INFLUENCE OF SOME COLOURING ADDITIVES ON THE CORROSION BEHAVIOUR OF BRASS IN AMMONIA SOLUTION

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Dyestuffs with fused benzene rings and containing functional groups having atoms like N, O, and S which posses a lone pair of electrons can be used as effective inhibitors in ammonia environment. However greater solubility of a particular corrosion product with specific compound reduces its effectiveness to a considerable extent when used in high ammonia. Concentration of pyrocatachol at the highest concentration affords protection upto 90% but at low cencentration of the dye, its efficiency is condierably less.

In practice a wide range of applications of Brass/Ammonia systems are being encountered and the Chemistry and Electro-chemistry of these systems are investigated in detail[1-2]. Brass corrodes extensively in ammonical solutions and the corrosion rate in many cases is generally observed to be enhanced with the rise in concentration of Ammonia. Desai et al [3-4] investigated colloids as inhibitors for the corrosion of 63/37 Brass in 0.05 M and 0.01 M ammonical chloride solutions. Corrosion of 70/30 Brass in Ammonia environment has been reported by Vakil [5]. Corrosion control through the use of inhibitors is an established practice. Hackerman [6,7] studied inhibitive properties of a series of secondary aliphatic amines and cyclic imines in acid media. Riggs and Every [8] interpreted the inhibition by aromatic amines on the basis of electron density pattern. Trabanelli, et al. [9] evaluated the influence of the molecular weight of the additives on inhibiton properties. A film theory of protective activity has been formulated by Balezin et al [10]. In recent years attempts have been made to understand the nature of interaction between the inhibitor and the metal surface in terms of adsorption isotherms [11,12].

For a given solution, adsorbability of any organic additive depends on the charge of the metal or approximately on the potential of the metal (ϕ scale of potential) [13,14].

In the present investigation the nature of adsorption and the effect of colouring organic substances during the corrosion of 70/30 Brass in ammoniacal solutions has been investigated by weight loss measurements.

EXPERIMENTAL

Commercial 70:30 Brass specimens of 25x55x2.1 mm size were used. Ammonia solutions of 0.1, 0.5, 1,2 and 3 N were used as corroding media. Methyl orange, Alizarin Red-S, Eriochrome Black-T, Pyrocatechol were studied in concentration of 1, 2, 5 and 10 mM. All the chemicals used were of A.R. grade. Total immersion test was carried out using 200 mL corrodant for a period of 24 hours in each case. At the end of the immersion period, the specimens were removed carefully, cleaned and weighed. The weight loss was determined in each case to obtain the corrosion rate (mdd) and inhibitor efficiency.

RESULTS AND DISCUSSION

The corrosion rate in mdd and inhibitor efficiency during static immersion of 70/30 Brass in ammonia are given in Table 1. The corresponding variation in surface coverage as a function of inhibitor concentration has been plotted in Fig 1(a-e).

It is seen from the results that corrosion rate in general decreases with inhibitor concentrations. But in 0.1 N ammonia solution, the inhibitor efficiency of methyl orange does not even reach 50% at the highest concentration of the inhibitor.

It is note worthy that the increase in ammonia concentration in the medium increases the corrosion rate but percentage inhibition of the inhibitors are also generally higher in more concentrated ammonia solution. The data shows that Eriochrom black T be used as effective inhibitor for brass in ammonia environment. Even in as dilute a concentration as

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TABLE 1

EFFECT OF COLOURING DYE STUFFS ON CORROSION RATES

Specimen 70/30 brass Corrodant NH_4 OH
Effective area of the specimen 13.7 Cm^2 ; Temperature 29 ± 1° C

Ammonia	0.1 N		0.5 N		1 N		2 N		3 N	
Inhibitor conc mM	Corr.	IE%	Corr.	IE%	Corr.	IE%	Corr.	IE%	Corr.	IE%
0.0	105.6	-	188.3	-	364.1	-	259.1	-	328.5	-
Alizarin Red S										
1.0	58.6	46.7	121.7	39.1	198.1	45.7	198.0	22.0	228.1	27.1
2.0	56.1	48.0	106.0	45.7	149.9	58.8	122.5	51.1	194.0	40.0
5.0	52.0	49.3	86.2	56.5	114.1	69.0	98.0	61.1	132.7	60.0
10.0	45.9	57.3	73.8	63.0	93.1	75.3	89.8	65.4	96.2	71.1
Pyrocatechol										
1.0	63.2	41.9	136.2	31.2	227.8	40.1	213.7	18.0	176.5	47.3
2.0	41.7	62.7	112.9	43.5	174.6	53.7	173.0	31.1	142.5	52.9
5.0	19.5	80.7	67.7	66.7	107.0	70.4	110.3	57.1	121.0	63.0
10.0	9.8	90.7	83.2	72.8	60.5	83.7	71.0	71.1	99.7	69.2
Eriochrom Blank T										
1.0	74.7	30.0	108.0	47.1	226.8	37.3	164.6	35.1	226.5	31.1
2.0	61.9	42.0	90.6	50.4	174.6	53.7	122.0	51.1	177.4	47.6
5.0	28.1	73.3	72.9	63.8	107.0	70.4	81.3	66.0	66.0	78.2
10.0	14.3	86.7	72.3	64.1	96.9	74.1	46.37	81.7	34.0	89.3
Methyl Orange										
1.0	77.7	27.3	132.3	35.1	242.7	34.1	160.4	38.5	250.5	20.2
2.0	70.1	36.7	120.2	41.7	206.0	44.2	122.2	52.9	114.4	65.8
5.0	60.4	38.7	111.1	43.5	146.1	57.1	84.2	65.1	71.9	77.8
10.0	58.7	46.0	100.5	49.6	100.9	73.5	81.2	68.0	60.0	81.7

