SUBSTITUTED THIOBIURETS AS CORROSION INHIBITORS FOR MILD STEEL IN L.ON SULPHURIC ACID

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ABSTRACT

Corrosion inhibition studies of mild steel in l.ON sulphuric acid have been performed at 25°C using substituted thiobiurets as inhibitors. All the inhibitors were found to inhibit the process by getting adsorbed on the metal surface. A comparative account of inhibition efficiencies of different compounds has been given considering their size and probable sites through which adsorption can take place. Among the studied thiobiurets methoxyphenyl derivative behaved as the best corrosion inhibitor followed by mefhylphenyl-, phenyl- and chlorophenyl-derivatives.

INTRODUCTION

Organic compounds containing nitrogen, sulphur and oxygen have been frequently used as inhibitors for a number of metals and alloys in a variety of environments. Since mild steel is considered as an inexpensive material particularly for construction of storage tanks and pipe lines etc. and it is susceptible to attack by sulphuric acid during operations like cleaning, pickling etc., it was considered interesting to study the inhibitive action of a few thiobiurets for mild steel - l.ON sulphuric acid system.

Experimental

l-aryl-5-phenyl-2 thiobiurets were prepared by the reported method. The working electrodes and specimens for weight loss experiments were prepared from mild steel sheets having the following percentage composition:

C	Mn	Si	P	S	N	Cu	Cr	Fe
0.12	0.11	0.02	0.02	0.02	0.02	0.01	0.01	Remainder

The specimens for the weight loss experiments were of me size 3x3 cm and those for electrochemical studies the size of the electrodes was 1x1 cm with a 4 cm long tag for electrochemical contact. Born sides of the specimens were exposed for both the techniques. The specimens were mechanically polished successively with 1/0, 2/0, 3/0 and 4/0 grade emery papers. After polishing with the paper of each grade, the surface was thoroughly washed with soap, miming tap water, distilled water and finally was degreased with acetone. The samples were dried and stored in a vacuum desiccator before immersing in the test solution. For weight loss experiments 300 ml of IN H_2S0_4 was taken in 500 ml glass beakers with lids. The inhibition efficiencies were evaluated after 24 h using 10, 20, 50, 100 and 150 ppm of inhibitors. The specimens were removed from the electrolyte, washed thoroughly with distilled water, dried and weighed.

The electrochemical experiments were carried out in a three-necked glass assembly containing 150 ml of the electrolyte with different concentration of inhibitors from (10 ppm to 150 ppm by weight) dissolved in it. Polarization studies were performed in unstirred undeaerated solutions using a Wenking Potentiostat (POS-73). Starting from open circuit

Potential the potential was manually applied in 10 mv steps in me anodic or cathodic direction and the corresponding steady state currents were measured directly from the ammeter on the panel of potentiostat. All experiments were performed at 25 ± 0.2°C in an electronically controlled air thermostat.

Results and Discussions:

The percentage inhibition efficiencies (IEs) in presence of 10, 20, 50, 100 and 150 ppm of all the inhibitors for corrosion of mild steel in l.ON H_2S0_4 solution at 25°C have been determined by weight loss and electrochemical polarization techniques and me results are summarized in the table. The data show that IE in general increases with increase in concentration of additives. The observed order of IEs for different inhibitors is as follows:

1-p-methoxy phenyl-5-phenyl-2-thiobiuret > l-p-methylphenyl-5- phenyl-2-thiobiuret > l,5-diphenyl-2-fhiobiuret- > l-p-chlorophenyl-5-phenyl-2-thiobiuret.

The observed order of IEs may be explained on the basis of variation in electron density at phenyl ring due to different substituents at p-position because the other active centers sulphur and oxygen remain the same in all the compounds.

The anodic polarization behaviour of mild steel was studied in 1 .ON sulphuric acid containing different concentrations of substituted thiobiurets at 25°C. Fig.l represents the anodic polarization behaviour of mild steel in presence of 20, 50, 100 and 150 ppm of l,5-diphenyl-2-thiobiuret at 25°C. It is evident from the figure that current density decreases with increase in concentration of the additive and the curves shift simultaneously towards noble direction. The magnitude of the shift in the anodic polarization curve is a function of the concentration of the inhibitors and their IEs at the respective concentration.

Fig.2 represents cafhodic polarization behaviour of mild steel in absence and presence of different concentration of l,5-diphenyl-2-thiobiuret in l.ON sulphuric acid at 25°C. It is apparent from the figure that nature of curve remains almost unaltered on the addition of the inhibitors; however, some decrease in current density is observed on the addition of each of the inhibitors. The magnitude of the decrease in current density varied according to the structure of the inhibitors and it is in the same order as me IE obtained for these inhibitors from the weight loss and electrochemical techniques.

All the compounds exhibited straight line for $\log \frac{\theta}{1-\theta}$ vs. log C at 25°C as required by Langmuir adsorption isotherm. However, the slopes of the straight lines were not found to be unity. The deviation from unity may be explained on me basis of interaction between the adsorbed species on me metal surface.

