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Research Article

AN OVERVIEW OF PLANT EXTRACTS AS GREEN INHIBITOR FOR PREVENTING CORROSION

Samsath Begum A* and Jamal Abdul Nasser A

Department of Chemistry, Jamal Mohamed College (Autonomous), Tiruchirappalli, India

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ABSTRACT

Corrosion of steel in environment is an unavoidable but a preventable process. One of the practical methods for controlling the effect of corrosion of steel especially in environments is by using corrosion inhibitors which are contained mainly of organic or inorganic substances. However, the toxic nature of organic and inorganic inhibitors of corrosion to the environment has forced the enquire for harmless corrosion inhibitors called 'green corrosion' inhibitor due to their personal effects like non-toxicity, biodegradability, cheap and easily available. The applying natural plant extracts as environmentally safe corrosion inhibitor for steel has in recent times received enormous attention by researcher scholars. Extracts of plant contains polar atoms such as S, N, O, P etc. Due to this nature, the lone pair of electrons present on these atoms is adsorbed on to the metal surface; loss of electrons from the metal surface can be prevented. Thus corrosion inhibition takes place. This approach has aided in understanding the component of the plant extracts responsible for imparting the inhibition effect. This review paper presents an overview of works published on natural green plant extracts as corrosion green inhibitor for preventing corrosion.

INTRODUCTION

Corrosion is the detoriation of a metal either by direct chemical or electrochemical reaction when in contact with the aqueous corrosive environment. It is an endless and costly problem, often difficult to wipe off completely. It is one of the most problem that has safety, improvement and economic impacts in various chemical, metallurgical, natural and medical engineering applications and more particularly in the project of a much more varied number of mechanical parts which equally vary in size, functionality and useful life time. Corrosion can cause life-threatening damage to metal and alloy structures. The prevention of corrosion has become most important area of research because of the growing need to implement effective and economical corrosion prevention presentation method. The present overview summarizes carried out on prevention of corrosion using environmentally friendly, less toxic, very cheap and easily available natural plant extracts as corrosion green inhibitor.

Various plant extracts have been used for this purpose. Extracts of plant contain many active principles. Polar atoms such as S, N, O, P etc are present in the plant extracts. By reason of this property, the lone pair of electrons present on these atoms is pumped on to the surface of metal; losing of electrons from the surface of metal can be reduced. Thus corrosion inhibition takes place. Because the formation of protective film by the adsorption of polar groups from plant extracts on metal surface. Thus corrosion is controlled by these hetero atoms.

Different methods have been employed such as Weight loss, Tafel polarization, electrochemical impedance, scanning electron microscope, X-ray diffraction techniques and surface morphological examination to evaluate corrosion inhibition efficiencies of inhibitors. Various surface analyses techniques such as SEM, AFM, FT-IR, UV-Visible, X-ray spectral elemental mapping etc., have been used to analyze the formation of the protective film the metal surface.

Metals

Extracts of plant materials have been used to control corrosion of various metals such as Stainless steel (Mehipour *et al.*,2015), Copper (Fouda, 2016; Ramda, 2014), Mild steel (Baran, 2016; Behrooz, 2016; Hamdani, 2015; Mounsi, 2015; Obikwu, 2015; Patel,2014; Prabhakaran, 2016; Rana, 2017; Rose, 2016; Saxena, 2016; Sethuraman, 2017; Sivakumar, 2017; Sunday, 2017; Vishalakshi, 2016), Steel reinforcement in concrete (Okeniyi, 2016;), Carbon steel (Benahmed, 2016 & 2015; El-Hamadani, 2015; Etteyeb, 2016; Fouda, 2015; Ghazouani,

Corresponding author:* **Samsath Begum A
Department of Chemistry, Jamal Mohamed College (Autonomous), Tiruchirappalli, India

2015; Hema, 2016; Kusumastuti 2017; Salhi, 2015; Venegas, 2016; Yamuna, 2015), X60 Pipieline steel (Umoren, 2016)

Medium

Extracts of plant materials have been used to prevent corrosion of metals and alloys immersed in various medium such as HCl (Baran, 2016; Behrooz, 2016; Benahmed, 2016 & 2015; El Hamdani, 2015; Fouda, 2015; Ghazouani, 2015; Hamadani, 2015; Hema, 2016; Mounsi, 2015; Patel, 2014; Rana, 2017; Rose, 2016; Salhi, 2015; Sethuraman, 2017; Sivakumar, 2017; Sunday, 2017; Vishalakshi, 2016;), H_2SO_4 (Fouda, 2016; Obikwu, 2015; Okeniyi, 2016; Patel, 2014; Prabhakaran, 2016; Saxena 2016; Umoren, 2016; Venegas, 2016;), HNO_3 (Faouda, 2016), NaCl (Kusumastuti2017; Rana, 2017), Na_2SO_4 (Ramde, 2014), Base (Etteyeb *et al*., 2016) and Neutral medium (Yamuna *et al*, 2015).

Temperature

To calculate inhibition efficiency, experiments were carried out at room temperature and at high temperature (Baran, 2016; Benahmed, 2016; Fouda,2016; Ghazouani, 2015; Hema, 2016; Hamdani, 2015; Obikwu,2015; Patel, 2014; Ramde, 2014,).

Methods

To evaluate the corrosion inhibition efficiency of various plant extracts, several methods such as weight loss Method (Fouda, 2016; Mounsi, 2015; Obikwu, 2015; Patel, 2014; Patel, 2016; Rana, 2017; Salhi, 2015; Yamuna, 2015;) electrochemical studies (such as polarization (Baran, 2016; Behrooz, 2016; El Hamdani, 2015; Benahmed, 2015 & 2016; Fouda, 2016; Fouda, 2015; Ghazouani, 2015; Hamdani, 2015;, Hema, 2016; Kusumastuti, 2017; Mounsi, 2015; Mehipour, 2015; Prabhakaran, 2016; Patel, 2014; Ramde, 2014; Rana, 2017; Rose, 2016; Salhi,2015; Saxena, 2016; Sethuraman, 2017; Sivakumar, 2017; Umoren, 2016; Venegas, 2016; Vishalakshi, 2016), AC impedance spectra (Baran, 2016; Behrooz, 2016; El Hamdani, 2015; Benahmed, 2015 & 2016; Fouda, 2016; Fouda, 2015; Ghazouani, 2015; Hamdani, 2015;, Hema, 2016; Kusumastuti, 2017; Mounsi, 2015; Mehipour, 2015; Prabhakaran, 2016; Patel, 2014; Ramde, 2014; Rana, 2017; Rose, 2016; Salhi, 2015; saxena, 2016; Sethuraman, 2017; Sivakumar, 2017; Umoren, 2016; Venegas, 2016; Vishalakshi, 2016;), Electrochemical noise (Obikuwu *et al*, 2015;) and gasometric method (Patel *et al*, 2014) have been employed.

Surface morphology of protective film

The protective films formed on metal surfaces have been analyzed by various surface analysis techniques FTIR spectroscopy (Fouda, 2016; Yamuna, 2015; Prabhakaran, 2016; Saxena 2016; Vishalakshi, 2016; Sivakumar, 2017;), UV-Visible spectroscopy (Yamuna, 2015; Prabhakaran, 2016; saxena 2016;), X-ray (Sethuraman, 2017; Prabhakaran, 2016;) SEM (Sethuraman, 2017; Sivakumar, 2017; Ramde, 2014; Mehipour, 2015; Sunday, 2017; Prabhakaran, 2016; Umoren, 2016), ASTM (Okeniyi, 2016;) and Central Composite design (Sunday, 2017;)

Adsorption isotherm

The protective film formed on the metal surface by the adsorption of active polar atoms of various types of plant extracts on the metal surface. The adsorption isotherms are such as Freundlich adsorption isotherms(Benahmed, 2016), Temkin adsorption isotherm (Fouda, 2016; Prabhakaran, 2016; Hamdani, 2015;), Langmuir adsorption isotherm (Benahmed, 2015; Fouda, 2015;Ghazouani, 2015; Hamdani, 2015;, Hema, 2016; Kusumastuti,2017; Mounsi, 2015; Prabhakaran, 2016; Rose, 2016; Salhi, 2015; Sethuraman, 2017; Sunday, 2017; Umoren, 2016;) , El-Awady (Prabhakaran, 2016;)

