iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** XII **Month of publication:** December 2022

DOI: https://doi.org/10.22214/ijraset.2022.48422

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue XII Dec 2022- Available at www.ijraset.com

Effect of Temperature on Adsorption Behaviour and Corrosion Inhibitive Performance of Aqueous Extract of Green Inhibitor Leaves in Mixed Acids

Mahima Srivastava
Associate Professor, Department of Chemistry, DBS (PG) College, Dehradun - 248001, India.

Abstract: ***Leaf extract of green inhibitor (commonly known as Borrachero or Morning Glory) is found to be efficacious on corrosion of mild steel in mixed acid solution in paste form using traditional weight loss measurements techniques. For different solution concentrations in the form of paste at various temperatures, corrosion inhibition efficiency of Borrachero leaf extracts was assessed with the help of weight loss measurements. For comparison, date of rust dissolution in liquid state has also been furnished. Different temperature conditions were appraised for the sake of overall inhibitor efficiency. From the results, Borrachero leaves have a good potential, at certain range of temperature, as eco-friendly, green, corrosion inhibitor.***
Keywords: Mild steel, corrosion, inhibitor, dissolution, Borrachero leaf.

I. INTRODUCTION

Corrosion is a natural process that converts a sifted metal into a more chemically stable oxide. It is the gradual degradation of materials (usually a metal) by chemical or electrochemical reaction with the environment. Corrosion deteriorates the useful properties of materials and structures including strength, appearance and permeability to liquids and gases. The hydrogen molecule, due to slow rate of formation in some cases, penetrates the crystal lattice and deforms it leading to brittleness of metal. Organic, inorganic, or a mixture of both inhibitors can inhibit corrosion by either chemisorption on the metal surface or reacting with metal ions and forming a barrier-type precipitate on its surface [1].

Because of the noxious nature and/or high cost of some chemicals currently in use as inhibitors, there is a need to develop environmentally acceptable and pocket - friendly ones. Natural products can be considered as a good source for this purpose. The aqueous extracts from different parts of some plants such as Pennyroyal oil from Mentha pulegium [2], Jojoba oil [3], *Artemisia oil from Artemisia herba alba* [4], [5], *Natural oil from Cassia auriculata, Cassia siamea gonrai, Strychnos nuxvomica and Crataeva religiaso* [6], Rosemary oil [7, 8], *Oil from Eucalyptus* [9]. the essential oils from various plants such Lavender [10], Foeniculum Vulgare [11], Pulicaria mauritanica [12], Prickly pear seed [13], Chamomile oil from Chamomilla recutita [14], Exyngium maritimum [15], Verbena [16, 17] are having a reasonable corrosion inhibition on metals in aggressive media.

In the present work our aim is to use inhibited pickling acid in the paste form so that it can be conveniently applied on large structures as well as on small tools to be pickled / cleaned. As a contribution to the current interest on environment friendly, green, corrosion inhibitors, the present study investigates the inhibiting effect of Borrachero leaves, a green inhibitor which is also known as Morning Glory. It is a robust, fast-growing, erect shrub or climber and is quite easily available in India.

II. EXPERIMENTAL

Mild steel (Fe 99.30%, C 0.076%, Si 0.026%, Mn 0.192%, P 0.012%, Cr 0.050%, Ni 0.050%, Al 0.023%, and Cu 0.135%) panels of size 10 cm * 7.5 cm of pickled cold rolled closed annealed mild steel (18 SWG) cut from a single sheet were used in all experiments. For identification of specimens all were numbered and a suspension hole of about 2 mm diameter near upper edge was made. The specimens were polished to mirror finish with emery paper. They were cleaned with cotton to remove powder and traces of adhered metal, and then they were degreased with sulphur – free toluene followed by cleaning with methanol before experiments. All the acid and chemicals used in the experiment were of AR grade quality. Distilled water was used for the preparation of solution. In the study, 4N solutions of acids were prepared.

Clay – soil was collected, washed, dried, powdered and sieved. 100 gm sieved soil was taken in a plastic glass with a hole at the bottom. This glass was put over uninhibited and inhibited acids. Soil-soaked acid uniformly and thus pickling paste was prepared. 100 gm soil soaked 31.3 cc acid.

Polished and weighed panels were suspended by a V-shaped hook made of capillary over 100 % humidity for 6 months at room temperature. In 6 months, heavy rust appeared on the panels. Panels were re-weighed to get the amount of rust.

