



18th September 2020

Organized by

Department of Computer Science, Parvathy's Arts and Science College, Dindigul, Tamilnadu, India

Corrosion Inhibition of Mild Steel by the Influence of Natural Aqueous Extracts in the Presence of Tannery Effluent

A.Christy Catherine Mary¹, M.Dinesh², J.Jeyasundari³

Assistant Professor, Department of Chemistry, Parvathy's Arts and Science College, Dindigul, Tamilnadu, India ¹

PG Research Student, Department of Chemistry, Parvathy's Arts and Science College, Dindigul, Tamilnadu, India ²

Assistant Professor, Department of Chemistry, SVN College, Madurai, Tamilnadu, India ³

ABSTRACT: The inhibitions potentials of two natural extracts (Solanum Tubersum extracts, Sechium eduel extract) was investigated by evaluating the corrosion behaviour of mild steel and immersed in tannery effluent solution containing natural extract. Linear Polarization resistance, corrosion current charge transfer resistance was utilized to evaluate the corrosion inhibition and adsorption properties of the natural extract Scanning Electron Microscopy studies (SEM) and Atomic Force Microscopy (AFM) provided the confirmatory evidence of improved provided surface condition, due to adsorption, for the corrosion protection.

KEYWORDS: corrosion, inhibition, efficiency, polarization, natural extracts, MS-alloy.

I. INTRODUCTON

Corrosion is known to the people as rust, which destroys the luster and beauty of the objects and shortens its life. Since prehistoric times corrosion has affected not only the quality of daily lives of the people, but also their technical progress. The word 'corrosion' is as old as the earth itself, but it has been known by different names [1].The corrosion of a metal is a chemical process by which the metal is oxidized. The tendency to suffer by the corrosion attack in a given environment varies with the metals. Corrosion is the result of a chemical reaction between a metal and its surrounding during which the metal is oxidized. Corrosion is the deterioration of a material due to interaction with its environment. It is the process in which metallic atoms leave the metal or form compounds in the presence of water and gases. Metal atoms are removed from a structural element until it fails, or oxides build up inside a pipe until it is worked. Metals can be corroded by the direct reaction of the metal to a chemical; such as zinc will react with dilute sulphuric acid, and magnesium will react with alcohols [2].The impulsive critical oxidation of metals is called corrosion [3]. Iron is the fourth most common element in soil, comprising 5% of the earth's crust. The iron in the soil is usually found in the soluble cation form (Fe²⁺). This reduced form is more common because of the lower levels of oxygen in the soil. This ion can be readily absorbed by plants. When high levels of oxygen are present in the air surrounding soil particles, oxidation occurs and the Fe³⁺ form of iron prevails. This form of iron is insoluble and therefore not available to plants. Usually in acid soil sufficient Fe²⁺ exists in the soil to meet the needs of plants. However, iron deficiencies are common in alkaline soil. The greater concentration of hydroxyl causes the oxidation of iron[3-7] Effort was for performed on MS alloy using natural extracts of solanum tuberosum extracts, sechiumedule extracts investigate the corrosion inhibition of mild steel and copper alloys by the influence of natural extracts in presence of tannery effluent[8-10].



18th September 2020

Organized by

Department of Computer Science, Parvathy's Arts and Science College, Dindigul, Tamilnadu, India

II. EXPERIMENTAL

MS alloy were put to use as Test material for this study .The Chemical Composition of the alloys is presented in Table

Table-1: MS alloy composition

Types of alloy	Composition (%)
1 MS Alloy	C – 0.16 to 0.18 %, Mg – 0.70 to 0.90 %, Si – 0.40 %, S – 0.04 %, P – 0.04 %

Procedure

1 cm length of metal specimen be used earlier the surface treatment .The metal specimens was submitted to surface polishing. They were remove excess of grease in the Company of vapoures of trichloroethylene & polishing with different polishing papers (course, medium, fine extra fine).

