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Inhibition effect of some schiff bases of S-triazole on the corrosion of mild steel in the hydrochloric acid solution

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ABSTRACT

The inhibition effect of 5-(3-bromophenyl)-4-{[(1E)-(4-methoxyphenyl) methylene]amino}-4H-1,2,4-triazole-3-thiols (SB_I) and 5-(3-bromophenyl)-4-{[(1E)-(4-methylphenyl)methylene]amino}-4H-1,2,4-riazole-3-thiols (SB_{II}) on the corrosion of mild steel in hydrochloric acid was investigated. The corrosion inhibiting action was studied through weight loss technique. The corrosion parameters such as corrosion rate (mpy) and corrosion inhibition efficiencies (%IE) were determined. The inhibition efficiencies increased with increase in inhibition concentration.
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KEYWORDS

Corrosion;
Mild steel;
Inhibition efficiency;
Corrosion rate.

INTRODUCTION

Corrosion causes huge losses to buildings, automobiles industries and their services and is possibly the greatest consumer of metals today. The quantity of metals lost each day through corrosion is enormous, but if one includes all expenses from finding an ore to production of finished good, the cost of corrosion is devastating. Synthetic plastics and polymers have made monstrous stride recently but metals will never be replaced because of their unique properties of malleability, ductility, electrical conductance, thermal resistance, etc.

Beside the direct losses certain indirect economic cost is also associated with corrosion. These include loss of material, loss of production due to structure failure and consequent shut down of plants, loss due to adulteration of the main product, loss of efficiency of machinery and over design which should be included considering future corrosion of a system.

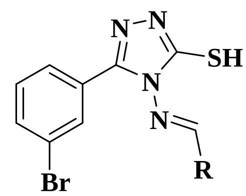
A great deal of study has been devoted to corrosion in multidisciplinary field of chemistry, engineering and metallurgy. Immense efforts have been made to understand the mechanism through which metals corrode in different environments and to minimize it by adopting various preventive measures. Methods to reduce corrosion include application of protective coatings, cathodic and anodic protection, alloying and use of different class of inhibitors alone or in combinations.

Corrosion may follow any one of several general patterns. Basically stated, corrosion results from the instability of a construction material with the environment in which the material is placed. All materials, both organic and inorganic, can react with their environments and may eventually lose their usefulness for a given application. Some non metals tend to decompose, usually as the result of chemical interaction with some component of their environment.

Corrosion can be defined as the destructive result of chemical reaction between a metal or metal alloy and its environment[1]. It is probably the commonest electrochemical phenomenon experienced in day to day life. Metal atoms are found in nature in the form of minerals. The same amount of energy needed to extract metals from their minerals emitted during the chemical reactions that produce corrosion. Thus corrosion has been called extractive metallurgy in reverse[2].

Mild steel is widely used as an engineering material and its corrosion in acidic medium is of great economic importance. The effect of various additives on corrosion of mild steel has extensively been studied[3-10]. It has been reported[11-16] that addition of certain organic compounds bearing hetero atoms retards the corrosion of mild steel in acidic environments. Recently considerable interest has been generated in the use of nitrogen, oxygen and sulphur containing organic compounds as corrosion inhibitors for mild steel in different acids[17,18]. Vishwanathan et al.[19] and others[20-22] have studied the effect of same aniline compounds on corrosion of mild steel in acidic solutions; pyrrole and its derivatives[23] have also been studied as corrosion inhibitor for mild steel in different acidic media. Pyridyl substituted triazoles have also been studied fro their effectiveness to reduce corrosion of mild steel in hydrochloric acid solution[24], certain aldehydes[25] have also been tested to reduce corrosion of mild steel in acid solutions. Fatty acid oxazoles[26] have also been studied to inhibit corrosion of mild steel. Querishi et al.[27] have studied tetramethyl-dithiaoctaazacyclotetradeca hexane as corrosion inhibitor for mild steel in acid solutions. Coatings containing poly-pyrrole has been applied on mild steel to inhibit corrosion[28].