Pickling paste was applied over weighed rusted panels under different conditions. After the experiment, paste was removed by washing with saturated sodium bicarbonate solution. The panels were again washed with water and dried with hot air. The panels were finally weighed to get the amount of rust dissolved. Experiments were conducted in triplicate and mean value is reported in the Table.

The Borrachero leaves were dried, crushed, and powdered. This powder thus obtained was used as inhibitor. 1 mg of it was added to 100 cc of acid and kept for 24 hours. This acid was used for the preparation of inhibited pickling paste.

The inhibitor efficiency was calculated from the following equation:

$$\%IE = \frac{W_{uninhibited} - W_{iinhibited}}{W_{uninhibited}} * 100$$

Where,

%IE = Inhibitor efficiency

$W_{uninhibited}$ = Wt. loss without inhibitor

$W_{inhibited}$ = Wt. loss with inhibitor

III. RESULT AND DISCUSSION

Table 1 and 2 and figure 1a and 2[a, b and c] show the effect of temperature (30°C-60°C) on attack of mild steel due to paste containing 40 HCl (4N) + 60 H_2SO_4 (4N) with and without 1.0% inhibitor. In uninhibited paste, the weight loss of mild steel specimens varied from 19.7 mg/dm^2/hr to 44.1 mg/dm^2/hr in a temperature range of 30°C to 60°C. In inhibited paste, the weight loss varied from 7.0 mg/dm^2/hr to 14.9 mg/dm^2/hr respectively at the same temperature range. The inhibitor efficiency varied from 64% at 30°C to 66% at 60°C.

Arrhenius plots have been drawn showing the dependence of log corrosion rate on 1/T for uninhibited paste and inhibited paste. The linear nature of both the curves indicates that they obey the Arrhenius Equation.

Table 1: Effect of temperature on the rate of dissolution of rust and on the rate of attack of mild steel [40 HCl (4N) + 60 H_2SO_4 (4N); 1 hr.; 3.0 gm paste/dm^2 = coating thickness]

Temperature (°C)	Rate of Dissolution of Rust (gm/dm^2/10min)	Weight Loss (mg/dm^2/hr)	
		Paste State	Liquid State
30	1.4	19.7	185
35	1.6	21.2	189
40	1.9	26.1	197
45	2.3	31.3	201
50	2.8	35.6	207
55	3.3	39.4	213
60	3.7	44.1	218

Figure 1: Effect of temperature on the rate of dissolution of rust and on the rate of attack of mild steel [40 HCl (4N) + 60 H_2SO_4 (4N); 1 hr.; 3.0 gm paste/dm^2 = coating thickness(for paste state)]