1.1. Preparation of test solution:

The Tannery effluent was used as corrosion medium to discover the inhibition potential of three natural extracts such as solanum tuberosum extract, sechiumedule extract.40 ml of natural extracts were mixed with 60 ml of tannery effluent composition. This mixture was used in this study to determine the active principle present in the natural extract which are forming a protective film on the metal surface (exterior).

1.2. Inhibitor System

40 ml of natural extracts were mixed with 60 ml of tannery effluent (blank) in a Standard measuring flask. This solution mixture was used to assess the corrosion resistance of metal alloys by way of various electrochemical and surface characterization studies[8-10]

1.3. Various environments

Table: 2 Environment for electrochemical

S.No	Natural Extract Environments
1	a)Blank b)Blank + solanum tuberosum
2	a) Blank b)Blank + sechiumedule



18th September 2020

Organized by

Department of Computer Science, Parvathy's Arts and Science College, Dindigul, Tamilnadu, India

Table: 3 Environment for surface examination study

S.No	Specimen	Natural extracts Environment
1	MS Alloy	a)Blank
		b)Blank + solanum tuberosum
		a) Blank
		b)Blank + sechiumedule

Table 2 provides the details concerning the preparation of diverse environment used for electrochemical method in the present study for the specimen. The table 3 gives the details for the selected surface examination studies. The surface examination study was brought off only for the foremost system. In the middle of the three inhibitor systems, the one which extends the elevated linear polarization resistance (LPR) and the lowest corrosion current (I_{corr}) was chosen as the finest system for surface characterization study.

III. RESULTS AND DISCUSSION

3.1. Potentiodynamic polarization study

Fig 1 to 2, illustrates the polarization curves (Tafel plots) of MS- alloy evaluated in various test solutions at a room temperature.

MS - alloy – solanum tuberosum Extract

The polarization curves of MS alloy immersed in various test solutions are shown in fig.1, the corrosion parameters namely corrosion potential (E_{corr}), Tafel slopes (b_c ; b_a), corrosion current (I_{corr}), Linear Polarization Resistance (LPR).

Table-4: Corrosion parameters of MS Alloy immersed in various test solution for Polarization study.

Aolly	System	E_{corr}	B_c	B_a	LPR	I_{corr}
		mv/SCE	V/decade	V/decade	ohm cm^2	A/ cm^2
Ms	Blank	-994	0.0914	0.1452	13998	1.742×10^{-6}
	Blank+ solanum	-907	0.1853	0.1945	44448	9.283×10^{-7}
	Blank	-994	0.0914	0.1452	13998	1.742×10^{-6}
	Blank + Sechiumedule	-1022	0.1664	0.0772	38352	5.981×10^{-7}

When MS Alloy immersed in Blank, LPR value 13998 ohm cm^2 . The corrosion current (I_{corr}) is 1.742×10^{-6} A/ cm^2 . The corrosion potential (E_{corr}). -994 mV vs SCE. When MS alloy immersed in blank and solanum tuberosum extract system, the LPR value increases to (44448 ohm cm^2) and the corrosion current value increases to (9.283×10^{-7} A/ cm^2) further decreases. This indicates that corrosion resistance of MS alloy increases in Blank + solanum

18th September 2020

Organized by

Department of Computer Science, Parvathy's Arts and Science College, Dindigul, Tamilnadu, India

tuberosum System,. Thus the polarization study leads to the conclusion that MS Alloy is immersed in various test solution, the decreasing order of corrosion resistance of MS Alloy is as follows:

Blank + Solanum tuberosum extract > Blank

In this medium of the MS Alloy in Blank +Solanum tuberosum, increases.