Concentration ppm	1,5-diphenyl-2thibiuret		l-p-methylphenyl-5-phenyl-2-thiobiuret		l-methoxylphenyl-5-phenyl-2-thiobiuret		l-chlorophenyl-5-phenyl-2-thiobiuret	
	Weight loss Method	Polarization Method	Weight loss Method	Polarization Method	Weight loss Method	Polarization Method	Weight loss Method	Polarization Method
10	66.31	65.12	68.54	67.19	72.32	71.11	60.12	58.83
20	72.24	70.86	73.84	72.28	78.48	77.16	62.24	61.21
50	76.12	75.16	77.24	76.17	80.42	78.93	66.13	65.16
100	81.31	80.12	83.34	82.16	84.38	83.17	73.42	72.12
150	83.12	81.93	87.12	85.94	88.32	86.84	76.18	74.82

Table 1 : Percrntage inihibition efficiency (%IE) values calculated by weight loss and electrochemical polarization techniques in presence of l-aryl-5-phenyl-2-thibiurets

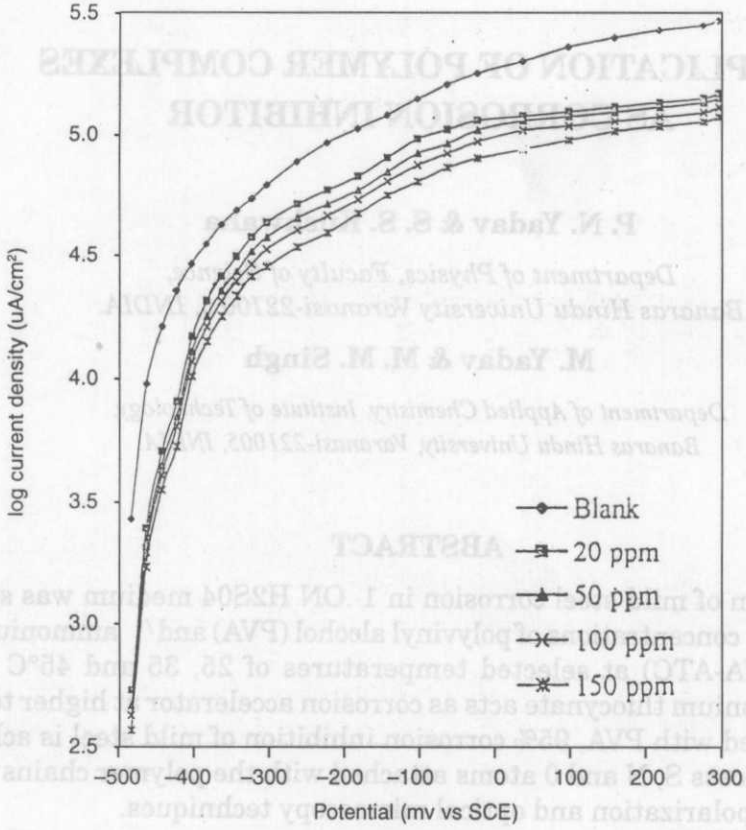

Fig. 1 : Anodic polarization behaviour of Mild steel in 1N-H_2SO_4 in absence and presence of different concentrations of 1-phenyl-5phenyl-2-thiobiuret at 25°C

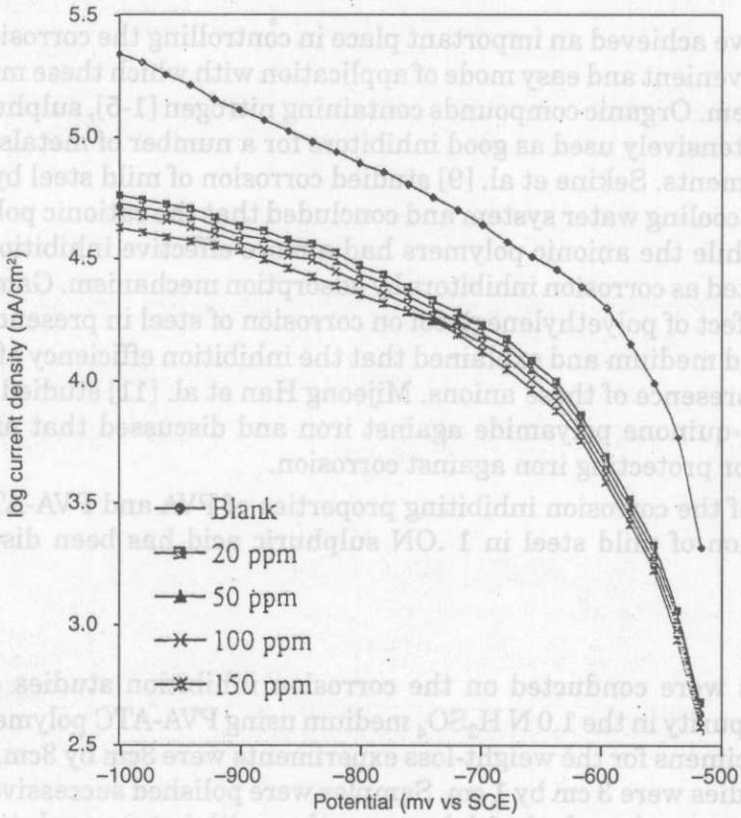

Table 1 : Cathodic polarization behaviour of Mild steel in 1N-H_2SO_4 in absence and presence of different concentrations of 1-phenyl-5-phenyl-2-thiobiuret Mo(V) complex at 25°C