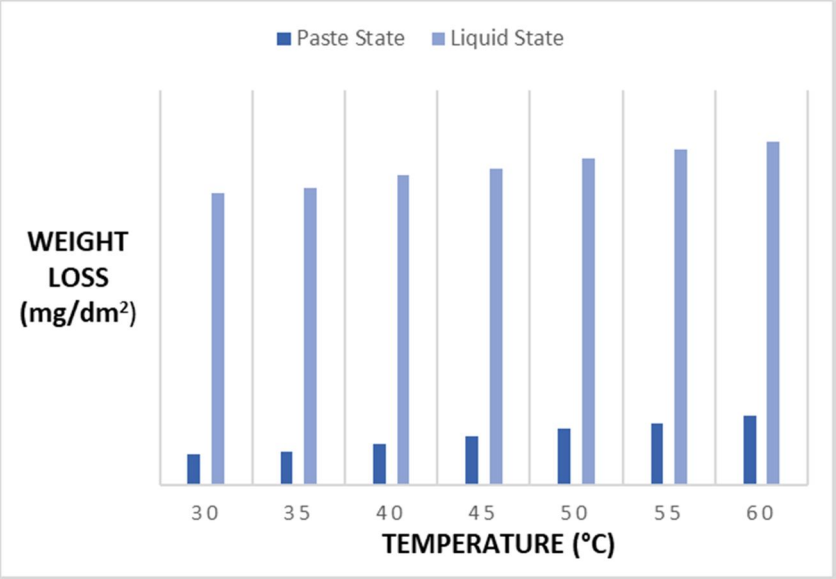
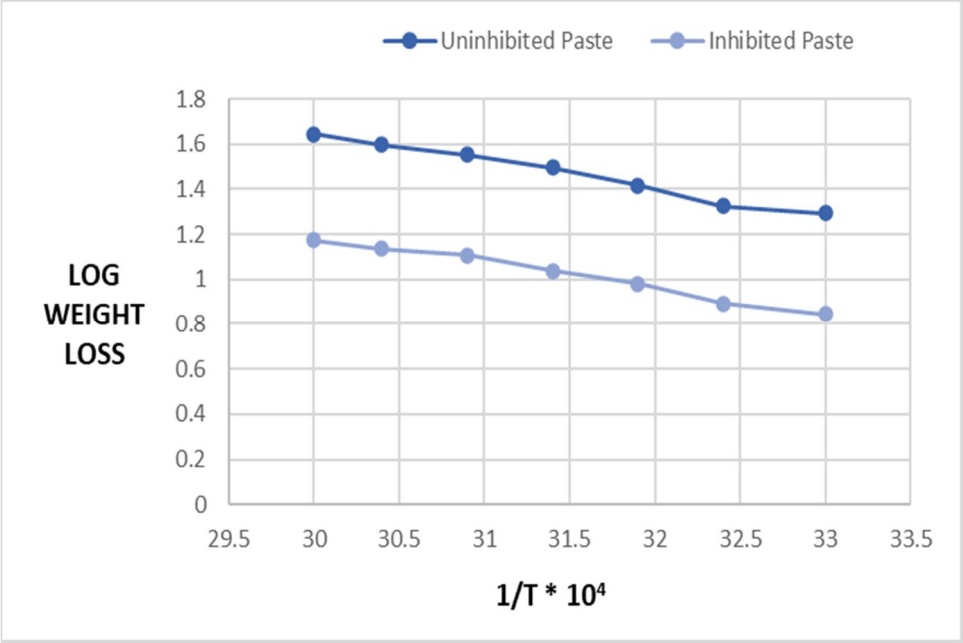


Table 2 : Effect of temperature on the rate of dissolution of rust and on the rate of attack of mild steel [40 HCl (4N) + 60 H_2SO_4 (4N); 1 hr.; 3.0 gm paste/dm^2 = coating thickness] {also shows the values of 1/T and log weight loss to obtain Arrhenius plot}

Temperature (°C)	1/T * 10^4	Weight loss (mg/dm^2)				Inhibitor Efficiency (%IE)
		Un.	log Weight loss	In.	log Weight loss	
30	33	19.7	1.2945	7	0.8451	64
35	32.4	21.2	1.3263	7.8	0.8921	63
40	31.9	26.1	1.4166	9.6	0.9823	63
45	31.4	31.3	1.4955	10.9	1.0374	65
50	30.9	35.6	1.5514	12.8	1.1072	64
55	30.4	39.4	1.5955	13.7	1.1367	65
60	30	44.1	1.6444	14.9	1.1732	66

Figure 2a : Effect of Temperature on the rate of attack of mild steel [40 HCl (4N) + 60 H_2SO_4 (4N); 1 hr.; 3.0 gm paste/dm^2 = coating thickness; inhibitor = 1%][Arrhenius Plot]



The activation energies calculated from the slopes of the two curves gave values 5.43 Kcal/mol for uninhibited paste and 5.08 Kcal/mol for inhibited paste. The presence of inhibitor lowers the activation energy and rate of the reaction which appears to be contradictory as for most of the inhibitors, the values of activation energy remain unchanged. This is attributed to increased coverage of metal surface with inhibitor at higher temperature and also because the chemisorbed passive film is produced faster than its dissolution at higher temperature.

Figure 2b : Figure 2a : Effect of Temperature on the rate of dissolution of rust [40 HCl (4N) + 60 H_2SO_4 (4N); 1 hr.; 3.0 gm paste/dm^2 = coating thickness; inhibitor = 1%]