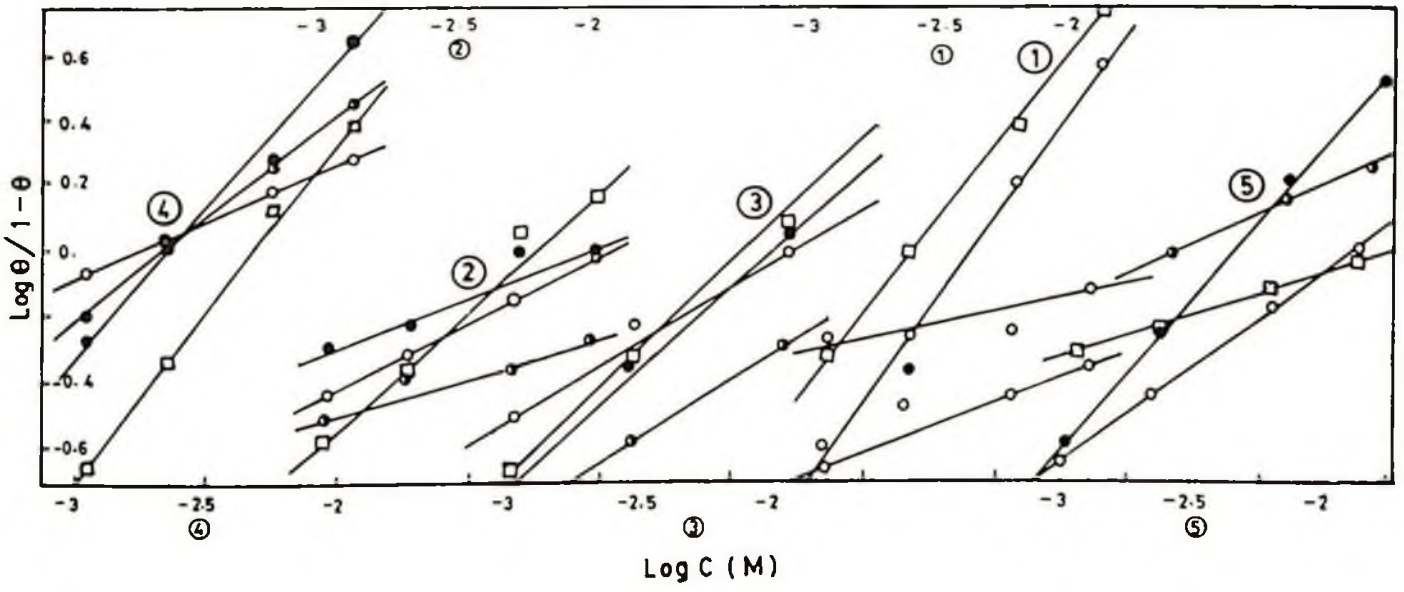


Fig. 1 (a-e) Variation of surface coverage with various concentrations of dye stuffs (1) 0.1 N ammonia; 2) 0.5 M ammonia 3) 1 N ammonia; 4) 2 N ammonia; 5) 3 N ammonia

1 mM dye, percentage inhibition is in the range 30-47 in different ammonia medium. The inhibitor efficiency rises with inrease in inhibitor concentration. Pyrochatechol can provide better protection against corrosion of brass in ammonia but at lower concentration of the dye, it is not as effective. At lower concentration of the dye and higher concentration of ammonia, the inhibitive power is very poor.

Decrease in corrosion rate observed in presence of added dye may be attributed to the formation of a continuous protective chemisorbed layer of the additive on the surface of the corroding material. Chemisorption of the additive is shown by linearity of log $[\theta/(1-\theta)]$ vs log C plots (Fig.1a-e). Copper forms soluble $Cu(NH_3)_4^{2+}$ complex ions during corrosion. The inhibitive power of the dye is due to its ability to cover the surface of the metal.

A methyl orange molecule has 3 nitrogen atoms and these have high electron density and can be considered as reaction centre. Comparatively low efficiency of Alizarin red S may be due to the smaller size of the molecule, fusion of the three phanyl rings and lesser number of -OH groups. Alizarin red S covers less of metal because it is chemisorbed on the brass surface vertically because of the two reaction centres (oxygen atom and OH group). Good performance of the Eriochrom black T can be attributed to the presence of $-NO_2$, and -OH groups in addition to the two nitrogen atoms in the molecule. The sulphuric acid group would have lost its proton and became sulphonate ion is formed in the pH range met with in ammonia solution (pH 7-12). The inhibitive power of the pyrocatechol may be due to the presence of two hydroxyl groups on the benzene ring which act as the reaction centres. This compound when absorbed can cover the metal surface to a larger extent. Increased concentration of this compound gives maximum protection indicating its effectiveness in ammonia environment. However the compound is not found to be as effective in higher ammonia concentration. This may be attributed to the greater solubility of the corrosion product in increased ammonia concentration.

It is evident from the present work that colouring additives (dye-stuffs) employed for the study can work as effective corrosion inhibitor in ammonia environment for brass. The comparative inhibitor power of the different dyes in 0.1 N ammonia environment is as Pyrocatechol > Eriochrome Black-T > Alizarine Red-S > Methyl Orange and for 3 N Ammonia environment -Eriochrome Balck-T > Methyl Orange > Alizarin red - S > Pyrocatechol.

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