International Journal of Engineering Sciences & Research Technology

(A Peer Reviewed Online Journal)
Impact Factor: 5.164

IJESRT

Chief Editor
Dr. J.B. Helonde

Executive Editor
Mr. Somil Mayur Shah

RESEARCHERID
THOMSON REUTERS

[Dubey *et al.*, 9(4): April, 2020]
IC™ Value: 3.00

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

CORROSION INHIBITION OF MILD STEEL USING NEEM EXTRACT IN TREATED WASTE WATER

R. S. Dubey[*1] & Somya Sharma[2]
[*1&2]Department of Chemistry, Institute of Applied Science,
Amity University
NOIDA, UP, INDIA

DOI: 10.5281/zenodo.3778554

ABSTRACT

The corrosion inhibition of mild steel by Neem (Azadirachtaindica) leaves extract as a green inhibitor in aqueous environment has been studied using the classical weight loss method. The corrosion inhibition efficiency increases with increasing concentration of plant extract. The effect of temperature on the corrosion behavior of mild steel in aqueous environment with addition of plant extract was studied at room temperature. Surface analysis was also carried out to establish the corrosion inhibitive property of this plant extract. The results of the study reveal that the different concentrations of the extract inhibit mild steel corrosion. The inhibition efficiency increases with increase in concentration of neem extract.

KEYWORDS: Weight loss, Corrosion, inhibitors, mild steel, neem extract, inhibition efficiency.

1. INTRODUCTION

Deterioration of metals and alloys is a natural process in which metals and alloys oxidize or convert to their anions and ultimately formed thermodynamics more stable form due to interaction with the environments. Metallic corrosion is more cost effective and directly influencing infrastructures because the metallic properties decrease and ultimately various industrial and transmission services shut down or enhance the maintenance cost of systems. The qualities of products are also influenced through corrosion process due to mixing of corrosion products with the products like drinking water and oil/gas pipeline.

The role of organic compounds containing hetero-atoms like oxygen, Sulphur and Nitrogen to inhibit metal corrosion on mild steel has been studied in the past decade [1-5]. The existing results show that organic compounds get adsorbed on the metal surface and form a strong film which acts as a good barrier [6-8]. Corrosion prevention may include both organic and inorganic compounds that adsorb on the metallic surface to isolate it from its surrounding environments to control the oxidation-reduction process at interface.

The Available lone pairs electrons in hetero-atoms containing molecules which facilitate the transfer of electron from the inhibitory molecules to the metal surface, resulting strong bond formed on interface [9-10]. The bond strength depends on the electron density of donor atom and the polarizability of the functional group. Plant extracts are an incredible source of naturally synthesized complex chemical compounds that are extracted by simple and very low cost process. The benefits of natural compounds are that they are biodegradable in nature and do not create any other environment issue.

In the 21st century, public awareness increased for protecting the environment with the help of scientific temperaments a long with researches in various fields. Presently, many corrosion scientists are interested to use green inhibitors for protection of metals in various environments [11-14].

Various investigations reveal that the inhibition properties of plant extract are mainly ascribed to the presence of complex organic species in their extract products. These organic products contain polar properties with hetero-atoms like N, S, O, P atoms and also presence of conjugated double bonds or aromatic skeleton in their complex molecular structures, which play major in adsorption on metal surface during interaction of complex organic products and metal surface.

IJESRT is licensed under a Creative Commons Attribution 4.0 International License.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

The aim of present investigation, by classical weight loss method, the effect of neem extract on the corrosion inhibition of mild steel in treated waste water. The results of present investigations are hoped to be a cheap, effective and an eco-friendly approach that can be used as green corrosion inhibitor for protection of mild steel in aqueous environment.

2. EXPERIMENTAL PROCEDURE

Mild steel samples
The mild steel sheets used for present investigation were collected from a local market. The samples were mechanically press cut in 2×2 cm coupons. They were polished with different grades emery paper, decreased in absolute alcohol, dried in acetone and finally stored in moisture free desiccator prior use for study.

Collection of treated water
Threated water samples were collected from sewage water treatment plant situated near sector 53, NOIDA, UP. The sewage water was treated by Sequencing Batch Reactor (SBR) treatment process.

Preparation of neem extract
The leaves of neem were collected from local plant situated near the university campus. The leaves were rinsed with distilled water, sunlight dried and ground to powder with the help of manual blender. Approximately 250 grams of the dry powder was extracted using absolute ethanol for 24 hours. The various concentration of neem extract was used for study. Some optical micrographs of the metal surface before and after exposure in treated water were made in the experiments.

Weight loss measurements
Weight loss experiments were performed under immersion in stagnant aerated condition using 500 mL Capacity beaker containing 240 mL treated water at room temperature. The mild steel coupons were weighed and hanged in the beaker with the help of nylon thread. The coupons were retried at different intervals (10,20,30,40 and 50 days), cleaned dried and reweighed. The weight loss was taken as the difference in the weight of samples before and after exposure in the different concentration of test solutions.

The inhibition efficiency (IE %) of neem extract was calculated by the following equation:

$$IE\ (\%)\frac{W1-W2}{W1}x100$$

Where W1 is the weight loss of coupon without inhibitor and W2 is the weight of coupon with inhibitor.

