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Fruit peels as corrosion inhibitors of metals in acidic media: A short review

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Abstract

The research on nontoxic, plant-based corrosion inhibitors has gained momentum in the last few years. Productive uses of fruit waste which comprises of rind, peels and seeds are also being explored as they pose a major problem of waste disposal the world over. Fruit peels can prove to be effective eco - friendly corrosion inhibitors. In this short review some of the fruit peels used for corrosion mitigation for various metals over recent years have been compiled in a tabular form. The techniques used and percentage efficiencies obtained for the maximum inhibitor concentration are also mentioned.

Keywords: Fruit peels; Inhibitor; Corrosion; Waste; Acidic; Mild steel

1. Introduction

Corrosion of metals assumes significance as it can have dire economic and structural losses. It occurs during exposure to acid solutions during processes of pickling, descaling, acid cleaning or oil well acidizing [1-4]. Various long - established methods for corrosion mitigation of metals include cathodic or anodic protection, electroplating, surface coatings, alloying, galvanization etc. [5]

Inhibitors can also assist in environmental control of corrosion when added to the solution in minute quantities.[6].

Synthetic inhibitors have traditionally been in widespread use for reducing corrosion. They have an extended shelf life [7] and usually higher efficacy. Synthesized inhibitors include amines, nitriles, phosphates, Schiff bases, carbazones [8]. However, their toxicity to aquatic organisms [9], environment and human health has been documented [10].

Safer and greener alternatives to retard corrosion rate of metals are being researched. In this area, plant-based corrosion inhibitors exhibit promising results in terms of inhibition efficiency, cost effectiveness, sustainability and bio degradation [11].

Fruit peels waste is emerging as a significant option in this regard. Tropical fruits such as banana, mango, watermelon and common citrus fruits like orange and lemon generate millions of tons of waste each year [12]. Inedible and perishable peels of these fruits are generated in an enormous volume. They pose a serious threat to the environment because of high fermentation and biodegradability. They can be utilized as a substrate to bio fertilizer, antioxidants, energy production and adsorbents [13]. Use of various fruit peels has also been listed in the treatment of different ailments [11]. The utilization of fruit peels to inhibit corrosion aids the principle of circular economy [14].

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2. Fruit peels

The present study aims to compile a short review on the recent use of fruit peels as corrosion inhibitors of various metals in acidic medium. These are tabulated below.

Table 1 Fruit Peels as corrosion inhibitors of various metals in acidic medium

Fruit Peel	Material	Acid Concentration	Techniques Used	Corrosion Inhibition efficiency and corresponding concentration of inhibitor
Sweet Orange Peel (Citrus sinensis) [11]	Mild Steel	5.0 Molar HCl	Weight loss, Gasometric, Potentiodynamic polarization, Electrochemical Impedance Spectroscopy, SEM	93.38% at 4.0g/l
Banana Peel [15]	Mild Steel	0.1Molar HCl	Weight loss, Electrochemical techniques, FTIR	87% at 500ppm
Banana Peel [16]	Mild Steel	1 Molar HCl	Weight loss	88.99% at 500ppm(25^{o}C)
Red Dragon Fruit Peel [17]	Mild Steel	1 Molar HCl	Weight loss, Thermodynamic studies, Statistical analysis, Optical microscopy	97.41% at 2.0%RDF waste peel extract
Banana Peel [14]	A36 Mild Steel	0.5 Molar HCl	STEM, Colorimetry, Gravimetry, pH and Conductivity analysis	24.44% at 15% inhibitor extract
Banana Peel [18]	Aluminium & Mild Steel	H_2SO_4	Weight loss technique	67.32% on Al and 62.45% on mild steel (5%)
Pomegranate Peel [19]	Mild Carbon Steel	1Molar HCl	Weight loss technique, FTIR, Light microscopy, Tafel plots	83.18% at 4% inhibitor vol
Citrus Limonum Peels [20]	A36 Mild Steel	0.5 Molar H_2SO_4	SEM, EDX, Thermodynamic analysis	94% at 0.4 w/v%(28^{o}C)
Jackfruit Peel Extract [21]	Carbon Steel	1 Molar HCl	Weight loss, Potentiodynamic polarization method	90.98% at 1000ppm

3. Conclusion

The above compilation displays the efficiency when peels of various fruits are used for metal corrosion inhibition purpose in acidic media. The results are reasonably good. These may be associated with the presence of biological molecules capable of interaction with surfaces of metals.[22] It may be concluded that waste of fruit peels can be put to judicious use as corrosion inhibitors.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] M. K. Bagga , R. Gadi, O.S. Yadav , R. Kumar , R. Chopra , G. Singh, Investigation of phytochemical components and corrosion inhibition property of Ficus racemosa stem extract on mild steel in H_2SO_4 medium, JECE 4(A) (2016) 4699-4707.

[2] M. Behpour, S.M. Ghoreishi, M. Khayatkashani, N. Soltani, The effect of two oleo-gum resin exudate from Ferula assa-foetida and Dorema ammoniacum on mild steel corrosion in acidic media, Corros. Sci. 53(2011) 2489-2501.

[3] M.R. Singh, A green approach: a corrosion inhibition of mild steel by Adhatoda vasica plant extract in 0.5 M H_2SO_4, J. Mater. Environ. Sci. 4 (2013) 119-126.

[4] G. Abubakar et al., Kinetic and correlation studies between varying corrosion parameters and corrosion rate of N-80 oil well tubular steel in 15% hydrochloric acid pickling solution using Ficus abutilifolia plant extract, IJECS 2 (2013) 2355-2363.

[5] H. M. Hussein Farh, M. El. Amine Ben Seghier, T. Zayed, A comprehensive review of corrosion protection and control techniques for metallic pipelines, Eng. Fail. Anal.,143 (2023) 106885.

[6] L. A. Nnanna, V. U. Obasi, O. C. Nwadiuko, K. I. Mejeh, N. D. Ekekwe, S. C. Udensi, Inhibition by Newbouldia leavis Leaf Extract of the Corrosion of Aluminium in HCl and H_2SO_4 Solutions. Arch. Appl. Sci. Res., 4 (1) (2012) 207-217.

[7] A.A. Al -Ameiry, W.N. R. Wan Isahak, W.K. Al-Azzawi, Corrosion Inhibitors: Natural and Synthetic Organic Inhibitors, Lubricants, 11(4) (2023) 174.

[8] Shwetha KM, B.M. Praveen, B. K. Devendra, A review on corrosion inhibitors: Types, mechanisms, electrochemical analysis, corrosion rate and efficiency of corrosion inhibitors on mild steel in an acidic environment, Results Surf. Interfaces 16 (2024) 100258.

[9] D.F. Ogeleka, E.L. Ikechukwu, F. Okeieimen, The toxicity of a synthetic industrial detergent and a corrosion inhibitor to brackish water fish (Tilapia guineensis) Turk. J. Biol. (2011) 35(2).

[10] K. Kishora K, B.M. Praveen, B.K. Devendra, Eco-Friendly Approaches to Corrosion Inhibition: A Comprehensive Review of Recent Developments in Plant-Based Inhibitors, IRJET 11 (1) (2024) 182-190.

[11] H. Kumar, V. Yadav, Citrus sinensis peels as a Green Corrosion Inhibitor for Mild Steel in 5.0 M Hydrochloric Acid Solution, Res. J. Chem. Sci. 6(1) (2016) 53-60.

[12] Y. K. Leong, J.S. Chang, Valorization of fruit wastes for circular bioeconomy: Current advances, challenges, and opportunities, Bioresour. Technol.359 (2022) 127459.

[13] S.A. Mandavgane, P.D. Pathak, D B. Kulkarni, Fruit Peel Waste: Characterization and its Potential Uses, Current Sci.113(3) (2017) 444-454.

[14] D. Hidalgo, C. Montero, D. Luna, V. Pazmiño, J. Brito, Evaluation of Banana-Derived Inhibitor for Corrosion Control in Mild Steel, Civ. Eng. Arch. 13(1**)** (2025) 664-677.

[15] C. B. Manikandan, S. Balamurugan, P. Balamurugan, S. L. Beneston, Corrosion Inhibition of Mild Steel by using Banana Peel Extract, IJITEE, 8(6) (2019) 1372-1375.

[16] N.R. Rosli, S.M. Yusuf, A. Sauki, W. Razali, Musa Sapientum (Banana) Peels as Green Corrosion Inhibitor for Mild Steel, Key Eng. Mater., 797 (2019) 230-239.

[17] R.R. Macadangdang JR, Red Dragon Fruit (Selenicereus costaricensis) Waste Peels as Corrosion Inhibitor: Adsorption and Thermodynamic Studies in Acidic Environment, IJB, 19(3) (2021) 99-109.

[18] C. Ayotamuno, Inhibiting Effect of Banana Peel Extract (BPE) On the Corrosion of Aluminium and Mild Steel in a Sulphuric Acidic Environment, 6(9) (2023) 54-60.

[19] A.M. Salim, N.M. Dawood, R. Ghazi, Pomegranate Peel Plant Extract as Potential Corrosion Inhibitor for Mild Carbon Steel in a 1 M HCl Solution, Mater. Sci. Eng. 987 (1) (2019)

[20] A.A. Ayoola, R. Babalola, B.M. Durodola, E.E. Alagbe, O. Agboola, E.O. Adegbile, Corrosion inhibition of A36 mild steel in 0.5 M acid medium using waste citrus limonum peels, Results Eng. 15 (2022) 100490.

[21] I. Kusumaningrum, R. Soenoko, E. Siswanto,F. Gapsari, Jackfruit Peel Extract as Environmentally Safe Inhibitor for Carbon Steel Protection in Acidic Solution, JNMES, 25(1) (2021) 46-54.

[22] O.E. Elazabawy, E.M. Attia, N.H. Shawky, A.M. Hyba, Eco- friendly orange peel extract as corrosion resistant for carbon steel's deterioration in petroleum formation water, Sci. Rep. 13 (2023) 21943.