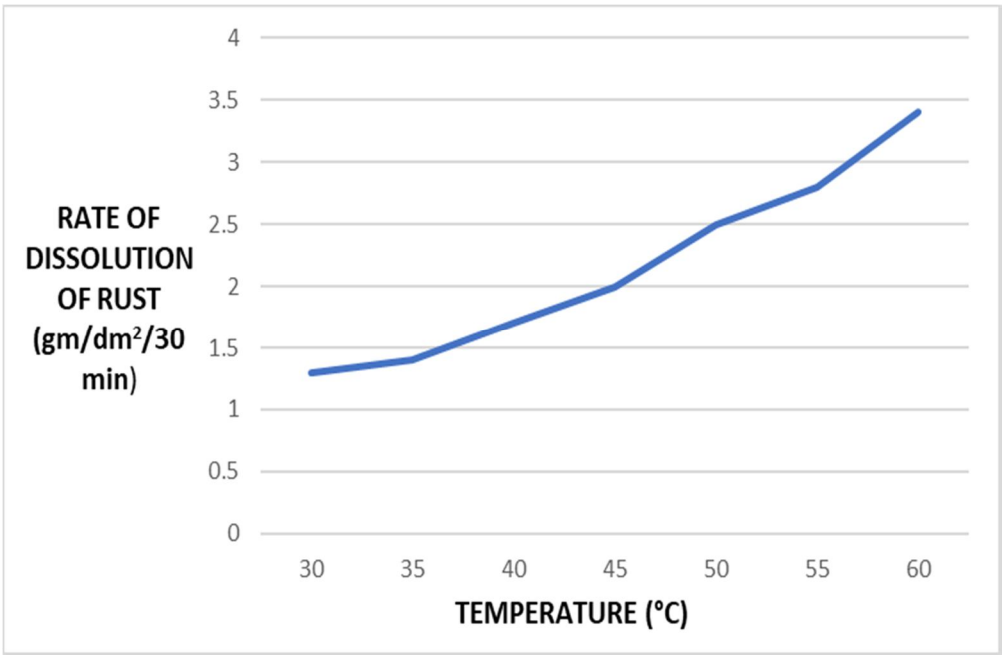
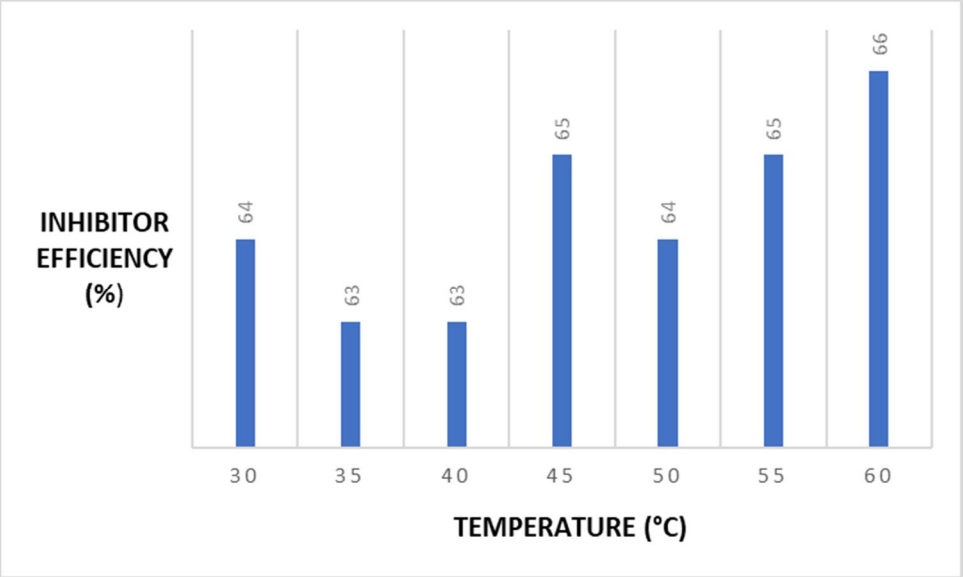
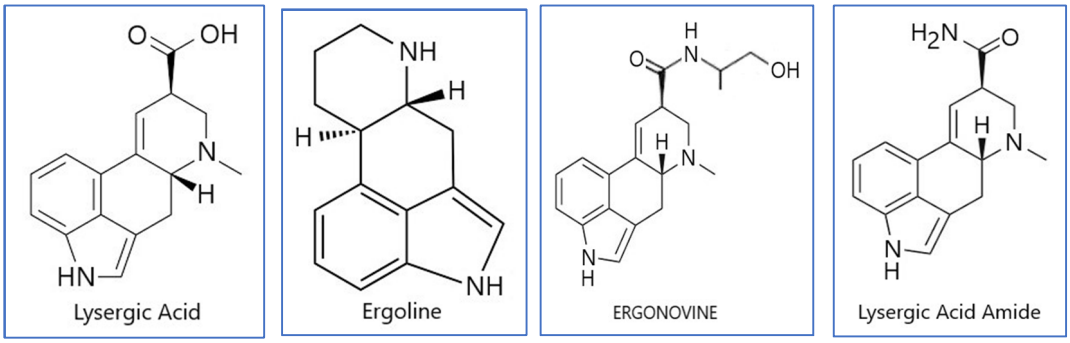


Figure 2c: Effect of Temperature on the inhibitive performance of Borrachero leaf extract [40 HCl (4N) + 60 H_2SO_4 (4N); 1 hr.; 3.0 gm paste/dm^2 = coating thickness; inhibitor = 1%]



IV. CONCLUSION

The efficiency of the inhibitor improved with the temperature, corresponding to the chemisorption of the inhibitor on the electrode. The adsorption of inhibitor extract is uniform over the surface. The inhibition is due to the formation of the film on the metal/mixed acid solution interface through adsorption of inhibitor extract molecules. Chromatographic separation of the extract resulted in the isolation of following alkaloids:



V. DECLARATION OF CONFLICTING INTERESTS

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

VI. FUNDING

The author received no financial support for the research, authorship, and/or publication of this article.

VII. ACKNOWLEDGEMENTS

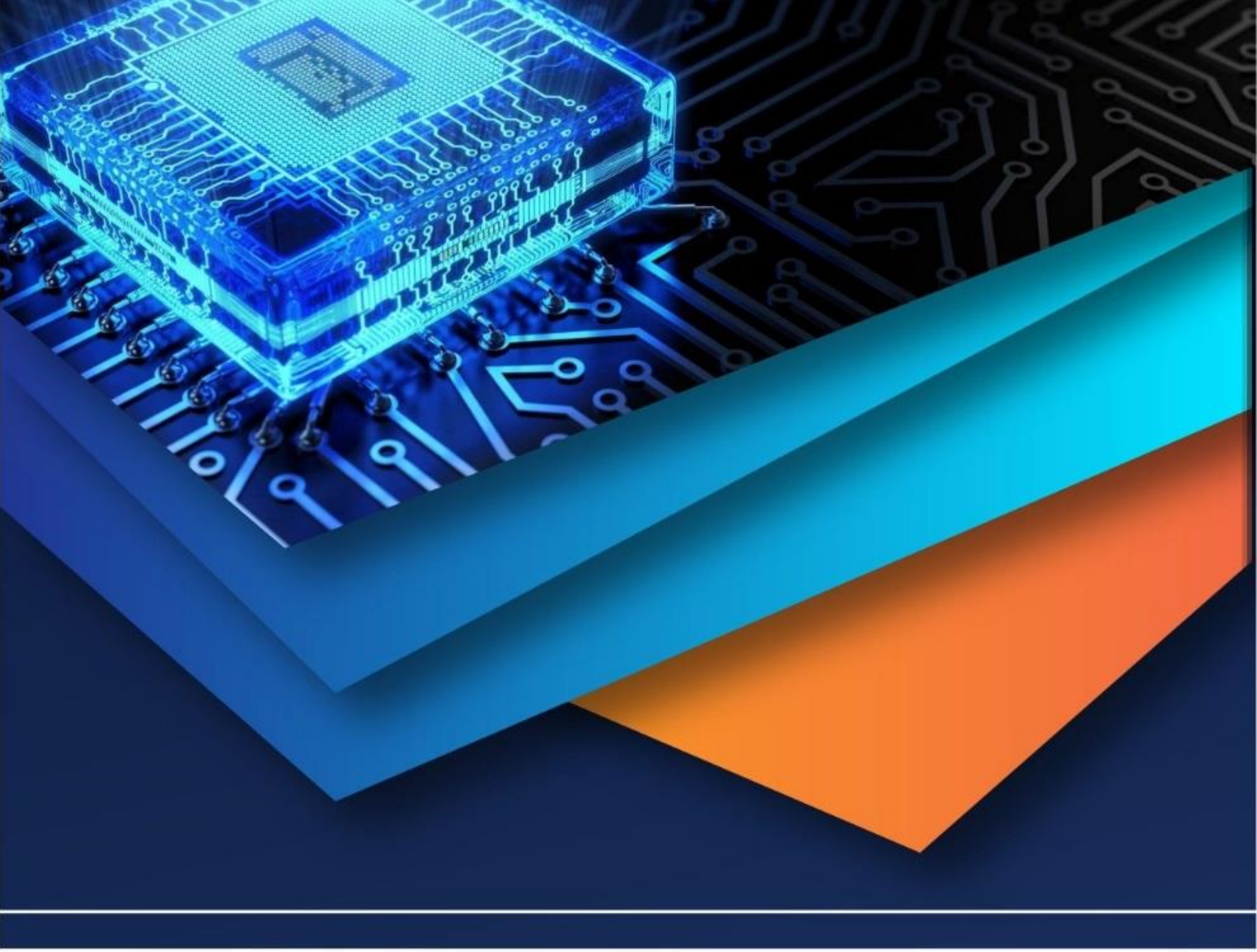
I am grateful to DBS(PG)College for letting me use their resources for the conduct of the experiments. I am also thankful to the editor and anonymous reviewers who helped with the current shape of the paper by their constructive and insightful comments and suggestions.

