Proceedings of the 8th World Congress on Mechanical, Chemical, and Material Engineering (MCM'22)
Prague, Czech Republic – July 31, 2022 - August 02, 2022
Paper No. ICCPE 113
DOI: 10.11159/iccpe22.113

The Inhibition Efficiency of Pineapple Crown Extract for Iron B500 in H_2SO_4 and Hcl Media

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Abstract - The use of green inhibitors as environmentally safe corrosion inhibitors for metal and alloys has, in recent times, received attention from researches. The extract of pineapple crown was studied as an inhibitor in 1M H_2SO_4 and 1 M HCl, with different concentration of pineapple extract, for iron B 500. The corrosion inhibition efficiency was investigated by using the weight loss method. The inhibition efficiency increases with the increase of the inhibitor concentration to attain 98.1 % at 4 g/L of pineapple crown extract. Based on the obtained results, pineapple crown extract reacts as a good inhibitor in aggressive media.

Keywords: pineapple crown extract, green inhibitor, iron-B500, weight loss method

1. Introduction

Steel is the most used metal to test corrosion inhibition due to its innumerable applications. Scientists are beginning to search for eco-friendly inhibitors, such as green inhibitors. Inhibition of corrosion is as a result of adsorption on the surface of the metal (chemisorption) and a protective thin film is formed with the inhibitor effect or from the combination of a metallic surface and an inhibitor ion. [1] The study of plant extracts as low-cost and ecofriendly corrosion inhibitors is of great interest from an environmental perspective. Green corrosion inhibitors have a promising future for the quality of the environment because they do not contain heavy metals or other toxic compounds. [2] They are biodegradable and a renewable source of materials. The corrosion inhibition performance of these compounds is attributed due to the presence of O and N atoms which ensures greater coverage of metal by the molecules and leads to more inhibition efficiency. [3] These green inhibitors are extremely important for the protection of metals against corrosion. Of which we can mention polyphenols, one of the most important extracts obtained from a pineapple crown. The aim of this study is to investigate the inhibition property of the extract from the crown of a pineapple, for iron B500 in 1 M H_2SO_4 + 1M HCl by using weight loss method.

2. Experimental

The material under investigation is iron B500, manufactured in Elbasan, which has the following composition:

Table 1: Composition of low alloy carbon steel tested

Elements %	C	Si	Mn	Cr	Ni	Cu	P	S
Iron B500	0.224	0.152	0.68	0.110	0.102	0.318	0.021	0.027

2.1 The environment

The environment in which we worked was 1M H_2SO_4 and 1M HCl for iron B500. Corrosive solutions (Blank) were prepared from 96% sulfuric acid and 37% HCl, with a density of 1.83 g/cm^3; taking 5.4 ml H_2SO_4 and 8.3 ml HCl. The environment in which we will experiment Fe, in addition to 1M H_2SO_4, also contains 1M HCl. The extract used is pineapple crown extract and the concentrations used are: 1g/L; 2g/L; 3g/L; 4g/L.

2.2 Preparation of the extract

To prepare the extract, we first dried the pineapple crown in a thermostat at 40ºC, grinding it finely to increase the contact surface. For the preparation of the alcoholic extract, 20 g of pineapple crown was taken and we poured 3 times into it 200 ml of 70 % ethyl alcohol, then we put it in a magnetic mixer for 6 hours and filtered the extract. The extract was then left for the alcohol to evaporate up until 1/4 of the amount and was placed for storage in the refrigerator, as it should be stored at 4oC and in the dark.

$$C_{ekstr} = \frac{A - B}{C} = \frac{20 - 15.23}{0{,}1025} = 46{,}536\ g/l \quad (1)$$

Corrosive acid solutions for Fe B500 were prepared while keeping in mind this concentration of the extract.

2.3 Weight loss measurements:

For weight loss studies the samples were prepared by cutting of them from a steel bar. Cylindrical samples of iron B500 were prepared on a lathe, with a length of 38 ± 4 mm and a diameter of 7 ± 1mm. On the top of them we drilled a hole with a diameter of 3 mm as shown in Figure 1.

