International Journal of Engineering Applied Sciences and Technology, 2018
Vol. 3, Issue 3, ISSN No. 2455-2143, Pages 6-10
Published Online July 2018 in IJEAST (http://www.ijeast.com)

INHIBITING EFFECTS OF BANANA PEEL EXTRACT (BPE) ON THE CORROSION OF MILD STEEL IN ACIDIC MEDIA

Oke, O.O.
Department of Mineral and Petroleum Resources Engineering,
Federal Polytechnic, Ado Ekiti, Ekiti State Nigeria

Nenuwa, O.B
Department of Mineral and Petroleum Resources Engineering,
Federal Polytechnic, Ado Ekiti, Ekiti State Nigeria

Boluwade, E.A
Department of Mineral and Petroleum Resources Engineering,
Federal Polytechnic, Ado Ekiti, Ekiti State Nigeria

Abstract: The use of local waste which is organic in nature for the production of ecofriendly corrosion inhibitor is the new trend in the corrosion industry. The main focus of this study is to produce corrosion inhibitor from Banana peel extract of varied concentration. Gravimetric method was used to determine the corrosion rate of mild steel in acidic media (HCl and H_2SO_4) in which banana peel extract (BPE) was added as a corrosion inhibitor. The results of the study showed that as the concentration of the inhibitor increases, the rate of corrosion decreases. It also showed that as the concentration of the inhibitor increases, the inhibitor efficiency also increases up to an optimum of 69% for 400g/20ml in 0.3M H_2SO_4 and 93% for 400g/20ml in 0.3M HCl. The result showed BPE can be used as corrosion inhibitor as this will reduce the use of some inorganic inhibitors that are toxic and not environmental friendly. Banana peel extract (BPE) is readily available around us and so the extract is relatively cheaper to produce.

KEYWORDS: Banana Peel Extract (BPE), Corrosion Inhibitors, Ecofriendly, Inhibition Efficiency, Mild Steel.

I. INTRODUCTION

Steel is by far man's most important engineering alloy (Higgins, 1990). However, it poses a serious problem of corroding when exposed to normal climatic conditions. Corrosion occurs in different forms in metallic structure such as in construction industries, industrial process equipment and allied industries. Mild steel accounts for a great deal of metallic material in these industries and is susceptible to various forms of corrosion such as pitting corrosion, uniform corrosion, intergranular corrosion, stress corrosion cracking and fatigue corrosion. Corrosion prevention has become more critical in process industries as it relates to products contamination in pigments, food and drugs. In some cases very small amount of corrosion that introduces some items into a solution may cause catalytic decomposition and may make the product toxic (Uhligh and Revic, 1985). This scenario may lead to fatal body injury if the product is consumed. It is therefore imperative that plant failure and contamination of products through corrosion is prevented for high productivity and cost saving. Corrosion is the disintegration of an engineered material into its constituent atoms due to chemical reactions with its surroundings. These surroundings, such as acids, water, salt water, mud water, air etc. are corrosive media (Baroux et al, 1995). A lot of money is lost every year due to corrosion. In United State, industries and government loss approximately S276 dollars annually or 3.1 percent of the GDP (Gerhardus *et al.*, 2002). It was estimated that about 25 to 30 % of this total could be avoided if corrosion prevention technologies are put in place (Gerhardus *et al.*, 2002). In Australia, Great Britain and Japan, the cost of corrosion is approximately 3 to 4 percent of the GDP (Kruger and Uhligh, 2000). Therefore, a way of preventing or avoiding corrosion is not only timely but also important. If corrosion is prevented, the money loss to corrosion can be channeled to other uses like creation of employment especially in developing countries like Nigeria where poverty level is above 70 %. (Federal Office of Statistics, 1996). There are several methods of corrosion control and prevention but this work looked at corrosion inhibitor as a way of preventing corrosion. Corrosion inhibitor is a chemical compounds that when added to a liquid or a gas, decreases the corrosion rate of a material (Yuhazri *et al.*, 2011a; Hubert, 2007). The performance of a corrosion inhibitor depends on quality of water, fluid composition and flow regime.

The common mechanism for inhibiting corrosion involves formation of a coating, passivation which prevents access of the substance to the metal. Inhibitors are added to many systems such as cooling systems, chemical, oil and gas production unit, boilers and refinery unit to prevent corrosion. In most cases, the effective inhibitors used contain heteroatom such as oxygen, nitrogen, sulphur and multiple bonds in their structure through which they are adsorbed on the surface of the metal (Singh *et al.*, 2012a; Yuhazri *et al.*, 2011b). It was observed by (Singh *et al.*,2012b) that adsorption depends solely on certain physiochemical properties of the inhibitor groups such as functional groups, electronic skeleton of the molecules and electron density at the donor atom. Many manufactured inhibitors have shown to have good anticorrosive ability but majority of them are toxic to human and environment. As a result of the adverse effects of synthetic inhibitors, plant extracts which are organic are now substituting the chemical inhibitors because they are environmental friendly, cheap, readily available and ecologically acceptable which make them to be green corrosion inhibitors.

II. EXPERIMENTAL METHODOLOGY

The mild steel coupon used for this study was provided by mild steel retailer at Ado Ekiti, Ekiti state, Nigeria and its chemical composition was obtained when subjected spectra analysis which is shown in Table 1.

Table 1 Chemical Composition of Mild Steel

Element	C	Si	Mn	P	S	Ni	Fe
% Composition	0.2522	0.1420	0.6255	0.0344	0.1420	0.1032	98.2273

The steel rod was prepared to meet test size specification of 8mm diameter and length of 30mm. The surface of the specimen was machined and finely ground with emery paper in order of size 220, 220, 220 and 400. This was to prevent the setting up of local anodic/cathodic region which an uneven specimen surface could create. The surface was subsequently pickled and degreased using mild acid and acetone solvent. The specimen was thereafter dried for some time and weighed on a sensitive digital weighing balance and placed in a desiccator to prevent corrosion prior to the experiment.

Preparation of Banana peel extract

An aqueous extract of Banana peel was prepared by grinding each weight of banana peel separately, 200g and 400g with distilled water, filtering the suspending impurities, and making up to 200 ml. The extract was used as corrosion inhibitor in the present study.

Weight Loss Method

Different mild steel coupons were used as the test specimen and each was immersed in 0.3M H_2S0_4 and 0.3M Hcl separately without Banana peel extract. The steel coupon was removed and weighed after 24 hours to determine loss in weight. It was immersed again in the media and at 48 hours, it was removed and reweighed. This was repeated after 72 hours, 96 hours, 120 hours, 144 hours and 168 hours. It was ensured that the inhibitor solution was completely removed from the coupon before weighing. The same procedure was carried out for all the inhibited media i.e 200g/10ml and 20ml, 400g/10ml and 20ml. of 0.3M H_2S0_4 and 0.3M HCl respectively. All the experiments were performed at ambient temperature.

The weights of the specimens before and after immersion were obtained using a Digital Balance. The corrosion inhibition efficiency (IE) was then calculated using the equation 1.

$$IE = 100\left[1-\left(\frac{W2}{W1}\right)\right]\%$$

Where W_1 = weight loss value in the absence of inhibitor and

W_2 = weight loss value in the presence of inhibitor.

III. RESULTS AND DISCUSSION

Table 1 shows the weight of mild steels coupon in different concentration of 400g of Banana peel extract in 0.3M H_2S0_4 at different time interval.

Table 1a: Weight of steel coupon in different concentration of 400g of banana peel extract in 0.3M H_2SO_4 at different time interval.

BPE (ml)	initial	24 hr	48 hr	72 hr	96 hr	120hr	144hr	168hr
10	11.93	11.50	11.40	11.30	11.27	11.14	11.09	11.07
20	10.59	10.43	10.18	10.38	10.18	10.14	10.08	10.05

International Journal of Engineering Applied Sciences and Technology, 2018
Vol. 3, Issue 3, ISSN No. 2455-2143, Pages 6-10
Published Online July 2018 in IJEAST (http://www.ijeast.com)

Table 1b: Weight of steel coupon in different concentration of 200g of banana peel extract in 0.3M Hcl at different time interval.

BPE(ml)	initial	24 hr	48 hr	72 hr	96 hr	120hr	144hr	168hr
10	9.35	9.20	9.06	8.93	8.67	8.49	8.21	7.98
20	8.30	8.26	8.17	8.07	7.94	7.80	7.65	7.55

Table 2 shows the weight loss of mild steel coupon in different concentration of banana peel extract in 3.0M H_2S0_4 at different time interval.The result revealed that as the concentration of inhibitor increases, the weight of mild steel coupon loss decreases. This means that the inhibitor concentration is inversely proportional to weight loss of materials. It also showed that corrosion is a function of time. That is as time increases, the rate of corrosion also increases at a specified condition.

Table 2a: Weight loss of steel coupon in different concentration of 400g of banana peel extract in 0.3M H_2SO_4 at different time interval.

BPE(ml)	0 hr	24 hr	48 hr	72 hr	96 hr	120 hr	144 hr	168 hr
10	0	0.43	0.53	0.63	0.66	0.79	0.84	0.86
20	0	0.16	0.41	0.21	0.41	0.45	0.51	0.54

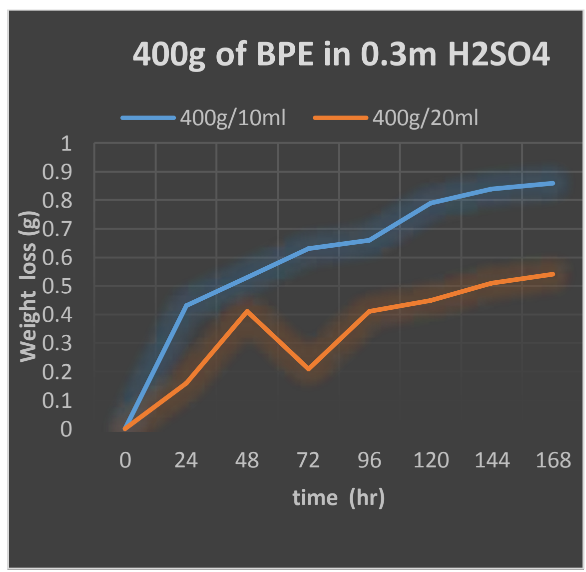
Table 2b: Weight loss of steel coupon in different concentration of 200g of banana peel extract in 0.3M Hcl at different time interval.

BPE(ml)	0 hr	24 hr	48 hr	72 hr	96 hr	120 hr	144 hr	168 hr
10	0	0.15	0.29	0.42	0.68	0.86	1.14	1.37
20	0	0.04	0.13	0.23	0.36	0.50	0.65	0.75

Table 3 shows the inhibitor efficiency for various weight and concentration of banana peel extract in 0.3M H_2S0_4 and 0.3M Hcl at different time interval. It shows in 200g weight of BPE in 0.3M H_2SO_4 that as the inhibitor concentration increases, percentage of inhibitor efficiency also increases which means inhibitor efficiency is directly proportional to inhibitor concentration at a particular time. It also revealed that at a specified concentration, percentage inhibitor efficiency is inversely proportional to time that is as time increases, percentage inhibitor efficiency decreases. The result also shows that the percentage inhibitor efficiency in Hcl is higher than that of H_2SO_4. The optimum inhibitor efficiency was approximately 93% which corresponds to 400g/20ml Banana peel extract in 0.3M Hcl at 48 hours.

Table 3: Inhibitor efficiency for various weight and concentration of Banana peel extract in 0.3M H_2SO_4 and 0.3M Hcl below

Concentration of BPE	%IE at						
	24 hrs	48 hrs	72 hrs	96 hrs	120 hrs	144 hrs	168 hrs
400g/20 ml (Hcl)	90	93	83	79	73	68	71
400g/20 ml (H_2SO_4)	62	27	69	49	48	43	40
200g/10 ml (H_2SO_4)	49	54	63	52	42	24	20
200g/20 ml (H_2SO_4)	87	80	80	75	66	57	47



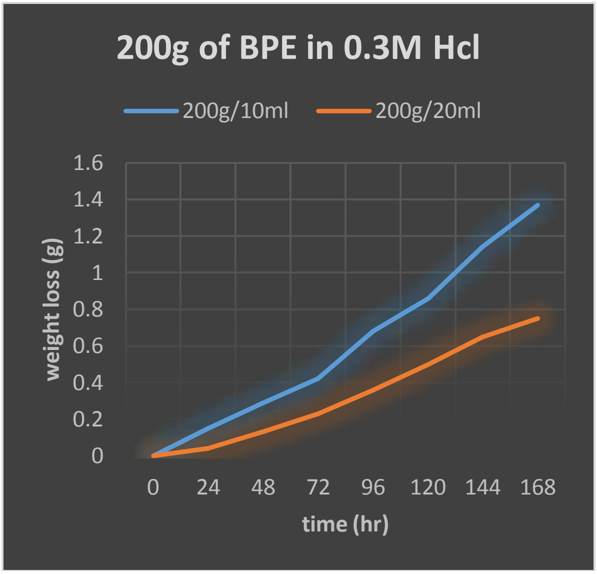


Figure 1: Graph of weight loss against time both in H_2SO_4 and Hcl of different weight of BPE.

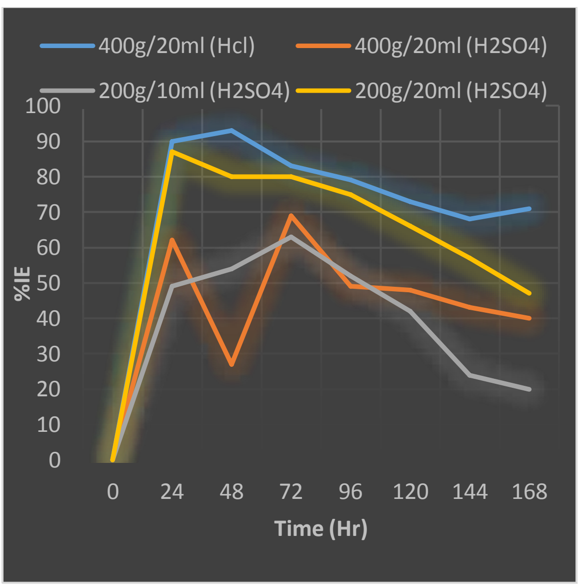


Figure 2: Graph of % IE against time at different concentration in HCl and H_2SO_4

IV. CONCLUSION

This study has shown that Banana peel extract can be used as corrosion inhibitor. As the concentration of inhibitor produced increases, the corrosion rate decreases and the inhibitor has an optimum efficiency of about 93 % which proved that its usage in the process industries will reduce drastically the corrosion rate. If the Banana peel extract is used as corrosion inhibitor, it will reduce the amount of money spent on importing chemical inhibitors and also make our environment less prone to pollution. In the same vein, banana peel extract will be more effective in HCl environment than in H_2SO_4 because of its higher inhibition efficiency.

The contribution of Ogundeji Francis, a technologist in the Department of Mineral and Petroleum Engineering, Federal Polytechnic, Ado-Ekiti, Ekiti State, during the experiment made this study a success. We really appreciate your effort.

V. REFERENCES

[1] **Baroux B., Marcus P., Oudar J. (1995a)**: Further insight on pitting corrosion of stainless steel. Corrosion mechanisms in theory and practice Marcel Delker Inc., New York, 1995, (pg265-309).

[2] **Baroux B. and Marcus P. (1995)**: ECS Meeting proc 95-15, Chicago, 368.

[3] **Gerhard H., Michael K., Brongers P., Neil G. (2002):** Corrosion costs and preventive strategies in the united states – Publication no FHWA – RD – 01- 156.

[4] **Hubert C., Voordouw G. (2007):** Control of sourcing through a novel class of bacteria that oxidize sulfide as well as oil organics with nitrate. Proceedings of corrosion/2006, NACE international Houston TX,(pp 06669.73(8), 2644-2652)

[5] **Kruger J. and Uhligs W. (2000):** Corrosion Handbook, 2nd edition, Wiley, (pp 165 – 170.)

[6] **Federal Office of \Statistics (1996):** Poverty profile for Nigeria: a statistical analysis of 1996/1997 national consumer survey.

[7] **Higgin R.A., Krieger R.E., Malaber F.L. (1990):** Engineering metallurgy, 5th edition, Krieger, Melabar, FL, 1983.

[8] **Singh, A., Ahmed I., Yadav D.,Singh V.,Quraishi M.(2012):**The effects of environmentally benign fruit extract on shahjan(moringa oleifera) on the corrosion of mild steel in hcl solution, chem . Engr. Commun. J, 199 (1), (pp. 63 – 77).

[9] **Singh A., Ebenso E., Quraishi M. (2012b):** Theoretical and Electrochemical; studies of metal forming as corrosion inhibitor for mild steel in hcl acid solution, Int j. Electrochem. Sci, 7,(pp.4766 – 4779.)

[10] **Uhligh W and Revic H. (1985):** Corrosion and corrosion control 3rd edition, John Wiley and sons, New York.

[11] **Yuhazri Y.,Jeefferie A.,Sihombing H.,Nooririnah O.,Warikh A. (2011) :** Coating effect condition on the corrosion

properties of mild steel substrate. International journal of applied science & technology.1 (1)(pp45 – 49.)