



# Comparative Studies on Inhibitor Efficiency in Mild Steel and Iron

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## Abstract

Metals generally corrode mild steel is an alloy form of from which undergoes corrosion easily in acidic medium. The corrosion products are formed when a metal give its electrons to the oxidizing substances, the organic compounds containing sulphur, nitrogen and oxygen are known to be effectiveness depends on the electron density at the functional groups. We need to reduce the corrosion of steel by adding inhibitor. Tensile strength of steel varies depends on the corrosion. Thus, the aim of this project is to determine the inhibitor efficiency of thiourea, urea, and hydroquinone for the corrosion of normal steel and iron in common HCL medium consists of different concentration of inhibitor.

**Keywords:** Corrosion, Efficiency Electron density, inhibitor, mild steel, pitting.

## 1. Introduction

Corrosion inhibitors were used to reduce the corrosion of steel due to chemical reaction. Organic chemical is used to reduce to corrosion up to 25% of more efficient than other chemical. [Mumtaz Ahmad Quraishi, 2002]. From the plant extracted chemical were used as inhibitor for the reduction of corrosion. [Pandian Bothi raja, et.al. 2007]. The corrosive changes of mild steel in Mix 1 and Mix 2 HCL, Mix 3 and Mix 4 H<sub>2</sub>SO<sub>4</sub> solutions consists of different concentrations of thiophenyl phenyl thiourea (TPTU) were investigated and that give good corrosion resistance capacity were found. [Divakara Shetty et.al, 2006]. The inhibition were react with the chemical give protection on the metal surface [Ashassi-Sorkhabi, et.al, 2006]. The behaviour of corrosion inhibitor were based on efficiently were found. It varies from the different concentration of TPTU [Jayaraman, et.al, 1996]. Fourier transform infrared spectrophotometry was used to obtain information on bonding mechanism between the metallic surface and the inhibitors [Abd EI-Maksoud, et. al 2001].

## 2. Experimental Method

### A. Preparation of Test Specimens

The test specimens of Mild steel and Iron required for the study was cut in a size of 6 cm is length and 1 cm breath. The specimens are finally weighed in a four digit electronic balance.

### B. Preparation of in Solution of HCL

The corrosion study is carried out by preparing Mix 1 solution of HCL. It is prepared by measuring 9.1 ml of HCL and then made up to mark in 100ml standard flask using distilled water.

### C. Preparation of Inhibitors in Different Concentrations

The inhibitor solutions are prepared with Mix1(1N), Mix 2(0.5N), Mix 3(0.25N) concentrations in the following

#### D. Thiourea

The 1N solution of thiourea is prepared in the following manner. About 7.61g of thiourea is weighed, transferred into a 100ml standard flask and made up to the mark using distilled water. Mix 2, Mix 3 solution of thiourea is prepared by weighing 3.8g and 1.9g of it respectively.

#### E. Urea

Mix1, Mix 2, Mix 3 solutions of urea is prepared in the above manner by weighing 6.1g, 3.05g, and 1.525g of it respectively.

#### F. Hydroquinone

Mix1, Mix 2, Mix 3 solutions of hydroquinone is prepared in the above manner by weighing 1.835g, 0.9175g, 0.4587g of it respectively.

### G. Determination of Inhibitor Efficiency Blank Experiment

50ml of 1N HCL is taken in a beaker. The test specimen steel which is weighed already is dipped in the solution. After a time limit of 2hours, it is taken out, air dried and weighed. The weight loss without inhibitor is noted.

To test the inhibitor efficiency 25ml of 1N HCL is mixed with 25ml of 1N solution of thiourea. The test specimen mild steel is then dipped in the solution. After 2 hours, it is taken out; air dried and weighed in a four digit electronic balance. The weight loss with the

presence of inhibitor is noted. The procedure is repeated for different concentrations of inhibitors in steel and iron respectively and tabulated.

$$\text{Inhibitor efficiency} = \frac{W_b - W_i}{W_b} \times 100; \text{Surface coverage} = \frac{W_b - W_i}{W_b}$$

Where,  $W_b$  - weight loss without inhibitor in g;  $W_i$  - weight loss with inhibitor in g

**For example:**

**The study of mild steel 1N HCl with 1N thiourea:**

Weight loss without inhibitor ( $W_b$ ) = 0.0016g

Weight loss with inhibitor ( $W_i$ ) = 0.0009g

$$\text{Inhibitor efficiency} = \frac{0.0016 - 0.0009}{0.0016} \times 100 = 43.75\%$$

$$\text{Surface coverage} = \frac{0.0016 - 0.0009}{0.0016} = 0.4375$$

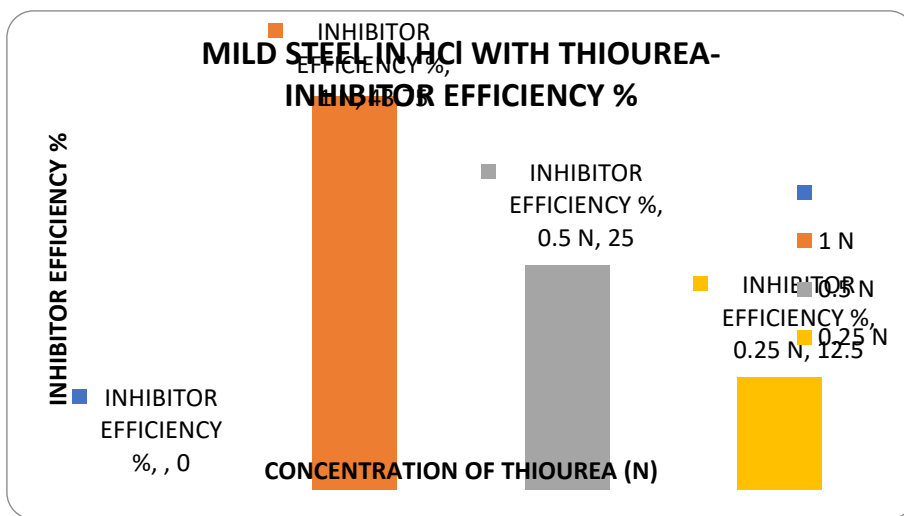
### 3. Experimental Results

Results for mild steel in HCL with thiourea, urea and hydroquinone were found in Table: 1, Table: 2 and Table: 3 respectively.

Corresponding graphs were mentioned in Fig.No.1, Fig. No.2 and Fig.No.3

**Table 1:** Mild Steel in HCL With Thiourea (2 Hours)

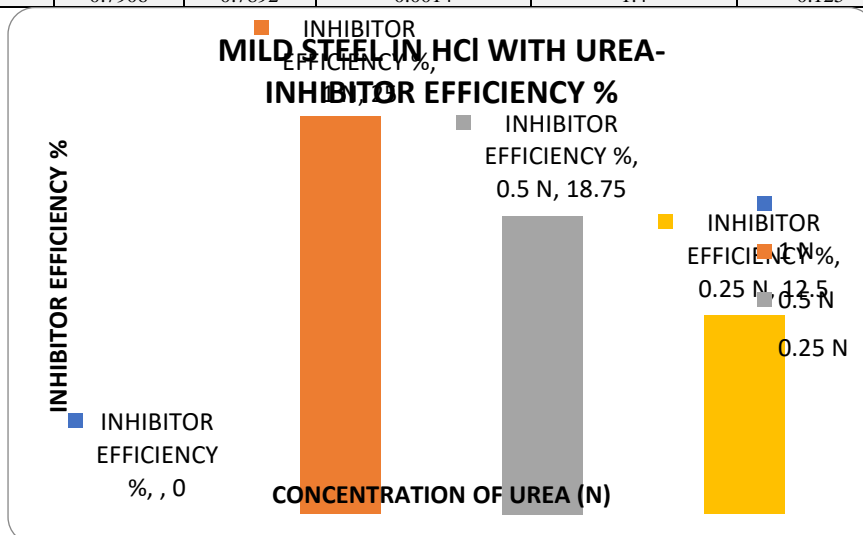
CONCENTRATION OF THIOUREA (N)	WEIGHT OF MILD STEEL				SURFACE COVERAGE	INHIBITOR EFFICIENCY %
	INITIAL	FINAL	DIFFERENCE IN (g)	DIFFERENCE IN (m.g)		
BLANK	0.7795	0.7779	0.0016	1.6		
1 N	0.8373	0.8364	0.0009	0.9	0.4375	43.75
0.5 N	0.8188	0.8176	0.0012	1.2	0.25	25
0.25 N	0.8589	0.8575	0.0014	1.4	0.125	12.5