3. RESULTS AND DISCUSSION

The results of weight loss in the absence and presence of different concentration of neem extract(NE) are given in Table 1. The classical weight loss measurement has found practical application to assess of the corrosive environment. The weight loss can be defined as the ratio of the weight loss to its sample area, density and exposure period. A major advantage of weight loss method is its simple reactivity and easily availability. The weight loss results directly support to further investigation for gaining detail and deep knowledge on same point. The results obtained for the corrosion of mild steel in sewage treated water with and without neem extract at different exposure periods are listed in Table 1. The table 2 shows the weight loss and inhibition efficiency for mild steel in treated water without and with different concentration of neem extract (05-30 mL) at different exposure period (10-50 days). It is seen from the table that amount of metal loss decreases significantly in the presence of the neem extracts compared to control (without extract). It was also found to be dependent on the concentration of neem extracts. This reveals that amount of metal loss increases with increase in exposure period and greater weight loss of mild steel was on 50 days in the absence of neem extract [15-18].

The inhibition efficiency values in the presence of different concentration of neem extract are listed in Table 2. Results indicate that the neem extract act as a good corrosion inhibitor for mild steel coupons in treated water. It is also indicating that weight loss reduced in the presence of extract compared to their absence.

IJESRT is licensed under a Creative Commons Attribution 4.0 International License.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

Table-1 Weight loss method based calculated values of weight loss for mils steel samples at different exposure periods with different concentration of neem extract.

Serial No.	Concentration of NE (mL)	Weight loss/ Exposure time (mg/Days)	Weight loss/ Exposure time (mg/Days)	Weight loss/ Exposure time (mg/Days)	Weight loss/ Exposure time (mg/Days)	Weight loss/ Exposure time (mg/Days)
		10	20	30	40	50
1.	Control	13.71	20.79	29.26	43.12	54.23
2.	05	07.23	09.37	12.69	16.27	19.77
3.	10	06.21	08.30	10.14	13.74	15.19
4.	15	05.81	07.83	09.07	11.23	10.07
5.	20	04.37	06.57	07.30	10.05	09.13
6.	25	03.78	05.43	06.24	08.25	7.44
7.	30	02.23	04.23	04.78	05.48	5.11

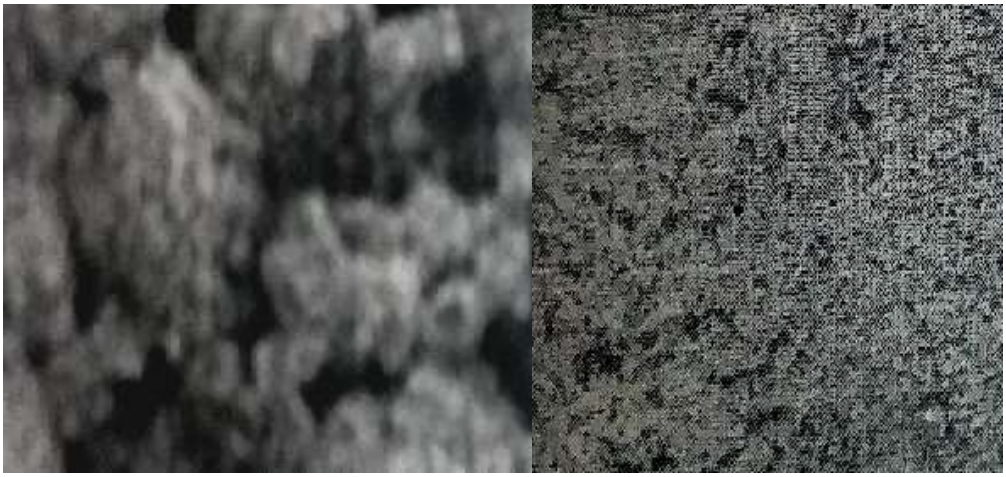
The inhibition efficiency also increases with increase the exposure periods. For instances the percentage of inhibition values of 63.54 and 90.57% were obtained at the higher exposure period. This suggests that the inhibitor layer formed on metal surface by the adsorption of natural compounds which are present in neem extract are more stable and effective for long time.

The inhibition properties can be attributed to phytochemical compounds presence in the extract. The extract constituents may be interacting with metal ions (Fe^{++}) at the interface and formed organometallic complexes. The inhibiting properties of phytochemicals are depending on their solubility and stability in the treated water [19-21]. Corrosion inhibition of neem extract is a very complex phenomenon. The inhibiting action of phytochemical constituents proves difficult to assess the exact mechanism due their complicated ingredients.

(A) (B)

IJESRT is licensed under a Creative Commons Attribution 4.0 International License.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7



(C) (D)

Figure 1. Micrographs of mild steel Coupons, (A) Control(without extrac); ((B) immersion, after 20 days with neem extract; (C) immersion, after 40 days with neem extract; (D) after removal of film from metal surface.

