COMPARITIVE STUDY AND EFFECT OF FRUIT PEEL EXTRACTS OF PUNICA GRANATUM AND CITRUS SINENSIS TO INHIBIT CORROSION ON MILD STEEL BY USING 1N HCL -A REVIEW

[1]R.Anitha, [2]M.Manjuladevi, [3]M.Narmatha, [4]K.Sruthi
[1, 2, 3] Department of Chemistry, SNS College of Technology, Coimbatore

Abstract: An aqueous extract of Punica Granatum and Citrus Sinesis has been used as a corrosion inhibitor in controlling corrosion of mild steel The paper reflects on the corrosion inhibition of mild steel in HCl solution in the presence of peel extracts of Punica Granatum and Citrus Sinesis .Different concentrations of plant fruit peel extracts were made by using 1N HCl. Mild steel plates were treated with the concentrations for 1, 3,5 hours at 30,40 and 50 degree Celsius. Punica granatum peels showed excellent efficiency at 40^0C with 97.52% inhibition efficiency. Citrus sinesis peels showed efficiency of 92.54%at 30^0C. Comparatively peel of Punica granatum showed higher inhibition to corrosion than Citrus Sinensis. The aim of this study is to investigate the inhibition efficiency of plant extracts against corrosion of mild steel in 1N HCl solution. To make a comparative study of two different plant extracts and their efficiency to prevent corrosion of mild steel, electrochemical measurements and Weight loss methods were employed to evaluate and investigate the inhibition. But both these extracts can be widely used as inner coating of walls of boilers and mild steel pipes.

Keywords: *Corrosion, Punica Granatum and Citrus Sinesis, Inhibition efficiency*

1. INTRODUCTION

Protection of different metals and their alloys from corrosion in acidic solution is the most demanding work in present research due to the large number of applications in the field like acid handling and cleaning industry, descaling industry, oil recovery industry and petrochemical related industry [1-3]. Most of the chemical based corrosion inhibitors used nowadays is organic compounds based which possess hetero atoms like N, O, S and some instauration [4]. Although organic compounds based corrosion inhibitors shows high inhibition efficiency but they are very poisonous to life as well as environment. The current research is focused on the development of cost effective, safe and green corrosion inhibitors like plants or their products [5]. The plant parts or their products are extensively researched for their anticorrosive properties as these are low in cost, bio-degradable and are eco-friendly in nature[6]. The purpose of using plants parts or their products like leaves, flowers, seeds, roots and fruits is that they are cheap, easily available and biodegradable expensive. The peel part of punicagrantum contains hydroxyl, carbonyl, and aromatic groups with considerable amount of punicalagin, punicalin, granatin,maleic acid ursolic acid, Gallic acid, and antioxidant materials. These substances with effective constitutive chemical groups in their structure could show corrosion inhibition performance. The citrus fruit orange popularly known as sweet orange, belongs to species Citrus sinensis in family of Rutaceae. The orange is extensively cultivated throughout the world.

2. MATERIAL AND METHODS

2.1Preparation of Punica Granatum

Fruit peel was shade dried for 20-25 days ,then grained and powdered. Finely powdered material was taken in one litre RB flask and sufficient quantity of ethyl alcohol was added .The RB flask was covered with stopper and left for 8-10 days.On Completion of soaking period,the ethanolic solution is refluxed with the help of Soxhlet extractor for 24 hours to concentrate the inhibiting chemicals.Thereafter it is distilled & then filtered to remove any suspended impurities. The stock solution of the extract was stored in a clean bottle for

further use.

2.2 Preparation of Citrus sinensis

The fruit peels of Citrus sinensis were washed with supply water and then with double distilled water. Then peels were dried first in sun and then in oven maintained at a fix temperature of 80^0C for 24.0 hrs. Then dried orange peels were crushed and grinded to make very fine powder.

$$\text{Inhibition efficiency (\%)} = \frac{W?}{?} = ?$$

2.3 Combined procedure

After initial weighing the specimens were immersed in 100ml of 1N HCl solution with and without different concentrations of plants extracts at 30,40 and 50 degrees for 1, 3and 5 hours. The oven was set to the appropriate temperatures and after 1, 3 and 5 hours of immersion the specimens were removed, washed, dried completely and their final weights were noted. From the initial and final weights of the mild steel, the weight loss, the corrosion rate, inhibition efficiency (%) were determined from the weight loss results.

