INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD)
© 2026 IJNRD | Volume 11, Issue 3, March 2026 | ISSN: 2456-4184 | IJNRD.ORG

SOLANUM TRILOBATUM AS ECO-FRIENDLY CORROSION CO-INHIBITOR FOR CARBON STEEL IN ACID MEDIUM

J. ANTONY LISA[1*], R. MANJUSHREE[2], VA. ROHINI[3]

[*1]Associate professor, Department of Chemistry, Sakthi College of Arts and Science for Women, Oddanchatram, Dindigul, Tamil Nadu, India.

[2,3]PG&Department of Chemistry, Sakthi College of Arts and Science for women, Oddanchatram, Dindigul, Tamil Nadu, India.

Abstract: Leaves extract are viewed as rich source of naturally synthesized chemical compounds than can be extracted by simple procedures with low cost. This paper emphasize the bring of eco-friendly co inhibitor obtained from plant extract .In the present study the effect of *solanum trilobatum* as corrosion co-inhibitor carbon steel in HCl was investigated bring weight loss method was analyses by Fourier transform infrared spectroscopy (FTIR),scanning electron microscopy (SEM) and also UV techniques it was found in that the corrosion rate decreases up to the addition of 2.0 ml of co-inhibitor as the efficiency obtained has 90%.

Keywords: **corrosion, co-inhibitors, Eco friendly, Solanum Trilobatum, corrosion rate, carbon steel.**

1.INTRODUCTION

1.1Corrosion

The metals have a natural tendency to revert back to combined states. During this process mostly oxides are formed but depending upon the presence of impurities, sulphides, carbonates, sulphates, etc may also be formed, and the process by which the metals have a tendency to go back to their combined state is known as “corrosion.[1]

1.2Classification of Corrosion

Corrosion may generally be of two types: 1. Direct chemical corrosion (or) Dry corrosion 2.Electrochemical corrosion (or) Wet corrosion ,Direct chemical corrosion The metal is surrounded by gases such as oxygen, halogen, Sulphur dioxide, hydrogen sulphide, nitrogen, etc in the surroundingEnvironment and as a result, corrosion occurs mainly through the direct chemical action of environment or atmospheric gases with Metal surfaces in immediate proximity.[2]

1.3Principles of Corrosion

The resistance to corrosion or chemical is controlled by many factors. Its complete and comprehensive study requires an understanding of several field of scientific thermodynamic and Electrochemistry is highly important for understanding and controlling corrosion.[3]

a) Metallurgical principles

b) Physical and chemical principles

c) Thermodynamic principles

d) Electro chemical principles

1.4Corrosion Rate

Loss of metal thickness per unit time is called the rate of penetration. The rate at which corrosion occurs is very significant and is commonly expressed in two ways: Weight loss per unit time, usually mdd (milligrams per square decimetre per days). Decrease in thickness per unit time, that is, rate of penetration or the thickness of metal lost. It may be stated in American units like mpy (mils per year) or in metric units.

2.1 MATERIALS AND METHODS

Preparation of Solanum Trilobatum

The co- inhibitor chosen is Solanum Trilobatum leaves extract

Kingdom: plantae

Family: Solanaceae

Scientific name: Solanum Trilobatum

Common Name: Purple Fruited Pea Eggplant

English Name: Climbing Brinjal

2.2 PREPARATION OF THE INHIBITOR SOLUTION

The 10 g of Solanum Trilobatum was weighted and boiled with distilled water. Then it was filtered to remove suspended impurities and the volume of the filtrate was made up to100 ml using the same solution, and this was taken as corrosion inhibitor solution.

2.3Weight Loss Method

The weighing specimen in duplicated were suspended by means of glass hooks in 100ml beaker containing the test solution and after various hours of an immersion, the specimen were taken out, wasted in ruuning,dired and weighed. From the changes in weights of the specimen, corrosion rate was calculated using the following relationship.

2.4Determination of Corrosion Rate

Corrosion inhibition efficiency (IE) was calculated using above the equation

$$\text{Corrosion Rate} = \frac{\text{Loss in Weight (mg)}}{\text{Surface area of the specimen (dm2} \times \text{Period of immersion (days)}}$$

2.5Potentio Dynamic Polarisation Study

Potentio dynamic polarisation studies were performed using an electrochemical impedance analyser (Model 660A). A three-electrode cell assembly was used with carbon steel as the working electrode and a saturated calomel electrode (SCE) as the reference electrode. The electrodes were immersed in an acid medium in the absence and presence of inhibitors, and the SCE was connected through a salt bridge. The potential (E) vs current (I) plots were recorded, and Ecorr with Tafel slopes (ba and bc) were obtained from the E vs log I plots.