**Fig. 1:** Mild Steel with Thiourea

**Table 2:** Mild Steel in HCL With Urea(2 Hours)

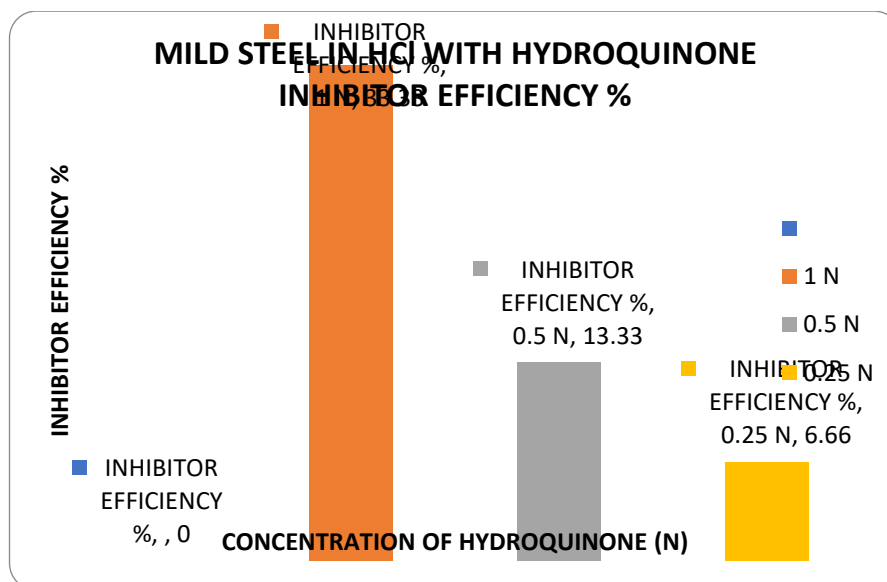
CONCENTRATION OF UREA (N)	WEIGHT OF MILD STEEL				SURFACE COVERAGE	INHIBITOR EFFICIENCY %
	INITIAL	FINAL	DIFFERENCE IN (g)	DIFFERENCE IN (m.g)		
BLANK	0.7795	0.7779	0.0016	1.6		
1 N	0.819	0.8178	0.0012	1.2	0.25	25
0.5 N	0.787	0.7857	0.0013	1.3	0.1875	18.75
0.25 N	0.7906	0.7892	0.0014	1.4	0.125	12.5



**Fig. 2:** Mild Steel with Urea

**Table 3:** Mild Steel in HCL With Hydroquinone (2 Hours)

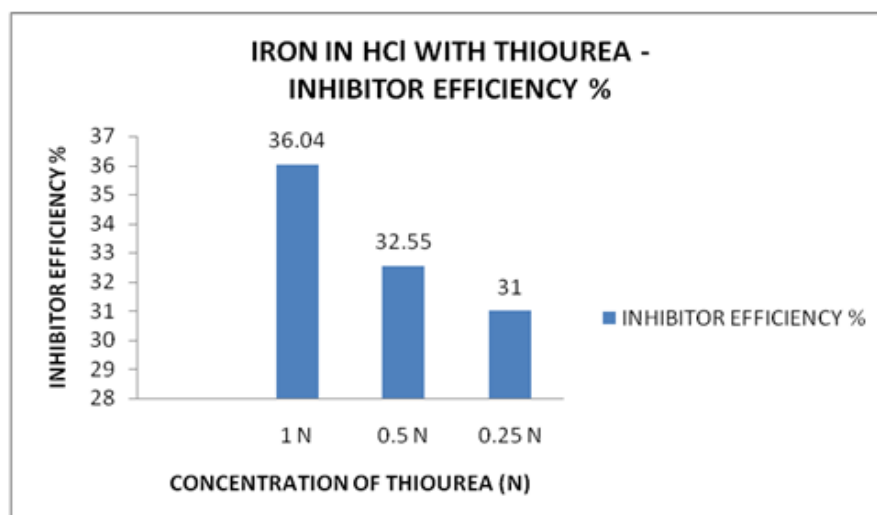
CONCENTRATION OF HYDROQUINONE (N)	WEIGHT OF MILD STEEL				SURFACE COVERAGE	INHIBITOR EFFICIENCY %
	INITIAL	FINAL	DIFFERENCE IN (g)	DIFFERENCE IN (m.g)		
BLANK	0.7183	0.7168	0.0015	1.5		
1 N	0.7130	0.7120	0.0010	1	0.3333	33.33
0.5 N	0.7620	0.7607	0.0013	1.3	0.1333	13.33
0.25 N	0.7720	0.7706	0.0014	1.4	0.0666	6.66

**Fig. 3:** Mild Steel with Hydroquinone

Results for mild iron in HCL with thiourea, urea and hydroquinone were found in Table: 4, Table: 5 and Table: 6 respectively. Corresponding graphs were mentioned in Fig.No.5, Fig. No.5 and Fig.No.6.

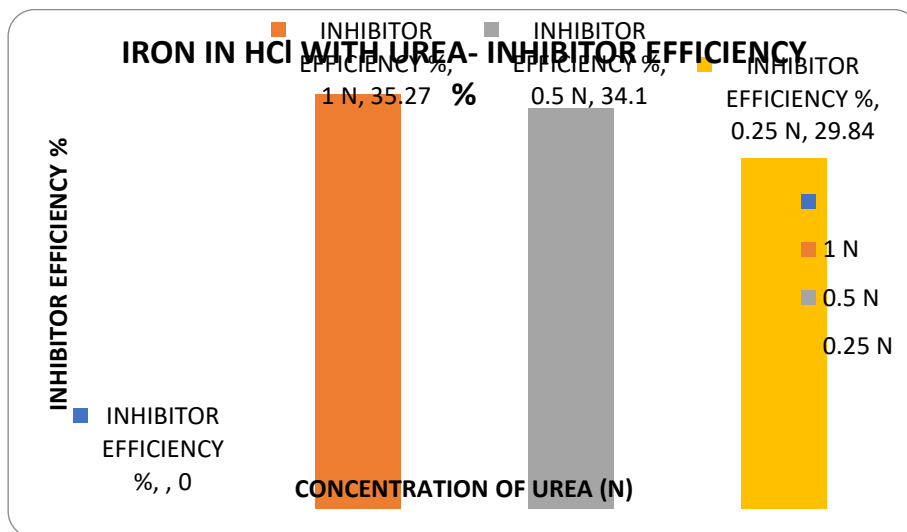
**Table 4:** Iron in HCL With Thiourea (2 Hours)

CONCENTRATION OF THIOUREA (N)	WEIGHT OF MILD IRON				SURFACE COVERAGE	INHIBITOR EFFICIENCY %
	INITIAL	FINAL	DIFFERENCE IN (g)	DIFFERENCE IN (m.g)		
BLANK	51.453	51.195	0.258	258		
1 N	45.985	45.720	0.165	165	0.3604	36.04
0.5 N	44.328	44.154	0.174	174	0.3255	32.55
0.25 N	41.315	41.137	0.178	178	0.31	31

**Fig. 4:** Iron in HCl with Thiourea

**Table 5:** Iron in HCL With Urea(2 Hours)

CONCENTRATION OF UREA (N)	WEIGHT OF MILD IRON				SURFACE COVERAGE	INHIBITOR EFFICIENCY %
	INITIAL	FINAL	DIFFERENCE IN (g)	DIFFERENCE IN (m.g)		
BLANK	37.453	37.195	0.258	258		
1 N	38.626	38.459	0.167	167	0.3527	35.27
0.5 N	37.721	37.551	0.170	170	0.341	34.1
0.25 N	36.598	36.417	0.181	181	0.2984	29.84

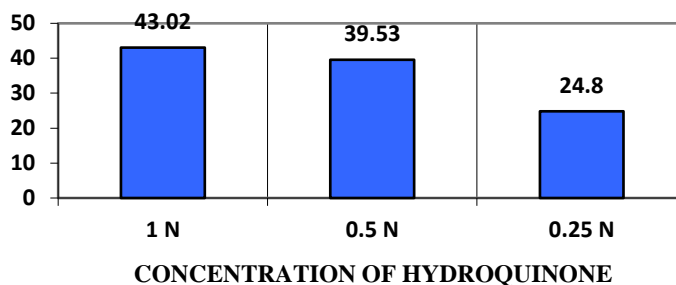


**Fig. 5:** Iron in HCl with Urea

**Table 6:** Iron in HCL With Hydroquinone(2 Hours)

CONCENTRATION OF HYDROQUINONE (N)	WEIGHT OF MILD IRON				SURFACE COVERAGE	INHIBITOR EFFICIENCY %
	INITIAL	FINAL	DIFFERENCE IN (g)	DIFFERENCE IN (m.g)		
BLANK	36.453	36.195	0.258	258		
1 N	36.636	36.489	0.147	147	0.4302	43.02
0.5 N	35.049	34.893	0.156	156	0.3953	39.53
0.25 N	31.886	31.692	0.194	194	0.248	24.8

**Iron in HCl with Hydroquinone**



**Fig. 6:** Iron in HCl with Hydroquinone

Comparison results is mentioned in Table: 7 and Graph is mentioned in Fig.No.7

**Table 7:** Comparison of Inhibitors Efficiency

DATA		THIOUREA			UREA			HYDROQUINONE		
		1 N	0.5 N	0.25 N	1 N	0.5 N	0.25 N	1 N	0.5 N	0.25 N
SURFACE COVERAGE	STEEL	0.4375	0.25	0.125	0.25	0.1875	0.125	0.3333	0.1333	0.0666
	IRON	0.3604	0.3255	0.31	0.353	0.341	0.2984	0.4302	0.3953	0.248
INHIBITOR EFFICIENCY %	STEEL	43.75	25	12.5	25	18.75	12.5	33.33	13.33	6.66
	IRON	36.04	32.55	31	35.27	34.1	29.84	43.02	39.53	24.8

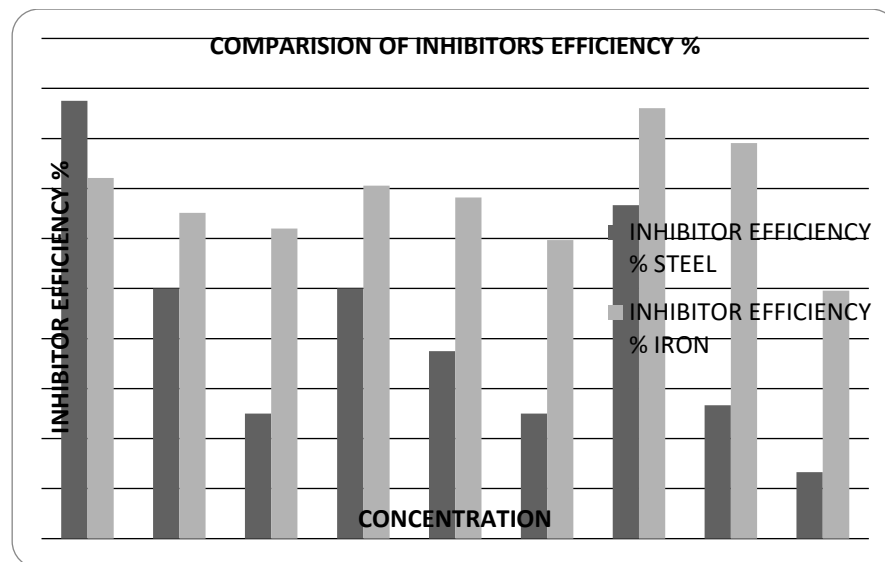


Fig. 7: Comparison of Inhibitors

#### 4. Observation

1. The inhibitor thiourea in mild steel shows an inhibitor efficiency of 43.75, 25, 12.5 in Mix 1, Mix 2, Mix 3 concentrations respectively
2. The inhibitor urea in mild steel shows an inhibitor efficiency of 25, 18.75, 12.5 in Mix 1, Mix 2, Mix 3 concentrations respectively
3. The inhibitor hydroquinone in mild steel shows an inhibitor efficiency of 33.33, 13.33, 6.66 in Mix 1, Mix 2, Mix 3 concentrations respectively
4. The inhibitor thiourea in iron shows an inhibitor efficiency of 36.04, 3.55, 31.00 in Mix 1, Mix 2, Mix 3 concentrations respectively
5. The inhibitor urea in iron shows an inhibitor efficiency of 35.27, 34.10, 29.84 in Mix 1, Mix 2, Mix 3 concentrations respectively
6. The inhibitor hydroquinone in iron shows an inhibitor efficiency of 43.02, 39.53, 24.80 in Mix 1, Mix 2, Mix 3 concentrations respectively.

#### 5. Result and Discussion

This study indicates that the organic compound thiourea taken for study acts as a best inhibitor in 1 N concentration. In general, organic compound containing lone pair of electrons acts as a best inhibitor.

#### 6. Conclusion

From the table and chart the following conclusions is made:  
The inhibitor efficiency of 1 N thiourea in steel found to be maximum than urea, hydroquinone the value is 43.75%. The next effective inhibitor in steel in hydroquinone, the value is 33.33%. The inhibitor efficiency of 1 N hydroquinone in iron is found to be maximum, the value is 43.02%. The next effective inhibitor efficiency in iron in hydroquinone, the value is 39.53% (0.5 N)

#### References

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