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The Effect of Magnolia Champaca Leaf Extract as a Natural Carbon Steel Corrosion Inhibitor in 1n Hydrochloric Acid

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Abstract:
The rusting inhibition the aqueous solution of magnolia champaca greenery on mild metal in 1n hydrochloric acid remained studied using mass loss measurements potentiodynamic polarization ac impedance spectroscopy and synergism parameters the weight loss results indicated that the addition of 8 ml of magnolia champaca greenery solution together using 50 ppm of zinc sulphate resulted in a maximum control efficiency of 92 in 1n hydrochloric acid solution FTIR spectral analysis confirmed that formation of a protective film consisting from an magnolia champaca greenery extract complex over the metal surface polarization studies revealed that inhibitor behaves predominantly as an anodic type inhibitor mainly controlling the anodic dissolution reaction ac impedance measurements supported the formation of protective layer on that metal interface analysis electron microscopy surface examination study also showed enhanced interface coverage along with formation of an insoluble complex into the presence of 8 ml from greenery solution and 50 ppm zinc.

Keywords: carbon steel, corrosion inhibition, polarization, AC impedance, Magnolia champaca leaf extract

1.INTRODUCTION

Rusting is a natural phenomenon that impacts the durability strength and appearance from metallic substances it occurs when alloys react chemically otherwise electrochemically alongside their encircling conditions and convert into more stable material such like oxides rusting preventives are chemical material that exist added to corrosive conditions until reduce. This rate from rusting along using improve that service life out of metals alongside industrial instruments carbon based rusting preventives generally include substituent atoms like similar to dioxygen o dinitrogen n also chalcogenide s such atoms act similar to dynamic adsorption centers that allow that preventives molecules into attach toward. The alloy exterior and form any shielding layer orientation refers into the deviation part of electrode potential out of its equilibrium value when an electric current flows in an electrochemical system electrochemical impedance spectroscopy is widely utilized towards evaluate rusting behavior along with determine. This capability of corrosion suppresser Fourier transform infrared spectroscopy FTIR helps in identifying that functional clusters present among substances and studying molecular interactions observing subatomic

microscopy surface examination study provides detailed visuals of the metal coating and helps analyze exterior configuration and the extent part of corrosion.

2. MATERIALS AND METHODS

2.1 Preparation of Stock Solutions

2.1.1 Zinc Sulphate Solution:

A concentrated solution from zinc sulphate occurred ready via hydrating exactly 1 g from zinc sulphate among refined water as well as making total volume up to 250 ml in criteria calibrated flask.

2.1.2 Hydrochloric Acid Solution:

A 1N hydrochloric acid solution existed fabricated via diluting 89 ml from strong hydrochloric acid including purified liquid along with making per volume up concerning 1000 ml in a standard flask.

2.2. Weight Loss Method

Weight reduction technique was used to determine any rusted rate along using prevention productivity based on inhibitor setup gentle steel samples occurred dipped into such test liquids to exact time intervals and the reduction in weight was determined.

2.2.1. Surface Area Determination:

The extent width thickness along with hole radius about mild steel samples existed recorded accompaniment Vernier calipers out made from those readings this surface area possession the specimens existed determined.

2.2.2 FTIR Analysis:

FTIR study was conducted out to study for nature. The protective film formed on the metal surface the main constituent of magnolia champaca leaf extract is reported to be 24-dihydroxy-14-benzoxazin-3-one. The FTIR spectra proved that formation of a MCLE complex in metal surface this complex acts as a protective barrier which prevents further oxidation of mild steel in acidic medium.

2.2.4. Surface examination study:

Carbon steel samples were immersed in different experiment solutions for one day after immersion this specimens existed removed flushed with distilled water. Dried the nature of the layer formed over this metal coating was analyzed using observing charge particle microscopy surface examination study. This surface morphology of carbon steel dipped in blank along with inhibitor reagents was analyzed using a Joel model 6390 computer-controlled surface examination study.

3. Results and discussion

Corrosion inhibitor of carbon steel in acidic medium using magnolia champaca leaf extract

Weight loss study

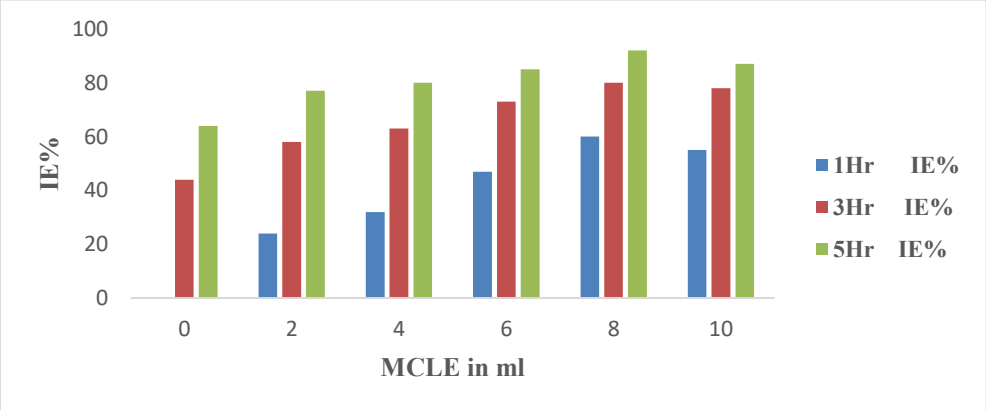
3.1. Inhibition Efficiency (IE) and Corrosion Rate (CR) of Carbon Steel in Hydrochloric Acid Medium

The prevention efficiency inhibition efficiency along alongside corrosion rate corrosion rate from this MCLE zinc sulphate system existed ascertained through this mass loss protocol this prevention capability increased accompanied by rising amount of zinc sulphate ions at 8 ml of MCLE and 50 ppm zinc sulphate that prevention efficiency was observed to be 60 80 and 92 after 1 3 and 5 hours respectively within 1n hydrochloric acid corrosive solution. These findings indicate this 50 ppm zinc sulphate is optimum level for achieving higher prevention efficiency the combined preventive agent

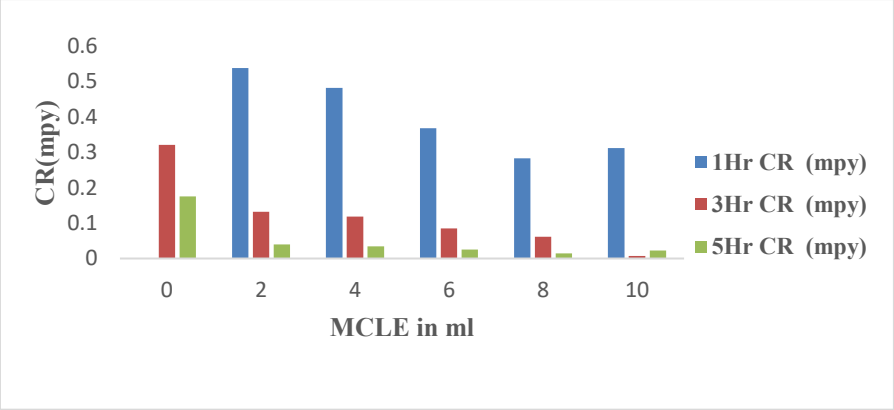
system presented greater effectiveness than that individual components it existed also detected. The corrosion rate declined being that concentration from MCLE enhanced in the presence of zinc sulphate ions.

TABLE 1: Corrosion IE% and corresponding (CR) in (mills per year) of MCLE- Zn^{2+} system in 1N Hydrochloric acid

MCLE in ml	Zn^{2+}					
	1Hr		3Hr		5Hr	
	IE%	CR (mpy)	IE%	CR (mpy)	IE%	CR (mpy)
0	-	-	44	0.3213	64	0.1758
2	24	0.5387	58	0.1323	77	0.0396
4	32	0.4820	63	0.1181	80	0.0340
6	47	0.3686	73	0.0850	85	0.0255
8	**60**	**0.2835**	**80**	**0.0614**	**92**	**0.0141**
10	55	0.3119	78	0.0070	87	0.0226



Graph of (IE) of MCLE-Zn^{2+} system in controlling the corrosion of carbon steel immersed in 1N Hydrochloric acid



