ABSTRACT

The synergistic effect of 2-chloroethylphosphonic acid (2 Cl EPA) and Zn$^{2+}$ on the inhibition of corrosion of carbon steel in neutral aqueous solution containing 60 ppm of Cl' has been evaluated in the present study. The influence of sodium gluconate, sodium potassium tartrate and trisodium citrate on the inhibition efficiency of the 2 Cl EPA - Zn$^{2+}$ system has been investigated.

In order to investigate the nature of the protective film, UV-visible reflectance spectroscopy, X-ray diffraction technique, FTIR spectroscopy and luminescence spectroscopy have been used in the present study. The mechanistic aspects of corrosion inhibition are based, in a holistic way, on the results obtained from the classical weight-loss method, the electrochemical method and different spectroscopic techniques.

This thesis is divided into six chapters. Chapter I presents a general introduction to the problem of corrosion, control of corrosion by inhibitors and a review of the literature on corrosion inhibitors for carbon steel in neutral aqueous environment. The need, objectives and the scope of the present study are discussed in Chapter II.
Details of methodology employed in the present study are given in Chapter III. Corrosion rates and inhibition efficiencies were determined by the weight-loss method. The electrochemical studies were carried out in the EG&G Electrochemical Impedance Analyser Model 6310. For impedance study software M398 was used and for polarisation study software M270 was used. FTIR spectra of the surface films were recorded using Perkin-Elmer 1600 FTIR spectrophotometer. UV-visible absorption spectra of aqueous solutions were recorded using Hitachi U-3400 spectrophotometer. The same instrument was used for recording the UV-visible reflectance spectra of the surface films. The XRD patterns of the surface films were obtained using a computer controlled X-ray powder diffractometer. Luminescence spectra were recorded in a Hitachi - 650-1 OS fluorescence spectrophotometer.

Experimental results on the synergistic effect of phosphonate and Zn\(^{2+}\) on the inhibition of corrosion of carbon steel are discussed in detail in Chapter IV. In the case of 2 Cl EPA - Zn\(^{2+}\) system, the protective film consists of Fe\(^{2+}\) - 2 Cl EPA complex and Zn(OH)\(_2\). In the case of 2 Cl EPA - Zn\(^{2+}\) - SG system, the protective film consists of Fe\(^{2+}\) - 2 Cl EPA complex, Fe\(^{2+}\) - SG complex and Zn(OH)\(_2\). In the case of 2 Cl EPA - Zn\(^{2+}\) - SPT system, the protective film consists of Fe\(^{2+}\) - 2 Cl EPA complex, Fe\(^{2+}\)-SPT complex and Zn(OH)\(_2\). In the case of 2 Cl EPA - Zn\(^{2+}\) - TSC system, the protective film consists of Fe\(^{2+}\)-2 Cl EPA complex, Fe\(^{2+}\)-TSC complex and Zn(OH)\(_2\).
Results of potentiostatic polarisation study show that phosphonate - Zn\(^{2+}\) system, and other systems investigated behave as mixed inhibitors. Based on the combined results of the weight-loss method, potentiostatic polarisation study, UV-visible absorption spectra, UV-visible reflectance spectra, FTIR spectra luminescence spectra, and XRD patterns, a suitable mechanism of corrosion inhibition is proposed.

The influence of biocides such as N-cetyl-N, N, N-trimethyl ammonium bromide (CTAB) and also N-cetylpyridinium chloride (CPC) on the inhibition efficiencies of various inhibitor systems has been investigated in Chapter V.

Summary and conclusions of the study are presented briefly in Chapter VI.

The references are given at the end of the thesis.