Photomicrographs of mild steel surface

Some of the micrographs made before and after exposure of treated water, in absence and presence of neem extracts are depicted in Figures 1 (A to D). Figure 1(A) show surface of mild steel before exposure. The growth of film of neem extract were observed on metal surface (Fig. 1 (B and C). After removal of film from the metal surface, figure1(D) shows a surface less corrosion attack on the mild steel surface in the presence of neem extract. The micrographs surface conservation shows that neem extract film on the metal surface act as good protective barrier.

Table-2 Calculated values of corrosion inhibition efficiency (%) of neem extract for mild steel sample at room temperature.

Serial No.	Concentration of neem extract	Inhibition efficiency (%)				
		10	20	30	40	50
1.	05	47.26	54.93	56.63	62.26	63.54
2.	10	54.70	60.07	65.34	68.13	71.98
3.	15	57.62	62.33	69.01	73.95	81.43
4.	20	68.12	68.39	75.05	76.69	83.16
5.	25	72.42	73.88	78.67	80.63	86.28
6.	30	83.73	79.65	83.66	87.29	90.57

4. CONCLUSIONS

The results obtained in the present investigation show that the corrosion of mild steel control in treated water by aqueous neem extract to an appreciable effort. The inhibition efficiencies of neem extracts increased with increase in concentration of neem extract at different exposure periods. It is also appreciated that the neem extract act as good green corrosion inhibitor for mild steel in treated sewage water due to formation of strong film on metal surface by adsorption of phytochemicals. The green inhibitors cab be used to replace highly toxic and costly, organic and inorganic chemicals.

REFERENCES

[1] K. F. Khaled, Electrochim. Acta, 53 (2008) 3484.
[2] A.H. Fadda,A.Zaki, Kh. Samir and F.A. Amr, J. Chem. Heterocycl. Comp., 9 (2003) 1413.
[3] F. Mansfeld, M.W. Kendig and S. Tsai, Corrosion, 38 (1982) 570
[4] R.W. Bosch, J. Hubrecht, W. F. Bogaerts, B.C. Syrett, Corrosion, 57 (2001) 600.

IJESRT is licensed under a Creative Commons Attribution 4.0 International License.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

[5] M. Kendig, S. Jeanjaquet, J. Electrochem. Soc., 149 (2002) B47.

[6] M. Dahmani, A. Et-Touhami, S.S. Al-Deyab , B. Hammouti, A. Bouyanzer, Int. J. Electrochem.Sci., 5 (2010) 1060.
[7] L. Bammou, M. Mihit, R. Salghi, L. Bazzi, A. Bouyanzer, S.S. Al-Deyab, B. Hammouti, Int. J.Electrochem. Sci., 6 (2011) 1454.
[8] B. Zerga, M. Sfaira, Z. Rais, M. EbnTouhami, M. Taleb, B. Hammouti, B. Imelouane, A.Elbachiri, Materiaux et Technique, 97 (2009) 297.
[9] E. Chaieb, A. Bouyanzer, B. Hammouti, M. Berrabah, Acta Phys. Chim. Sin. 25 (2009) 1254.
[10] E. El Ouariachi, J. Paolini, M. Bouklah, A. Elidrissi, A. Bouyanzer, B. Hammouti, J-M. Desjobert,J. Costa, Acta Mettal lurgicaSinica, 23 (2010) 13.
[11] Z. Faska, A. Bellioua, M. Bouklah, L. Majidi, R. Fihi, A. Bouyanzer, B. Hammouti, MonatsheftefürChemie, 139 (2008) 1417.
[12] Chris O. Akalezi, Conrad K. Enenebaku, Emeka E. Oguzie, J. Mater. Environ. Sci. 4 (2013) 217.
[13] M. Ramananda Singh, J. Mater. Environ. Sci. 4 (2013) 117.
[14] O. Benali, H. Benmehdi, O. Hasnaoui, C. Selles, R. Salghi, J. Mater. Environ. Sci. 4 (2013) 127.
[15] L. Afia , R. Salghi , El. Bazzi , L. Bazzi , M. Errami , O. Jbara , S. S. Al-Deyab , B. Hammouti,Int. J. Electrochem. Sci., 6 (2011) 5918
[16] K. Shanker, S.C. Singh, S. Pant, P. Srivastava, A.K. Yadav, R. Pandey, R.K. Verma, M.M. Gupta, Chromatographia, 67 (2008) 269-274.
[17] Raja M.M. Raja, S.H. Mishra, HerbaPolonica. 55 (2009 44
[18] M.K.M.M. Raja, R.S. Patel. S.H. Mishra, J. Chinese Integrat. Med. 9 (2011) 105
[19] R. Roy, V.B. Pandey, Phytochem. 37 (1994) 1775Int. J. Electrochem. Sci., Vol. 8, 2013 2655
[20] I. Elouali, Hammouti B., Aouniti A., Ramli Y., Azougagh M., Essassi E.M., Bouachrine M. J.Mater. Environ. Sci. 1 N°1 (2010) 1.
[21] M. Dahmani, M. Dahmani, A. Et-Touhami, S.S. Al-Deyab , B. Hammouti, A. Bouyanzer, Int. J.Electrochem. Sci., 5 (2010) 1060

IJESRT is licensed under a Creative Commons Attribution 4.0 International License.