removed in a Dean-Stark trap connected with a reaction vessel. On cooling, the solid was obtained. It was crystallized from ethanol. The pure 2-salicylid-eneaminobenzothiazole, m.p. 201°C. The spectrum of this Anil gave broad peaks at 2900-3000 cm^{-1} due to hydroxy group and at 1635, 1580 cm^{-1} due to salicylaldinine group. Similarly other Anils were synthesized by the condensation of the salicylaldehyde with 6-substituted benzothiazole derivatives.



Scheme-1

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

Various corrosion parameters such as percentage inhibition efficiency (IE) and corrosion rate of Anils obtained by weight loss method at different concentrations and temperatures. It is seen that all the Anils show good inhibition of the corrosion of mild steel for all the concentrations under study. The percentage inhibition efficiency for all the inhibitors increases with increasing the concentrations. All the compounds (Anils) show their maximum inhibition efficiency at 500 ppm concentration in both the acid solutions. It is seen from these tables and figures that the percentage inhibition efficiency decreases with increasing the temperature in all the cases in both the acids except parent Anil (SABT), which is quite stable in 1N H_2SO_4, at a concentration of 500 ppm even at 60 °C, indicating its stronger adsorption over the metal surface as compared to other Anils.

This decrease in percentage inhibition efficiency indicates that the inhibitor film, formed on the metal surface is less protective in nature at higher temperatures. Most probably the desorption of the inhibitor molecule occurs at a quicker rate from the metal surface at higher temperatures. The performance of all the Anils except parent anil (SABT) has been found to be better in 1N HCl. The order of corrosion inhibition by different anils except SABT in both the acids solutions is as follows:

SACLBT > SAMEOBT > SAMEBT

The higher inhibition efficiency of chloro-derivative may be attributed to its higher dipole moment than parent anil (SABT). The better performance of methoxy anil compared to methyl substituted anil can be explained on the basis of Pearson's "HSAB" principle [7]. Since methoxy group be considered as a hard base, it forms a ferrous and ferric ion strong can bond with which leads to more adsorption and more inhibition. In methyl substituted anil, the inductive effect of methyl group makes nitrogen centre a softer base. So, ferrous and ferric ions form a weak bond with soft base methyl-anil (SAMEBT). This may lead to lesser adsorption and lesser inhibition.

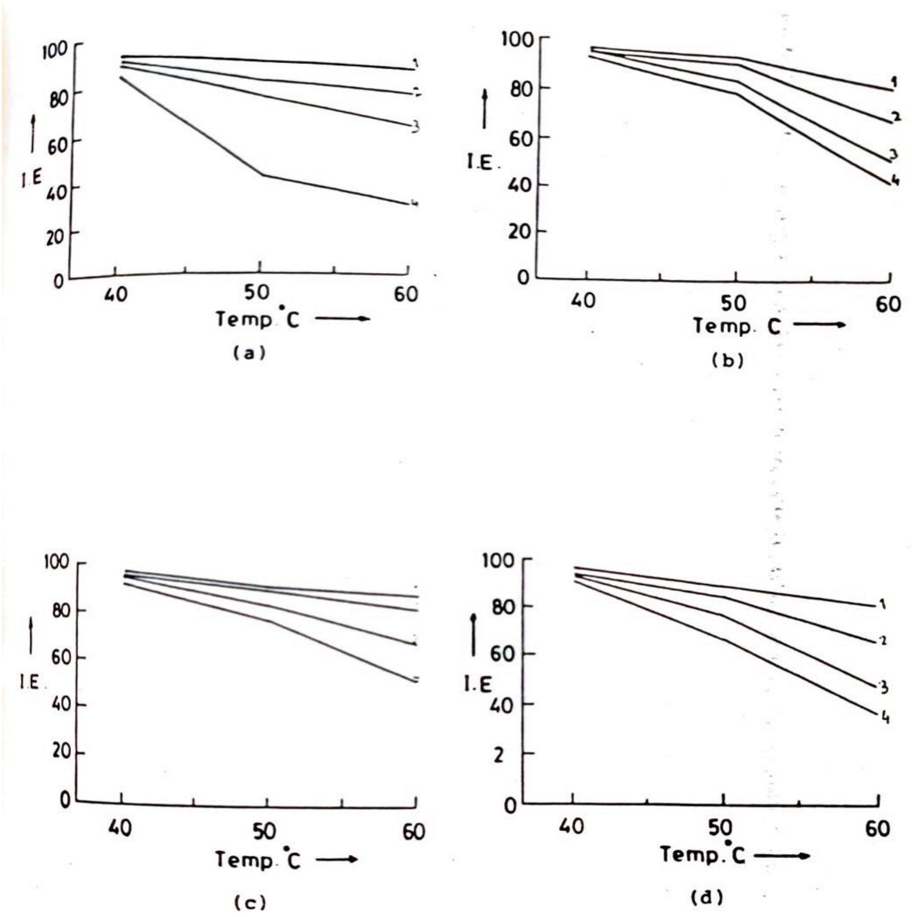


Figure 1. The variation of Inhibition Efficiencies with temperature in 1N HCl,
1, 500 ppm; 2, 400 ppm; 3, 300 ppm; 4, 200 ppm.
a, SABT; b, SACLBT; c, SAMEOBT; d, SAMEBT.