Formula Where W_0 is difference in weight of mild steel strip dipped in blank solution. W is difference in weight of mild steel strip dipped in different concentration of inhibitor.

3. RESULTS AND DISCUSSION

3.1 Effect of concentration on corrosion rate

The result showed that the corrosion rate of mild steel in 1N HCl decreases with increase in the concentration of the extracts at all temperature values ie 30^0C, 40^0C and 50^0C, indicating that acid extracts of Punica Granatum and Citrus sinensis inhibited the corrosion of mild steel in 1N HCl with more efficiency as their concentration increases. (Table 1 toTable 3). This is because as the concentration of the plant extracts increases the fraction of the surface covered by the adsorbed molecule also increases which results in an increase in the inhibition efficiency.

Table 1: Comparison between (Punica Granatum and citrus sinesis) at 30^0

Temperature	50^0 C					
	1 hours		3 hours		5 hours	
Concentration	P.G	C.S	P.G	C.S	P.G	C.S
2	45.01%	28.19%	34.63%	12.97%	10.52%	9.5%
4	85.12%	45.34%	50.25%	22.53%	50.20%	22.82%
8	85.86%	80.69%	68.52%	32.64%	68.48%	30.81%
10	85.87%	80.69%	74.54%	44.14%	73.89%	43.39%
15	93.73%	92.54%	87.61%	57.44%	86.48%	56.23%

Table 2: Comparison between Punica Granatum and Citrus sinesis at 40 ^{0}C

Temperature	40^0 C					
	1 hours		3 hours		5 hours	
Concentration	P.G	C.S	P.G	C.S	P.G	C.S
2	20.89%	20.80%	20.14%	8.14%	19.58%	19.53%
4	44.32%	44.43%	44.32%	42.32%	44.21%	22.55%
8	65.02%	62.62%	64.54%	22.12%	63.54	53.78%
10	91.43%	75.44%	95.46%	30.31%	92.53%	61.72%
15	94.62%	78.50%	95.46%	32.35%	97.52%	70.9%

Table 3: Comparison between at Punica Granatum and Citrus sinesis at 50 ^{0}C

Temperature	500 C					
	1 hours		3 hours		5 hours	
Concentration	P.G	C.S	P.G	C.S	P.G	C.S
2	15.81%	14.72%	22.13%	17.18%	12.29%	38.45%
4	19.21%	19.40%	23.45%	19.20%	16.87%	43.43%
8	31.65%	30.63%	28.75%	22.78%	18.98%	48.51%
10	35.99%	35.65%	32.68%	25.52%	23.21%	50.54%
15	48.54%	43.54%	39.85%	26.20%	23.21%	50.83%

The inhibition efficiency increases progressively in the observations as the concentration of the extracts increases. Highest inhibition is seen at 15% concentration of both plant extracts thus proving the above statem.

3.2 Effect of temperature on corrosion rate

The effect of temperature on the ocrrosion rate of mild steel in free acid and in the presence of different concentrations of the inhibitor was studied in the temperature range of 30^0C to 50^0C. It was observed that

the rate of corrosion of mild steel in free acid solution increases with increase in temperature [7]. This was seen by comparing the weight of mild steel strips immersed in the blank solutions of various temperatures at various time intervals. Thus we can conclude that as temperature increases, the rate of corrosion of mild steel also increases as a result of increase in the average kinetic energy of the reacting molecules. However, the corrosion rate is much less for the inhibited acid solution than in the free acid solution. The decrease in the corrosion rate for the inhibited acid solution is the result of the inhibitory effect of the plant extract on the corrosion rate of the mild steel.This proves that corrosion activity is higher in processes having higher temperatures and hence more attention should be given to the instruments used in the processes involving high temperatures.

3.3 Effect of temperature on inhibition efficiency

It was observed that as the reaction temperature

increases from 30^0C to 50^0C the inhibition efficiency of the Citrus sinesis extract on the mild steel also decreases suggesting an increase in the corrosion rate.

Investigation proved above showed that the corrosion rate increases with increase in temperature which results into a decrease in the inhibition efficiency. But Punica Granatum extracts were able to control and inhibit corrosion to a greater extent. Its highest inhibition potential was seen at 40^0C for5 hours at 15% v/v concentration. Hence this proved to be a better inhibitor than Citrus sinesis. But at 50^0C, it gradually showed a decrease in efficiency. Therefore decreasing and controlling the reaction temperature up to30^0C favours the inhibition efficiency of acid extracts of Citrus sinesis on mild steel in hydrochloric acid and controlling temperatures upto 40^0C favours corrosion inhibition of mild steel by Punica Granatum extract. A new breakthrough in use of these extracts in paints and varnishes can be applied by using heat resistant ingredients doped with these natural inhibitors to protect these heat labile plant (fruit peel) extracts to degenerate due to increased temperature thus increasing their use in processes involving high temperatures. Sol-gel coatings doped with green inhibitors show real promise for corrosion protection of a many metals and alloys.

4. CONCLUSION

The extract of the peel of Citrus sinesis acts as a good corrosion inhibitor for mild steel in hydrochloric acid solution, inhibition efficiency increases with inhibitor concentration and maximum efficiency is seen at 15% v/v concentration. Thus we can conclude that the inhibitor works best at 30 ^{0}C with efficiency of 92.54%. The best effect of the inhibitor is seen at 30 ^{0}C degrees at all the time intervals. As the temperature increases efficiency decreases with least efficiency showing at 50 degrees for 3hours. The peel of Punica granatum extract acts as a better inhibitor for mild steel corrosion in hydrochloric acid solution than Citrus sinesis this is because it shows maximum inhibition efficiency of 97.52% at 15% v/v concentration at 40^0C for 5 hours. This inhibition by both these fruit extracts occurs due to chemical adsorption. Also can be termed as physisorption process. The adsorption of inhibitor obeys langmuir adsorption isotherm. The plant extract creates a thin protective film over the mild steel plates thus protecting them from attack from corrosive agents.

REFERENCES

[1] Citrus sinensis peels as a Green Corrosion Inhibitor for Mild Steel in 5.0 M Hydrochloric Acid Solution, Harish Kumar* and Vikas Yadav**,** Electrochem. and Mat. Sci. Lab., Dept. of Chemistry, Ch. Devi Lal University, Sirsa, INDIA. November 2015.

[2] Oguzie EE (2008) Studies on the inhibitive effect of Ocimumviridis extract on the acid corrosion of mild steel. Mater ChemPhys 99:441–446

[3] Subramania A, Sathya priya AR, Saravanan S, Abdul Nasser AJ,Vasudevan T (2005) Investigation of some natural product extractas corrosion inhibitors for mild steel in acid medium. Corr SciTech 4:231–235

[4] Behpour M., Ghoreishi SM., Khayatkashani M, Soltani N (2012)Green approach to corrosion inhibition of mild steel in two acidsolutions by the extract of Punica granatum peel and mainconstituents. Mater Chem Phys 131:621–633

[5] Vinodkumar K P., Sangaranarayanapillai M., Rexinthusnavis G (2011) Seed extract of Psidium guajava as ecofriendly corrosioninhibitor for carbon steel in hydrochloric acid medium. J MeterSci Technol 27(12):1143–1149

[6] Satapathy A K., Gunasekaran G., Sahoo SC, Kumar A, RodriguesPV (2009) Corrosion inhibition by Justicia

gendarussa plantextract in hydrochloric acid solution. Corr Sci 51:2848–2856

[7] Koliyar J. G and Sheeba Aiman Comparitive study and effect of Plant fruit peel extracts (Musa sapientium and cucurbita maxima) to inhibit corrosion on mild steel Journal of Environmental Research And Development Vol. 9 No. 3A, January-March 2015822

[8] Department of Environmental Science, SIES (Nerull solution. Material Chemistry and Physics, 70:241-268.

[9] Eddy, N.O. (2009). Ethand Extract of Phyllanthus Amarus as a green inhibitor for the corrosion of mildsteel in H_2SO_4. Portugaliae Electronchemica Acta,27, (5), 579-589.Ehteram.

[10] Okafor, P.C.; Osabor, V.I.; Ebenso, (2007). E.E. Ecofriendlycorrosion inhibitors: inhibitive action ofethanol extracts of Garcinia kola for the corrosion ofmild steel in H_2SO_4 solutions. Journal Pigment andResin Technology 2007, 36, 299-305.Rajendran, A., Narayana .V and Gnanavel.I. (2007)

[11] Behpour M, Ghoreish SM, Soltani N, Salavati-Niasari M (2009)The inhibitive effect of some bis-N, S-bidentate Schiff bases oncorrosion behavior of 304 stainless steel in hydrochloric acidsolution. Corr Sci 51:1073–1082