2.6Fourier Transfer Infrared Spectroscopy (FTIR)

These spectra were recorded in a Perkin-Elmer1600spectroscophotometr using KBrpellet. The FTIR spectrum of protective film was recorded by carefully removing the film, mixing it with KBr and making the pellet.

2.7Scanning Morphology Studies (SEM)

The surface morphology measurement of the carbon steel was examined by using JEOLJMS6390 model. All SEM micrographs of carbon steel are taken at a magnification of x=500.

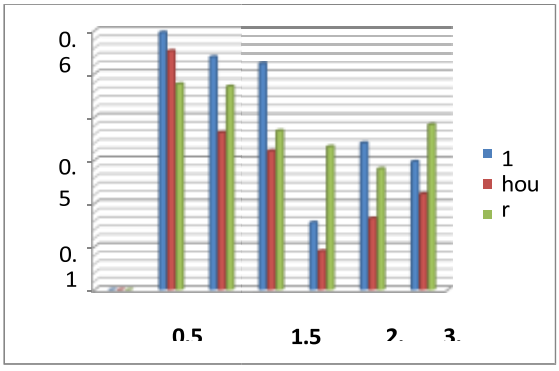
3.RESULTS AND DISCUSSION

3.1Analysis of the Results of Weight Loss Method

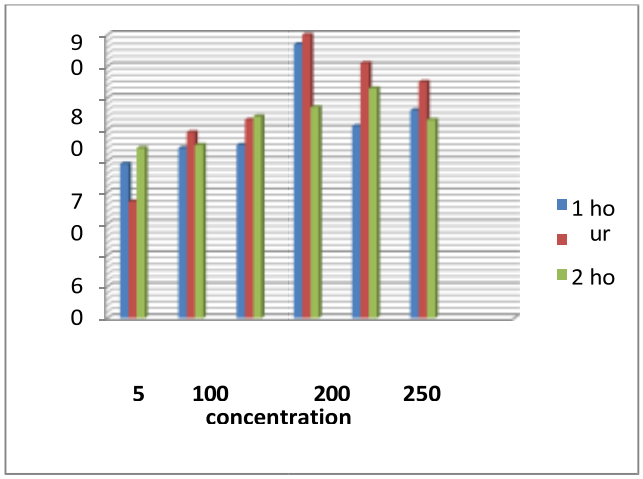
The calculated inhibition efficiencies (IE) of Solanum Trilobatum leaves extract (ST) controlling the corrosion of carbon steel immersed in Hcl acid medium. The calculated values indicating the ability of Solanum Trilobatum (ST) leaves extract to be an Eco-friendly corrosion Co- inhibitor. The 50ppm of Acalypa Indica Root Extract (AIRE)with low inhibition efficiency and 2ml of Solanum Trilobatum (ST) offers 90% inhibition efficiency. Inhibition efficiency increases with increasing the concentration of ST up to the addition of 2ml as corrosion rate decreases.

Table3.1: Inhibition efficiency of ST on carbon steel in Hcl for different immersion periods and corrosion rate at room temperature from weight loss method

AIRE (ppm)	ST leave Extract (ml)	Inhibition Efficiency % (IE) at various Immersion period and corrosion rate (mpy)					
		1hr		3hr		5hr	
		IE%	CR (mpy)	IE%	CR (mpy)	IE%	CR (mpy)
0	0	O	0	0	0	0	0
50	0.5	49	0.5954	37	0.5529	54	0.4763
50	1.0	54	0.5387	59	0.3638	55	0.4706
50	1.5	55	0.5245	63	0.3213	64	0.3686
50	2.0	87	0.1559	90	0.0897	67	0.3317
50	2.5	61	0.3402	81	0.1654	73	0.2806
50	3.0	66	0.2971	75	0.2221	63	0.3827



Graph of 50ppm of AIRE+2 ml ST system of IE at various immersion periods (hours) by weight loss method



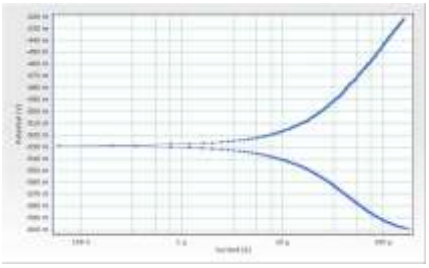
Graph of 50 ppm of AIRE + 2 ml ST system of CR (mpy) at various corrosion rate (hour) by weight loss method

