CONTENTS

CHAPTER – 1 INTRODUCTION

Page No.

1.1	Introduction to corrosion	1
1.1.1	Civilization and corrosion	1
1.1.2	Definition of corrosion	1
1.1.3	Historical background	2
1.1.4	Importance of corrosion studies	2
1.1.5	Consequences of corrosion	3
1.1.6	Expense of corrosion	4
1.1.7	The social implications of corrosion	4
1.1.8	Classification of corrosion process	5
1.1.9	Classification of corrosion	6
1.1.10	Principles of corrosion	7
1.1.11	Theories of corrosion	9
1.1.12	Factors influencing the rate of corrosion	9
1.1.13	Forms of corrosion	13
1.1.14	Methods of corrosion control	17
1.1.15	Corrosion mechanism in acid solutions	19
1.1.16	Corrosion mechanism in neutral solutions	20
1.1.17	Corrosion mechanism in alkaline solutions	20
1.1.18	Synergistic effect and corrosion inhibition	21
1.2	Introduction to corrosion inhibitors	21
1.2.1	Requirements of corrosion inhibitors	22
1.2.2	Classification of inhibitors	23
1.2.3	Functioning of organic inhibitors	27
1.2.4	Theories of inhibitors	27
1.2.5	Factors affecting the applicability of inhibitors	31
1.2.6	Adsorption isotherm	32
1.2.7	Mechanism of inhibitor action in acid corrosion processes	33
1.2.8	Quantum chemical approach	35
1.3	Corrosion monitoring techniques	37
1.3.1	Definition of corrosion monitoring	37
1.3.2	Physicochemical methods	37
1.3.3	Electrochemical methods	39
1.3.4	Non-destructive testing (NDT) methods	45

1.4	Introduction to chalcones	49
1.5	References	52
	CHAPTER – 2	
	REVIEW OF LITERATURE	
2.1	Introduction	56
2.2	Background to this work	72
2.3	Objective to this work	72
2.4	An Overview of the objectives and aims of this thesis	73
2.5	References	74
	CHAPTER – 3	
(CORROSION INHIBITION CHARACTERISITIC OF ISOXAZOLINE DERIVATIVES FOR MILD STEEL IN 1MH ₂ SO ₄	
3.1	Introduction	77
3.2	Experimental work	79
3.2.1	Synthesis of inhibitors	79
3.2.2	Corrosion monitoring techniques	80
3.2.2.1	Non-electrochemical measurements	81
3.2.2.2	Electrochemical studies	83
3.2.2.3	Surface examination study	85
3.2.3	Computational details	86
3.2.3.1	Quantum chemical studies	86
33	Results	88
3.3.1	Weight loss method	89
3.3.2	Electrochemical impedance spectroscopic method	90
3.3.3	Potentiodynamic polarization method	91
3.4	Discussion	91
3.4.1	Mechanism of adsorption of organic compounds on the mild steel surface	91
3.4.2	Adsosprtion of isoxazolines on mild steel surface	94
3.4.3	Nature of adsorption-effect of temperature on inhibition efficiency	95
3.4.4	Atomic absorption spectrophotometric studies	103
3.4.5	Electrochemical behaviour of inhibition	103
3.5	Surface characterization	110
3.5.1	FTIR analysis of mild steel plate	110
3.5.2	Scanning electron microscope- Energy dispersive X-Ray spectroscopy (SEM-EDS)	110
3.5.3	X-ray diffraction patterns	111

3.5.4	Atomic Force microscopy	112
3.6	Quantum chemical studies	112
3.6.1	Quantum chemical study of non-protonated form of the studied inhibitors in aqueous phase	112
3.6.2	Quantum chemical study of protonated form of the studied inhibitors in aqueous phase	114
3.6.3	Mulliken charge density distribution	115
3.7	Evaluation of isoxazolines: Chemical structure and corrosion inhibition of Fe	116
3.8	Conclusions	117
3.9	References	119

CHAPTER – 4

ANTI CORROSION PROPERTIES OF HYDROXY PYRAZOLINE DERIVATIVES FOR MILD STEEL IN 1M H₂SO₄

4.1	Introduction	124
4.2	Experimental work	125
4.2.1	Synthesis of inhibitors	125
4.2.2	Evaluation of inhibition efficiency of the hydroxy pyrazolines	127
4.2.2.1	Non-electrochemical techniques	127
4.2.2.2	Electrochemical techniques	128
4.2.2.3	Surface morphology	128
4.3	Results and Discussion	128
4.3.1	Characterization of synthesized hydroxy pyrazolines	128
4.3.2	Corrosion monitoring techniques	129
4.3.2.1	Non-electrochemical methods	129
4.3.3	Electrochemical measurements	135
4.3.3.1	Electrochemical impedence spectroscopy (EIS) measurements	135
4.3.3.2	Potentiodynamic Polarization measurements	136
4.3.4	Surface characterization	137
4.3.4.1	FTIR analysis of mild steel plate	137
4.3.4.2	Scanning electron microscope- Energy dispersive X-Ray spectroscopy (SEM-EDS)	137
4.3.4.3	X-Ray diffraction patterns	138
4.3.4.4	Atomic force microscopy	139
4.3.5	Quantum chemical studies	139
4.3.5.1	Quantum chemical study of non- protonated form of the studied inhibitors in aqueous phase	139
4.3.5.2	Quantum chemical study of protonated form of the studied inhibitors in aqueous phase	140

4.3.5.3	Mulliken charge density distribution	141
4.3.6	Mechanism of corrosion inhibition	141
4.3.7	Evaluation of pyrazolines: Chemical structure of the inhibitors and its effect on the corrosion inhibition	142
4.4	Conclusions	144
4.5	References	145

CHAPTER – 5

CORROSION INHIBITION PERFORMANCE OF FURYL, PYRIDYL SUBSTITUTED AZOLES AND PYRIMIDINES FOR MILD STEEL IN $1M\ H_2SO_4$

5.1	Introduction	147
5.2	Experimental work	147
5.2.1	Synthesis of inhibitors: Synthesis of pyrimidine and azole derivatives	147
5.2.2	Evaluation of inhibition efficiency of pyrimidine and azole derivatives	149
5.3	Results and Discussion	150
5.3.1	Non-electrochemical methods	150
5.3.2	Atomic absorption spectrophotometric studies	155
5.3.3	Electrochemical measurements	155
5.3.3.1	Electrochemical impedence spectroscopy (EIS) measurements	155
5.3.3.2	Potentiodynamic polarization measurements	157
5.3.4	Surface characterization	158
5.3.4.1	FTIR analysis of mild steel plate	158
5.3.4.2	Scanning electron microscope- Energy dispersive X-Ray spectroscopy (SEM-EDS)	159
5.3.4.3	X-Ray diffraction patterns	159
5.3.4.4	Atomic force microscopy	160
5.3.5	Quantum chemical studies	160
5.3.5.1	Quantum chemical study of non- protonated form of the studied inhibitors in aqueous phase	160
5.3.5.2	Quantum chemical study of protonated form of the studied inhibitors in aqueous phase	161
5.3.5.3	Mulliken charge density distribution	162
5.3.6	Mechanism of corrosion inhibition	162
5.3.7	Evaluation of inhibitors	163
5.4	Conclusions	165
5.5	References	166

CHAPTER – 6 CORROSION INHIBITING EFFECT OF BIS-ISOXAZOLES, PYRAZOLES, PYRIMIDINES FOR MILD STEEL IN 1M H₂SO₄

6.1	Introduction	168
6.2	Experimental work	169
6.2.1	Synthesis of inhibitors	169
6.2.2	Evaluation of inhibition efficiency of bis-heterocyclic derivatives	170
6.3	Results and Discussion	171
6.3.1	Non-electrochemical methods	171
6.3.2	Atomic absorption spectrophotometric studies	178
6.3.3	Electrochemical measurements	178
6.3.3.1	Electrochemical impedence spectroscopy	178
6.3.3.2	Potentiodynamic polarization measurements	180
6.3.4	Surface characterization	181
6.3.4.1	FTIR analysis of mild steel plate	181
6.3.4.2	Scanning electron microscope- Energy dispersive X-Ray spectroscopy (SEM-EDS)	182
6.3.4.3	X-Ray diffraction patterns	183
6.3.4.4	Atomic force microscopy	183
6.3.5	Quantum chemical studies	184
6.3.5.1	Quantum chemical study of non- protonated form of the studied inhibitors in aqueous phase	184
6.3.5.2	Quantum chemical study of protonated form of the studied inhibitors in aqueous phase	184
6.3.5.3	Mulliken charge density distribution	185
6.3.6	Mechanism of corrosion inhibition and evaluation of inhibitors	186
6.4	Conclusions	188
6.5	References	189
	CHAPTER – 7	
EFFECT OF CHANGE IN THE ANION OF THE AGGRESSIVE MEDIUM ON THE INHIBITVE INFLUENCE OF ISOXAZOLINES, PYRAZOLINES, PYRIMIDINES AND BIS-DERIVATIVES		

Introduction	192
Results and Discussion	193
Comparison of inhibition efficiency of the inhibitors in $1M H_2SO_4$ and $2M HCl$	195
Conclusions	199
References	200
	Results and Discussion Comparison of inhibition efficiency of the inhibitors in 1M H ₂ SO ₄ and 2M HCl Conclusions

CHAPTER – 8

SYNERGISTIC EFFECT OF HALIDE IONS AND SURFACTANTS ON CORROSION INHIBITION OF MILD STEEL IN SULPHURIC ACID

8.1	Introduction	201
8.2	Review of literature	202
8.3	Experimental work	206
8.4	Results and discussion	207
8.4.1	Synergistic effect of halide ions	207
8.4.2	Significance of synergism parameter	208
8.4.3	Adsoprtion isotherm	209
8.4.4	Synergistic effect of surfactants (SLS/CTAB)	210
8.4.5	Comparison of % IE of CTAB and SLS	213
8.5	Conclusions	214
8.6	References	215
CHAI	CHAPTER – 9: SUMMARY AND CONCLUSIONS	
CHAPTER – 10: SCOPE FOR FUTURE WORK		224
LIST OF PUBLICATIONS		225