The surface coverage values (θ) were evaluated using values of inhibition efficiency as reported earlier [8]. The surface coverage values (θ) were tested graphically for fitting a suitable adsorption isotherm. The plots of log C yields straight line in both the acids suggesting that the adsorption of salicylideneaminobenzothiazole from both the media on the mild steel surface obeys "Temkin's adsorption isotherm" which is shown in Figure 3. The inhibition of corrosion of mild steel in acidic solutions by the anils can be explained on the basis of adsorption.

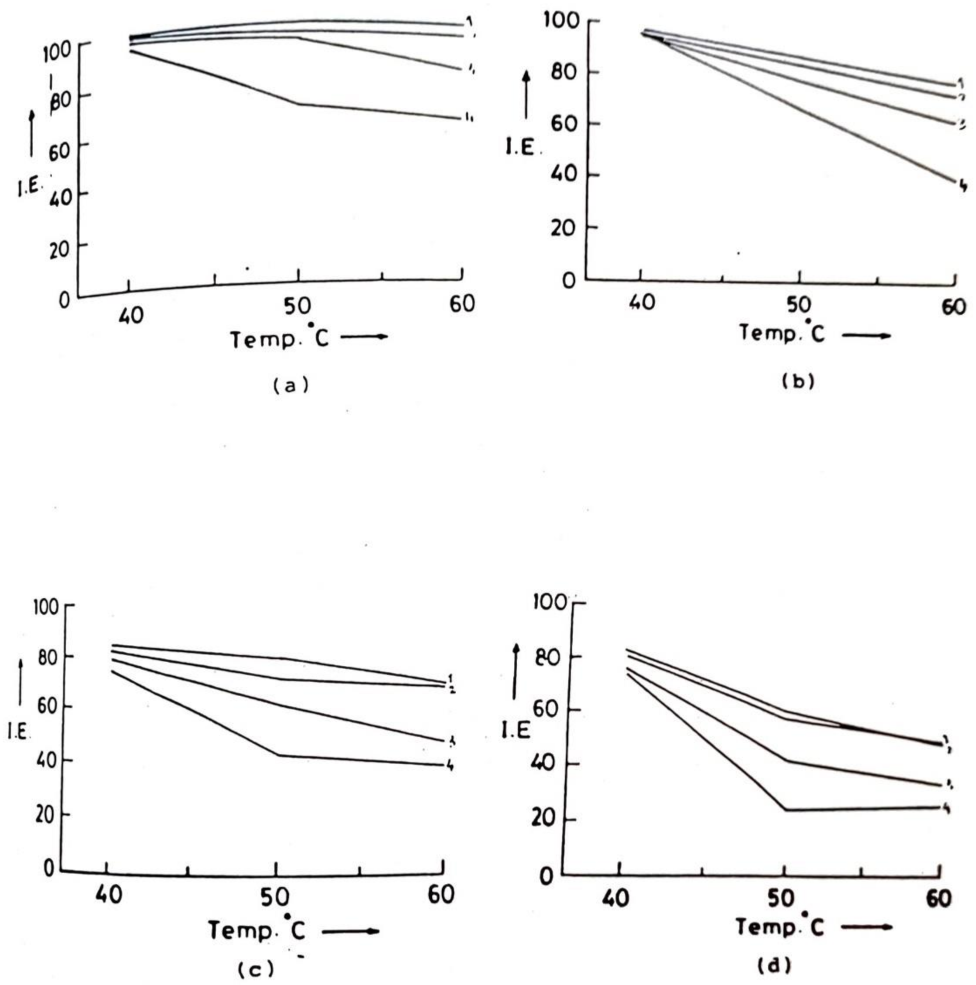


Figure 2. The variation of Inhibition Efficiencies with temperature in 1N H_2SO_4,

1, 500 ppm; 2, 400 ppm; 3, 300 ppm; 4, 200 ppm.

a, SABT; b, SACLBT; c, SAMEOBT; d, SAMEBT.

These Anils can adsorb on to the metal surface due to following interactions: (i)Lone pairs of electrons of nitrogen and sulphur atoms can interact with the positively charged metal surface. (ii) π-electrons of azomethine group (-C-N-), benzothiazole and benzene being can also interact with positively charged metal surface.

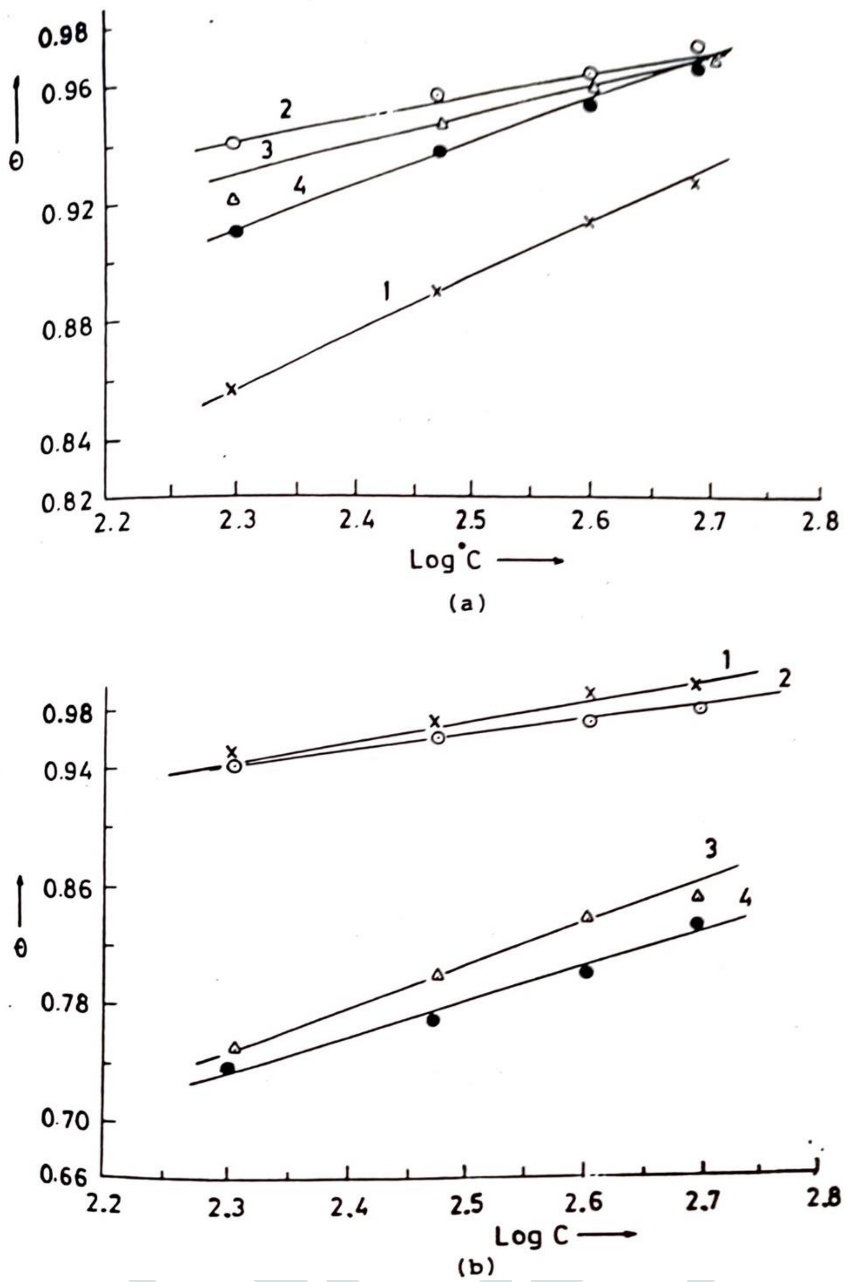


Figure 3. The Temkin Isotherm Plots from 1N HCl and 1N H_2SO_4 at 40 °C
a, 1N HCl; b, 1N H_2SO_4. 1, SABT; 2, SACLBT; 3, SAMEOBT; 4, SAMEBT.

Conclusion

These Anils have been found to perform well as corrosion inhibitors in both sulphuric and hydrochloric acids but a better performance is noticed in the case of hydrochloric acid. The mechanism of the inhibition of corrosion of mild steel in the presence of these inhibitors in both 1N HC1 and 1N H_2SO_4 is under mixed control except the parent compound which behaves predominantly as anodic. All these anils have been found inhibit the corrosion of mild steel in acidic solutions by getting adsorbed on the active sites of the steel surface through lone pair of electrons, Π-electrons of the benzothiazole ring and Azomethine (-C-N-) group. Except parent compound showed predominantly anodic behaviour. All the anils bring down the permeation current considerably in both the acids. The adsorption of anils on the mild steel surface from both the acids obey Tenkin's adsorption isotherm.

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