ABSTRACT

This thesis embodies the results of synergistic inhibition of corrosion of mild steel in neutral aqueous medium containing 60 ppm chloride using new phosphonates, Zn$^{2+}$ ions and organic additives. The new phosphorates used in this study are phosphonoacetic acid (PAA) and 2-phosphonobutane-1,2,4-tricarboxylic acid (PBTC). The organic additives used are gluconate, citrate and tartrate ions.

The objectives of the present study are:
1. To develop economical and environmentally friendly inhibitor systems containing PAA/PBTC using zinc ions as synergist (binary systems)
2. To develop environmentally friendly inhibitor systems containing PAA, PBTC, zinc ions (primary synergist) and organic salt, viz., gluconate or citrate or tartrate as the secondary synergist (ternary systems)
3. To study the nature of the inhibition process and to determine the type of inhibition, whether anodic or cathodic or mixed.
4. To investigate the nature of the surface film formed during the inhibition process, and,
5. To elucidate the mechanism of the corrosion inhibition.

The following experimental methods were used to achieve the above objectives.

Weight-loss studies for a seven-clays-immersion-period were undertaken to determine the corrosion rates. Analysis of solutions for Zn$^{2+}$ ions was done by Atomic absorption spectroscopy (AAS). Potentiostatic polarization studies and A.C. impedance studies were carried out to determine on the nature of the inhibitor process. For surface film characterization, Fourier Transform Infrared
spectroscopy technique, X-ray photoelectron spectroscopy (XPS) and Scanning Electron Microscopy technique (SEM) were used.

This thesis consists of the results and discussion on synergistic inhibition of corrosion of mild steel using phosphonoacetic acid, zinc ions (as primary synergist) and organic additives using gluconate, citrate and tartrate (as second synergist). The synergistic effect on increasing corrosion inhibition efficiency and the effect of pH on inhibition efficiency are discussed in detail. The results of the potentiostatic polarization studies have been used to decide whether the inhibition process is under anodic or cathodic or mixed control. The results of Nyquist plots based on A.C. impedance studies have been discussed. The nature of the protective films in all the inhibitor systems have been thoroughly investigated using the FTIR spectra and XPS patterns of the surface films. Finally the mechanistic aspects of corrosion inhibition are presented.

The results and discussion on synergistic inhibition of corrosion of mild steel using PBTC, zinc ions (as primary synergist) and organic additives, using gluconate, citrate and tartrate (as second synergist) are also presented in this thesis. The same processes and techniques adopted for PAA system were employed and the results obtained have been recorded. Based on the results a mechanism of corrosion inhibition for these systems is proposed.