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Corrosion Inhibition of Methanol Extract of *Parkia Biglobosa* Pulp on Carbon Steel in Acidic Medium

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Abstract
The inhibition efficiency of methanol extract of p. bglobosa pulp on the corrosion of carbon steel in 2M HCl was investigated by weight loss measurement. The corrosion rate of carbon steel and the inhibition efficiency of the extract were calculated. The result obtained shows that, the extract could serve as an effective inhibitor. Inhibition was found to increase with increase in concentration of the plant extract.
Keyword: *parkia biglobosa, carbon steel, HCl and corrosion.*

1. Introduction

Regardless of all the recent advances in polymer technology and the development of high strength plastics, industry and civilization would grind to a halt without the metals. Unfortunately all metals are subject to corrosion, a continuous process that consumes increasingly scarce raw materials [1].

Corrosion is a very common phenomenon in industries and it has wide amount of interest because of its hazardous nature on metals. Due to the excellent mechanical properties and low cost, mild steel is extensively used as a constructional material in many industries. However, when exposed to the corrosive industrial environment, it is easily corroded. Normally, acid solutions such as hydrochloric acid are widely used such as in acid pickling, industrial cleaning, oil well cleaning, etc. The use of inhibitors is one of the most practical methods for protection against corrosion to protect metal dissolution and acid consumption [2].

Corrosion is a natural process. Just like water flows to the lowest level, all natural processes tend toward the lowest possible energy states. Thus, for example, iron and steel have a natural tendency to combine with other chemical elements to return to their lowest energy states. In order to return to lower energy states, iron and steel frequently combine with oxygen and water, both of which are present in most natural environments, to form hydrated iron oxides (rust), similar in chemical composition to the original iron ore. Corrosion is unavoidable. However, losses due to corrosion can be considerably reduced [3]. Corrosion is one of the important aspects of Electrochemistry study at various level nowadays. Corrosion can be

defined in many ways. Some definitions are very narrow and deal with a specific form of corrosion, while others are quite broad and cover many forms of deterioration. Corrosion is define as loss of useful properties of a material as a result of chemical or electrochemical reaction with it environment [3].corrosion can also be define as the destructive attack of a metal and its properties by chemical (dry corrosion) or electrochemical (wet corrosion) reaction with its environment [4].

The use of corrosion inhibitor of protecting metal surfaces against aggressive environments is an effective measure and has received considerable attention from academic and industrial point of view. Now a days preventive step have been taken care with prior importance to inhibit corrosion of useful materials in various acid like aggressive environments [5]

The use of inhibitors is one of the most practical methods for protection against corrosion, especially in acidic media where it is critical to prevent unexpected metal dissolution and acid consumption [6]. An inhibitor is a substance that, when added in small concentrations to an environment, decrease the corrosion rate [4].

Carbon and low-alloy steels are the most widely used materials in the marine environment, for both structural components and pressure-retaining applications. Gluconates are environmentally suitable and efficient corrosion inhibitors used predominantly in cooling water systems. A successful inhibition of carbon steel was obtained also in the seawater or solutions containing different chloride concentrations by gluconate corrosion inhibitors are used in variety of system. For many years corrosion inhibitors are extensively been used in oil and gas production and transmission system and new formulations developed in order to obtain better corrosion protection and safer properties towards the environment [7]. Natural products extracted from plant sources, as well as some non toxic organic compounds, which contain polar functions with nitrogen, oxygen and/or sulphur in conjugated systems in their molecules, have been effectively used as inhibitors in many corrosion systems. Amino acids are attractive as corrosion inhibitors because they are relatively easy to produce with high purity at low cost and are soluble in aqueous media [8].Thus tannins have an array of hydroxyl and carboxyl groups through which the molecules can adsorb on corroding metallic surfaces [9].

Parkia biglobosa commonly known as African locust bean is a perennial deciduous tree with a height ranging from 7-20cm although it can reach 30cm under exceptional condition. Crown large, spread wide with branches low down on a stout bole, amber gum exudes from wounds, bark dark Grey brown, thick, fissured. The medicinal uses of the plant are, the bark of the tree is use as toothache, diarrhea, skin infection and the pulp is use as diuretic, purgative, fever etc.

The aim of the research is to know the efficiency of the plant *P. biglobosa* pulp as inhibitor on carbon steel in acidic medium.

2. Material

Seperatory funnel, conical flask, glass rod stirrer, filter paper, electrical weighing balance, water bath, carbon steel coupons, spatula and *parkia biglobosa*.

2.1 Material preparation

The materials used for study were mild carbon steel sheet of composition (Wt %) Mn (0.60), P (0.36), C (0.15), Si (0.03) and the remaining is iron. The sheet was mechanically pressed cut to form different coupons. Each of dimensions 4* 3*0.04 cm. Each coupon was de-grease by washing with methanol and dried in an oven. All reagent used for the study were analar grade and distilled water was used for their preparation.

