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Full Length Research Paper

The study of corrosion inhibition of Mild-Steel in 1.5M HCl with *Taliniun Triangulare* extract

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ABSTRACT: Corrosion inhibition of mild steel in 1.5M hydrochloric acid solution with *Talinum Triangulare* (waterleaf) extract was investigated using the weight loss method. It was deduced that the extract from *Talinum Triangulare* was an effective corrosion inhibitor of mild steel in a hydrochloric acid solution which acted as a corrodent. There was a significant decrease in weight loss of the mild-steel in the corrodent solutions containing mixtures of the leaf extract and 1.5M hydrochloric acid compared to the control corrodent of hydrochloric acid only. This showed that the extract from *Talinum Triangulare* played a major role in inhibiting the corrosion level of the mild steel by the hydrochloric acid solution. The finding indicates that *Talinum Triangulare* acts as an effective corrosion inhibitor for mild steel in hydrochloric acid solution. The effectiveness of the inhibition and surface coverage of mild steel increased with the increasing concentration of hydrochloric acid but reduced as the temperature is lowered. Langmuir adsorption isotherm and Freundlich adsorption isotherm were used to deduce that the adsorption mechanism was physical adsorption. The inhibitive ability of the extract was attributed to the presence of oxygen, nitrogen, and aromatic components in its structure.

Keywords: *Talinum Triangulare,* inhibitor, hydrochloric acid

INTRODUCTION

Recent researches on corrosion inhibition had centred on natural inhibitors which are non toxic, eco-friendly and readily available obtained from plants. Some of the evidences where bio-renewable green chemical were used for corrosion inhibitors are Carica papaya (Okafor and Benson 2010) water hyacinth (Oloruntoba *et al*., 2012), bread food peel (Orie and Christian 2015), Topsportcrispa (Hussin *et al*., 2016) Citrus aurantium leaves (Hassan *et al.,* 2016), extract of red onion skin (James and Akarenta, 2002), Karanj (Pongama pinnate) seed, (Singh *et al.,* 2011).Corrosion of metals is a natural phenomenon which proceeds until inhibited according to Ostovari et al. (2009). Since metals are used in different technological structures and in various environments, protection of metallic structures is pertinent (Okorosaye–Orubite and Ngobiri, 2017). Corrosion of metal is a serious environmental problem that has been given adequate attention in the oil and gas industries, because during industrial processes such as acid cleaning and etching, metal surfaces are often made to come into contact with the acid medium and these metals corrode due to the attack of the acid on the metal. Corrosion is an inevitable phenomenon and the only way to avoid corrosion totally is to operate in a vacuum but conditions make it impossible (Roberge, 2000). Acid solutions are extensively used in industry, the most important of which are acid pickling, industrial acid cleaning, acid decaling and oil well acidizing. The commonly used acids are hydrochloric acid, sulphuric acid, nitric acid, etc. Inhibitors are widely used in the corrosion protection of metals in several environments. Lowering the aggressiveness of an environment towards a metal can reduce corrosion rate. This is usually done by the addition of inhibitors. Mild steel is known as plain-carbon steel, is now the most common form of steel because its price is relatively low,

while it provides material properties that are acceptable for many applications. Mild steel is an alloy of iron that contains the following elements and percentages; carbon (0.05 – o.15%) silicon (0.18), phosphorus (0.04%), sulphur (0.02%), manganese (0.70-0.48%) and iron which is about (98.9%) (Emmanuel *et al*., 2013 used in industry, the most important of which are acid pickling, industrial acid cleaning, acid decaling and oil well acidizing.

The commonly used acids are hydrochloric acid, sulphuric acid, nitric acid, etc. This is usually done by the addition of inhibitors. Corrosion inhibitors are substances which, when added to a corrosion system decreases or eliminates anodic dissolution. In recent years, most researchers are focusing on natural products as corrosion inhibitors as reported by (Arukalam and Obidiegwu, 2011).

MATERIALS AND METHODS

The materials used include ethanol, distilled water, hydrochloric acid and mild-steels samples, all reagents were obtained from Sigma Aldrich and British Drug House (BDH) companies. The organic solvents used were purified using standard methods. The leaves of *Talinum Triangulare* were collected from an agricultural industry in Oyibo local government area in Rivers State.

Preparation of mild steel coupon

The corrosive environment, 1.5M HCl prepared according to known standards. Mild steel sheets with composition, (C, 0.16-18%, Mn 0.7-0.9%, P 0.0 4%, Si 0.40% and S, 0.04%) were obtained from the Engineering workshop of the university of Port Harcourt Choba Rivers State Nigeria. They were cut into 4cm/3cm sizes of 1.0mm thickness.

The coupons were perforated at the top centre with holes of diameter 2.0mm to allow passage of thread. They were mechanically cleaned and scrubbed with sandpaper to expose shining surfaces, degreased in absolute ethanol and dipped in acetone and finally dried in an oven at 40^{o}C. Dried coupons were stored in desiccators before use. The initial weight of the coupons was taken, using an analytical weighing balance. Each weight was an average of three replicate measurements

Solutions preparation

About 1.5 M HCl solutions were prepared by the dilution of 37% HCl using distilled water. The concentrations of the leaf extract employed were varied from 2.07x10^{-5}M to 3.5 x10^{-5} M. This concentration range was chosen upon the maximum solubility of *Talinum Triangulare* extract. The powdered, *Talinum Triangulare* extract was first dissolved in ethanol before it was diluted to standard solution.

Weight loss measurement

The rectangular mild steel specimens of dimension4cm/3cm sizes of 1.0mm thickness were immersed (complete immersion) in 100 mL of deaerated electrolyte in the absence and presence of different concentrations of *Talinum Triangulare* at different temperature of 303K, 303K and 323K. The weight loss of mild steel specimens was determined after 24 hours of immersion for the duration of days.

Procedure

The grinded leaves were placed in a beaker and soaked with ethanol. After 24 hours the content of the beaker was stirred and filtered to acquire the leaf extract. Then, 1.5M of hydrochloric acid was prepared using standard methods. The acid was divided into 5 portions and mixed with the leaf extract in different proportions to form the corrodent solutions which are represented in (Table 1).

RESULTS AND DISCUSSION

Table 2 shows the different weights measured with the mixture of *Talinum Triangulare* extract and the freshly prepared hydrochloric acid which were mixed in various proportions. The acid was used as a corrodent which acted as a control to the various mixtures of acid and the extract, there was a general trend of weight loss recorded which indicates the effectiveness of the extract as shown above.

This is also an indication that water leaf (*Talinum Triangulare*) could be a corrosion inhibitor of mild-steel in hydrochloric acid solution. However, there was an observable trend in weight loss of all the mild-steel samples from day one to day four which corresponds to progression of corrosion with increase in the volume of the extract according to Ituen et al. (2017).

The comparison of the different weights measured with the mixture of acid and extracts to that of the control shows the efficiency of the green extract in curbing corrosion in mild-steel. According to Oloruntoba *et al*. (2012) green or natural corrosion inhibitors are being preferred to chemical corrosion inhibitors because of their efficiency, low toxicity and availability.

Table 1: Volume of Hydrochloric acid and water leaf extract.

Beaker (samples)	Volume of extract (Ml)	Volume of hydrochloric acid (Ml)
B	----	30
B1	20	10
B2	40	20
B3	50	20
B4	60	30
B5	70	30

Table 2: Different weights measured with the mixture of Talinum Triangulare extract and the freshly prepared hydrochloric acid.

CONCENTRATION OF CORRODENTS	1	2	3	4
	Weight (g)	Weight (g)	Weight (g)	Weight (g)
30ml HCl (control)	22.90	22.80	22.90	22.70
20ml extract + 10ml HCl	20.70	20.20	20.00	19.70
40ml extract + 20ml HCl	20.30	20.00	19.50	19.10
50ml extract + 20ml HCl	20.10	19.20	18.50	18.30
60ml extract + 30ml HCl.	19.70	19.10	18.10	17.80
70ml extract + 30ml HCl	19.20	18.60	18.00	17.20

Conclusion

There is an indication that natural plant extract are effective green corrosion inhibitors against mild steel. Weight loss method was used to test for corrosion in hydrochloric acid mixed with water leaf (Talinum Triangulare) extract in different proportions. From the results obtained, the water leaf (Talinum Triangulare) extract appears to be an inhibitor of corrosion of mild steel in hydrochloric acid solution. The inhibition efficiency is expected to increase with increasing concentration of the plant leaf extract in the corrodent mixtures.

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