iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 Issue: X Month of publication: October 2021

DOI: https://doi.org/10.22214/ijraset.2021.38543

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue X Oct 2021- Available at www.ijraset.com

Mechanism of Inhibitive Action of Dl-Methionine Towards the Corrosion of Mild Steel in Hydrochloric Acid Solution

Dr. Abhay Singh
Associate Professor, Department of Chemistry, K.L.P. College, Rewari, India

Abstract: DL-methionine has been investigated as inhibitor for the corrosion of mild steel in 1.0M hydrochloric acid solution using weight loss method and Scanning Electron Microscope (SEM) analysis. The investigated results showed that the inhibition efficiency increases with the increase in concentration of the inhibitor and decreases with the increase in temperature. SEM analysis indicated that the metal surface was in a better condition in the presence of inhibitor than the specimen exposed in the absence of the inhibitor. DL-methionine acted as a very good inhibitor and is also environmentally friendly, non -toxic, biodegradable and relatively cheap.
Keywords: DL-methionine, mild steel, SEM, Corrosion inhibitor.

I. INTRODUCTION

Mild steel has found wide applications in a variety of industries and is most frequently used due to its low cost, good ductile strength and accessibility [1]. However, in the industrial environments mild steel is severely corroded by using acid solutions like sulphuric acid and hydrochloric acid. There are possibilities to reduce the corrosion rate to a safe level by adding inhibitors to the acid solutions. It is observed that compounds possessing nitrogen, sulphur and oxygen as active centres are easily and quickly adsorbed on the metal surface forming a protective layer on the surface of metal and have been extensively used for the inhibition of steel corrosion by acids [2-5]. When the nitrogen. atom exists as $-NH_2$ or -NH- and the oxygen as -OH, then such organic compounds can act as corrosion inhibitors [6]. Ascorbic acid and folic acid which have these structures have been studied [7] as inhibitors for the protection of mild steel in NaCl solution. However, in the literature DL-methionine which has the similar structure as those of ascorbic acid and folic acid, has not been investigated as corrosion inhibitor for mild steel in hydrochloric acid solution.

The present investigation deals with the study of the corrosion inhibition properties of DL-methionine on mild steel in 1.0M hydrochloric acid solution at 20, 30 and 40°C temperatures using weight loss measurements and scanning electron micrographs analysis of mild steel specimens in presence and absence of the inhibitor.

II. EXPERIMENTAL

All the chemicals used were of AR grade and double distilled water was used for preparing solutions. The mild steel sheet used for the present investigation had the following composition

Element	C	O	Si	P	S	Cr	Ni	Fe
% (w/w)	0.25	1.10	0.77	0.07	0.05	0.03	0.05	Balance

A. *Weight Loss Method*

Rectangular specimens of mild steel of size 2 x 4 cm² were used for weight loss experiments. Specimens were polished successively with different grades of emery papers, thoroughly cleaned with double distilled water and acetone, dried and then stored in a desiccator over silica gel. Weight loss experiments were performed in the absence of inhibitor and in presence of 100, 200 and 400 ppm concentrations of the Inhibitor DL-methionine in 1.0M hydrochloric acid solution. Experiments were performed at 20, 30 and 40°C temperature and the exposure time was 12 hours. The specimens in absence and presence of inhibitor were weighed using electronic balance before and after exposure to calculate the loss in weight due to corrosion. The corrosion rate and percentage inhibition efficiency were calculated using the following relations:

$$\text{Corrosion Rate(mpy)} = \frac{534\,W}{DAT}$$

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue X Oct 2021- Available at www.ijraset.com

where,

W= Weight loss in mg
D= Density of specimen in gcm^{-3}
A= Area of specimen in square inch
T= Exposure time in hours

and $E = (\frac{A-B}{A}) \times 100$

where, E= Percentage inhibition efficiency
A= Weight loss in uninhibited system
B= Weight loss in inhibited system

B. Surface Morphology Study

Scanning Electron microscope (Model JSM-840, JEOL Make) was used to study the morphology of corroded surface of the specimens. The specimens were exposed to 1.0M hydrochloric acid solution for 12 hours in absence and presence of 200 and 400 ppm of DL-methionine.

III. RESULTS AND DISCUSSION

Percentage inhibition efficiency and corrosion rate data calculated using weight loss method when mild steel specimens were exposed to 1.0M hydrochloric acid solution in absence and presence of 100, 200 and 400 ppm concentrations of DL-methionine at 20, 30 and 40°C temperatures have been recorded in Table 1.

