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Research Article

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Influence of Zn^{2+} on the corrosion inhibition of adipic acid

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ABSTRACT

The inhibition efficiency of adipic acid in controlling corrosion of Aluminium in an aqueous solution at pH 10, in the absence and presence of Zn^{2+} has been evaluated by weight loss method. The formulation consisting of 250 ppm of adipic acid and 50 ppm of Zn^{2+} has 98% corrosion inhibition efficiency. A synergistic effect exits between adipic acid and Zn^{2+}. The protective film has been analyzed by UV-visible absorption spectroscopy and Fluorescence spectra

Keywords: Corrosion inhibition, Aluminium at pH 10, adipic acid, synergistic effect, Fluorescence spectra and UV- spectra

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INTRODUCTION

Aluminium and its alloys are very good corrosion resistant materials in neutral aqueous solution, due to the formation of passive film. It is well known that pitting corrosion occurs on metals covered with passive films. During pitting corrosion, large parts of the metal surface are covered with a protective film and are in the passive state, while other small parts of the surface are in the active state.

Corrosion inhibition of aluminium using super hydrophobic films (1),structure and stability of adhesion promotion aminopropyl phosphonate layers at polymer/aluminium oxides interfaces (2),microbially influenced corrosion of Zinc and aluminium (3) ,corrosion inhibition of aluminium by rare earth chlorides (4),effects of inhibitors on corrosion behavior of dissimilar aluminium alloy friction stir weld(5),a high through but assessment of aluminium alloy corrosion using Fluorometric methods (6),surface modification for aluminium pigment inhibition (7) and filiform on 6000 series aluminium (8)have been investigated. Because of the voice raised environment scientists, several corrosion researches have started using environmental friendly Priya et al have studied the corrosion behavior of aluminiumin rain water containing garlic extract(8)

The present work is undertaken
i. To evaluate the inhibition efficiency of adipic acid in controlling corrosion of aluminium immersed in an aqueous solution at pH 10, in the absence and presence of Zn^{2+} using the weight loss method
ii. To analyse the protective film by UV-visible absorption spectroscopy and Fluorescence spectra.

2.1. Preparation of specimens
Commercial aluminium specimens of dimensions 1.0 x 4.0 x 0.2cm, containing 95% pure aluminium were polished to mirror finish, degreased with trichloroethylene, and used for the Mass-loss method.

2.2. Weight loss method
Three aluminium specimens were immersed in 100mL of the solution at pH 10 and various concentrations of the inhibitor in the absence and presence of Zn^{2+} for a period of 1 day. The weight of the specimen before and after immersion was determined using shimadzu balance AY62.Inhibition efficiency (IE) was calculated from the relationship.

IE = 100 [1-W2/W1)] %

Where W1 and W2 are the corrosion rates in the absence and presence of the inhibitor, respectively.

2.3.UV – visible spectrum
A spectrophotometer can be either *single beam* or *double beam*. In a single beam instrument (such as the Spectronic 20), all of the light passes through the sample cell. I_o must be measured by removing the sample. This was the earliest design and is still in common use in both teaching and industrial labs.

In a double-beam instrument, the light is split into two beams before it reaches the sample. One beam is used as the reference; the other beam passes through the sample. The reference beam intensity is taken as 100% Transmission (or 0 Absorbance), and the measurement displayed is the ratio of the two beam intensities. Some double-beam instruments have two detectors (photodiodes), and the sample and reference beam are measured at the same time. In other instruments, the two beams pass through a beam chopper, which blocks one beam at a time. The detector alternates between measuring the sample beam and the reference beam in synchronism with the chopper. There may also be one or more dark intervals in the chopper cycle. In this case, the measured beam intensities may be corrected by subtracting the intensity measured in the dark interval before the ratio is taken.

2.4. Fluorescence spectra
In fluorescence spectroscopy, the species is first excited, by absorbing a photon, from its ground electronic state to one of the various vibrational states in the excited electronic state. Collisions with other molecules cause the excited molecule to lose vibrational energy until it reaches the lowest vibrational state of the excited electronic state. In a typical fluorescence (emission) measurement, the excitation wavelength is fixed and the detection wavelength varies, while in a fluorescence excitation measurement the detection wavelength is fixed and the excitation wavelength is varied across a region of interest.

Fluorescence spectroscopy is used in, among others, biochemical, medical, and chemical research fields for analyzing organic compounds. There has also been a report of its use in differentiating malignant skin tumors from benign.

RESULTS AND DISCUSSION

3.1. Analysis of result of weight loss method
The corrosion rate of aluminium in an aqueous solution at pH 10 (dil NaOH) in the absence and presence of inhibitors obtained by weight loss method are given in Table 1. The inhibition efficiency are also given in this table.

Table -1 Inhibitor system : Adipic acid (AA)and Zn^{2+}
Corrosion rates of Aluminium in an aqueous solution at pH 10 (dil NaOH),in the absence and presence of inhibitor system and the inhibition efficiencies (IE) obtained from weight loss method

Adipic acid ppm	Zn^{2+} system ppm	Corrosion rate mdd	Inhibition efficiency %
0	0	23.48	--
50	0	5.16	78
100	0	4.69	80
150	0	4.46	81
200	0	3.99	83
250	0	3.28	86

3.2. Influence of Zn^{2+} on the inhibition efficiency of adipic acid(AA)
The influence of Zn^{2+} on the IE of AA is given in Table 1. In the presence of Zn^{2+} (50ppm) excellent inhibitive property is shown by AA. A synergistic effect exists between AA and Zn^{2+} for example , 2mL of AA has 92% IE, 50ppm of Zn^{2+} has 13% IE. But their combination has 98%.

Table -2 Inhibitor system : Adipic acid (SA) and Zn^{2+}

Corrosion rates of Aluminium in an aqueous solution at pH 10 (dil NaOH),in the absence and presence of inhibitor system and the inhibition efficiencies (IE) obtained from weight loss method.

Adipic acid ppm	Zn^{2+}system Ppm	Corrosion rate Mdd	Inhibition efficiency %
0	50	23.48	--
50	50	2.58	89
100	50	2.11	91
150	50	1.87	92
200	50	1.40	94
250	50	1.17	95
0	50	19.25	18

3.3. Influence of N-Cetyl N,N,N-trimethylammonium Zn^{2+} (50ppm) system.

The influence of CTAB on the inhibition efficiency of AA(250ppm)-Zn^{2+} (50ppm) system is given in Table 2. It is interesting to find that the IE of the AA -Zn^{2+} system is not changed by the addition of CTAB. CTAB is a biocide .It can control the corrosion caused by inhibition efficiency. It is expected that this formulation will have excellent biocidal efficiency also.

3.4 Analysis of UV –visible absorption spectra

UV-visible absorption spectrum of an aqueous solution containing adipic acid and Al^{3+} (Aluminium Sulphate) is shown in Fig.1 A peak appears at 420nm .Is indicate that a complexes from between Al^{3+} and adipic acid Fig

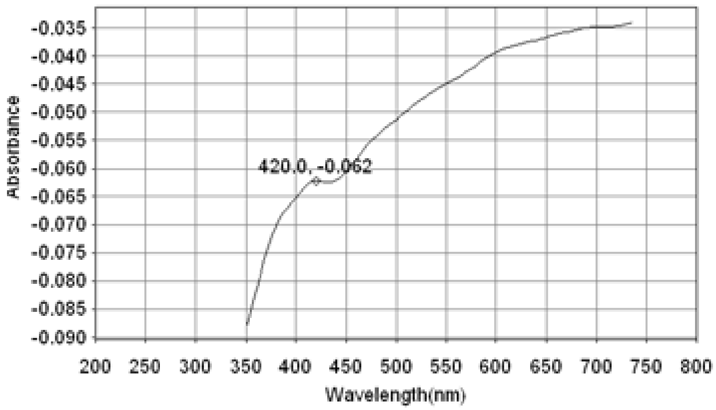

Fig.1 UV – visible absorption spectrum of an solution containing Adipic acid and Al^{3+}

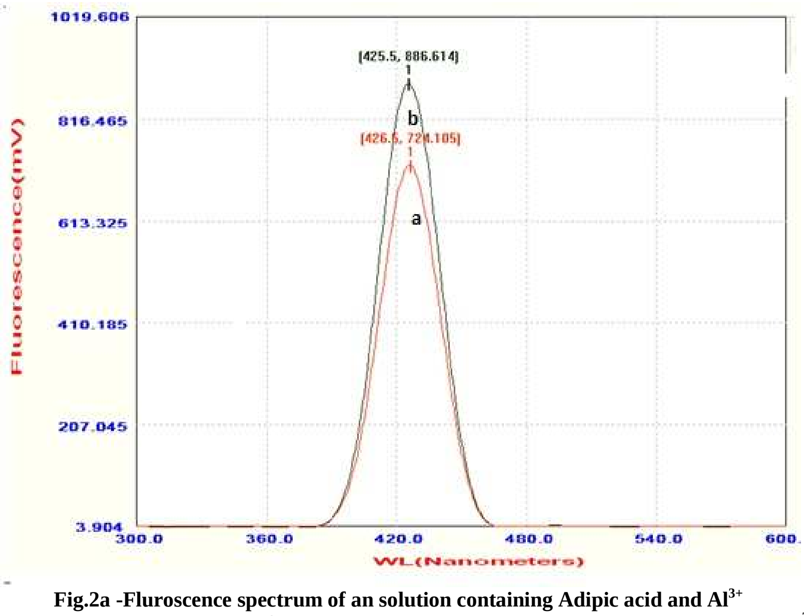

Fig.2a -Fluroscence spectrum of an solution containing Adipic acid and Al^{3+}

Fig.2b -Fluroscence spectrum of an solution containing250ppm Adipic acid and 50ppm Zn^{2+}

3.5 .Analysis of Fluroscence spectra

The Fluroscence spectrum ($\lambda^{excitation}$ = 300nm) Fluroscence spectrum of an aqueous solution containing Al^{3+} and adipic acid (Al^{3+}-Adipic acid) is shown in Figure 2a.Apeak appears at 426.6nm. The fluroscence spectrum of ($\lambda^{excitation}$ = 300nm) protective film formed on aluminium metal surface after immersion in the solution containing 250ppm of adipic acid and 50ppm Zn^{2+} solution after for 1 day is shown in figure 2b. A peak appears at 420.5n.The peak matches which that of aluminium adipic acid complex. Hence it is conforming that the protective film formed on the metal surface is Aluminium and adipic acid complex ion.

CONCLUSION

The present study lead to the following conclusions Inhibition efficiency of Adipic acid in controlling corrosion of aluminium in distilluted water in the absence and presence of Zn^{2+} has been evaluated by weight loss method UV –visble spectra reveal that the protective film consists of Al^{3+} and adipic acid complex.

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