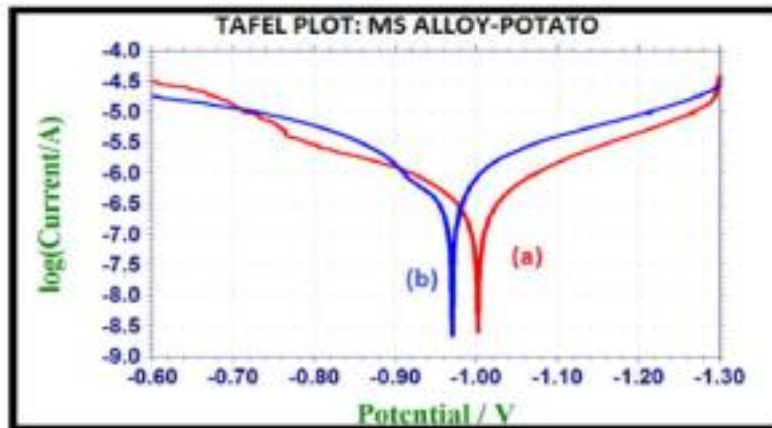


Figure-1: Polrization cure of MS alloy immersed in various test solution (a) tannery effluent; (b) tannery effluent + Solanum tuberosum extract.

3.2. MS Alloy – Sechiumedule Extract

The polarization curves of MS Alloy immersed in various test solution are shown in fig 4.3. The corrosion parameters namely corrosion potential (E_{corr}), Tafel slopes (b_a ; b_c), corrosion current (I_{corr}), Linear Polarization Resistant (LPR) are given table.

When MS Alloy immersed in Blank, LPR value 13998 ohm cm^2 .The corrosion current (I_{corr}) is $1.742 \times 10^{-6} A/cm^2$. The corrosion potential (E_{corr}). -994 mV vs SCE. When MS alloy immersed in blank and a sechiumedule extract system, the LPR value is increases to (38352 ohm cm^2) and the corrosion current value decreases to ($5.981 \times 10^{-7} A/cm^2$). This indicates That corrosion resistance of MS alloy increases in Blank + sechiumedule System,. Thus the polarization study leads to the conclusion that MS Alloy is immersed in various test solution, the decreasing order of corrosion resistance of MS Alloy is as follows:

Blank + Sechiumedule extract > Blank

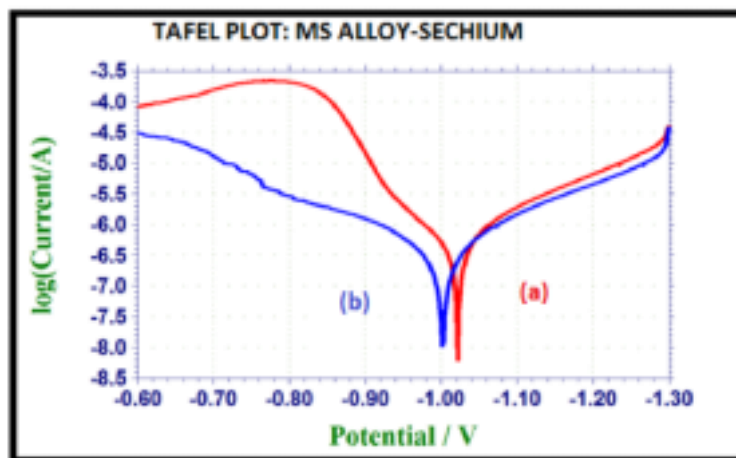


Figure-2: Polarization cure of MS alloy immersed in various test solution (a) tannery effluent;(b) tannery effluent + sechiumedule extract

3.3 Scanning Morphology study

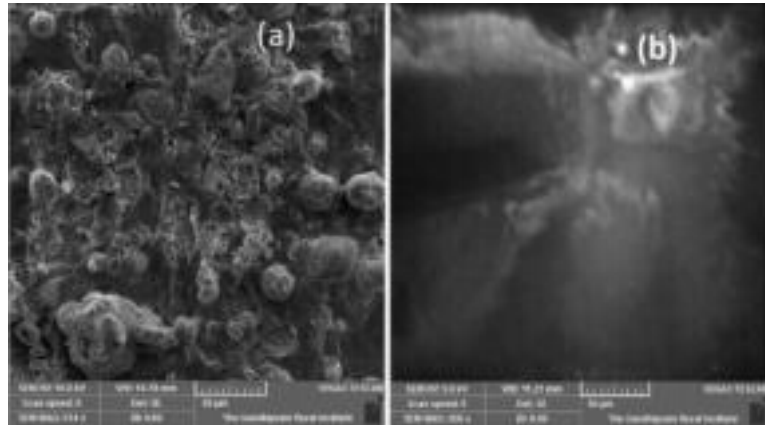


Figure-3: SEM image (a) polished MS (b) MS + solanum tuberosum extract + tannery effluent

