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# Study of Corrosion Inhibition Efficiancy of Cannabis Extract for Mild Steel in Different Acidic Medium

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## Abstract

*Corrosion control of metal and their alloy is significant and an environmentally imperative matter extract of plant material serves as the superior alternative to replace the environmentally hazardous organic and inorganic corrosion inhibitors. Corrosion of mild steel in acidic and other adverse environmental condition can be inhibited by extract of plant several organic compound with heteroatom such as N,O,S and P present in the plant extract are adsorbed directly onto the metals surface through polar atoms and thereby forming the protective layer. Their adsorption follows various adsorption isotherms. This paper discusses the different types of eco-friendly inhibitors for corrosion control of mild steel in acidic media extract of plant material are less expensive and environmentally friendly extract of plant material contains many active principals they contain polar atom because of this nature the lone pair of electron present on these atoms is pumped on to the metal surface lose of electron from the metal surface can be avoided thus corrosion inhibition takes place because of adsorption inhibitors molecule on metal surface protective film is formed thus corrosion is controlled*

**KEYWORDS:** *Corrosion inhibitors; Eco-friendly; non-toxic; plant materials; adsorption isotherms*

## 1. Introduction

Mild steel also called as the carbon steel which is low carbon (0.3%) steel with superior strength, it is used when large amount of steel is needed and can be twisted and welded into an infinite range of shapes for use in vehicles, construction material and vessels fabrication etc. in many industries mild steel (MS) is the material of the choice in the fabrication of reaction vessels storage tank etc which get corroded in the presence of acid.

Hydrochloric acid solution are widely used in several industrial process some of the important fields of application being acid pickling of steel, chemical cleaning and processing, or production and oil well acidification because of general aggression of acid solution inhibitors are commonly used to reduce the chemical corrosive attack on acidic material.

Acid solution is commonly used in the chemical industry to remove mill scales from metallic surface, the inhibitors are adsorbed and depends on the structure and surface of metal in atom among the method of corrosion control, use of inhibitors is very popular due to easy of application extract of plant material contains many active principles they contain polar atom such as S,N,O,P etc. because of this nature lone pair of electron present on these atoms is pumped on the metal surface can be avoided thus corrosion inhibition takes place because of adsorption of inhibitors molecule on metal surface protective film is formed thus corrosion is controlled. Various extracts of plant material have been used to prevent a variety of metals immersed in various media at different temperatures in present and absence of many additive methods have been employed such as weight loss method electrochemical studies etc. to evaluate corrosion inhibition efficiency of inhibitors the protective film has been analyzed by various surface

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analyses techniques.

### Metals

Extracts of plant material have been used to control corrosion of various metals such as stainless steel, copper, mild steel, nickel, zinc, iron, tin, brass, aluminium and its alloy

### Medium

Extracts of plant material have been used to prevent corrosion of metal and alloyed immersed in various media such as acidic medium, basic medium and natural medium.

### Temperature

To calculate inhibition efficiency experiment was done at room temperature or at high temperature.

### Additives

A mixture of inhibitors shows better inhibition efficiency than individual members. This is called synergistic effect. For this purpose many additives have been used to improve the inhibition efficiency of plant extracts. For this purpose Zn2+, methylene dichloride and n-butanolic extract [5], formaldehyde and diethylamide [6], ethyl acetate [9], dimethyl sulfoxide[28], sodium nitrite [34, 35], potassium iodide [38], potassium chloride, potassium bromide, potassium iodide [49].

To evaluate the corrosion inhibition efficiency of various plant extracts several method such as weight lose method, electrochemical studies, such as polarization.

### Suraface Morphology of Protective Film

The protective films formed on metal surface have been analyzed by various surface analysis techniques FTIR, Spectroscopy, UV visible spectroscopy, EDAX and AFM.

### Adsorption Isotherms

The protective films formed on metal surface by adsorption of active principles of various plant extracts on the metal surface the adsorption isotherms are such as freundlich adsorption isotherms, Temkin adsorption isotherms, Langmuir adsorption isotherms, Flory Huggins adsorption Isotherm, Frumkin adsorption isotherms.

