



Evaluation of Inhibitive Action of Plantain Peduncle Extract on the Corrosion of Medium Carbon Steel in Tetraoxosulphate (vi) Acid Medium

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Abstract: *The use of inhibitors is one of the most practical methods for protecting metal against corrosion, especially in acidic media. In this research work, the evaluation of inhibitive action of plantain peduncle extract on the corrosion of medium carbon steel in tetraoxosulphate (vi) acid medium was investigated. The medium carbon steel bars were machined into coupons and suspended in solution of 0.25M tetraoxosulphate (vi) acid to the varying concentrations of plantain extract inhibitor (0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5% v/v) that were added and allowed to in media for a duration of ten (10) days. The weight loss and electrochemical measurement of each coupon was at a duration of two days interval and the rate of corrosion and protection efficiency of the inhibitor calculated. The results obtained revealed that the corrosion rate decreased with increasing concentration of inhibitor to maximum level of 2.0v/v% while the protective (inhibition) efficiency increased with increasing concentration of inhibitor. More so, this research work has demonstrated that plantain peduncle can be used for the corrosion inhibition of medium carbon steel in*

Keywords: *Inhibitors, Plantain Peduncle Extract, Corrosion Rate, Tetraoxosulphate (vi) acid, Medium Carbon Steel*

INTRODUCTION

There is a growing demand for environmentally appropriate inhibitors such as vegetal inhibitors (Nwabanne *et al.*, 2012). It is estimated that more than 30% of the steel produced worldwide and used for spare parts, pieces of equipment and facilities is damaged by corrosion (Oyejide *et al.*, 2017). Corrosion is costly due to operational downtime necessary for parts replacement. There is also concern about damage to the environment for example the breaking of oil pipelines in the petroleum industry. Corrosion resistant products are in great demand and have been increasing in technological advances. Recent studies have estimated that annual costs worldwide related to corrosion damage are around 4% of the Gross Domestic Product (GDP) of an industrialized country. Management practices and corrosion control can reduce 20 % of direct costs [maintenance (protection processes) and/or replacement of parts or equipment] or indirect, such as downtime due to equipment failure, product contamination, production losses and personal and also environmental safety (Oguzie *et al.*, 2010).

Large numbers of organic compounds revealed that nitrogen, Sulphur, and oxygen containing organic compounds acted as promising inhibitors. However, most of these compounds are not only expensive, but also toxic to living beings (Iloamaeke *et al.*, 2013). So, considerable efforts are made to select corrosion inhibitors which are environmentally safe, readily available and of relatively low cost. Literature shows a growing trend in the use of natural products known as non-toxic compounds, called also green inhibitors, as corrosion inhibitors. Natural products such as extracts of easily available plants and trees have been used as eco- friendly corrosion inhibitors. Plant extract contains several organic compounds which have corrosion inhibition abilities. The extracts from different parts of many plants have been reported as corrosion inhibitors in acidic media (Iloamaeke *et al.*, 2013, Leelavathi *et al.*, 2013, Mouden *et al.*, 2015). Corrosion inhibitors are common for protecting steel structures and their alloys in industry (Mouden *et al.*, 2015). Hence, there is a growing demand for environmentally appropriate inhibitors such as vegetal inhibitors (Nwabanne *et al.*, 2012).

MATERIAL AND METHOD

2.1 Collection of Plantain Peduncles

The plantain peduncles were collected from local market in Effurun, Nigeria.

2.2 Plantain Peduncle Extraction

A Retsch Planetary Ball Mill PM 400 was used for the pulverizing of the plantain peduncles. Standard method was adopted as described in the research work carried out by Orhororo *et al.*, 2016. Fig. 1 shows the picture of the plantain peduncle extract.



Fig. 1 Picture of the plantain peduncle extract.

2.3 Preparation of Medium Carbon Steel Samples

The medium carbon steel samples with dimension of 15 x 15 x 2 mm were used as coupons for the corrosion study in this research work. The coupons were mechanically polished with emery papers and the samples degreased in ethanol, dried, weighed and stored in a desiccator. The initial weight of each sample was taken and recorded.

2.4 Gravimetric Evaluation

Tetraoxosulphate (vi) acid of 0.25 M concentration was poured into beakers at a constant volume of 500 ml. The plantain peduncle extract was added to the beakers at 0 %, 0.5 %, 1 %, 1.5 %, 2.0 %, 2.5 %, 3 %, and 3.5 % respectively. The experiment was conducted at room temperature of 25°C and time interval of two days that lasted for 10 days. At interval of two days, a sample is evaluated for weight loss, rate of corrosion, inhibition efficiency and degree of surface coverage. The standard expression for measurement of corrosion rate in mills per year (mpy) was used which is given by Equation (1).

$$\text{Corrosion Rate (mpy)} = \frac{87.6w}{DAT} \quad (1)$$

where,

w = Corrosion weight loss of medium carbon steel

A = Area of the coupon

T = Exposure time

D = Density of medium carbon steel

The inhibition efficiency was computed using Equation (2)

$$I.E (\%) = \frac{W_0 - W}{W_0} \times 100 \quad (2)$$

where,

W and W_0 = Corrosion rates with and without inhibitor respectively

The degree of surface coverage was calculated from Equation (3)

$$\text{Degree of Surface Coverage } (\theta) = \frac{1}{\%IE} \times 100 \quad (3)$$

RESULTS AND DISCUSSION

Fig. 2 shows the graph of corrosion rate with inhibitor concentration. It was observed that the corrosion rate (CR) of the medium carbon steel decreased with addition of plantain peduncle plant extract and exposure time. However, increases in time of exposure from 2 to 10days reduced the corrosion rate. This agreed with the research work of [Orhorhoro et al., 2017](#), [Orhorhoro et al., 2018](#); [Okuma et al., 2020](#), that reported that the decreased in the corrosion rate can be ascribed to the aggressiveness of the chemical reactivity, transport properties of the corrosion medium, pH of the corrosion medium, concentration of the corrosion species, and the metallurgy of the alloy sample.

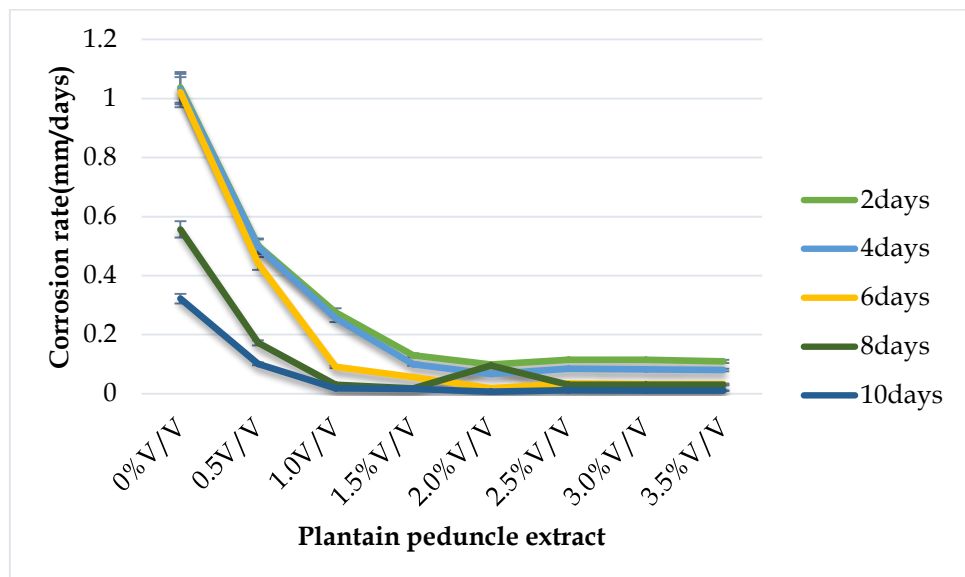


Fig. 2 Graph of Corrosion rate with inhibitor concentration

Fig. 3 shows the degree of surface coverage and inhibition efficiency (IE). It was observed that both the degree of surface coverage and inhibition efficiency increases with time of exposure and inhibitor concentration up to a maximum of 2.0% v/v. Nevertheless, at exposure time of 10days, higher % IE was calculated to be 97.57% at 2.0 g/v plant extract addition. While at 2.0 v/v inhibitor concentration for 2 and 10days exposure time, corrosion rate/IE were found to be 0.0988mm/day/90.48% and 0.0067mm/day/97.57% respectively.

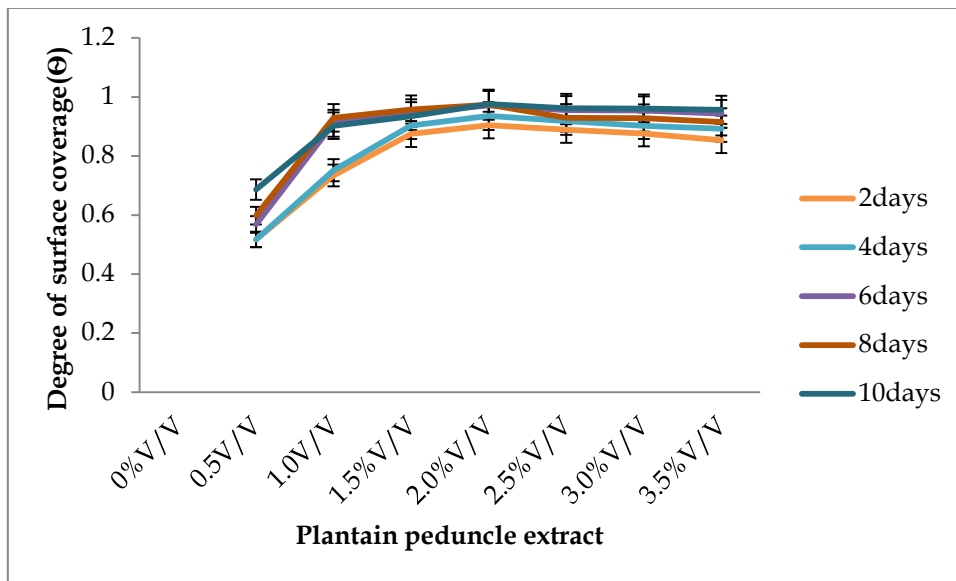


Fig. 3 Graph of variation of degree of surface coverage with inhibitor concentration

Fig. 4 shows the of variation of inhibitor efficiency with inhibitor concentration. It was observed that inhibitor efficiency with inhibitor concentration was higher on day 8 and lower on day 2.

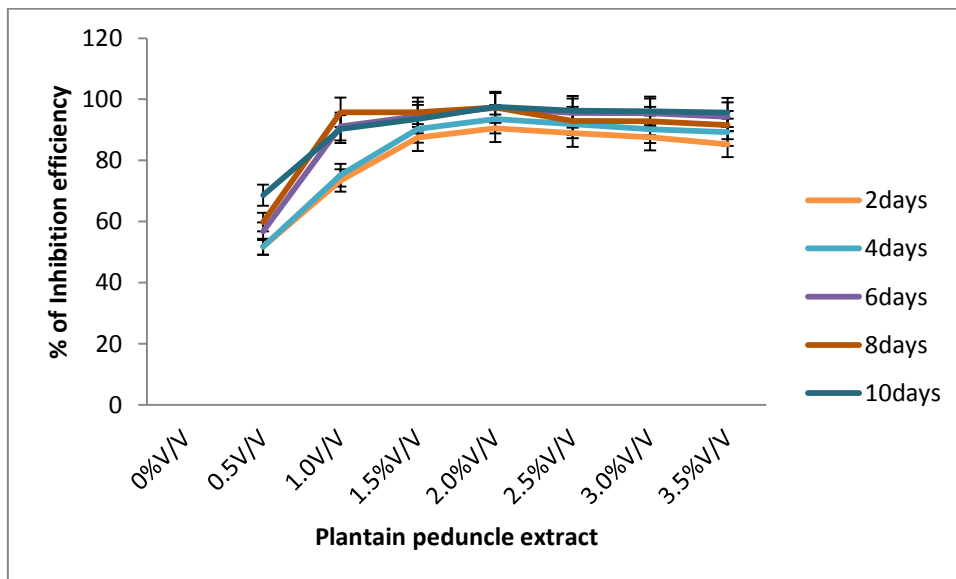


Fig.4 Graph of variation of inhibitor efficiency with inhibitor concentration

CONCLUSION

In this research work, evaluation of inhibitive action of plantain peduncle extract on the corrosion of medium carbon steel in tetraoxosulphate (vi) acid medium was investigated. The outcome of the finding from the research work revealed that plantain peduncle extract has the potential of inhibiting 0.25M tetraoxosulphate (vi) acid solution. More so, the inhibition efficiency increases with increasing concentration of the inhibitor to maximum level of 2.0v/v% and start to decrease.

CONFLICT OF INTEREST

I hereby state that no conflict of interest will arise in any form the publishing of this study.

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