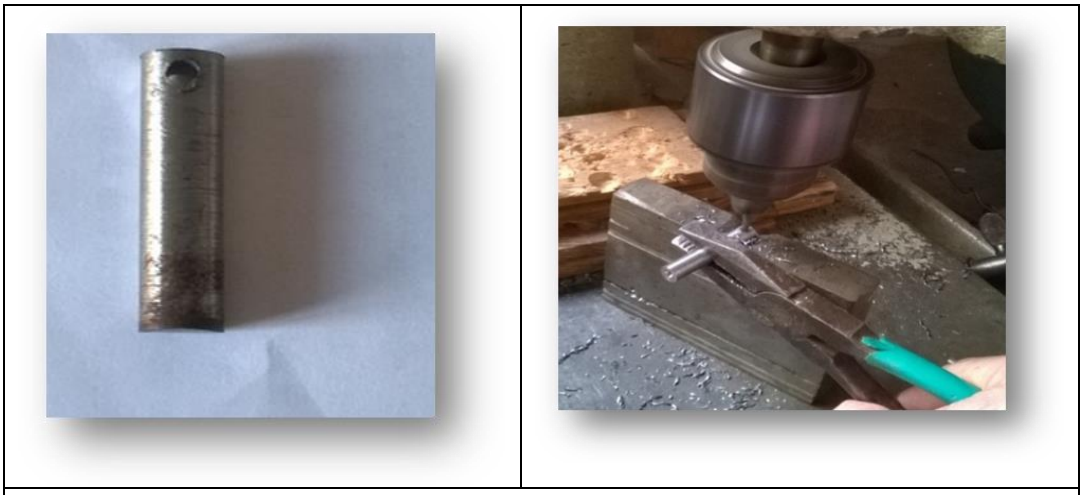

Figure1: Preparing of the sample for the weight loss measurements

The samples were then polished using different grades of abrasive paper from 200 up to 1200, washed with distilled water, degreased with acetone and dried before immersing them into the test solution. The experiment was carried out in a closed glass vessel using a pure of stream of nitrogen inside the solution. After 3 hours of immersion in 1 M H2SO4 and 1M HCl solution with and without the addition of the pineapple crown extract at different concentrations, the specimen was withdrawn, rinsed with distilled water, washed with acetone, dried and weighed. The cleaning of corrosion products is done in an ultrasonic bath with the solution prepared from the mixture with a ratio 1: 1 HCl and water in which we have dissolved 1g urotropin, then via distilled water and acetone for 5 minutes.

Corrosion rate in form of mm/year is calculated from the equation [4,5]:

$$V_{(mm/vit)} = \frac{87.6 \cdot \Delta m}{d \cdot A \cdot t} \quad (2)$$

Where: Δm - the difference of weight in mg;

d- the density in g/cm^3;
A - the surface of sample in cm^2;
t - the time of exposure of the sample in hours

The percentage of inhibition efficiency (IE %) was calculated as follows [6]:

Inhibitor Efficiency (%) = [(CR uninhibited – CR inhibited)/ CR uninhibited] x 100 (3)

Table 2: Composition of solution for weight loss method

Nr.	Blank	Concentration of pineapple crown extract (g/L)			
		1	2	3	4
1	+				
2	+	+			
3	+		+		
4	+			+	
5	+				+

3. Results and Discussions

The obtain weight loss measurement results in form of corrosion rate and protection efficiency of different concentration of pineapple crown extract, are given in table 3.

Table 3: Corrosion rate, surface coverage and inhibition efficiency for iron B500 with and without the presence of the inhibitor (pineapple crown extract) in a H_2SO_4 and HCl (1M) solution.

Sample	Media	Corrosion rate (mm/vit)	θ (surface coverage)	Inhibition Efficiency (%)
1	Blank (1M H_2SO_4/1M HCl)	52.64	0	0
2	1g/L	3.221	0.939	93.9
3	2g/L	2.095	0.96	96
4	3g/L	1.449	0.972	97.2
5	4g/L	1.003	0.981	98.1