### THERMODYNAMIC PARAMETORS

From the adsorption isotherms various thermodynamic parameters such as changes in free energy entropy, enthalpy and activation energy have been calculated.

### Plant Material

Extracts of various part of the plant have been used as corrosion inhibitors. Fruits, leaves, barks, flower and seeds have been used as corrosion inhibitors.

### Extraxt

The plant materials have been extracted by making use of alcohol acid and water.

Plant extracts are environmental friendly, non toxic low cost and easily biodegradable.

Plant extract (cannabis) also known as marijuana among other name is psychoactive drug from the cannabis plant used primarily for medical and recreational purposes. Tetrahydrocannabinol (THC) is the main psychoactive component of cannabis which is one of the 483 known compound in the plant including at least 65 other cannabinoids (CBD). Cannabis used by smocking, vaporizing, within food or as an extract.

Product Name - Cannabis (Marijuana)

Source Plant - Cannabis Sativa, Cannabis Indica, Cannabis Ruderalis

Part of Plant - Flower Fruits Leaves Stem Barks

Geographical Origin - Cental Asea and Indian Sub continent

Active Inrediants - Tetrahydrocannabinol (Thc) Cannabidiol, Cannabinol Tetrahydrocannabivarin.

USES - Medical, Recreational, Spiritual

LEGAL STATUS

-AU: S9 (Prohibited AU Substance)

-CA: Unscheduled

-DE: Medical cannabis from state controlled

-UK: Class B

-US: Schedule I

-UN: Narcotic schedule I

### View Of Plant Scientist

If plant materials are used as corrosion inhibitors, the various plants will be slowly extinct a list of plant material that have been used as corrosion inhibitors is given in Table 1

| | Metal | Medium | Inhibitor | Additive | Method | Findings | Reference |
|---|---|---|---|---|---|---|---|
| 1. | Steel | HSO solution | An extract of Hemidesmus indicus leaves | | Conventional mass loss, gasometric techniques, electrochemical polarisations and electrochemical impedance spectroscopy. | Mixed-type corrosion inhibitor | 1 |
| 2. | Brass | 0.1M $Na_2SO_4$ solution | Extract of Camellia sinensis | | Electrochemical techniques (potentiodynamic polarization, electrochemical impedance spectroscopy) | Avoid both the dark patina and the pits formation. | 2 |
| 3. | Zinc | 3% NaCl | Ethanol extract of Mansoa alliacea | | Polarization and electrochemical impedance | Mixed-type inhibitor | 3 |
| 4. | Mild steel | HSO solution | Extract of Phyllanthus fraternus leaves | | Conventional weight loss gasometric techniques, electrochemical polarizations and electrochemical | Mixed-type inhibitor | 4 |
| 5. | Carbon steel (CS) | 1.0M HCl | Reuteralutea (Desf.) Maire (Apiaceae) | Methylene dichloride extract (MDE) and n-butanolic extract (BE) | Weight loss and potentiodynamic polarization measurements, electrochemical impedance spectroscopy, and scanning electronmicroscopy techniques, 293-323K | Freundlich isotherm, physisorption, The free energies, enthalpies, and entropies for the adsorption process explained | 5 |
| 6 | Q235A steel | 1wt% HCl | Pomegranate huskextract | Formaldehyde and diethylamide | Weight loss method, good inhibition efficiency | Langmuir adsorption isotherm | 6 |
| 7 | Copper(Cu) | 2.0MHCl | Sarcocarpa(ES) extract | | Potentiodynamic polarization and electrochemical impedances pectroscopy (EIS) at 298K | Cathodic type protection, Langmuir adsorption isotherm | 7 |
| 8 | Mild steel | Hydrochloric acid | Aqueous extracts of opuntia Ficus Indica (OFI) | | Weight loss and polarisation measurements, EIS, at 308K. | Mixed-type corrosion inhibitor, formation of protective films. obeys Langmuir's isotherm. | 8 |

| | Metal | Medium | Inhibitor | Additive | Method | Findings | Reference |
|---|---|---|---|---|---|---|---|
| 9 | Mild steel X52 | Hydrochloric acid (1MHCl) | Pistaciaatlantica extract | Ethyl acetate | Weight loss, polarization and AC impedance | Cathodic type inhibitors, Langmuir | 9 |
| 10 | Mild steel | 0.5M $H_2SO_4$ solution | Extracts of Anacyclus pyrethrum L. (leaves and stems, AP-LS; flowers AP-F; roots, AP-R) | | Electrochemical impedance spectroscopy (EIS) and potentiodynamic polarization | Anodic type inhibitors, formation of protective films, obeys the Langmuir adsorption isotherm. Activation energies in the presence and absence of AP-LS and AP-F were obtained by measuring the temperature dependence of the corrosion current. | 10 |
| 11. | Steel | 0.5M HSO4 | Bark-extract of Rhiz-ophora Mangle L | | Electrochemical techniques, Statistical analyses | Inhibiting steel-reinforcement corrosion | 11 |
| 12. | Carbon steel | 1M HCl solutions | Punica Plant extract | | Potentiodnamic polarization, AC electrochemical impedance spectroscopy (EIS), potentiodynamic anodic polarization, scanning electron microscope (SEM) 30-50°C. | Langmuir Adsorption isotherm. Thermodynamic Parameters of Activation and Adsorption were calculated. mixed-type inhibitor. | 12 |
| 13. | Carbon Steel | 1M HCl solutions | Oil of Thymus pallidus plant from Morocco | | Potentiodynamic polarizations and electrochemical impedance spectroscopy (EIS) at 298K. | Langmui adsorption isotherm | |
| 14. | Aluminum and aluminum silicon | 0.5M hydrochloric acid solution | Alcoholic extract of Phoenix dactylifera plant | | Potentiodynamic polarization, electrochemical impedance spectroscopy (EIS) and electrochemical frequency modulation (EFM), 20-60°C | Physical adsorption, Temkin adsorption isotherm, Thermodynamic functions of dissolution Processes were calculated. | 14 |

| | Metal | Medium | Inhibitor | Additive | Method | Findings | Reference |
|---|---|---|---|---|---|---|---|
| 15. | Aluminium alloy | 0.5M hydrochloric acid | Camellia Sinensis (green tea) extract | | Weight loss/corrosion rate and potential measurement techniques | Freundlich isotherm model. The value of Gibb's free energy of adsorption was found to be physisorption. | 15 |
| 16. | MildSteel | X52 | 20% $H_2SO_4$ | Retamaretam extracts | Potentiodynamic polarization at 25°C | Anticorrosive behaviour | 16 |
| 17. | MildSteel | potable water | Saracaindica (Asoka) leaf extract | | Weight loss,open circuit potential measurements and potentiostatic polarization techniques | A complex on the surface of the metal. | 17 |
| 18. | Mild steel | 1N HCl | Acid extract of Ephedraalata leaves | | Potentiodynamic polarization, impedance | Mixed-type with cathodic predominance. | 18 |
| 19. | Carbon steel | HSOsolutions | Extracts from the root of Nauclealatifolia | | Gasometric techniques | Temkin adsorption isotherm. | 19 |
| 20. | Q235A steel | 1M hydrochloric acid solution | Extracts of pomegranate | | Weight loss and potentiodynamic polarization | Mixed-type inhibitor. | 20 |
| 21. | Aluminium | 1M NaOH solution | Solanum trilobatum leaves extract | | Weight loss, hydrogen evolution, polarisation and electrochemical impedance spectroscopy. | Mixed-type inhibitor. | 21 |
| 22. | Aluminium | 1M HCl solution | Morinda citrifolia L. (M. citrifolia L.) leaves extract | | Chemical (weight loss, gasometry) and electrochemical (acimpedance and polarisation) | Obeys with Langmuir adsorption isotherm, Thermodynamic parameters ($\Delta$Gads $\Delta$Hads and $\Delta$Sads) were found | 22 |
| 23. | Mild steel | $H_2SO_4$ solutions | Ethanol extracts from leaves (LV), bark (BK) and roots (RT) of Nauclealatifolia | | Weight loss and gasometric techniques at 30-60°C | Physical adsorption. | 23 |
| 24. | Aluminium and its alloys | - | Various plant extract | | FTIR, HPLC-RP, SEM, EDS | Obey various adsorption isotherms, protective film formation. | 24 |