Table 1. Percentage inhibition efficiency of DL-methionine towards the corrosion of mild steel in 1.0 M Sulphuric acid solution by weight loss method (Exposure Time = 12 hours)

Concentration of Inhibitor (ppm)	Temperature (^{0}C)	Weight Loss (mg)	Corrosion Rate(mpy)	Inhibition Efficiency (%)
Nil	20	49.70	227.20	----
	30	87.31	399.14	----
	40	127.22	581.50	----
100	20	9.74	44.52	80.40
200	20	6.13	28.02	87.66
400	20	3.19	14.58	93.58
100	30	21.09	96.41	75.84
200	30	15.85	72.45	81.84
400	30	11.12	50.83	87.26
100	40	43.85	200.46	65.53
200	40	35.88	164.02	71.79
400	40	27.92	127.63	80.05

Results of weight loss measurements at 20, 30 and 40°C (Table 1) show that the DL-methionine is an effective inhibitor for the corrosion of mild steel in 1.0M hydrochloric acid solution. There is a slight decrease in percentage inhibition efficiency with increase in temperature from 20 to 30°C but is it is more pronounced with the rise of temperature from 30 to 40°c. The inhibition efficiency increases with the increase of DL-methionine concentration from 100 to 400 ppm. A maximum inhibition efficiency (93.58%) was obtained at 400ppm concentration of the studied inhibitor in 1.0M hydrochloric acid solution at 20°C.

Fig. 1, 2 and 3 show the scanning electron micrographs (SEM) of mild steel specimens exposed to 1.0M hydrochloric acid solution for 12 hours in absence and presence of 200 and 400 ppm of inhibitor respectively. Micrographs have indicated that in presence of inhibitor the surface of mild steel was in a much better condition than that in the absence of inhibitor. With the increase in concentration of inhibitor from 200 to 400 ppm the condition of surface was further improved which indicated that the efficiency of the inhibitor is less at lower concentration of the inhibitor. The absence of either pitting or preferential dissolution suggested that a uniform protective layer of DL-methionine is present on the surface of mild steel.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue X Oct 2021- Available at www.ijraset.com