3. Extraction of the plant

P.biglobosa pulp obtained fron Alhaji Shehu Idris farm at Ungoggo local Government, Kano

Nigeria was air dried, grinded, sieved and soaked in methanol for 24 hour. The sample was filtered and the filtrate obtained was then subjected to evaporation in order the for the sample to be free of methanol. The filtrate of 0.5, 1.0, 1.5, 2.0 and 2.5gms were prepared by dissolving in 1L each of 2M HCl respectively.

3.1 Corrosion of carbon coupons by HCl without inhibitor

Method: the corrosion rate of the carbon specimen was determined by weight loss measurement techniques. The simplest and most useful method for corrosion determination is the weight loss measurement. The weight loss of the coupons was determined at the end of each exposure period to determine their corrosion. Carbon coupons of 3.562gm were put into six empty beakers labeled A, B, C, D, E and F various concentration of HCl was poured into each beaker starting from 1M to 6M at 30^0C after 2 hours. The weight loss of the carbon coupons was determined. The same experiment was repeated at 40^0C and 50^0C respectively at the same time interval.

3.2 Corrosion of carbon coupons by HCl with inhibitor

Method: 0.5gm of the extract was weigh and dissolved with 5cm3 of distilled water in a beaker and was named sample A. The experiment was repeated with 1.0, 1.5, 2.0 and 2.5gms of the extract with constant volume of distilled water to obtain different concentration in five different beakers B, C,D, E and F respectively using constant concentration of acid 2M. The carbon coupons of approximately 3.562gm weight were immersed into these beakers. The beakers were then placed into water bath to maintained constant temperature of 30^0C for 2 hours. The coupons were then retrieved, washed with distilled water and reweighed. The experiment was repeated at 40^0C and 50^0C.

4. Result and discussion

The weight loss of the coupons was calculated in grams as difference in weight of the coupons before and after immersion using the relation

$W = Wi - W_f$

Where Wi is the initial weight of carbon coupon

And W_f is the final weight of the coupon

The inhibition efficiency (% I.E) was calculated using the equation

% I E =(1-Wp/Wa) x100

Where Wp and Wa t are the weight loss in the presence and absence of inhibitor respectively and the surface coverage (θ) was calculated from:

$\Theta = 1 - Wp/ Wa.$

The corrosion rate was calculated from the weight loss using the formula given by [10]

$R\ corr = 87.6 (W/ ADT)$

Where A is the area of coupons in (cm2)

D stand for density of carbon coupon (g/cm^3)

W is the weight loss measured in (gm)

T is the time of immersion measured in Hours

The density of the coupons is 72.57g/cm3 and the initial weight of all coupons used were approximately 3.562g.

Table 1: carbon coupon in various concentration of HCl without inhibitor after 2hrs.

a) at 30^0C.

S/N	Conc. Of HCl(M)	Weight loss(g)
1	1.0	0.010
2	2.0	0.096
3	3.0	0.098
4	4.0	0.116
5	5.0	0.365
6	6.0	0.857

b) at 40^0C

S/N	Conc of HCl (M)	Weight loss (g)
1	1.0	0.223
2	2.0	0.235
3	3.0	0.238
4	4.0	0.438
5	5.0	0.444
6	6.0	1.185

c) at 50^0C

S/N	Conc of HCl (M)	Weight loss (g)
1	1.0.	0.285
2	2.0	0.362
3	3.0	0.385
4	4.0	0.501
5	5.0	0.821
6	6.0	1.716

Table 2: carbon coupons in 2M HCl and various concentration of inhibitor after 2hrs

A) at 30^0C.

S/N	Conc. of inhibitor (g)	Weight loss(g)	Corrosion rate (g/cm^2)	θ	% I.E
1	Blank	0.090	0.045	0	0
2	0.5	0.095	0.048	0.011	1.1
3	1.0	0.094	0.047	0.041	4.1
4	1.5	0.053	0.027	0.543	54.1
5	2.0	0.027	0.014	0.926	92.6
6	2.5	0.013	0.007	0.985	98.5

b) at 40^0C

S/N	Conc. of inhibitor (g)	Weight loss(g)	Corrosion rate (g/cm^2)	θ	% I.E
1	Blank	0.1238	0.120	0	0
2	0.5	0.200	0.101	0.103	10.3
3	1.0	0.179	0.090	0.238	23.8
4	1.5	0.115	0.038	0.660	66.0
5	2.0	0.100	0.050	0.772	77.2
6	2.5	0.090	0.045	0.798	79.8

c) at 50^0C

S/N	Conc. of inhibitor (g)	Weight loss(g)	Corrosion rate (g/cm^2)	θ	% I.E
1	Blank	0.309	0.155	0	0
2	0.5	0.358	0.180	0.011	1.1
3	1.0	0.341	0.171	0.114	11.4
4	1.5	0.287	0.144	0.427	42.7
5	2.0	0.207	0.104	0.748	74.8

5. Conclusion

The method used shows that the p biglobosa extract possess good inhibition properties for the corrosion of carbon steel in HCl at the temperature studied. Percentage inhibitor efficiency increased with increase in concentration of inhibitor.

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