| | Metal | Medium | Inhibitor | Additive | Method | Findings | Reference |
|---|---|---|---|---|---|---|---|
| 25. | Mild steel | 1M HCl and 0.5m $H_2SO_4$ | Extract of dodonaea viscosa leaves (DLVE) | | Mass loss and electro chemical measurements, GC-MS and FT-IR,UV spectroscopy | The formation of protective layer on the mild steel (MS) surface, thermodynamic parameters revealed that the inhibition is through spontaneous adsorption of inhibitors on to the metal surface | 25 |
| 26. | Copper | Aqueous 0.5M sulphuric acid | Extract of cannabis plant | | Electrochemical impedance spectroscopy (EIS), potentiodynamic polarization, weight loss and optical micrograph techniques. | Cathodic-type inhibitor, Langmuir, Flory-Huggins, and the kinetic-thermodynamic model were tested. | 26 |
| 27. | Carbon steel | Hydrochloric acid solution | The aqueous extract leaves of Larrea tridentate (AELL) | | Weight loss and potentiodynamic polarization techniques, FTIR spectroscopy and phytochemical analysis | A mixed-type corrosion inhibitor, thermodynamic adsorption parameters are | 27 |
| 28. | Carbon steel AISI1020 | Saline medium | The hydro-alcoholic extract of the plant species Croton cajucara Benth (CC) | Micro emulsion system (MES-CC) as well as in dimethyl sulfoxide (DMSO-CC) | Potentiodynamic technique and Tafel extrapolation | Obeys Langmuir adsorption isotherm, Frumkin isotherm. | 28 |
| 29. | Aluminium and copper | HCl solution | Ziziphus mauritiana Fruit extract | | Weight loss method, Surface analysis (FT-IR) | Obey Langmuir adsorption isotherm. | 29 |
| 30. | Aluminium | 0.5N Hydrochloric acid | Alcoholic extract of Lawsoniainermis leaves | | Mass loss measurement, The temperature studies | Temkin adsorption isotherm, chemisorptions followed by physisorption, The protective film formed on the metal surface, Qads, ΔGads suggests that the adsorption may be exothermic and endothermic and spontaneous process. | 30 |

| | Metal | Medium | Inhibitor | Additive | Method | Findings | Reference |
|---|---|---|---|---|---|---|---|
| 31. | Mild steel | 2.0M HCl solution | ethanol extracts of Andrographis paniculata (king bitters) EEAP | | Weight loss (gravimetric) and hydrogen evolution (gasometric) techniques, at the temperature of 30, 40, 50 and 60 °C | Langmuir adsorption isotherm, physical adsorption. | 31 |

## 2. Results and Conclusion

The summarized discussions concluded that the naturally occurring plant extract is readily available. Cheap and renewables are eco-friendly and ecologically acceptable it is required to minimize and control metal corrosion which is a major industrial problem.

Green corrosion inhibitors are found to be effective and can play major role over toxic inhibitors; the efficiency of corrosion inhibitors depend not only the kind of the environment in which they act the nature of the metal surface and electrochemical potential at the interface but also on the structure of the inhibitors itself which include the member of adsorption active center in the molecule, their charge density in the molecular size and the mode of adsorption, the formation of metallic complexes and the projected area inhibitor on the metallic surface from the experimental study can thus be concluded that the main mechanism of corrosion inhibition follows the different adsorption isotherm and their adsorption further depends on the physical and chemical properties of the metal surface.

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