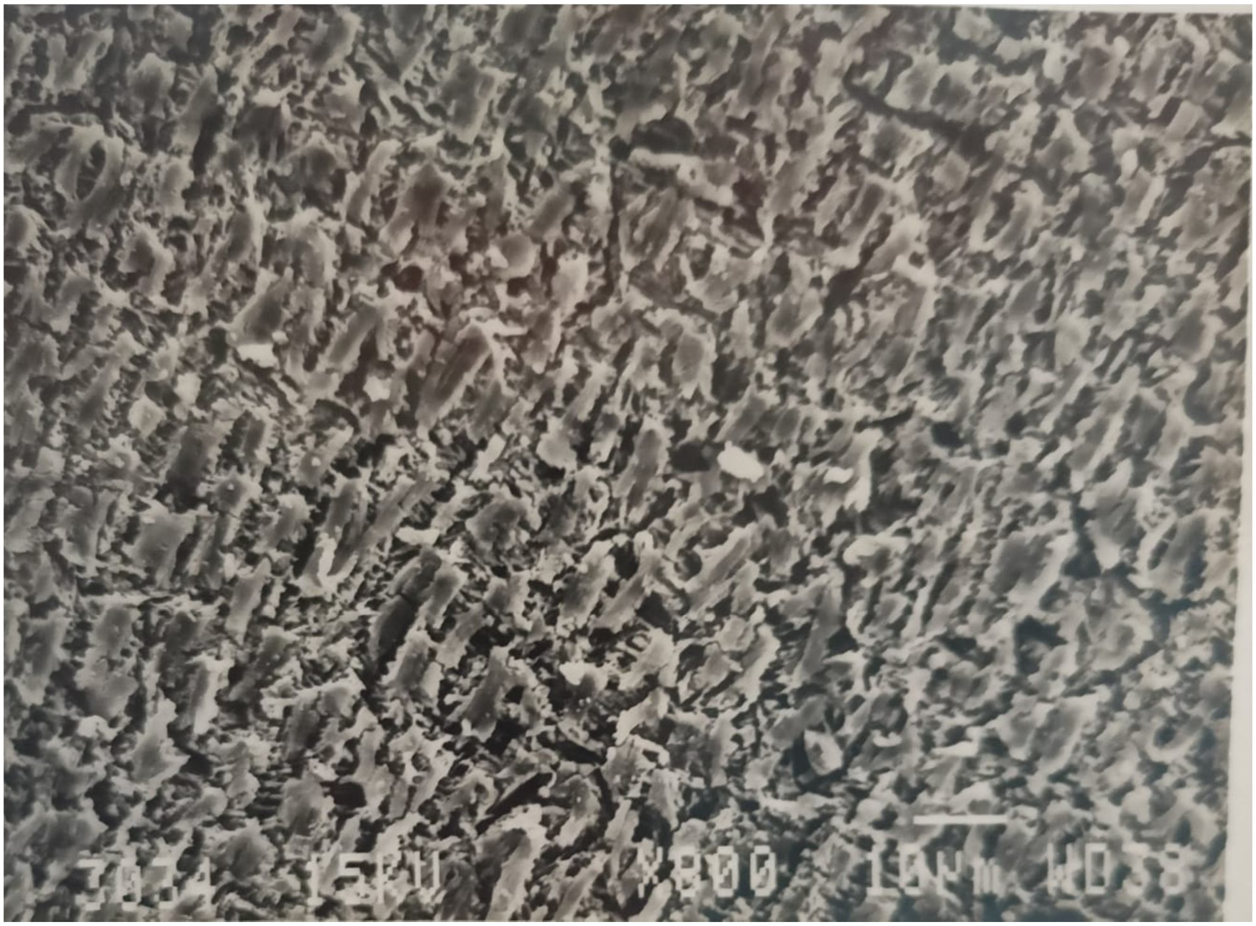


Fig. 1 SEM micrograph of mild steel exposed to 1.0M hydrochloric acid solution for 12 hours (x 800).

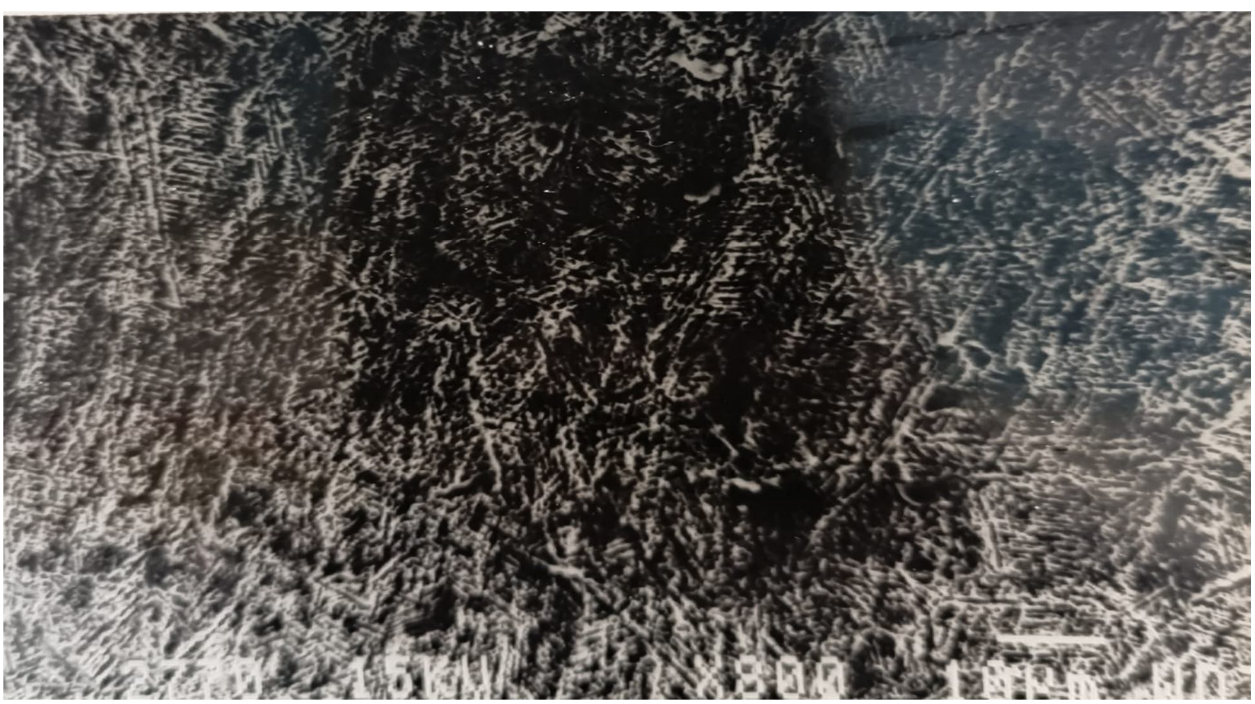


Fig. 2 SEM micrograph of mild steel surface exposed to 1.0M hydrochloric acid solution in presence of 200 ppm of DL-methionine for 12 hours (x 800).