3.2Analysis of Potentiometric Polarization Curves

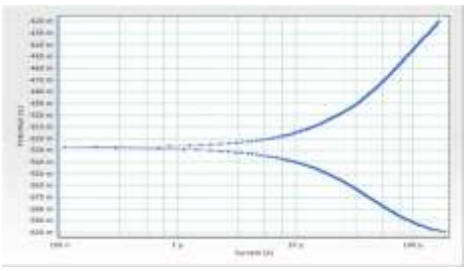
The data show that the corrosion potential of carbon steel in HCl medium is –529.063 mV. When 2 ml of co-inhibitor (ST) is added, the value shifts to –527.535 mV, indicating a decrease in corrosion potential. The corrosion current decreases from –15.642 A/cm² to –15.167 A/cm². This polarization study confirms the formation of a protective film on the metal surface.

Potentiometric polarization parameters for carbon steel in Hcl and co-inhibitor solution at 2ml

System	E_{Corr} mv Vs SCE	b_c mv	b_a mv	I_{Corr} A / cm^2
Acid	-529.063	79.426	103.893	-15.642×10^{-6}
ST	-527.535	80.459	100.307	-15.167×10^{-6}



(a) **Acid medium**



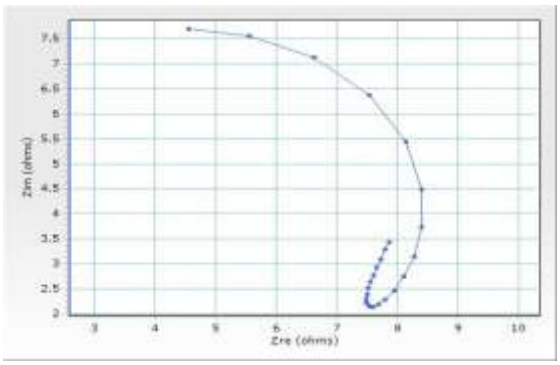
(b) Acid+ST in ml 50 ppm of AIRE + 2ml of ST

3.3ANALYSIS OF AC IMPEDANCE SPECTROSCOPY

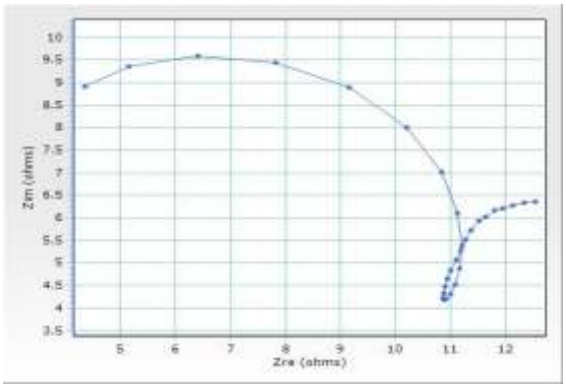
Nyquist representations of carbon steel in acid medium in the absence and presence of coinhibitory system are shown fig 4.4 (a) & (b).AC impedance spectra have been used to detect the formation of film on the metal surface. The impedance parameters, namely charge transfer resistance (R t) and double layer capacitance (Cdl).

Corrosion parameters of carbon steel immersed in acid medium in the presence and absence of co- inhibitor obtained by AC impedance spectra

AIRE ppm	ST in ml	Rt ohm	C_{dl} µF
0	0	3.5	0.0258×10^{-4}
50	2.0	9.2	0.0098×10^{-4}



(a) Acid medium



(b)Acid + 50 ppm of AIRE + 2 ml of ST AC impedance spectra of carbon steel immersed in various test solution

3.4ANALYSIS OF UV SPECTRA

UV visible spectrum of the ST extract was recorded using water as the solvent in SHIMADZUAY220 double beam spectrophotometer. UV visible spectrum of the aqueous ST extract. It shows absorbance is 270-668 nm. This shows the presence of a compound with hetero atom oxygen in the ST leaf extract