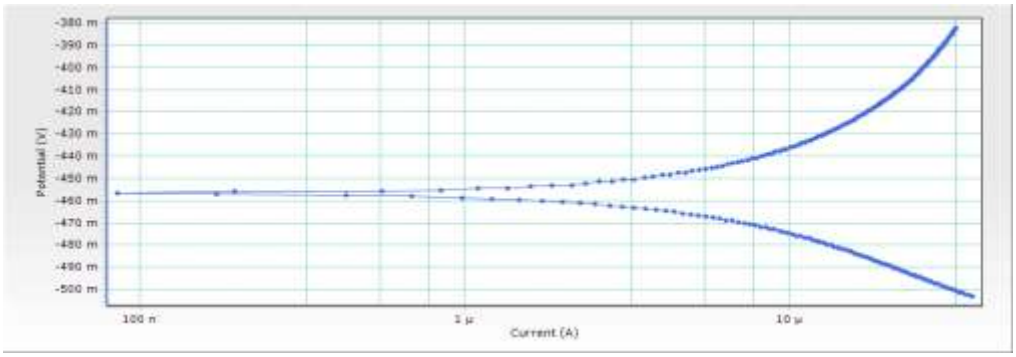
Graph of CR (mpy) of carbon steel in the presence of MCLE-Zn^{2+} system immersed in 1N Hydrochloric acid

3.2. Analysis of polarization curves

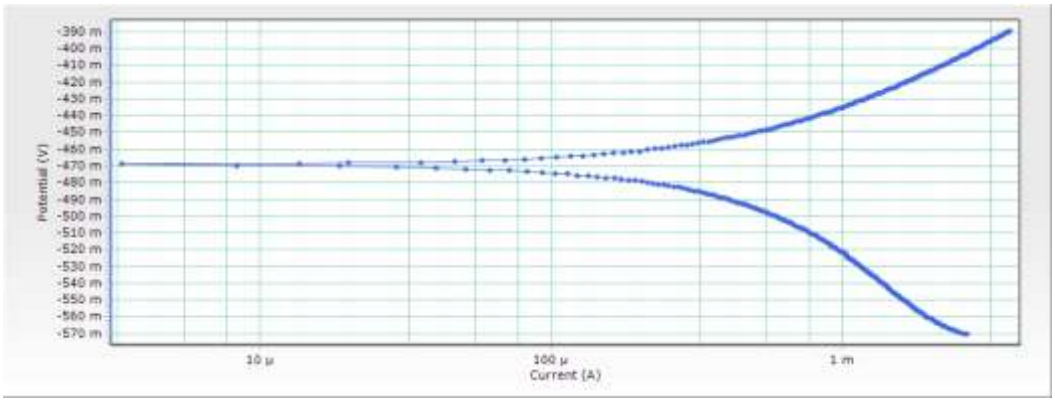
Polarization curves existed collected to carbon steel into 1n hydrochloric acid corrosive substance into the absence also existence from the protective agent system. The cathodic branch matches to that hydrogen evolution reaction. While these oxidizing electrode branch represents this solubilization carbon steel into the absence from the suppressor. The oxidation potential ecorr existed observed at 456774 mv versus see later this addition of 8 ml made from MCLE. The corrosion potential shifted slightly toward 490589 mv versus see this shift recommends this inhibitor mainly affects the anodic reaction this results indicate the inhibitor behaves predominantly as an anode related type protective agent by controlling this solubilization made from carbon metal.

TABLE 2: Corrosion parameter of carbon steel in acidic solution in the absence & presence of various concentration of inhibitor obtained by polarization method