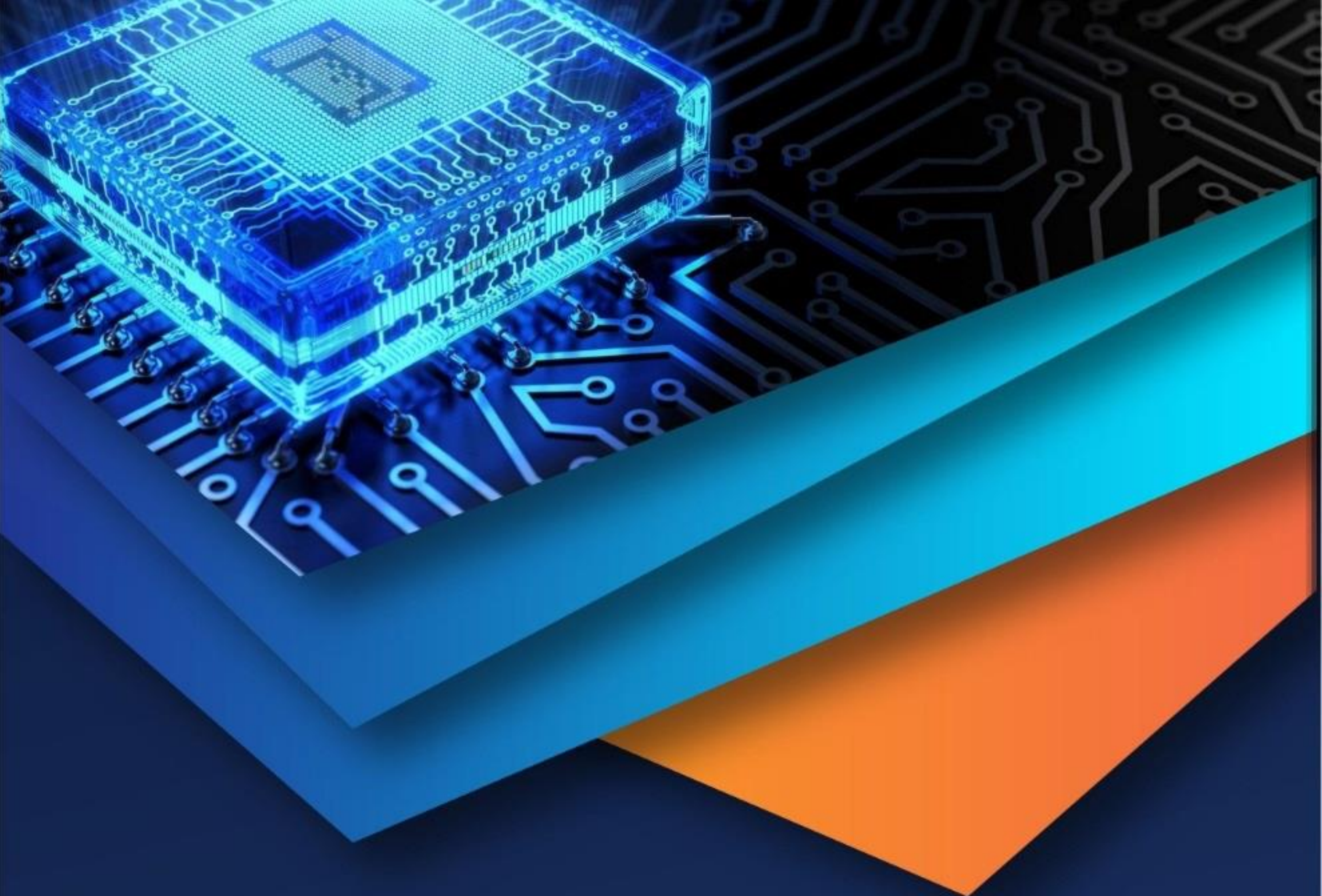
Fig. 3 SEM micrograph of mild steel surface exposed to 1.0M hydrochloric acid solution in presence of 400 ppm of DL-methionine for 12 hours (x 800).

IV. CONCLUSIONS

A. Dl-methionine is an effective inhibitor for the corrosion of mild steel in 1.0 M hydrochloric acid solution.
B. With the increase in concentration of the inhibitor the inhibition efficiency increases gradually.
C. A slight decrease in inhibition efficiency with rise in temperature from 20 to 30°C however the decrease in inhibition efficiency is much more when temperature increases from 30 to 40°C.
D. Maximum inhibition efficiency (93.58%) was provided by 400 ppm concentration of inhibitor at 20°C.
E. SEM showed that a uniform protective layer of DL-methionine was present on the surface of mild steel.

REFERENCES

[1] S. Saravanamoorthy, S. Velmathi, Physiochemical interactions of Chiral Schiff bases on high carbon steel surface: Corrosion inhibition in acidic media. Progress in Organic Coating, 2013, 76, 1527-1535.
[2] G. Schmitt, Br. Corr. J., 1984, 19, 165.
[3] B. Abd-El Nabey, E. Khamis, G. Thompson and J. Dawson, Surf. Coat, Technol, 1986, 28, 83.
[4] E. Stupnisek-Lisac, K. Salajster and J. Furac, Corros. Sci, 1988, 28, 1189.
[5] S. Arab and B. Abd-El Nabey, Int. J. Chem., 1991, 2, 23.
[6] S. Fuji, Bosei Kanri, 1979, 23, 29
[7] Jsao Sekine, Yoshirou Nakahata and Hiroshi Tanabe, Corros. Sci., 1988, 28,987.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY