

The most important highlights of the present work entitled “Inhibitive Performance of selected biomass-*Passiflora vitifolia*, *Pyrostegia venusta* and marine algae-*Sargassum polycystum*, *Padina boergesenii* on acid and alkali corrosion of mild steel and aluminium alloy – Experimental and Theoretical approach” are summarized and discussed under different phases as per the methodology adopted

#### Phase I:

- Phytochemical screening test conducted for the leaves extract of PAVL, PVL and seaweed extract of SP, PB was carried out using the standard procedure.
- The prepared extracts were characterized using UV, FT-IR, GC-MS and HPTLC,.
- HPTLC analysis revealed that the inhibitors possessed flavonoid, alkaloid and steroids in it.
- The results of FT-IR and UV studies proved that the phytochemical constituents present in the PAVL, PVL, SP and PB were absorbed over the metal surface and metal surface can be protected from corrosion.

#### Phase II:

##### Electrochemical measurements for MS/Inhibitors/1M HCl, AA/Inhibitors/1M HCl and AA/Inhibitors/1M NaOH

##### Polarisation studies

- Analysis of Potentiodynamic polarisation results revealed that the  $E_{\text{corr}}$  for PAVL, PVL, SP and PB in acid/alkaline media did not change considerably with the addition of the inhibitor solution and thus affected the anodic dissolution as well as cathodic hydrogen evolution reactions and acted as mixed type inhibitors.
- $I_{\text{corr}}$  values decreased extensively in the presence of the studied inhibitors showed that all the studied inhibitors were an efficient inhibitor for controlling corrosion reaction.
- The Tafel constants for the studied systems and the polarization plotstheMS/AA in acidic and alkaline medium inferred that all the studied inhibitors behaved like mixed type inhibitor.

- $R_p$  values increased by the increased in the investigated inhibitor concentration indicated a better protective ability of the inhibitors from corrosion under study.

### Impedance studies

- The value of impedance parameters were obtained from a suitable equivalent circuit. The results revealed that an increase in charge transfer resistance ( $R_{ct}$ ) values with enhance in the concentration of the studied inhibitor solution. The main reason is that the phytochemical compounds were adsorbed on the MS/AA surface. The  $C_{dl}$  value decreased with increase in the concentration of the investigated inhibitors by decreased value of dielectric constant due to the protective film formed on the acid/metal interface.
- The impedance at low-frequency range of Bode plot proved that the maximum shield occurred on the metal surface by enhancing the concentration of the studied extracts solution and this has happened through adsorption of the studied inhibitor molecules on the MS/AA surface.

### Mass loss Measurements

- Inspection of the results of the mass loss studies of MS / AA in HCl/NaOH inferred that %IE enhanced with rising concentration of the studied inhibitors. The results indicate that as the immersion time enhanced from ½ h to 24h, the IE was also increased. All the studied inhibitors were found to be promising candidates.
- The study of the influence of temperature on the corrosion of mild steel and aluminium alloy in 1M HCl/1M NaOH can reflect the kinetic and mechanistic character of the corrosion process. The results revealed that appreciable I.E. obtained in 1M HCl/1M NaOH for the investigated inhibitors. When the temperature increased, IE increased up to a particular temperature (333K) with a decrease in temperature. The main reason is that the adsorption of the investigated inhibitor molecules took place in the metal surface up to a particular temperature and then desorption occurred at elevated temperature.
- Statistical inspection of the inhibitors using SPSS noticed that all the investigated inhibitors followed the Langmuir isotherm model.
- In the current study, the  $E_a$  values were greater in the presence of the studied inhibitor solution than those calculated in the absence of the studied inhibitors. The higher values of  $E_a$  in the inhibited solution related to enhancing in the thickness of the double layer thus enhanced the activation energy of the corrosion reaction.

- The positive values of entropy of activation ( $\Delta S_a^\circ$ ) with the studied inhibitors in MS/AA/1M HCl/1M NaOH implied that an enhance in the disorders took place on going from reactants to the activated complex. The positive value of the enthalpy of activation ( $\Delta H_a^\circ$ ) reflecting the endothermic reaction of the corrosion process.
- The negative values of  $\Delta G_{ads}$  for the studied systems showed that the studied inhibitors were spontaneously adsorbed onto the MS/surface. In the current research, the values of  $\Delta G_{ads}^\circ$  were observed from the studied systems range between -7.9 kJ/mole to -20.9 kJ/mole reflected the adsorption process was physical adsorption but chemical adsorption could not be excluded.
- The negative sign of  $\Delta H_{ads}^\circ$  identified that corrosion reaction was exothermic in nature. The positive sign of  $\Delta S_{ads}^\circ$  reflected that an enhance in disorders due to huge water molecules were desorbed from the metal surface by all the studied inhibitors (AA/1M HCl). The negative sign of entropy ( $\Delta S_{ads}$ ) in the presence of all the studied inhibitors using MS/AA in 1M hydrochloric acid/1M NaOH implied freely moving in the bulk solution was adsorbed in an orderly manner onto the metal surface.

#### Phase III:

- UV spectral analysis proved the formation of the protective film of the metal-inhibitor complex in the metal surface.
- FT-IR spectral values revealed that the adsorption of the investigated inhibitor molecules on the surface of the metal specimen.
- Surface topography of the metal surfaces using SEM and reflected that the surface of the metal was rough after exposing the metal samples in acidic and alkaline solution which identified that the aggressive nature of the inhibitor solution. The inhibited surface was smooth and the surface of the metal was prevented from corrosion due to adsorption of the active compounds present in the investigated inhibitors. The EDX patterns supported the results of SEM analysis.
- The surface morphology of metal samples by XRD and 3D Optical Profiler further confirmed the mitigating behaviour of the investigated inhibitors under study.

**Phase IV :** Quantum chemical studies proved the possible adsorption centres by which the Fe/Al atom formed Fe/Al – inhibitor complex.