SUMMARY AND CONCLUSION

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Corrosion inhibitors are of great practical importance since these are used in minimizing metallic waste in industries. Organic compounds and the natural products that contain organic constituents when used as inhibitors act through surface adsorption. The efficiency of the inhibitor not only depends on the environment and the metal, but also on the structure of constituents in the inhibitor, the number of active sites in the molecule, their charge density, the size of the molecule and the mode of adsorption. These factors have been evaluated for the selected materials for the dissolution of mild steel in 1M HCl and 0.5M H_2SO_4 and the conclusions arrived at the study are as follows.

- All the three plant materials selected for the study (CFL, BSL and MJF) proved as effective inhibitors for corrosion of mild steel in 1M HCl and 0.5 M H_2SO_4.
- The efficiency of the inhibitors was found to increase with increase in concentration of the inhibitor and the inhibition efficiency of above 90% was obtained at 5%v/v of the inhibitors.
- The efficiency of all the inhibitors increased with increase in immersion period. The optimum immersion period for CFL was12 h in 1M HCl and 3h in 0.5M H_2SO_4. The maximum efficiency was obtained at 48 h for BSL in 1M HCl and 7 h in 0.5M H_2SO_4. The MJF extract showed a maximum efficiency at 24 h in 1M HCl and 12 h in 0.5M H_2SO_4. This shows the persistence of the adsorbed inhibitor molecules on the mild steel surface over a longer period.
- The inhibitors were effective at the studied range of temperatures in both the acid medium. There was a regular trend of increase in efficiency with increase in temperature at higher concentrations of the inhibitors. CFL showed a maximum efficiency at 343 K (93.4%) in 1M HCl and at 323K (83.01%) in 0.5M H_2SO_4 whereas for BSL, the maximum efficiency was at 333 K (90.9% in 1M HCl and 90.48% in 0.5M H_2SO_4). MJF provided maximum efficiency at 323 K in 1M HCl and 0.5M H_2SO_4 (91.43% and 88.37%).
- The data from weight loss measurements at different temperatures were fit into different isotherms. The data fit well for the Langmuir, Freundlich and

Temkin isotherms with R^2 values very closer to 1 suggesting that the inhibition is by physical adsorption of the inhibitors on the mild steel surface.

- The higher and positive values of molecular interaction parameter 'a' calculated from the Temkin isotherm showed that there exists an attractive force in the adsorbed layer.
- The number of active sites obtained from the slope of El-Awady thermodynamic model ranged from 1 to 3 confirming that the phytochemical constituents replace more than one water molecule from the mild steel surface, hence the maximum efficiency.
- The energy of activation E_a were negative for all the three inhibitors in both the acid media suggesting the formation of adsorption film of physical nature.
- Enthalpy of adsorption ΔH_{ads} and Heat of adsorption Q_{ads} was negative for all the inhibitors in both media confirming the adsorption as an exothermic process.
- The negative values of free energy of adsorption ΔG_{ads} and the large and positive values of entropy of adsorption ΔS_{ads} in all the cases confirm the spontaneous adsorption of the phytochemical constituents of the extracts on the mild steel surface and the rate of adsorption is controlled by activation complex.
- Polarization studies suggest mixed type of inhibition for all the three inhibitors in both the acid media.
- The diameter of the Nyquist plot increased with increase in concentration of the inhibitor which is due to the formation of inhibitive film strengthened by the addition of the inhibitor. Nyquist plots with no loops suggest that the mild steel – inhibitor system is under charge transfer resistance control and the selective adsorption of the inhibitor on the surface of mild steel.
- The Nyquist plots are not perfect semicircles. The depressed semicircles are due to the presence of pores on the electrode surface or due to the adsorption of the inhibitor on the mild steel surface.
- The Bode plots show that the adsorption is a single step process.
- The efficiencies obtained from the weight loss method and electrochemical method when compared showed the same trend of increase in efficiency with increase in concentration of the inhibitors. The magnitude of the efficiencies obtained by different methods varied. This may be attributed to the fact that

Weight loss method gives average corrosion rate whereas Electro chemical methods give instantaneous rates.

- ❖ Among the three materials selected and investigated as inhibitors for mild steel in 1M HCl and 0.5M H_2SO_4, BSL was found to be the best. It provided maximum efficiency by all the methods.
- ❖ The phytochemical constituents of these inhibitors mostly comprise of =O, -OH and >NH groups. The FTIR studies confirmed the interaction of these constituents with the mild steel surface via these active centres by chemisorption.
- ❖ Durability of the acid extracts under different storage conditions was studied. The study revealed that the inhibitors are stable upto six months of storage even under laboratory conditions and hence need not be refrigerated, thereby minimizing the cost of storage.
- ❖ The pickling baths (1M HCl and 0.5 M H_2SO_4) containing 5% v/v concentrations of the extracts (CFL, BSL and MJF) were found to be effective for 3 sets of mild steel samples.
- ❖ The extracts prepared after washing the leaves and flowers with petroleum ether showed lower efficiency when compared to the extract prepared by refluxing without washing in petroleum ether.
- ❖ The extract prepared by soaking the leaves for 12 hours in the acids proved effective for the studied range of concentrations.
- ❖ The bioaccumulation of the aqueous extracts was analysed. All the three inhibitors were found to be environmentally safe.
- ❖ All the three extracts in both 1M HCl and 0.5M H_2SO_4 were effective under the industrial conditions.

RECCOMMENDATIONS

SCOPE FOR FURTHER STUDY

- The plant extracts can be tried as inhibitor for other medium and for different metals and alloys.
- The plant extracts may be tested in more number of industries.
- The study may be carried out for different period of soaking the leaves or flowers in pickling baths above 12 h to find the optimum period of soaking for maximum efficiency.
- The plant material can be tried as an inhibitor for microbiological corrosion.
- The plant material can be tried as a coating by the addition of suitable binder.
- Vapour phase inhibitors can be tried from these selected plant materials.