The two dimensional representation of the surface gives the nature of the protective film formed on Metal surface. Gives the SEM images of polished surface of MS alloys exposed for one day in tannery solution for the uninhibited and inhibited. In comparing SEM microgram of MS alloy, there was rough surface for uninhibited solution and smooth surface for inhibited solution with extract of tannery effluent in forming an insoluble complex of MS –solanum tuberosum extract on the surface. Thus, it had become free from corrosion. The inhibitor effectively controls the dissolution of MS alloy.

3.3.4. Atomic Force Microscopy (AFM) study

AFM is the most powerful technique for nano scale study of sample. It can image both 2D and 3D topography. It is a scanning probe microscopy with very high resolution. It is usually used to obtain average roughness (Sa), root mean square roughness (Sq) and maximum peak – to – valley (Sy), height value. The two dimensional and three dimensional AFM morphologies and AFM cross sectional profile of MS alloy polished surface in Tannery effluent without and with the addition of solanum tuberosum extract are represented in figure 4(a) and (b), Figure 5.(a) and (b), Figure 6.(a) and (b) respectively. Table 5 gives summary of average roughness (Sa), root mean square roughness (Sq) and maximum peak - to - valley (Sy) values. AFM is the most powerful technique for nano scale study of sample. It can image both 2D and 3D topography. It is a scanning probe microscopy with very high resolution. It is usually used to obtain average roughness (Sa), root mean square roughness (Sq) and maximum peak – to – valley (Sy), height value.

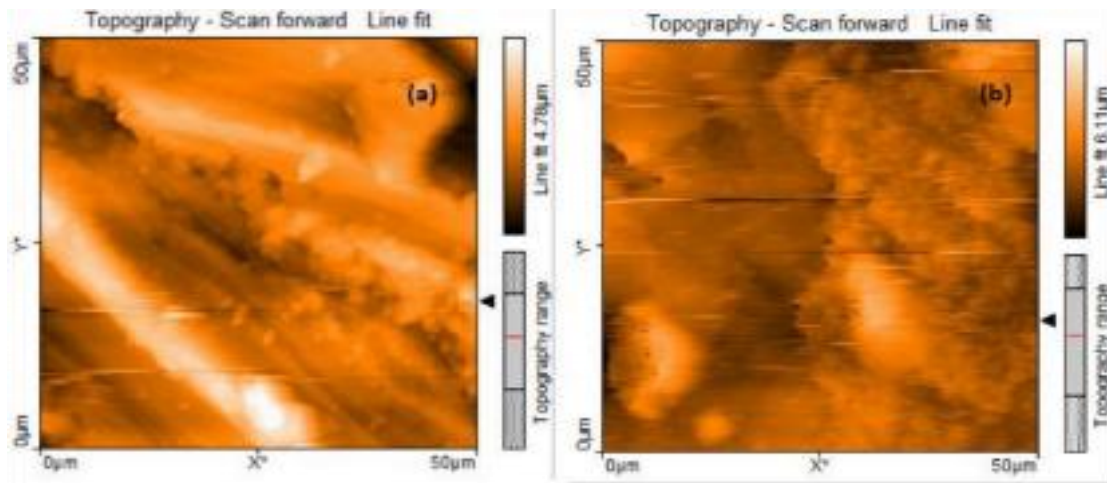


Figure-4: Two dimensional AFM images of the surface of polished MS Alloy after exposed to (a) polished MS; (b) tannery effluent + solanum tuberosum +MS