MCLE in ml	E_{corr} mv Vs SCE	I_{corr} A/Cm^2	b_a (mv/dec)	b_c (mv/dec)
0	-456.774	14.259×10^{-6}	173.526	100.7
8	-490.589	559.66×10^{6}	92.336	164.028



a) 1N Hydrochloric acid



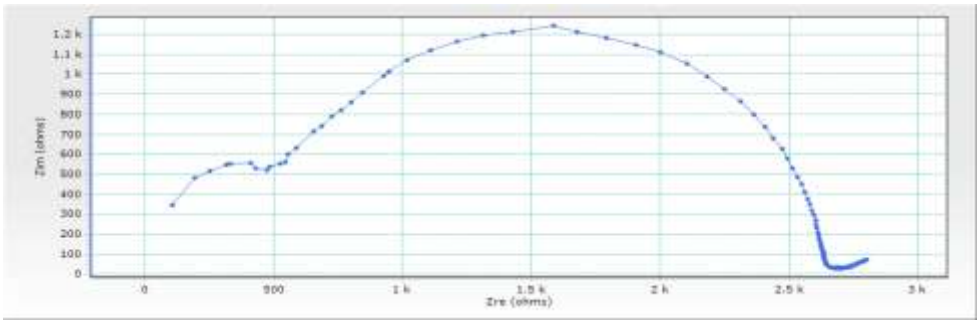
b) 1N Hydrochloric acid + 8 ml of MCLE + 50 ppm of Zn^{2+}

3.3. Analysis of AC impedance spectra

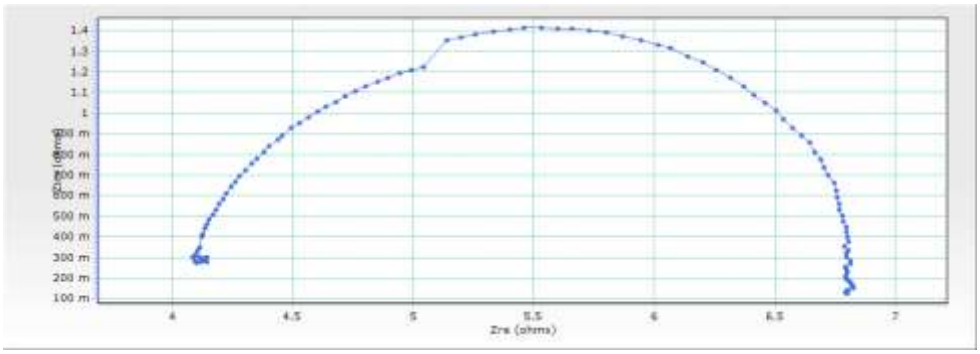
AC impedance spectroscopy was applied into analyze the formation. The protective motion picture on the metal surface Nyquist plots obtained that presence along with absence this inhibitor system were approximately elliptical in shape as indicates these arrangement in protective oxide film was expand the diameter. The impedance loop alongside higher passivate concentration confirmed a improved shielding effect from the inhibitor on the carbon steel surface.

TABLE 3: Impedance parameters of carbon in acidic solution in the absence and presence of various concentrations of the MCLE

SYSTEM	R_t Ohm cm^2	C_{dl} F/Cm^2
Blank	1.9	2.6839×10^{-6}
8 ml MCLE+50_{ppm}	2.6	1.9613×10^{-6}