Thermodynamic parameters

By using the adsorption isotherms various thermodynamic parameters such as changes in free Energy (Baran, 2016; Benahmed, 2016; Salhi, 2015; Sethuraman, 2017;), entropy (Baran, 2016; Benahmed, 2016;), enthalpy (Baran, 2016; Benahmed, 2016;), and activation energy (Baran, 2016; Salhi, 2015; Sethuraman, 2017;) have been calculated.

Plant materials

Extracts of various parts of the plant have been used as corrosion green inhibitors. Fruit peel (Baran,2016;), Fruit pulp (Ghazouani, 2015;), leaves (Hema, 2016; Kusumastuti, 2017; Mounsi, 2015; Obikuwu, 2015; Sivakumar, 2017; Umoren, 2016; Vishalakshi, 2016; Yamuna, 2015;), barks (Venegas, 2016;), plant oil (Salhi, 2015; Sunday, 2017;) and seeds (Umoren, 2016;), have been used as corrosion inhibitors.

Extracts

The plant materials have been extracted by making use of alcohol (Baran, 2016; Patel, 2014;), and water (Etteyeb, 2016; Fouda , 2015;).

Merits and demerits

Plant extracts are environmental friendly, harmless, lour cost and easily biodegradable. But it is easily contaminated by microorganisms. The decomposition of plant extracts can be prevented by addition of biocides such as sodium dodecyl sulphate and N-acetyl-N, N, N-trimethyl ammonium bromide. (Anuradha, 2008; Johnsi Rani, 2015; Karthiga, 2015; Noreen Antony, 2004; Priya, 2005; Rajendran, 2005; Shymala Devi, 2011). Recently Sangeetha *et al*, 2015; Mushira *et al*., 2017, have published a review report on the use of extracts of plant materials as corrosion inhibitor.

View of plant scientists

If plant materials are used as corrosion green inhibitors the various plants will be slowly destroyed

Plant materials as corrosion inhibitors

Metal; Medium; Green Inhibitor; Different Methods Used; Findings; Reference

Mild Steel; 0.5M HCl; Methanol extract of Gentiana olivieri; Potentiodynamic polarization, electrochemical impedance spectroscopy (EIS) and Surface analyses (SEM/EDX); Mixed type inhibitor, Thermodynamic parameters (Ea, δ, H°, δ, S°, δ. G°); Baran *et al* (2016)

Mild steel; 1M HCl; Orange peel extract (OPE) Potentiodynamic polarization and electrochemical impedance spectroscopy (EIS); Bio-inhibitor, The inhibiting effect could be attributed to the presence of organic compounds with functional groups including O, N, Cl, Br and F atoms in the

OPE which are adsorbed on the surface of the mild steel; Behrooz *et al*(2016)

Carbon steel (X52); Hydrochloric acid (1M HCl); Saccocalyx satureioides; Weight loss measurement, potentiodynamic polarization, electrochemical impedance spectroscopy and scanning electron microscopy techniques; Mixed type inhibitor, follows Freundlich adsorption isotherm, free energies, enthalpies and entropies for the adsorption and dissolution process were discussed; Benahamed *et al* (2016)

Carbon steel (API 5L Gr B); 1M HCl and 0.5M H_2SO_4 Bupleurum lancifolium (Apiaceae) Extract; Weight loss, polarisation and electrochemical impedance spectroscopy; Follows with Langmuir adsorption isotherm, scanning electron microscope shows a significant improvement on the surface morphology of the steel; Benahamed *et al* (2015)

Carbon steel; 1M HCl solutions; Alkaloids extract of Retama monosperma (L.) Boiss. Seeds; Electrochemical impedance spectroscopy, potentiodynamic polarization measurements and surface characterization; Mixed type inhibitor, X-ray photoelectron spectroscopy (XPS) showed that the inhibition of steel corrosion in normal hydrochloric solution by AERS is mainly controlled by a physisorption process and obeys Langmuir adsorption isotherm; El Hamdani *et al* (2015)

Carbon steel; Alkaline medium; Aqueous extract of some trees cultivated in arid regions; Analytical, electrochemical techniques, scanning electron microscope (SEM) and ED; Mott-Schottky analysis shows the formation of a passive layer on the metallic surface. EIS results suggest an increase in the corrosion resistance of carbon steel; Etteyeb *et al* (2016)

Carbon steel; HCl solution; Melissa officinalis aqueous plant extract; Weight loss, potentiodynamic polarization, FT-IR spectroscopy and electrochemical impedance spectroscopy (EIS); Adsorbed layer on C-steel surface obeying Langmuir adsorption isotherm. FT-IR spectroscopy observation of the metal surface proved the existence of the adsorbed film on the metal surface; Fouda *et al* (2015)

Copper; 1M HNO_3 solution; Trigonella stellate extract Weight loss (temperature range of 25-45°C), potentiodynamic polarization, electrochemical impedance spectroscopy (EIS), electrochemical frequency modulation (EFM) technique and scanning electron microscope (SEM); Mixed type inhibitor and obeys Temkin adsorption isotherm; Fouda *et al* (2016)

C-steel; 1 M HCl; Quince pulp extract; Weight loss method, potentiodynamic polarization and impedance spectroscopy measurements; Mixed type inhibitor, the presence of QPE enhances the values of R_t and reduces the C_{dl} values. The adsorption of QPE under consideration on a steel/acidic solution interface at all temperatures follows the Langmuir adsorption isotherm. The QPE inhibitor efficiency was temperature-independent; Ghazouani *et al* (2015)

Mild steel; Hydrochloric acid medium; Thymus algeriensis plant extract (TEA); Weight loss measuremen, potentiodynamic polarization and electrochemical impedance spectroscopy (EIS) techniques; Mixed type inhibitor, the Nyquist plots showed that increasing TEA concentration, charge-transfer resistance increased and double-layer capacitance decreased, involving increased inhibition efficiency. Linearity of Temkin isotherm adsorption; Hamdani *et al* (2015)

Carbon steel; 1N HCl; Ziziphus jujuba leaves extract; Weight loss measurements, gasometric method, potentiodynamic polarization curves and electrochemical impedance spectroscopy methods; Mixed type inhibitor follows the Langmuir adsorption isotherm EIS shows that the capacitance of double layer decreases and charge-transfer resistance increase with the optimum concentration of ZJL extract; Hema *et al* (2016)

Low carbon steel; 3.5% NaCl solution; Morindacitrifolia L. (Noni); Electrochemical polarization method with CMS 600-Gamry instruments, weight loss and FTIR; Mixed type of inhibitor and obeys Langmuir adsorption; Kusumastuti *et al* (2017)

Mild steel; Molar HCL solution; Nigella sativa L extract; Weight loss measurements, electrochemical polarization and EIS methods; Mixed inhibitor without modifying the hydrogen reduction mechanism obeys Langmuir adsorption isotherm. Mounsi *et al* (2015)

Stainless steel; 1M H_2SO_4; Aloe plant extract; linear polarization and electrochemical impedance spectroscopy, electrochemical noise (EN) and SEM; environmentally friendly inhibitor; Medipur *et al* (2015)

Mild steel; 1M HCl and H_2SO_4; Okazi leaf (Gnetum africanum), Utazi leaf (Gongronema latifolium) and Elizabeth leaf (Chromolena odaratum) extract; Mass loss method (results were obtained at intervals of 24, 48, 72 and 96 h); Elizabeth leaf (Chromolena odaratum) has the best inhibition efficiency on mild steel; Obiukwu *et al* (2015)

Steel reinforcement in concrete; 0.5M H_2SO_4; Anthocleista djalonensis and $Na_2Cr_2O_7$ Macrocell corrosion measurements were obtained and analysed as per ASTM G109-99; Anthocleista djalonensis admixtures that exhibited better inhibition than $Na_2Cr_2O_7$ admixtures indicates positive prospects of the plant as an eco-friendly and sustainable corrosion protection alternative for the toxic chemical in microbial/industrial environment; Okeniyi *et al* (2016)

Mild Steel; 1M H_2SO_4 Rhus verniciflua; Weight loss measurements, UV-visible spectroscopy, FTIR spectroscopy, electrochemical impedance spectroscopy, potentiodynamic polarization measurements. Scanning electron microscopy, energy-dispersive X-ray spectroscopy; Mixed type of inhibitor, The adsorption of the plant extract constituents is discussed based on the Langmuir, Temkin, and El-Awady isotherms; Prabakaran *et al* (2016)

Mild steel; H_2SO_4 medium; Ethanol extracts of Hemidesmus indicus leaves; Mass loss, gasometric techniques, electrochemical polarisations and electrochemical impedance spectroscopy; Mixed type of inhibitor, both the cathodic hydrogen evolution and the anodic dissolution of mild steel were inhibited, the active molecule of the extract studied acted as inhibitor; Patel *et al* (2014)

Mild steel; H_2SO_4; Extract of Phyllanthus fraternus Weight loss, electrochemical polarizations, electrochemical impedance spectroscopy and hydrogen evolution (gasometric) techniques Mixed type of inhibitor; Patel *et al* (2014)

Cu65/Zn35 brass corrosion; 0.1 M Na_2SO_4 solutions with pH 7 and pH 4.; Natural extract of Camellia sinensis; Electrochemical techniques (potentiodynamic polarization, electrochemical impedance spectroscopy) and scanning electron microscopy (SEM); Very effective corrosion inhibitor for brass corrosion process in both the acidic and neutral media by virtue of adsorption. The inhibition effect increases by time as demonstrated by the EIS monitoring for 120 h. In the blank solution the corrosion process leads to the formation of a dark oxide patina at pH 7 and induces localized corrosion morphology at pH 4. The extract presence can avoid both the dark patina and the pits formation; Ramde *et al* (2014)

Mild Steel; 0.5M NaCl solution; Areca catechu, Laurus nobilis and Catharanthus roseus plant extracts; Immersion tests, inhibition mechanism and corrosion potential measurements; Areca catechu and Catharanthus roseus plant extracts (anodic inhibitor), Laurus nobilis extract (mixed type inhibitor) based on the potential measurement; Rana *et al* (2017)

Mild Steel; 1M Hydrochloric Acid; Tabernaemontana divaricata plant extract; Weight loss and electrochemical measurements, energy dispersive X-ray spectral elemental mapping; The homogeneous adsorption of a green inhibitor on the surface of steel was evidenced using energy dispersive X-ray spectral elemental mapping. The adsorption of green inhibitor was found to obey the Langmuir's isotherm model; Rose *et al* (2016)

Carbon steel; HCl solution; Essential oil and extract of Tetraclinis articulate; Potentiodynamic polarization, electrochemical impedance spectroscopy (EIS) methods, and weight loss measurements; Mixed-type inhibitor, adsorbing onto the carbon steel surface according to the Langmuir isotherm inhibitors. Thermodynamic parameters such as activation energy and free energy of adsorption were calculated. And the kinetic-thermodynamic model were tested; Salhi *et al* (2015)

Mild steel; 8% H_2SO_4; Withania somnifera; Polarization measurements, UV, IR and weight loss study; Behaving as Anti corrosive; Saxena *et al* (2016)

Mild steel; 1.0M HCl and H_2SO_4 solutions Ervatamia Coronaria; Weight loss, Tafel polarization, electrochemical impedance, scanning electron microscope, X-ray diffraction techniques and surface morphological examination; Langmuir adsorption isotherm, physisorption, thermodynamic parameters such as adsorption equilibrium constant, standard free energy of adsorption and activation energy, surface morphological examination supports the formation of protective flim; Sethuraman *et al* (2017)

Mild steel; 1.0N HCl: Schreabera swietenioids leaves; Mass loss method, polarization measurements and electrochemical impedance spectroscopy at room temperature, FTIR, SEM; Mixed type inhibitor, Nyquist plot revealed that the addition of extracts increases the charge transfer resistance and hence increases the inhibition efficiency. Photochemical constituents and organic moieties that were adsorbed on the metal surface was well supported by FTIR studies. Protective film formation was confirmed by SEM; Sivakumar *et al* (2017)

Mild steel; HCl Essential oils of Alpinia galangal; Weight loss and Response Surface Methodology with Central Composite Design, scanning electron microscopy (SEM); Obeys with Langmuir adsorption isotherm; Sunday *et al* (2017)

X60 pipeline steel; 2M HCl and 1M H_2SO_4 solutions Mustard seed extract (MSE); Gravimetric and electrochemical (electrochemical impedance spectroscopy, linear polarization resistance and potentiodynamic polarization) methods, morphology of the corroding steel surface in the absence and presence of the MSE was visualized using scanning electron microscopy; Mixed type inhibitor, inhibition efficiency increased with increase in the concentration of the extract but decreased with increase in temperature, obeys Langmuir adsorption isotherm; Umoren *et al* (2016)

Carbon steel; Acid media; Decoction of the external bark, internal bark and medulla of the Eulychnia acida phil. (cactaceae) stems extracts; Mass loss and polarization; Metabolites present in the extracts act as corrosion inhibitors and are able to promote surface protection by blocking active sites on the metal; Venegas *et al* (2016)

Mild Steel; 1N HCl; Balsamodendron Caudatum (BC) leaves extracts; Weight loss, potentiodynamic polarization methods and Electrochemical Impedance Spectroscopy and characteristics analysis by Fourier Transform Infra-Red (FTIR); Tafelconstants data indicated that BC extract can act as mixed type inhibitors. The surface morphology was determined using Scanning Electron Microscopy. Anticorrosive behavior; Vishalakshi *et al* (2016)

Carbon steel; Neutral medium; Citrus medica [CM] leaf as an inhibitor; Mass loss measurements at different time FTIR spectroscopy; Percentage of inhibition efficiency is increased with increase of inhibitor concentration and decreased with rise in period of contact. And it is a effective corrosion inhibitor; Yamuna *et al* (2015)

Reference

Anuradha, K, R. Vimala, B. Narayanasamy, J. Arockiaselvi and S. Rajendran, (2008) Chemical Engineering Communications, 19(3), 352-366.

Baran, E., Cakir, A., Yazici, B.,(2016) Inhibitory effect of Gentiana olivieri extracts on the corrosion of mild steel in 0.5M HCl: Electrochemical and phytochemical evaluation, *Arabian Journal of Chemistry*.

Behrooz, N., Ghaffarinejad, A., Salahandish, R. (2016) Effect of orange peel extract on the corrosion of mild steel in 1 M HCl solution 6th Conference on Thermal Power Plants, (CTPP),7483055, pp. 64-68

Benahmed, M., Djeddi, N., Akkal, S., Laouar, H.(2016) Saccocalyx satureioides as corrosion inhibitor for carbon steel in acid solution *International Journal of Industrial Chemistry*,7(2), pp. 109-120

Benahmed, M., Selatnia, I., Achouri, A.,Gherraf, N., Akkal. S.,(2015) Steel Corrosion Inhibition by Bupleurum lancifolium (Apiaceae) Extract in Acid Solution Transactions of the Indian Institute of Metals,68(3), pp. 393-401

El Hamdani, N., Fdil, R., Tourabi, M., Jama, C., Bentiss, F.(2015) Alkaloids extract of Retama monosperma (L.) Boiss. Seeds used as novel eco-friendly inhibitor for carbon steel corrosion in 1M HCl solution: Electrochemical and surface studies, Applied Surface Science,357, pp. 1294-1305

Etteyeb, N., Nóvoa, X.R.,(2016)Inhibition effect of some trees cultivated in arid regions against the corrosion of steel reinforcement in alkaline chloride solution Corrosion Science 112, pp. 471-482.

Fouda, A.S., El Mgeed, A.A., El-Salam, S.A.,(2015)Melissa officinalis aqueous plant extract as eco-friendly corrosion inhibitor for carbon steel in aqueous solutions Der Pharma Chemica7(7), pp. 27-38.

Fouda, A.S., Mohamed, A.E., Khalid, M.A. (2016)Trigonella stellate extract as corrosion inhibitor for copper in 1M nitric acid solution *Journal of Chemical and Pharmaceutical Research,*8(2), 86-98.

Ghazouani, T., Ben Hmamou, D., Meddeb, E., Hammouti, B., Fattouch, S.(2015) ,Antioxidant activity and effect of quince pulp extract on the corrosion of C-steel in 1M HCl, Research on Chemical Intermediates,41(10), 7463-7480

Hamdani, I., El Ouariachi, E., Mokhtari, O., Hammouti, B., Costa, J. (2015)An investigation of mild steel corrosion inhibition in hydrochloric acid medium by environment friendly green inhibitor, Der Pharmacia Lettre7(9), 109-118

Hema, K.,Venkatraman, B.R.,Subramania, A. (2016)Potential of Ziziphus jujuba leaves extract as green corrosion inhibitor against carbon steel in 1N HCl solution, *Der Pharma Chemica*,8(2), 332-342

Johnsirani.V S.Rajendran, A.Christy Catherine Mary, R.Joseph Rathish, T. Umasankareswari and J Jeyasundari, (2015) *Int.J of Nano Corrosion Science and Engineering*, 2(3)22-2.

Karthiga.N S. Rajendran, P. Prabhakar and R. Joseph Rathish,(2015) *Int. J. Nano. Corr. Sci. Engg*., 2(4), 31-49.

Kusumastuti,T, R., Pramana, R.I., Soedarsono, J.W.(2016)use of morinda citrifolia as a green corrosion inhibitor for low carbon steel in 3.5% NaCl solution

Mehdipour, M., Ramezanzadeh, B., Arman, S.Y.(2015) Electrochemical noise investigation of Aloe plant extract as green inhibitor on the corrosion of stainless steel in 1M H2SO4 *Journal of Industrial and Engineering Chemistry,*21, 318-327

Mounsi, E., Elmsellem, H., Aouniti, A., EL Ouadi, Y., Hammouti, B.(2015) Anti-corrosive properties of Nigella sativa L extract on mild steel in molar HCl solution, Der Pharma Chemica,7(6), 64-70

Mushira Banu.A , K.Riaz Ahamed ,(2017),World journal of pharmaceutical research, Natural products as corrosion inhibitors-Review,6,(17),410-418.

Noreen Anthony, E. Malarvizhi, P.Maheshwari, SusaiRajendran and N. Palaniswamy,(2004) *Indian Journal of Chemical Technology*, 11, 346-350.

Obiukwu, O, Opara, I., Grema, L.U.(2015)Corrosion inhibition of mild steel by various plant extracts in acid media *Research Journal of Applied Sciences, Engineering and Technology*,10(10), 1197-1205.

Okeniyi, J.O., Loto, C.A., Popoola, A.P.I.(2016)Total-corrosion effects of Anthocleista djalonensis and Na2Cr2O7 on steel-rebar in H2SO4: Sustainable corrosion-protection prospects in microbial/industrial environment TMS Annual Meeting (CONFCODENUMBER),187-192

Patel, N.S., Šnita, D.(2014) Ethanol extracts of Hemidesmus indicus leaves as eco-friendly inhibitor of mild steel corrosion in H2SO4 medium Chemical Papers

Patel, N.S., Hrdlicka, J., Beranek, P.,Al-Deyab, S.S., Salghi, R.(2014)Extract of Phyllanthus fraternus leaves as corrosion inhibitor for mild steel in H2SO4 solutions *International Journal of Electrochemical Science*

Prabakaran, M., Kim, S.-H., Hemapriya, V., Kim, I.S., Chung, I.-M.(2016) Rhus verniciflua as a green corrosion inhibitor for mild steel in 1 M H2SO4, RSC Advances ,6(62),57144-57153

Priya,S.L A.Chitra, S. Rajendran and K. Anuradha,(2005)Surface Engineering, 21(3), 229-231.

Rajendran, S,V. Ganga Sri,J. Arockiaselvi and A. J.Amalraj, (2005) *Bulletin of Electrochemistry*, 21(8), 367-377.

Ramde, T., Rossi, S., Zanella, C.(2014)Inhibition of the Cu65/Zn35 brass corrosion by natural extract of Camellia sinensis Applied Surface Science, 307, pp. 209-216

Rana, M., Joshi, S., Bhattarai, J.(2017) Extract of different plants of nepalese origin as green corrosion inhibitor for mild steel in 0.5 M NaCl solution *Asian Journal of Chemistry* 29(5), pp. 1130-1134

Rose, K., Kim, B.-S., Rajagopal, K., Arumugam, S., Devarayan, K. (2016) Surface protection of steel in acid medium by Tabernaemontana divaricata extract: Physicochemical evidence for adsorption of inhibitor *Journal of Molecular Liquids*, 214, pp. 111-116

Salhi, A., Bouyanzer, A., Hamdani, I., (...), Costa, J., El Azzouzi, M. (2015) The use of essential oil and extract of Tetraclinis articulata as eco-friendly corrosion inhibitors of carbon steel in hydrochloric acid solution*Der Pharma Chemica*,7(2), pp. 138-147

Sangeetha.M S.Rajendran, J.Sathiyabama, T.Umasankareswari, A Krishnaveni and RM Joany, (2015) *Int.J of Nano Corrosion Science and Engineering,* 2(3), 14-21.

Saxena, A., Prasad, D., Haldhar, R. (2016) Withania somnifera extract as green inhibitor for mild steel in 8 % H2SO4 *Asian Journal of Chemistry*,28(11), pp. 2471-2474

Sethuraman, M.G., Aishwarya, V., Kamal, C., Jebakumar Immanuel Edison, T. (2017) Studies on Ervatinine-The anticorrosive phytoconstituent of Ervatamia coronaria,*Arabian Journal of Chemistry* 10, pp. S522-S530

Shyamala Devi. B, S. Rajendran,(2011) *International Journal of Chemical Science and Technology*,1(1), 79-87

Sivakumar, P.R., Srikanth, A.P.(2017)Anticorrosive activity of Schreabera swietenioids leaves as green inhibitor for mild steel in acidic solution *Asian Journal of Chemistry*,29(2), pp. 274-278

Sunday O. Ajeigbe, Norazah Basar, Muhammad A. Hassanand Madzlan Aziz(2017) Optimization of Corrosion inhibitions of essential oils of Alpinia galanga on mild steel in hydrochloric acid solution using response Surface Methodology,(2017), *Asian Research Publishing Network* (ARPN),12(9),pp.2763-2771

Umoren, S.A. (2016) Biomaterials for corrosion protection: Evaluation of mustard seed extract as eco-friendly corrosion inhibitor for X60 steel in acid media *Journal of Adhesion Science and Technology*, 30(17), pp. 1858-1879.

Venegas, R., Figueredo, F., Carvallo, G., Molinari, A., Vera, R.(2016) Evaluation of Eulychnia acida phil. (cactaceae) extracts as corrosion inhibitors for carbon steel in acidic media*, International Journal of Electrochemical Science* 11(5), pp. 3651-3663

Vishalakshi, K., Sivakumar, P.R., Srikanth, A.P.(2016) Analysis of corrosion resistance behavior of green inhibitors on mild steel in 1N HCl medium using electrochemical technique Der Pharma Chemica 8(19), pp. 548-553

Yamuna, J., Anthony, N.(2015)Corrosion protection of carbon steel in neutral medium using Citrus medica [CM] leaf as an inhibitor *International Journal of ChemTech Research,*8(7), pp. 318-325

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