

## ABSTRACT

Iron, one among the most important engineering materials is more susceptible to acid attack. Due to its economic and safety consequences, protection of iron from corrosion is imperative. A significant method to shield the metals from corrosion is addition of inhibitors to the corrosive media. To this end, the utilization of organic compounds containing heteroatoms as inhibitors to reduce corrosion especially Schiff bases have received great attention in this regard. Various investigations have proved that Schiff bases could act as effective corrosion inhibitors.

In the present work, the inhibition efficiency of the synthesised Schiff bases on the inhibition of corrosion of mild steel in 1M HCl and 0.5M H<sub>2</sub>SO<sub>4</sub> acid media have been studied using weight loss method, electrochemical techniques such as Electrochemical Impedance Spectroscopy (EIS), Potentiodynamic polarization studies and Quantum chemical studies and the results were compared. The mechanism of inhibition of these compounds has also been discussed based on the values of Potential of Zero Charge (PZC) on the metal surface in various acid media and the adsorption isotherm.

The results obtained from weight loss method, Electrochemical Impedance method and Potentiodynamic Polarization method have been discussed in terms of various parameters such as inhibition efficiency (IE), Corrosion rate (CR), charge transfer resistance ( $R_{ct}$ ), double layer capacitance ( $C_{dl}$ ), Corrosion current density ( $i_{corr}$ ) and corrosion potential ( $E_{corr}$ ). The influence of concentration of Schiff bases and the temperature of the

environment on corrosion of mild steel in both the acid media have been studied and discussed.

Weight loss results revealed that the inhibition efficiency increases with the increase in concentration of the inhibitor fixing the optimum concentration at around 400 ppm.

The impedance studies showed that the charge transfer resistance ( $R_{ct}$ ) values increased with inhibitor concentration due to an increase in surface coverage by the inhibitor molecules in both the media. Decrease in double layer capacitance ( $C_{dl}$ ) and admittance ( $Y_0$ ) values in both the media with the addition of inhibitor concentration was attributed to the decrease in dielectric constant and/or, increase in thickness of the electrical double layer.

Potentiodynamic polarization measurements clearly revealed the fact that these Schiff base compounds brought down the corrosion current without causing appreciable change in the  $E_{corr}$  values and prevented both anodic and cathodic reaction by blocking the active sites by adsorption which in turn proved that these inhibitors are of mixed type.

Adsorption of Schiff bases on to the mild steel surface obeyed Langmuir adsorption isotherm. The Free energy change ( $\Delta G_{ads}$ ) has been calculated from the adsorption isotherm and discussed.

The weight loss and the Potentiodynamic polarization studies were carried out in the temperature ranges from 30 - 60°C and the kinetic parameter, activation energy ( $E_a$ ) and the Corrosion Rate (CR) were determined. The corrosion rate increased with the increase in temperature.

The rise in temperature imparted greater kinetic energy to the molecules which affects their adsorption and promoted the desorption process.

The thermodynamic ( $\Delta G_{ads}$ ) and the kinetic parameters ( $E_a$ ) indicated that the adsorption process is spontaneous as well as occurred predominantly through physisorption.

PZC values indicated that the metal surface is positively charged in both the media at the Open Circuit Potentials (OCP) and the adsorption of the protonated Schiff base molecules were facilitated through  $Cl^-$  and  $SO_4^{2-}$  bridges.

Formation of a protective layer on the metal surface due to the presence of inhibitor was further confirmed by surface morphological study (Atomic Force Microscopy).

The results of Quantum chemical calculations were in good concurrence with the results obtained from electrochemical and weight loss method.