18th September 2020

Organized by

Department of Computer Science, Parvathy's Arts and Science College, Dindigul, Tamilnadu, India

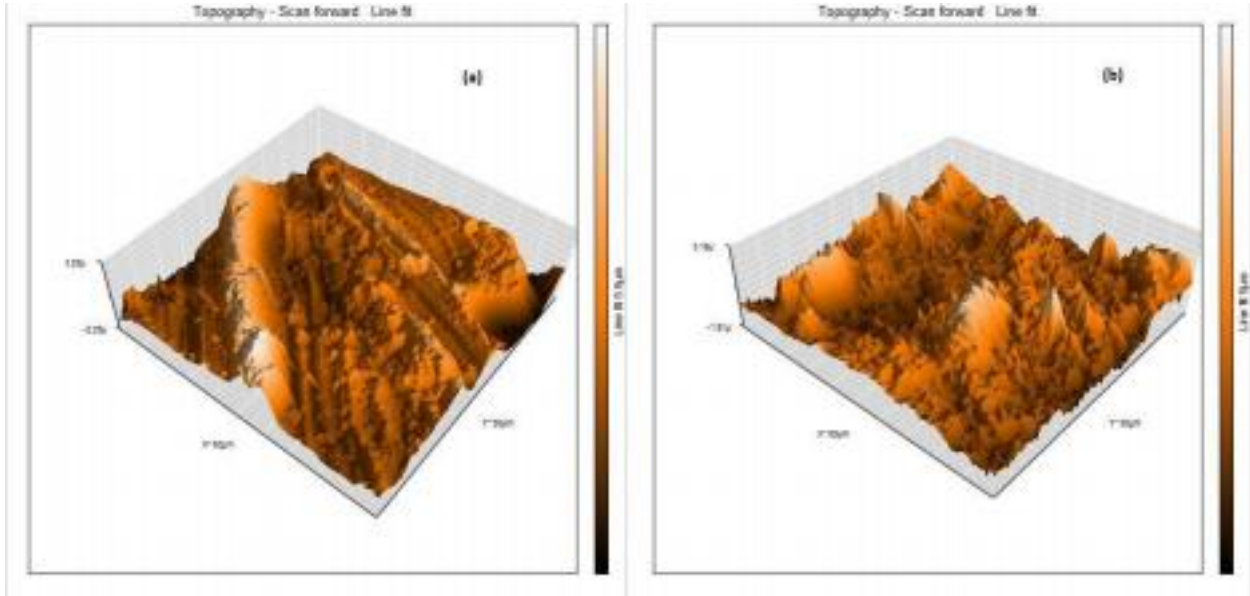


Figure-5: Three dimensional AFM of the surface of polished MS Alloy after exposed to (a) polished MS; (b) tannery effluent + solanum tuberosum +MS

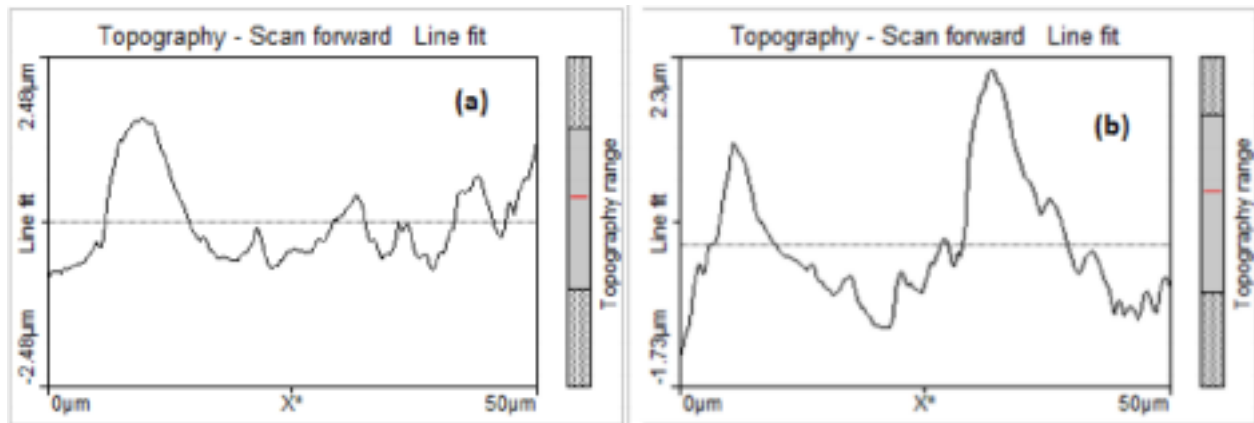


Figure 6: AFM cross sectional images of the surface of polished MS Alloy after exposed to (a) polished MS; (b) tannery effluent + solanum tuberosum +MS

Table 5: AFM data for MS - alloy immersed in tannery effluent in the absence and presence of solanum tuberosum extract

Samples	RMS (sq) Roughness (nm)	Average (Sa) Roughness (nm)	Maximum peak-valley height(nm) (Sy)
Polished MS	747nm	575nm	543nm
MS + solanum Tuberum + Blank	561nm	428nm	3250nm

IV. CONCLUSION

The natural products are used as inhibitor MS alloy affected by tannery effluent. The electrochemical reaction occurring on the alloy's surface lead to the formation of chemical compound .The chemical reaction lead to the materials with the under degradation The corrosion is the deterioration of a material due to interact with its environment .It is the process in which metallic atoms leave the metal or form compounds in the presence of water and



18th September 2020

Organized by

Department of Computer Science, Parvathy's Arts and Science College, Dindigul, Tamilnadu, India

gases. Alloy can be corroded by the direct reaction of metal to a chemical. Corrosion is a global problem that has played building, monuments, equipment and infrastructure for centuries. The systematic analysis of natural extracts as corrosion inhibitors and also use of various electrochemical techniques, examination techniques besides. The SEM. so as to bring out some useful conclusion regarding the mechanistic aspects of corrosion inhibition by MS alloy the surface analytical studies like SEM, also provide better understand about the reaction takes place on the metal surface. The highest resistance to corrosion of two of the MS alloy was shown by solanum tuberosum extract, sechiumedule extract. The practitioner can use the outcomes of our experiment to decide or recommend to their corrosion inhibition of natural products to maintain the corrosion is MS alloy.

Acknowledgement

The authors of thankful to their managements.

REFERENCES

- [1] Doe Fundamentals Handbook Material Science, 1(2) (1993).
- [2] Nasa - Corrosion Control And Treatment Manual - Tm-584c Revision C
- [3] H.D. Foth, Fundamentals of Soil Science. John Wiley & Sons, New York (1978). 4. R.L. Hausenbuiller, Soil Science: Principles and Practices. Wm.C. Brown Publishers, Iowa (1985).
- [4] Holt, Rinehart, and Winston, the Winston Canadian Dictionary for Schools, Holt, (1974).
- [5] Rinehart and Winston of Canada, Ltd., Toronto. R.E. White, Introduction to the Principles and Practice of Soil Science. Blackwell Scientific Publications, Boston, (1987).
- [6] A.C. Wilbraham, D.D. Staley, C.J. Simpson, and M.S. Matta, Chemistry, Addison Wesley Publishers Ltd., Don Mills, Ontario, (1993).
- [7] A. Christy Catherine, Corrosion Resistance of Mild Steel in Simulated Produced Water in Presence Of Sodium Potassium Tartrate, Int. J. Nano. Corr. Sci. Engg 2.1 (2015).
- [8] A.Christy Catherine, Corrosion Resistance of Mild Steel in Simulated Produced Water in Presence Of Sodium Potassium Tartrate, Int. J. Nano. Corr. Sci. Engg 2.1 (2015).
- [9] A. Christy Catherine, Corrosion Resistance of Mild Steel in Simulated Produced Water In Presence Of Sodium Potassium Tartrate, Int. J. Nano. Corr. Sci. Engg 2.1 (2015)