Application of Hydroxytriazenes in Corrosion Protection of Brass

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Abstract: Three hydroxytriazenes have been screened for their inhibitive action against corrosion of brass in ammoniacal environment. They have been found to possess 31.43 to 80.77%. Percentage inhibitive efficiency at 7.5 to 12 N ammonia solutions. The results indicate that hydroxytriazenes can further be explored for corrosion inhibitive property.

Keywords: Hydroxytriazenes, Corrosion protection, Corrosion inhibitor, Brass, Metallurgy.

Introduction

Hydroxytriazenes have been extensively used as spectrophotometric and complexometric reagents for estimation of entire 1st transition metal series. A number of voluminous reviews have been published by our laboratory on application of hydroxytriazenes¹⁻⁷. Not only this they have also been screened for their biological activities as evidenced by recent papers appearing in the literature^{8,9}. However, on the basis of literature it is revealed that compounds containing O, N and S act as corrosion inhibitor. In view of this in the present investigation 3-hydroxytriazenes have been used as corrosion inhibitors for brass in ammoniacal environment.

Brasses undergo mechanical failure in ammoniacal environment. It poses a serious metallurgical problem. The Zn dissolves preferentially^{10,11} leaving behind a spongy mass of copper on the surface of alloy. This de-alloying of brass causes stress corrosion cracking^{12,13} leading to failure of machine. On the basis of survey of literature it was found that compounds containing one or more of polar atoms such as oxygen, sulphur or nitrogen and compounds containing II-bonds offer protection against corrosion of metals. In view of this three hydroxytriazenes containing O, N as well as S have been chosen for inhibition studies. The studies have been based on weight loss method. All the three hydroxytriazene taken were water or water / alcohol soluble one.

The compounds taken are -

- (1) 3-Hydroxy-3-*p*-tolyl-1-*p*-sulphonato (sodium salt) phenyl triazene (HTST).
- (2) 3-Hydroxy-3-phenyl-1-*p*-sulphonato (sodium salt) phenyl triazene (HPST).
- (3) 3-Hydroxy-3-methyl-1-(4-sulphonamido phenyl) triazene (HMST).

Experimental

Commercial grade brass sample containing 70% Cu and 30% Zn were used for the present studies. Specimens (2 cm x 2 cm) were cut from the brass sheet and thoroughly polished by linen buffing and cleaning with water as well as acetone. They were weighed. To expose specimen uniformly to the corroding medium *i.e.* ammonia solution each of the specimen was held vertically inside a cylindrical glass tube open at both the ends and having a few holes on the surface to give maximum exposure to the corroding media. The specimen was held in this tube and the tube was placed in a conical flask (250 mL) in which 150 mL of ammonia solution of three different concentration (7.5 N, 10 N and 12 N) were taken of each set of experiment. The conical flask was tightly covered to minimize loss of ammonia. The conical flask was kept in a thermostat maintained at $30 \pm 1^\circ\text{C}$. The samples were exposed for 24 h. After 24 h. the samples were taken out, washed thoroughly with water, dried and weighed. The experiment was repeated thrice with and without inhibitors at three different concentrations of inhibitors.

The percent efficiency of each inhibitor was calculated using formula.

$$\text{P.I.} = \frac{W_o - W}{W_o} \times 100$$

Where, W and W_o are weight losses of brass with and without inhibitor respectively.

Results and Discussion

Table 1 describes values of weight loss in presence and absence of inhibitors at various concentrations along with PI values for each one of them.

A close examination of Table 1 reveals that weight loss in absence of any inhibitor increases with increasing concentration of ammonia solution. Thus, the concentration of ammonia stimulates corrosion. The varying concentration of inhibitors as shown in Table 1 in general inhibits the corrosion. In case of compound no. (1) in 7.5 N ammonia solution the percentage inhibitive efficiency (P.I.) value becomes almost double. The trend for this compound even in higher concentration (10 N and 12 N ammonia solutions) is almost same.

For compound no. (2), although the P.I. values increase with increasing concentration of inhibitors, but with increasing concentration of ammonia the P.I. value for this compound does not increase to that extent. For compound no. (3), the trend is the same. However, the P.I. values with increasing concentration of ammonia increase remarkably indicating this inhibitor gives a P.I. value of 80.77, which is very significant.

Inhibitors in general protect corrosion by being adsorbed at the surface of corroding alloy. It has been shown that adsorption of molecules of inhibitor reduces the number of electrode sites making the protection or inhibition a predominant process when the alloy surface is covered by a monolayer of inhibitor^{14,15}. Although a definite mechanism for this cannot be predicted on the basis of such a small number of observations, however, one thing is certain that hydroxytriazenes can offer excellent inhibitive properties against corrosion by ammonia solution if explored further. Thus, the present studies though a very preliminary one has opened a new possibility of exploring hydroxytriazenes as corrosion inhibitors.

Table 1. Results of immersion test in ammonia solution with and without inhibitor at temperature 30°C and immersion period 24 h.

Inhibitor Concentration, M	7.5 N Ammonia solution		10 N Ammonia solution		12 N Ammonia solution	
	Weight loss, g	P.I. *	Weight loss, g	P.I.	Weight loss, g	P.I.
Without inhibitor (Nil)	0.0035	--	0.0041	--	0.0052	--
HTST 10^{-5}	0.0023	34.29	0.0026	36.59	0.0029	44.23
10^{-4}	0.0018	48.57	0.0019	53.66	0.0020	61.54
10^{-3}	0.0013	62.86	0.0015	63.41	0.0017	67.30
Without inhibitor (Nil)	0.0035	--	0.0041	--	0.0052	--
HPST 10^{-5}	0.0024	31.43	0.0025	39.02	0.0030	42.31
10^{-4}	0.0019	45.71	0.0020	51.22	0.0024	53.85
10^{-3}	0.0017	51.43	0.0018	56.09	0.0021	59.62
Without inhibitor (Nil)	0.0035	--	0.0041	--	0.0052	--
HMST 10^{-5}	0.0021	40.00	0.0023	43.90	0.0027	48.07
10^{-4}	0.0014	60.00	0.0016	60.98	0.0020	61.54
10^{-3}	0.0011	68.57	0.0009	78.05	0.0010	80.77

* Percentage inhibitive efficiency

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