In the present study an attempt has been made to study the influence of varying concentrations of Schiff's bases derived from 4-methoxybenzaldehyde and 4-amino-5-(3-bromophenyl)-4H-1,2,4-triazole-3-thiol (SB_I) and 4-methylbenzaldehyde and 4-amino-5-(3-bromophenyl)-4H-1,2,4-triazole-3-thiol (SB_{II}), on corrosion of mild steel in different concentrations of hydrochloric acid and sulphuric acid employing mass loss technique.



R= 4-OCH_3-C_6H_4- and 4-CH_3-C_6H_4-

EXPEREMENTAL

Mild steel specimens of composition 0.12% C, 0.32% Mn, 0.05% S, 0.02% SiO_2, 0.02% W and rest Fe of size cm were used. For the complete immersion test, buffing and rubbing with emery paper to obtain mirror like finish polished all specimens. Chemical treatment was given by immersing the specimen in ammonium citrate (20%) at 75 to 80°C for about 20 minutes[29]. The specimens were finally degreased using acetone. All chemicals used were of AR grade quality and solutions were prepared in double distilled water.

The concentration of acid under sturdy was taken as 1N, 2N 3N and 4N concentration of inhibitor was varied from 0.2% to 0.8%. A specimen suspended by glass hook was immersed completely in each beaker containing 250 ml of the solution at 25±0.1°C. The immersion duration was ranging from 3 hours to 72 hours in different acid concentrations as shown in TABLE 1 visual inspection of the specimen was done and after

TABLE 1: Corrosion parameters obtained from weight loss measurements in 1N to 4N HCl on different concentration on inhibitor at 25 ± 0.1°C

Inhibitor	Conc. (%)	1N HCl			2N HCl			3N HCl			4N HCl		
		Wt. loss (mgm)	% IE	CR (mpy)	Wt.loss (mgm)	% IE	CR (mpy)	Wt.loss (mgm)	% IE	CR (mpy)	Wt.loss (mgm)	% IE	CR (mpy)
Nil	0.0	20.2	-	407.92	45.7	-	922.87	59.0	-	1191.45	77.7	-	1569.09
SB_I	0.2	5.3	73.76	107.03	6.9	84.90	139.34	5.7	90.34	115.10	5.2	93.31	105.01
SB_I	0.4	3.4	83.17	68.66	5.5	87.96	111.06	4.4	92.54	88.85	4.4	94.34	88.85
SB_I	0.8	2.3	88.61	46.44	4.7	89.72	94.91	3.3	94.40	66.64	3.2	95.88	64.62
Nil	0.0	20.2	-	407.92	45.7	-	922.87	59.0	-	1191.45	77.7	-	1569.09
SB_{II}	0.2	1.8	91.09	36.35	3.6	92.12	72.70	9.5	83.90	191.84	14.0	81.98	282.71
SB_{II}	0.4	1.6	92.08	32.31	3.4	92.56	68.66	8.8	85.08	177.70	12.5	83.91	252.42
SB_{II}	0.8	1.4	93.06	28.27	3.2	93.00	64.62	7.5	87.29	151.45	10.8	86.10	218.09

removal of corrosion products, mass loss measurements were made.

CALCULATIONS

The percentage inhibition efficiencies can be calculated using following equation[30].

Percentage inhibition = M_u - M_i / M_u × 100

Where, M_u is the mass loss in uninhibited solution and M_i is the mass loss in inhibited solution.

Corrosion rate is determined from the loss in mass as follows[30].

CR (mpy) = 534 X M / A X D X t

Where, M is the loss in mg, A is the area of the specimen square inches, D is the density in g/cm^3 and 't' is the time in hours.

RESULTS AND DISCUSSION

From the above results the following conclusion are drown,

1. Both the Schiff bases of S-triazole are proved to be efficient inhibitors for corrosion of mild steel in various concentration of HCl.
2. The inhibition efficiency was found to increase with increase in the inhibitor concentration.

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