REFERENCES

[1] K. Srivastava and P. Srivastava, British Corrosion Journal,16(4),pp.221,1981.
[2] B. Bouyanzer, B. Hammouti and L. Majadi, Mater. Lett., 60, 2840(2006), DOI: 10.1016/j.matlet.2006.01.103.
[3] A. Chetouani, B. Hammouti and M. Benkaddour, Pigm. Res. Techn., 33, 26(2004), DOI: 10.1108/03699420410512077.

[4] A. Bouyanzer and B. Hammouti, Pigm. Res. Techn., 33, 287(2004), DOI:10.1108/03699420410560489.
[5] M. Benabdellah, B. Hammouti, M. Bendahhou and A. Aouniti, Appl. Surf. Sci., 252, 6212(2006), DOI: 10.1016/j.apsusc.2005.08.030.
[6] N. Poongothai, N. Rajendran and M. Palaniswamy, Indian J. Chem. Tech., 12, 641(2005), DOI: 10.1016/j.nopr.niscair.2005.123456789/8684.
[7] E. Chaieb, A. Bouyanzer, B. Hammouti, M. Benkaddour and M. Berrabah, Trans. SAEST., 39, 58, (2004).
[8] M. Bendahou, M. Benabdallah and B. Hammouti, Pigm. Res. Techn., 35, 95(2006), DOI: 10.1108/03699420610652386.
[9] A. Bouyanzer, L. Majidi and B. Hammouti, Bull. Electrochem., 22, 321 (2006).
[10] O.Ouachikh, A. Bouyanzer, M. Bouklah, J-M. Desjobert, J. Costa, B. Hammouti and L. Majidi, Surf. Rev. Lett., 16, 49(2009), DOI: 10.1142/S0218625X09012287.
[11] B. Zerga, M. Sfaira, Z. Rais, M. Ebn Touhami, M.Taleb, B. Hammouti, B. Imelouane and A. Elbachiri, Materiaux et Technique, 97, 297(2009), DOI: 10.1051/mattech/2009045.
[12] N. Lahhit, A. Bouyanzer, J.M. Desjobert, B. Hammouti, R. Salghi, J. Costa, C. Jama, F. Bentiss and L.Majidi, Portugal. Electrochimi. Acta., 29, 57(2011), DOI: 10.4152 / pea.201102127.
[13] M. Znini, G. Cristofari, L. Majidi, A. Bouyanzer, J. Paolini , B. Hammouti and J. Costa, Int. J. Electrochem. Sci., 6, 6699(2011).
[14] D. Ben Hmamou, R. Salghi, Lh. Bazzi, B. Hammouti, S.S. Al-Deyab, L. Bammou, L. Bazzi and A. Bouyanzer, Int. J. Electrochem. Sci., 7, 1303(2012), DOI: 10.1186/2228-5547-3-25.
[15] D. Ben Hmamou, R. Salghi, A. Zarrouk, B. Hammouti, S.S. Al-Deyab, Lh. Bazzi, H. Zarrok, A. Chakir and L. Bammou, Int. J. Electrochem.Sci., 7, 2361 (2012).
[16] F. Darriet, M. Znini, L. Majidi, A. Muselli, B. Hammouti and A. Bouyanzer, J. Costa, Int. J. Electrochem. Sci., 8, 4328(2013).
[17] D. Ben Hmamou, R. Salghi, A. Zarrouk, H. Zarrok, M. Errami, B. Hammouti, L. Afia, Lh. Bazzi and L. Bazzi, Res. Chem. Intermed., 39, 973(2013).

*****



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY