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Corrosion inhibition efficiency of sodiumlaurylsulphateandzn^{2+}SYSTEMFORCARBONSTEELINWELL WATER

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ABSTRACT
The corrosion inhibition efficiency of sodium lauryl sulphate and Zn^{2+}system for carbonsteel in well water was studied using weight loss study and electrochemical study .The resultsobtainedrevealthatsodiumlaurylsulphateisgoodinhibitorandshowsgoodinhibitionefficiency.ThesodiumlaurylsulphatereducemetaldissolutioninaqueousenvironmentandthismaybeduetoadsorptioncomplexformationatthemetalsurfacewiththecombinedapplicationofsodiumlaurylsulphateandZn^{2+}.Hencecorrosionprocessisinhibited.

Keywords:*corrosioninhibitor,sodiumlaurylsulphate,,weightlossmethod,electrochemicalpolarizationFT-IR,SEM*

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I. INTRODUCTION

To control corrosion, application of inhibitorshas been used in the present investigation which controls corrosion by reducing the aggressive ofthe corrosive medium and forming a protective layer over the metallic structure.[1-6]The well wateralongwithappropriateproportionofinhibitors aloneandorinthepresenceofsynergisticcompoundsmaybeusedincoolingwatersystem,boilers,condenser,and heatexchangers, etc.ElectrochemicalstudiessuchaspolarizationandACimpedancespectraprovidemechanistic aspects of corrosion inhibition.[7-10] To analyse the protective film formed on the carbonsteel by FTIR study. The surface analytical techniques also provide better understanding aboutthe reaction takes place on the metal surface.

II. MATERIALSANDMETHODS

2.1 Preparationof thecarbonsteelspecimens

Thecarbonsteelspecimens werechosenfromthesamesheetofthefollowingcomposition:

Elements	**S**	**P**	**Mn**	**C**	**Fe**
Composition (%)	0.026	0.06	0.4	0.1	99.365

2.2.Preparationofthestocksolution

Zincsulphatesolution

Exactly 1.1g of zinc sulphate was dissolved in double distilled water and made up to 250ml in a 250 ml standard measuring flask. A hundred- fold dilution yields exactly 50 ppm of Zn^{2+}concentration.

Nickelsulphatesolution

Exactly1.1gofnickelsulphatewasdissolvedindoubledistilledwaterandmadeupto250 ml in a 250 ml standard measuring flask. A hundred- fold dilution yields exactly 50 ppm ofNi^{2+}concentration.

Megnesiumsulphatesolution:

Exactly1.1gofmegnesiumsulphatewasdissolvedindoubledistilledwaterandmadeupto250mlina250mlstandardmeasuringflask.Ahundred-folddilutionyieldsexactly50ppmofMg^{2+}concentration

Sodiumhydroxidesolution

About13gofsodiumhydroxidewasdissolvedin250mlofdoubledistilledwaterinorderto make a solution of normality slightly greater than1N. Its exact strength was determined bytitrating with a standard oxalic acid solution using phenolphthalein indicator .Then 1N sodiumhydroxidewaspreparedbytransferringtherequiredvolumeofsodiumhydroxidesolutioninto250mistandardmeasuringflaskandmakinguptothemarkwithdoubledistilledwater.

2.3Inhibitorssolution:
Stock solutions of the inhibitors already listed in IV.2 except hydroquinone werepreparedindoubledistilledwaterbyweighing1ganddissolvedinsodiumhydroxidesolution,pHwasnotedandmadeupto100mlina100mlstandardflask.Onemlofthissolutionwasdilutedto100ml,whichyieldsexactly100ppmof inhibitor.

2.4 SODIUMLAURYLSULPHATESOLUTION
Exactly1.1gofSodiumlaurylsulphatesolutionwasdissolvedindoubledistilledwaterandmadeupto250mlina250mlstandardmeasuringflask.Ahundred-folddilutionyieldsexactly50ppmofZn^{2+}concentration.

III. RESULTANDDISCUSSIONS

3.1.Analysisofweightlossstudy:
The calculated inhibition efficiencies (IE) and corrosion rates (CR) of **SODIUMLAURYLSULPHATE(SLS)**incontrollingcorrosionofcarbonsteelimmersedinWellwater,for a period of three days in the absence and presence of different metal ions like Zn^{2+} ,Ni^{2+},Mg^{2+} are given in Table . The calculated value indicates the ability of SLS to be a goodcorrosion inhibitor. The IE is found to be enhanced in the presence of metal ion. SLS aloneshows some IE. But the combination of 250 ppm SLS and 15 ppm Zn^{2+} shows **90%** IE. ThissuggestsasynergisticeffectexistsbetweenSLSandZn^{2+}.Thecombinationof250ppmSLSand15ppmNi^{2+}shows**85%**IE.Thecombinationof250ppmSLSand15ppmMg^{2+}shows**75%**IE.

Table 1: Inhibitionefficiencies(IE%)andcorrosionrates(CR)obtainedfromSLS–Zn^{2+},SLS –Ni^{2+} and SLS-- Mg^{2+} systems, when carbon steel immersed in Well water.periodofimmersion3days

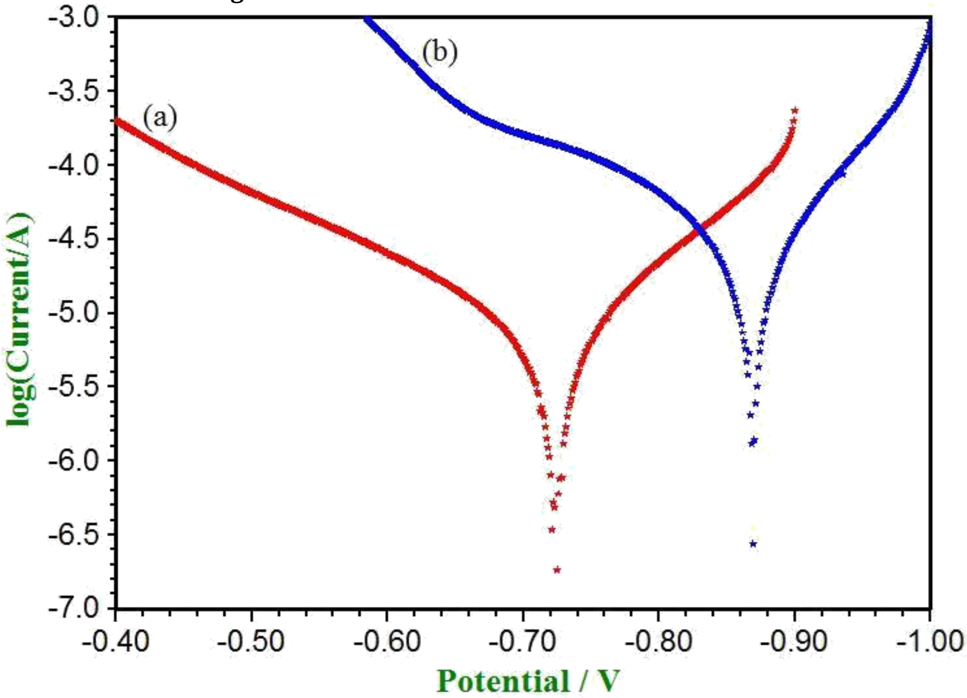
SLS (ppm)	Zn^{2+} 15(ppm)		Ni^{2+} 15(ppm)		Mg^{2+} 15(ppm)	
	I.E%	CR (mmpy)	I.E%	CR (mmpy)	I.E%	CR (mmpy)
0	29	0.0067	25	0.0071	20	0.0076
50	57	0.0040	50	0.0047	40	0.0057
100	68	0.0030	65	0.0033	55	0.0043
150	75	0.0023	70	0.0028	60	0.0034
200	87	0.0012	80	0.0019	70	0.0020
250	90	0.0009	85	0.0014	75	0.0012

.Table 2:SYNERGISMPARAMETER(SI):

SLS(ppm)	Zn^{2+} (15ppm)	ϴ1	ϴ2	ϴ'1+2	SI	IE%
50	15	0.15	0.27	0.57	1.4430	57
100	15	0.15	0.35	0.68	1.7265	68
150	15	0.15	0.48	0.75	1.7680	75
200	15	0.15	0.60	0.87	2.6153	87
250	15	0.15	0.71	0.90	2.4650	90

SLS-Zn^{2+}at250:15ppm,SI=2.4650indicatestheexistenceofsynergismbetweenSLSandZn^{2+}

Fig 1: POTENTIODYNAMICPOLARIZATIONSTUDY



Polarizationcurvesofcarbonsteelimmersedin varioustestsolutions

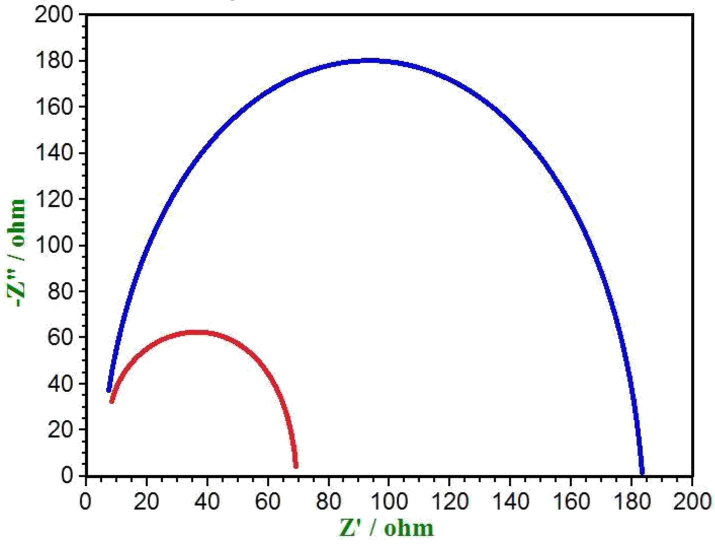
(a) Wellwater

(b) Wellwater +SA (250 ppm) +Zn^{2+}(15 ppm)

Corrosionparametersofcarbonsteelimmersedin Wellwaterintheabsenceandpresenceof inhibitorsobtained bypolarizationstudy

System	Ecorr mV vsSCE	BcmV/decade	BamV/decade	LPR Ωcm^2	IcorrA/cm^2
Wellwater	– 731	135.5	162.3	1.0756 x 10^4	3.80x10^{-4}
Wellwater+ SLS(250ppm) +Zn^{2+} (15 ppm)	– 779	156.7	183.0	1.6086 x 10^4	2.90x10^{-4}

Fig 2. A.CIMPEDANCESPECTRA



Impedanceparametersofcarbonsteelimmersedinwellwaterintheabsenceandpresenceofinhibitorsobtainedb yACimpedancespectra

System	Rt **Ωcm^2**	Cdl **F/cm^2**	Log **(z/ohm)**
wellwater	68.63	7.7500×10^{-6}	2.011
wellwater+ SLS(250ppm) + Zn^{2+} (15ppm)	189.38	$6.5275 x10^{-6}$	2.061

3.2 ANALYSISOFFT-IRSPECTRA:

FTIR spectrum (KBr) of pure Sodium Lauryl Sulphate (SLS) is shown in Fig. 1a. he C=Ostretchingfrequencyof carboxylgroup appears at1700cm^{-1}. TheO-Hstretchingfrequencyof SAappears at3180cm^{-1}.TheFTIRspectrum(KBr)offilmformedonthe surfaceofmetalafterimmersionin Wellwater containing250 ppmof SLSand15ppm ofZn^{2+}isshown inFig..TheC=Ostretchingfrequencyofcarboxyl grouphasshiftedfrom 1700cm^{-1}to1594 cm^{-1}The O-H

stretching frequency of SLS has shifted from 3180 cm^{-1} to 3425 cm^{-1} .This indicates that thesegroups has coordinated with Fe^{2+} , resulting in the formation of Fe^{2+} -SLS complex on the anodicsitesofthemetal surface.Thepeakat1402cm^{-1}is duetoZn(OH)2formed onthecathodicsitesofthemetal surfaceThusFTIR spectrastudy leadstotheconclusion thatthe Fe^{2+}-SLS complex formed on anodic sites of the metal surface controlled the anodic reaction and Zn(OH)2formedon thecathodicsites of themetal surface controlling thecathodicreaction.

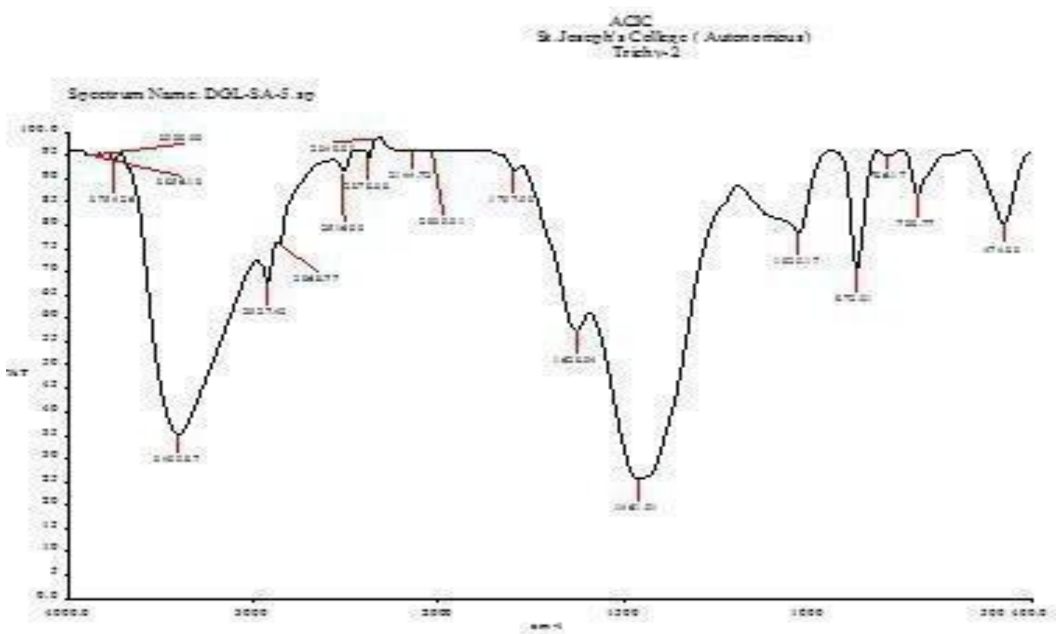
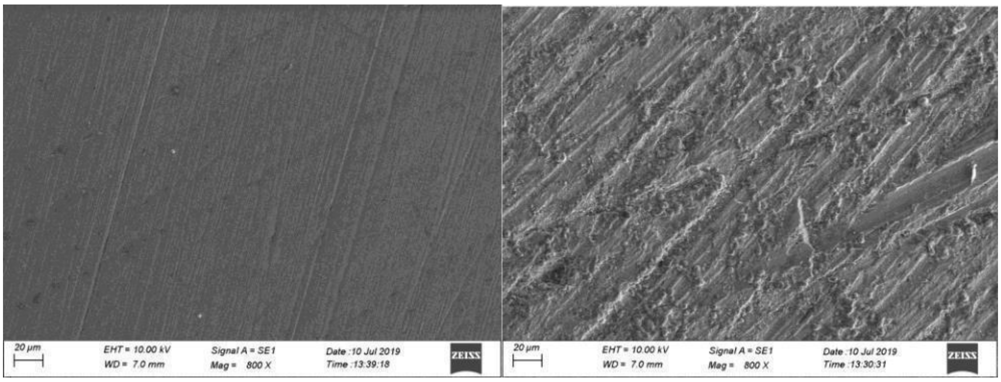


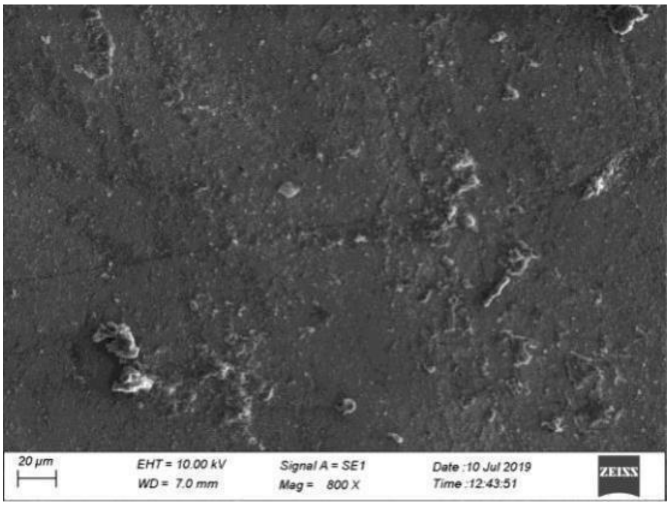
Fig.3 FTIRspectrumof Well-water+250ppmof SLS +15ppmofZn^{2+}

Fig.4 FTIR

3.4 ANALYSISOFSCANNINGELECTRONMICROSCOPY



a) Carbonsteel –Polished b) Blank (WW)



SLS-Zn^{2+}system(250:15ppm)

IV. CONCLUSION:

Theweight– lossstudy reveals that theformulation consisting of100ppmof Zn^{2+},Ni^{2+}, Mg $^{2+}$ and 250ppm of Sodium Lauryl Sulphate has 90 % and 85% and 75%inhibitionefficiency,forthreedayssystem and explainstheSynergisticeffect betweenSLS-Zn^{2+}complexesandSLS-Ni^{2+}complexes.Theprotective filmconsists ofFe^{2+}-SLSandZn(OH) 2is explained by FTIR spectroscopy.The results of polarization study show that theanodic reaction is controlled predominantly indicating the reduction resolution of metal as moremoleculesaretransportedto theanodicsides in thepresenceZn^{2+}ions. TheACimpedencespectral studies reveal that the protective film obtained act as a barrier to the corrosion processthat clearly explains the formation of the protective film on the metallic surface.The formation ofFe^{2+}-SLScomplexover themetalsurfacewereexaminedbyFT-IRspectra.SEMstudiesconfirmthattheprotectivefilm isformedonthecarbonsteelsurfaceand the corrosionprocessisinhibited.

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