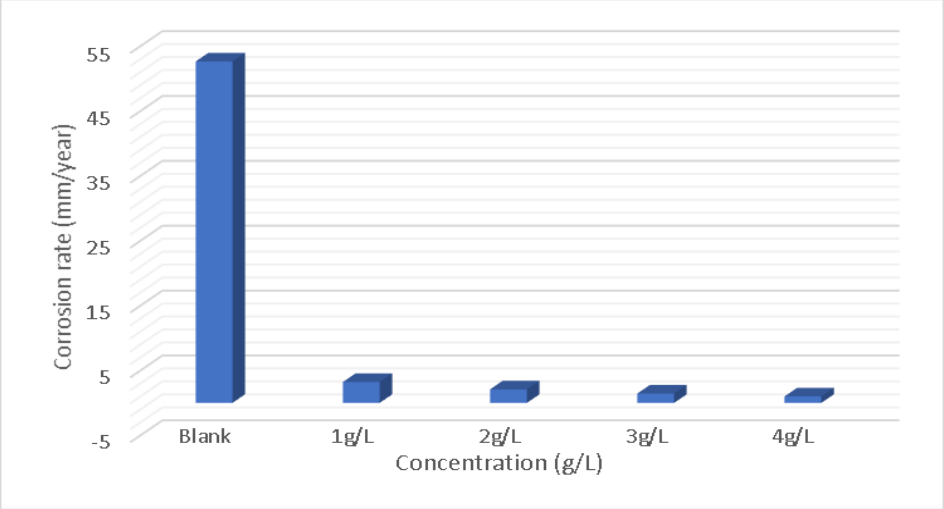

Figure 2. Corrosion rate in various concentration of inhibitor

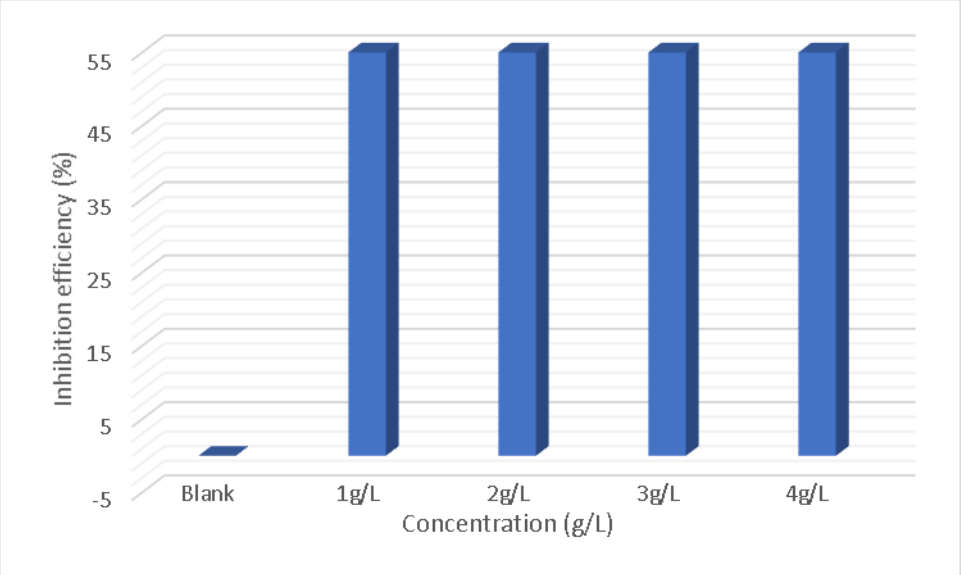

Figure 3. inhibition efficiency in various concentration of inhibitor

Inhibition efficiency and corrosion rate for iron B500 was determinate with and without the inhibitor and the results are presented in Table 3 and in the graphs. From the data obtained via the weight loss method, it is seen that the inhibitor extracted from the pineapple crown, has good inhibitory properties against corrosion for iron B 500. From the graphs, the rate of corrosion decreasing with the increasing of the concentration of the inhibitor, while inhibition efficiency increases with the increase of concentration. The best inhibitor efficiency for iron B500, was approximately 98.1 % which corresponds to 4 g/L pineapple crown extract in 1M H2SO4 and 1M HCl at 3 hours. This can be explained by the increase of adsorption of inhibitors molecules on the metal and thus increases the degree of surface coverage. The increased coverage will protect the metal from the corrosion process [7, 8]. The inhibitor was absorbed in the steel and forming the layer on the surface of the steel. The layer which is like the coating, prevents the contact of the acid to the surface of the steel. The corrosion process will not happen when there is thick protection layer on the surface [9].

4. Conclusion

Weight loss method show that the pineapple crown extract presents a good inhibition efficiency in aggressive media 1M H2SO4 and 1M HCl, which mitigate the corrosion rate of iron B500 from 52.64 to 1.003 mm/year with a protection efficiency 98.1 %.

The weight loss method shows that the use of pineapple crown extract in concentration 4g/l is a good green corrosion inhibitor for iron B500 in acidic media.

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