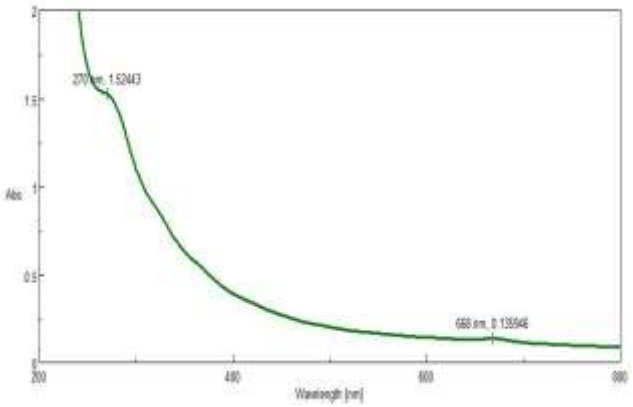


Fig3.4: UV-Visible spectroscopy

3.5ANALYSIS OF FTIR SPECTRA

The presence of the O-H Stretching frequency at 3408 cm-1. The stretching frequency CH appear at 2918 cm-1. The stretching frequency N-H appear at 1632 cm-1

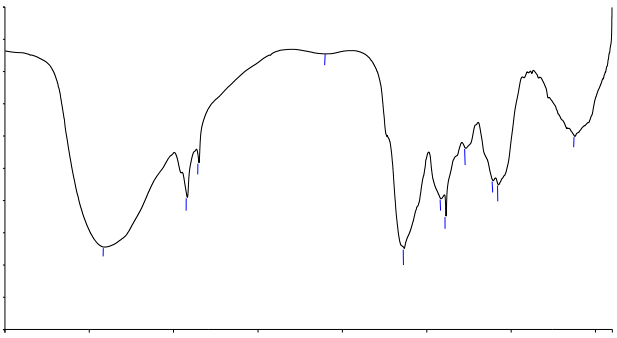
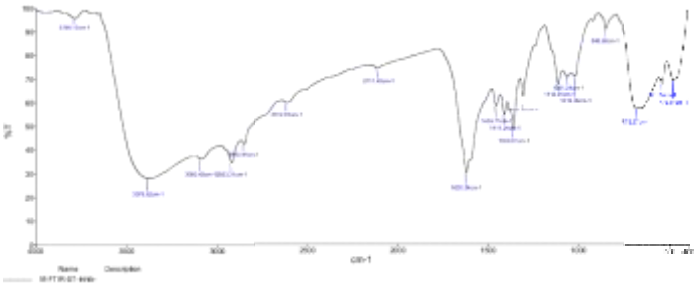


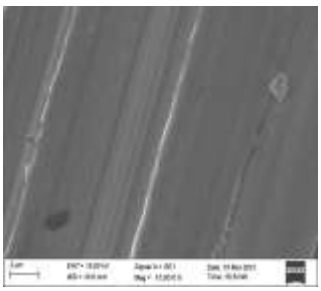
Fig3.5: FTIR spectra of ST powder



FTIR spectra of carbon steel after immersion of Hcl acid containing 50 ppm of AIRE and 2.0 ml of ST

3.6Analysis of SEM

The SEM micrographs of carbon steel surface immersed in acid medium shows that the surface is highly corroded and there is formed of different forms of corrosion products (iron oxides) on the surface in the absence of inhibitor. It further shows that the corrosion products appear very uneven and the surface layer is too rough.



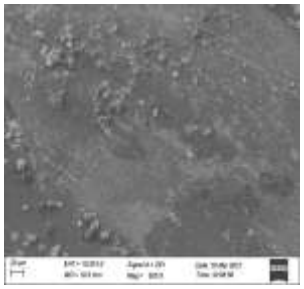


Fig3.6: SEM spectroscopy

CONCLUSION

Weight loss method reveals that the formulation consisting of 50 ppm AIRE and 2.0 ml of ST has 90% inhibition efficiency in controlling the corrosion of carbon steel immersed in an acidic solution containing hydrochloric acid medium. Polarisation study reveals that the inhibitor formulation controls anodic reaction predominantly. The UV visible spectroscopy shows the hetro atom present in metal surface impedance spectra reveal that a protective film is formed on the metal surface. The FTIR spectra reveal that a protective film consists of Fe^{2+} - ST complex's study indicates the presence of protective film is formed on the metal surface.

REFERENCE

[1] Jain & Jain, et.al., (2021) green corrosion inhibitors for coatings 147-174.

[2] H. Vaidyanathan, et.al., (1968) Effect of furan derivatives on the anodic dissolution of Fe, 737-750.

[3] F. El-Taib Heakal †, S. Haruyama,et.al.,(1980) Impedance studies of the inhibitive effect of benzotriazole on the corrosion of copper in sodium chloride medium 887-898.