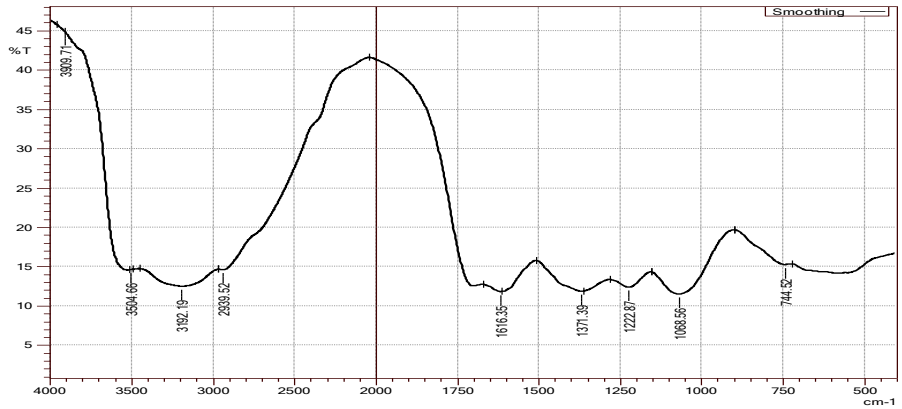
(a) **1N Hydrochloric acid**



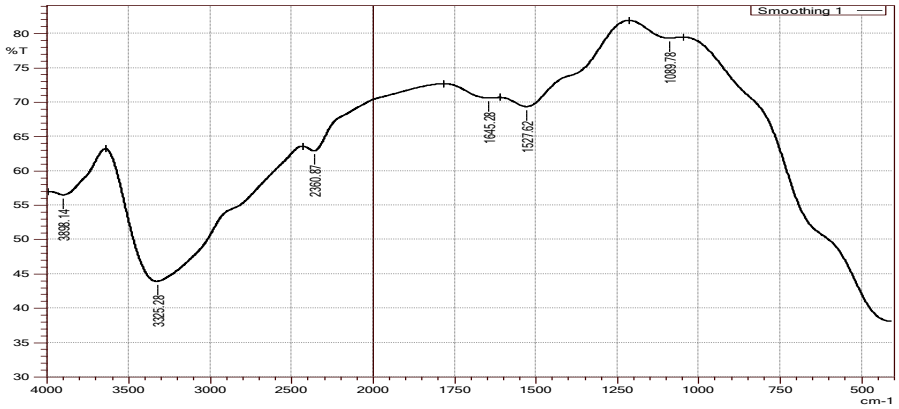
(b) 1N Hydrochloric acid + 8 ml of MCLE + 50 ppm of Zn^{2+}

3.4. Analysis of FTIR spectra

FTIR study was conducted out to study for nature the protective film formed on the metal surface the main constituent of magnolia champaca leaf extract is reported to be 24-dihydroxy-14-benzoxazin-3-one. The FTIR spectra proved that formation of a MCLE complex in metal surface this complex acts as a protective barrier which prevents further oxidation of mild steel in acidic medium.



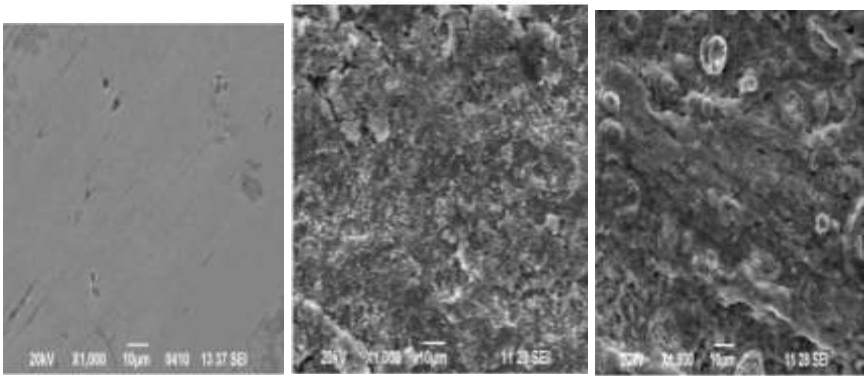
FT-IR spectra of pure Metal



The film formed on the metal surface after immersion in 1N Hydrochloric acid containing 8 ml of MCLE and 50 ppm of Zn^{2+}

3.5. SEM analysis of metal surfaces

Carbon steel samples were immersed in different experiment solutions for one day after immersion this specimens existed removed flushed with distilled water. Dried the nature of the layer formed over this metal coating was analyzed using observing charge particle microscopy surface examination study..



(a) b) c)

a) Polished carbon steel

b) Carbon steel immersed in 1N hydrochloric acid

c) carbon steel immersed in 1N Hydrochloric acid containing 8ml of **mangolia champaca** leaf extracts 50ppm of Zn^{2+}

4. Conclusion

Corrosion inhibition of carbon steel in acidic medium using magnolia champaca leaf extract

The weight loss study showed that the combination of 8 ml MCLE and 50 ppm zinc sulphate provided an protective productivity of 92 in 1n hydrochloric acid. Corrosion rate decreased as protective productivity increased a synergistic effect was observed with MCLE along with zinc sulphate ions electrochemical studies indicated that the inhibitor predominantly acts as an anodic inhibitor ac resistance evaluation confirmed in formation of protective film on metal surface FTIR study revealed the protective layer consists of an MCLE complex.

5. References

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