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Predictive model for the corrosion inhibition of mild steel in 1.5 M HCl by the leaf-juice of *Carica papaya*

ABSTRACT

This current study employed the predictive models driven by the artificial neural network (ANN) and multiple regression (MR) to forecast the corrosion inhibition of mild steel in 1.5 M HCl by the leaves of the Carica papaya plant. Corrosion studies were carried out using the weight loss method at room temperature. The corrosion rate of the mild steel coupon, obtained from the study environment was predicted taking into cognizance the influence of the independent variables viz: the time of exposure, the concentration of HCl (1.5 M), and the concentration of the papaya leaf juice. The fresh papaya leaves were obtained within the surrounding of the Federal University of Technology, Owerri, Imo State, Nigeria. A grinding machine powered by an internal combustion engine was used for grinding the fresh leaves, and a white cloth was utilized to squeeze out the juice. Filtration of the produced juice was done twice with a clean white cloth. Different bowls containing mild steel coupons (5.0 x 5.0 x 0.1 cm) and HCl (1.5 M) solutions were treated with Carica papaya leaf extracts at concentrations of 5 ml, 10 ml, 15 ml, and 20 ml. Results indicated that the highest inhibition efficiency of 95.91% was observed after 120 hours when 20 ml of papaya leaf extract was added. Conversely, the highest corrosion rate of 114.19 mpy was recorded after 24 hours of exposure to HCl (1.5 M) with 5 ml of papaya leaf extract. Generally, the addition of papaya leaf extract in different concentrations added to 1.5 M HCl resulted in a decrease in the rate of mild steel corrosion over time. It was noted that the prediction of the experimental corrosion rate by the artificial neural network offered a lesser error in comparison with that obtained by multiple regression according to the error margin obtained after the prediction of the experimental corrosion rate.

***Keywords:** Inhibitive model, papaya leaf juice, corrosion, mild steel, artificial neural network, multiple regression*

1. INTRODUCTION

The action of preventing the interaction between a material and a corrosive environment, when a substance is added in minute quantity to the corrosive medium is referred to as corrosion inhibition [1, 2]. The level of noxiousness of manufactured corrosion inhibitors that are effective such as phosphates-, molybdates-, and chromates-based [3,4] has currently necessitated the search for alternative sources of plant extracts that can serve as their replacement [5, 6]. Main organic chemicals found in plant extracts have been reported to prevent rusting and various plant sections have a significant impact on the output of these chemicals as well as their capacity to suppress corrosion [7,8]. Studies have shown that plant extracts from leaves, roots, heartwood, fruits, bark, and seeds can prevent metallic corrosion in acidic environments [9-11].

For a long time, researchers have been investigating potent methods of corrosion control by introducing materials or processes that can protect the alloys that are susceptible to corrosion from degrading [12-14]. Corrosion inhibitors, which are particularly helpful in primer coatings and also used in industrial process streams also shield the metals and alloys in continuous contact with corrosive environments [15] from degradation. The majority of plant-based inhibitors offer their inhibitive capabilities by adhering to the surfaces of

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the corroding metals where they influence the anodic or cathodic processes in one way or another [16-22] to avert corrosion. Furthermore, because of its established technology, straightforward operation, and exceptional protective impact, the application of the inhibitor during pickling has been revealed as one of the key strategies for preventing metal corrosion [23-27]. Ravi et al. [28] have identified bio-based constituents in coatings and anticorrosive systems as viable alternatives for synthetic organic and inorganic materials used to deter metal corrosion. On the other hand, Dagdag et al. [29] acknowledged the efficacy of plant extracts to inhibit the corrosion of metals while Abdel-Karim et al. [30] maintained that active corrosion-inhibitive components are readily available in plants, making them a veritable source for the development of corrosion inhibitors.

A recent study to unravel the corrosion inhibition effectiveness of some active phytochemical constituents of Allium Jesdianum flower has been undertaken [31]. The phytochemicals were scrutinized using Monto Carlo simulations and DMol3 to understand their effectiveness to inhibit corrosion as well as their adsorption characteristics and chemical interactions. The results revealed that the phytochemical component, I-Ecosanol was more efficacious at inhibiting corrosion and all the phytochemicals were found to adsorb on the surface of the metal in a parallel manner [30]. In another study, Kaya et al. [32] worked on the corrosion deterrence of mild steel by the Rheum ribes leaf extract in a 1M HCl medium. They conducted their investigations by carrying out electrochemical, potentiostatic, and potentiodynamic studies. It was reported that the increase in the concentration of the leaf extract led to a higher inhibition efficiency of up to 94.9 % at about 1000 ppm Rheum ribes leaf extract concentration. In another study, the authors [33] found that the leaf extract of Rheum ribes impeded both the cathodic and anodic reactions of the corrosion process. Three plant extracts viz: roots of Zingiber zerumbet, seeds of Fraxinus excelsior, and leaves of Isatis tinctoria extracts have been used to prevent the degradation of mild steel in phosphoric acid [34]. The authors reported that an increase in the extract’s concentration increased the inhibition efficiency with the Fraxinus excelsior seed extract outperforming the others. The corrosion inhibition of all the studied extracts was found to be of mixed type. Huang et al. [35] separated the phytochemical called cinchonain ila from the Uncaria laevigata plant and used it to inhibit the corrosion of steel (Q235) in the HCl (1 M) medium. They reported an inhibition efficiency of 94.08 % after 2 days following the addition of 200 mg/L cinchonian ila. Subsequently, after 28 days, about 93 % inhibition efficiency was observed. In another interesting study, Al-Qurashi et al. [36] isolated three phytochemicals from the flower of Aerva lanata plant to investigate their chemical reactivities and corrosion behaviour. They observed that all the studied phytochemicals showed physisorption and chemisorption characteristics. The phytochemicals were found to adsorb in a parallel manner on the surface of the inhibited material. In another study, Vashishith et al. [37] investigated the corrosion inhibition of mild steel in hydrochloric acid (1M) medium using a natural inhibitor (i.e., black pepper) and two synthetic inhibitors namely: phenosafranin dye and thoron dye. They conducted their corrosion studies using electrochemical impedence, potentiodynamic polarization, and weight loss techniques. It was reported that the black extract gave the highest inhibition efficiency of 97 % while its adsorption behaviour was found to conform with the Temkin and Langmuir adsorption isotherm models. Berrissoul et al. [38] on the other hand, inhibited the corrosion of mild steel in 1 M HCl using the ethanol extracted Origanum Compactum plant. The results showed that the addition of 400 mg/L concentration of the extract produced an inhibition efficiency of 90 %. The inhibitor was found to agree with the Langmuir isotherm model while exhibiting a mixed-type inhibition behaviour.

The use of plant extracts as corrosion inhibitors has gained attention from both environmental and cost perspectives [39-41]. Previous studies have explored the use of different plant-leaf extracts such as sida acuta, clerodendrum splendens, voacanga Africana, tridax procumbens, and landolphia dulcis [42-46] to reduce the rate of mild steel degradation in various acidic solutions with positive results [47]. Specifically, Carica papaya leaf extract has shown promise in preventing bio-corrosion in mild steel in the maritime environment [48]. In one study [49], the leaf juice of the papaya plant effectively inhibited corrosion in hydrochloric acid (1 M), with a 97.99% inhibition efficiency observed after immersing the mild steel coupon in the corrosive environment for 480 h.

According to previous research [50], Carica papaya, also known as papaya and pawpaw, is thought to have originated from Southern Mexico and Central America [51-54]. The plant is not only cultivated for its tasty fruit but also for its leaves, seeds, bark, flowers, latex, and roots, which have been used in traditional medicine globally [55,56]. The present study aims to investigate the potential use of Carica papaya leaf extract as an inhibitor for the protection of mild steel against degradation in

1.5M HCl. The study will include an examination of the rate of mild steel degradation in both inhibited and uninhibited acidic media, as well as an assessment of the inhibitory effects of the leaf juice of Carica papaya on mild steel degradation using the weight-loss method. By taking into consideration the impact of some independent variables, namely the exposure duration, concentration of HCl (1.5M), and papaya leaf juice concentration, the study will also attempt to forecast the rate of corrosion of the mild steel coupon obtained from the study environment. The forecasting is to be achieved using multiple regression (MR) and artificial neural networks (ANN).

2. MATERIAL AND METHODS

2.1. Materials and Equipment

The primary components utilized in the study were Carica papaya leaves, hydrochloric acid, acetone, and distilled water (all of the analytical grades with 99.99% purity). The tools and equipment used for the study include the foot shear cutter, drilling machine, centre punch, scriber, and the Ohaus digital weighing balance. The Carica papaya leaves were acquired nearby at the Federal University of Technology in Owerri, Nigeria. Before setting up the apparatus for the experiment, the plant leaves were squeezed to obtain the juice, the mild steel coupons on the other hand were fabricated, while the acidic environment was prepared using the dilution formula.

2.2. Fabrication of coupons made of mild steel

The foot shearing cutter and drilling machine were used to produce the mild steel coupons. The sheet metal of 20 by 20 by 0.1 cm was physically press cut into dimensions of 5.0 cm by 5.0 cm by 0.1 cm. To permit their suspension into the research environment, the coupons had a hole drilled through the centre of their upper sides.

2.3. Production of the plant-leaf extract

Carica papaya leaves were gathered and ground with a grinding machine powered by an internal combustion engine; a bowl was placed at the lower end of the grinder to retrieve the ground leaves. After that, a filter (clean white cloth) was used to separate the ground leaves from the juice (extract) during squeezing. This filtering process was repeated two times to ensure a pure filtrate. Consequently, the filtrate` was stored in a plastic container at room temperature. This became the stock inhibitor solution from which measured concentrations of the extracts were introduced into the various solutions for experimentation as was previously reported [57].

2.4. Weight loss experiment

The weights of the coupons were initially measured using an electronic weighing scale with high precision before exposing them to various research conditions. The coupons were abraded with coarse and fine abrasive papers, degreased with acetone, and allowed to dry for five minutes.

Next, five coupons were placed in each bowl of the 1.5M HCl solution that had been supplemented with papaya leaf extracts at concentrations of 5 ml, 10 ml, 15 ml, and 20 ml, respectively and left to soak at room temperature. The uninhibited system did not contain any inhibitors. At the end of each day, one coupon was removed from the research environment, cleaned with acetone, and allowed to dry for five minutes before its final weight was determined using a digital balance made by Ohaus. The experiments took 120 hours to complete.

The corrosion rate, measured in mils penetration per year, was calculated using the following equation [58]:

Corrosion rate,

$$R_{Corr}\ (mpy) = 534W_{loss}/\rho AT \qquad (1)$$

Where:

W_{loss} (mg) - weight loss (mg)

A in (in^2) - an exposed area of the specimen

ρ (g/cm^3) - specimen density

T (h) - the time that the specimen was exposed

The following formula was used to measure inhibition effectiveness (in percentage) [53-56]:

$$E_{IE} = (R_{if} - R_{in})/R_{if}) \times 100 \qquad (2)$$

Where:

E_{IE} (%) - inhibition effectiveness of efficiency

R_{if} (mpy) - inhibitor-free corrosion rate

R_{in} (mpy) - corrosion rate with an inhibitor

2.5. IBM SPSS software

SPSS, which stands for Statistical Package for the Social Sciences, is a software that is suitable for analysing different kinds of data from any source including, research (scientific), and even the customer's database [59]. The software enables the prompt extraction of immeasurable insights from any data [60]. SPSS presents data in a spreadsheet-like format. This sheet, known as the data view, always shows data values. A variable view sheet is included in the SPSS data file. It displays the metadata that is linked with the data. Metadata is data that describes the meaning of variables and data values. This is commonly referred to as the "codebook" [59]. This current study predicted the dependent variable (experimental corrosion rate) as a result of the influence of independent variables including the concentration of papaya leaf extract, time of exposure, and concentration of HCl (1.5 M).

2.5.1. Predictive models

2.5.2. Artificial neural networks

The artificial neural network (ANN) paradigm entails calculations and mathematics that imitate human-brain activities [61]. According to Mohseni-Dargah et al. [62], artificial neural networks (ANNs) are composed of input, hidden, and output layers with linked neurons (nodes) to replicate the human brain.

ANN has been used to determine the interdependence of input and output variables. With the input database, an appropriate ANN structure can predict output variables [63]. This current study utilized the multilayer perceptrons (MLPs) as the predictive protocol within the ANNs. MLPs in simple terms, are supervised procedures with three layers: input, hidden, and output [64]. With hyperbolic tangent and identity as the hidden and output layer activation functions respectively, the pictorial representation of the current study is presented in Figure 1.

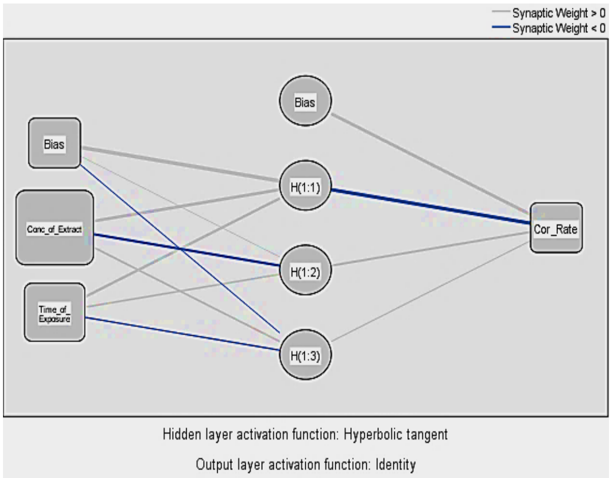

Figure 1. Pictorial representation of the hidden and output layer activation functions

Slika 1. Grafički prikaz funkcija aktivacije skrivenog i izlaznog sloja

2.5.3. Multiple Regression (MR)

A statistical method called multiple regression may be used to investigate the relationship between a single dependent variable and several independent variables. Using well-known independent variables, multiple regression analysis seeks to forecast the value of a single dependent variable [65]. Basic linear regression [y = f(q)] may be expanded to more complicated multiple regression [$y = f(q_1, q_2, q_3,..., q_n)$]. The equation for multiple regression is as follows [66]:

$$Y = g + h_1q_1 + h_2q_2 \pm p \quad (3)$$

Where;

g = on the y-axis, the intercept

h_1 and h_2 = coefficients of partial regression.

q_1 and q_2 = the autonomous variables.

and p = an error term.

2.6. Error in Prediction

The mean square error (MSE) is a tried-and-true technique for examining prediction errors. It is used to assess how well the anticipated value corresponds to the actual value. In mathematics, it is stated as follows [67-69]:

$$MSE = (1/c)\sum(p - q)^2 \quad (4)$$

In this case,

p = Predicted value.

q = Real value.

c = Number of samples taken into account.

3. RESULTS AND DISCUSSION

3.1. The impact of incorporating extracts from papaya leaves on the corrosion of mild steel coupons immersed in 1.5 M HCl

The results of the study's various research conditions, which used 5 ml, 10 ml, 15 ml, and 20 ml of papaya-leaf extracts in 1.5 M HCl, are presented in Table 1, and Figures 2 and 3 display the findings of corrosion rates and inhibition efficiencies.

Table 1. Impact of the addition of Carica papaya plant leaf extract on the corrosion of mild steel immersed in 1.5M HCl

Tabela 1. Uticaj dodatka ekstrakta listova biljke Carica papaya na koroziju mekog čelika uronjenog u 1,5M HCl

T, (h)	5 ml		10 ml		15 ml		20 ml	
	R_{Corr},(mpy)	E_{IE}, (%)	R_{Corr}, (mpy)	E_{IE}, (%)	R_{Corr}, (mpy)	E_{IE}, (%)	R_{Corr} (mpy)	E_{IE}, (%)
24	114.19	60.29	45.53	84.17	13.45	95.33	36.51	87.30
48	66.35	80.63	37.29	89.12	26.95	92.13	31.51	90.80
72	32.31	93.28	30.75	93.61	27.85	94.21	25.84	94.63
96	47.12	89.25	27.45	93.74	29.97	93.16	25.69	94.14
120	46.18	87.31	21.82	94.00	15.65	95.70	14.89	95.91

The corrosion rate and inhibition effectiveness were calculated using Equations 1 and 2. It was observed that the rate at which the steel coupon corroded generally decreased with time when papaya leaf extract was introduced to 1.5 M HCl.

The study used different concentrations of papaya leaf extracts (5, 10, 15, and 20 ml) to evaluate the inhibition efficiency of these extracts in 1.5 M HCl. The results of the study are shown in Figures 2 and 3, which depict the corrosion rate-time and inhibition efficiency-time curves, respectively. It was found that the addition of papaya leaf extracts resulted in a decrease in the corrosion rate of mild steel. Specifically, after 24 hours of exposure to the HCl solution, the addition of 5 ml of papaya leaf extract resulted in the highest corrosion rate of 114.19 mpy with 60.29% inhibition efficiency. This suggests that papaya leaf extract has the potential to inhibit the corrosion of mild steel in acidic environments.

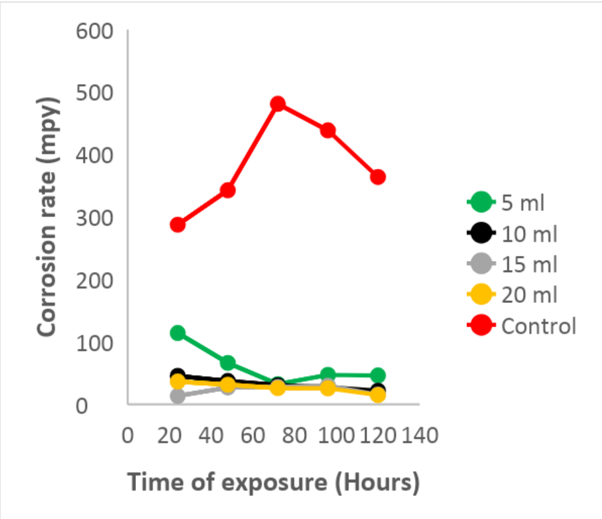

Figure 2. Depicts the outcomes of introducing different quantities of Carica papaya leaf extracts (5 ml, 10 ml, 15 ml, and 20 ml) into a 1.5M HCl solution

Slika 2. Rezultati uvođenja različitih količina ekstrakta listova Carica papaya (5 ml, 10 ml, 15 ml i 20 ml) u 1,5M rastvor HCl

After 48, 72, 96, and 120 hours, respectively, the corrosion rates decreased while the corresponding inhibition efficiencies rose to 66.35 mpy (80.63%), 32.31 mpy (93.28%), 47.12 mpy (89.25%), and 46.18 mpy (87.31%). When 5 ml of papaya extract was added to 1 M HCl, the results of the previous study [49] showed a greater inhibitory efficiency of 97.73% than the 87.31% of the current investigation. The highly acidic (1.5 M HCl) environment used in the current investigation may be the cause of the discrepancy in the results.

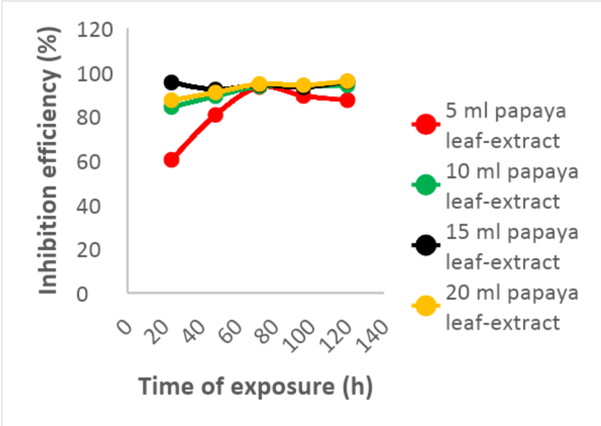

Figure 3. Illustrates the ability of Carica papaya to prevent corrosion on mild steel coupons that were immersed in 1.5M HCl. The experiment involved testing various concentrations of leaf extract, namely 5 ml, 10 ml, 15 ml, and 20 ml.

Slika 3. Ilustracija sposobnosti Carica papaya da spreči koroziju na uzorcima od mekog čelika koji su bili uronjeni u 1,5M HCl. Eksperiment je uključivao testiranje različitih koncentracija ekstrakta lista, odnosno 5 ml, 10 ml, 15 ml i 20 ml.

As the exposure duration increased from 24 hours to 48, 72, 96, and 120 hours, respectively, the corrosion rates dropped from 45.53 mpy (84.17%) to 37.29 mpy (89.12%), 30.75 mpy (93.61%), 27.45 mpy (93.74%), and 21.82 mpy (94%) respectively when the papaya leaf extract was raised to 10 ml in 1.5 M HCl medium. Following the addition of 15 ml of papaya leaf extract, inconsistent values of inhibition efficiencies and corrosion rates were noted. The corrosion rate and concomitant inhibition efficiency were 13.45 mpy and 95.33% at 24 hours, 26.95 mpy (92.13%) at 48 hours, 27.85 mpy (94.21%) at 72 hours, 29.97 mpy (93.16%) at 96 hours, and 15.65 mpy (95.7%) at 120 hours. In addition, the corrosion rates dropped from 36.51 mpy (87.3%) in 24 hours to 31.51 mpy (90.8%) after 48 hours, 25.84 mpy (94.63%) after 72 hours, 25.69 mpy (94.14%) after 96 hours, and 14.89 mpy (95.91%) after 120 hours when 20 ml of papaya extract was added to 1.5 M HCl. The addition of 20 ml of papaya leaf extract in 1.5 M HCl resulted in the maximum inhibition efficiency, which was measured at 95.91%, at 120 hours. This greatest inhibition effectiveness (95.91%) is higher than the earlier reported (94.64%) inhibition efficiency [49] for the addition of the same quantity of papaya leaf extract (20 ml) to a lower concentration of acid (1 M HCl) at 120 h. These investigations' high inhibition efficiency shows that papaya leaf extract is efficient at preventing mild steel corrosion in a hydrochloric acid solution.

Table 2. A summary of the predicted experimental corrosion rate values using ANN and MR

Tabela 2. Rezime predviđenih eksperimentalnih vrednosti brzine korozije korišćenjem ANN i MR

CorrRate (mpy)	Conc. of leaf-extract (ml)	Conc. of acid (M)	Time of exposure (h)	Prediction by ANN		Prediction by MR	
				CorrRate (mpy)	Forecasting error	CorrRate (mpy)	Forecasting error
114.19	5.00	1.50	24.00	107.44	6.75	66.71350	47.4765
66.35	5.00	1.50	48.00	66.23	0.12	59.62100	6.7290
32.31	5.00	1.50	72.00	37.55	-5.24	52.52850	-20.2185
47.12	5.00	1.50	96.00	35.79	11.33	45.43600	1.6840
45.53	10.00	1.50	24.00	49.62	-4.09	55.11200	-9.5820
37.29	10.00	1.50	48.00	32.62	4.67	48.01950	-10.7295
30.75	10.00	1.50	72.00	32.99	-2.24	40.92700	-10.1770
27.45	10.00	1.50	96.00	34.15	-6.7	33.83450	-6.3845
13.45	15.00	1.50	24.00	27.21	-13.76	43.51050	-30.0605
26.95	15.00	1.50	48.00	27.86	-0.91	36.41800	-9.4680
27.85	15.00	1.50	72.00	29.37	-1.52	29.32550	-1.4755
29.97	15.00	1.50	96.00	31.04	-1.07	22.23300	7.7370
36.51	20.00	1.50	24.00	25.12	11.39	31.90900	4.6010
31.51	20.00	1.50	48.00	25.58	5.93	24.81650	6.6935
25.84	20.00	1.50	72.00	26.35	-0.51	17.72400	8.116
25.69	20.00	1.50	96.00	27.50	-1.81	10.63150	15.0585

3.2. Forecasting of the experimental corrosion rate using artificial neural network (ANN) and multiple regression (MR)

The SPSS software aided the forecasting of the experimental corrosion rates by ANN and MR respectively. The predicted values, model coefficients, parameter estimates and the corresponding disparities in forecasting are presented in Tables 2, 3, 4 and 5 and shown in Figures 4 and 5. The corrosion rate was set as the dependent variable whereas the exposure time and concentrations of acid and the leaf extract of papaya constituted the independent variables.

Table 3. Model coefficients for forecasting the experimental corrosion rate of mild steel in HCl (1.5 M) by MR

Tabela 3. Model koeficijenti za predviđanje eksperimentalne brzine korozije mekog čelika u HCl (1,5 M) pomoću MR

Constant	Exposure time (h)	Extract concentration (ml)
85.408	-0.296	-2.320

Table 4. Parameter estimates for predicting the experimental corrosion rate of mild steel in HCl (1.5 M) by ANN

Tabela 4. Procene parametara za predviđanje eksperimentalne stope korozije mekog čelika u HCl (1,5 M) od Ann

Parameter Estimates					
Predictor		Predicted			
		Hidden Layer 1			Output Layer
		H(1:1)	H(1:2)	H(1:3)	Cor_ Rate
Input Layer	(Bias)	4.087	0.003	-0.152	
	Conc_of_Extract	2.199	-0.666	0.438	
	Time_of_Exposure	1.668	0.284	-0.207	
Hidden Layer 1	(Bias)				2.801
	H(1:1)				-3.034
	H(1:2)				0.603
	H(1:3)				0.157

Table 5. Analyses of errors in forecasting the experimental corrosion rate of mild steel in HCl (1.5 M) using the MSE method

Tabela 5. Analize grešaka u predviđanju eksperimentalne brzine korozije mekog čelika u HCl (1,5 M) metodom MSE

Error in prediction	Forecasting of corrosion rate by ANN	Forecasting of corrosion rate by MR
Mean squared error (MSE)	40.7439	279.7566

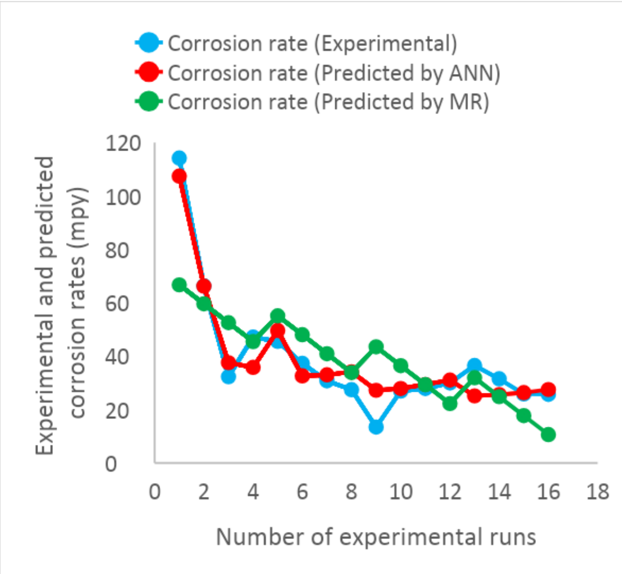

Figure 4. The disparity in the prediction of the experimental corrosion rate by ANN and MR

Slika 4. Disparitet u predviđanju eksperimentalne brzine korozije pomoću ANN i MR

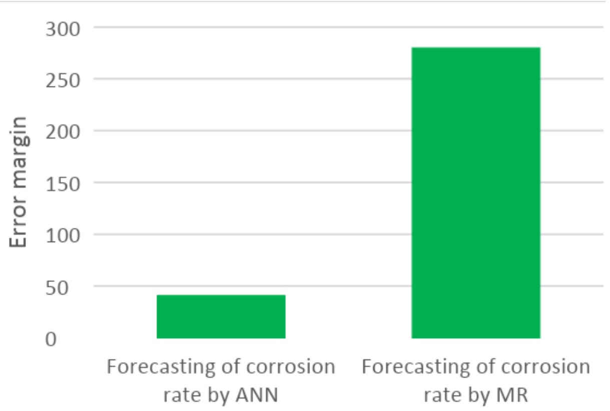

Figure 5. Error margin obtained following the prediction of the experimental corrosion rate by MR and ANN

Slika 5. Margina greške dobijena nakon predviđanja eksperimentalne brzine korozije pomoću MR i ANN

The predictive equivalence for forecasting the experimental corrosion rate occasioned by the papaya inhibition of mild steel in 1.5 M HCl by multiple regression is given below:

$$CorrRate_{[1.5\,M\,(HCl)]} = 85.408 - 0.296\,[Exposure\ time\ (h)] - 2.320\,[Extract\ concentration\ (ml)] \qquad (5)$$

The prediction of the corrosion rate by the artificial neural network was observed to give a minimal error according to the error margin obtained following the prediction of the experimental corrosion rate by MR and ANN. In other words, the predicted corrosion rate values by ANN were far closer to the experimental corrosion values than those predicted by MR.

4. CONCLUSIONS

The following conclusions can be drawn from this current study:

1. In general, the addition of papaya leaf extract to 1.5 M HCl at different concentrations (5 ml, 10 ml, 15 ml, and 20 ml) slowed down the rate of steel coupon corrosion over time. This is an important finding because it suggests that papaya leaf extract could be a useful additive in industrial applications where hydrochloric acid is used and metal corrosion needs to be prevented.

2. The maximum corrosion rate of 114.19 mpy was measured after 24 hours when 5 ml of papaya leaf extract was added to 1.5 M HCl. This finding provides valuable information about the effects of different concentrations of papaya leaf extract on corrosion rates over time. It suggests that there may be an optimal concentration of papaya leaf extract to use in industrial applications where corrosion prevention is important.

3. The highest inhibitory efficacy of 95.91% was achieved after 120 hours when 20 ml of Carica papaya leaf extract was added, according to this study. This finding further supports the potential usefulness of papaya leaf extract as a corrosion inhibitor.

4. The difference in values between the experimental and predicted corrosion rates indicates that the predictions obtained by ANN were closer to the true values than the predictions made by MR.

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IZVOD

MODELIRANJE INHIBITORNOG PONAŠANJA EKSTRAKTA LISTA PAPAJE NA KOROZIJU MEKOG ČELIKA U 1,5 M HCL

Ova studija razvila je model za inhibiciju korozije mekog čelika u 1,5M HCl od strane listova biljke papaje Carica. Studije korozije su sprovedene metodom gubitka težine na sobnoj temperaturi. Brzina korozije uzorka od mekog čelika, dobijenog iz okruženja za proučavanje, je predviđena uzimajući u obzir uticaj nezavisnih varijabli, a to su: vreme izlaganja, koncentracija HCl (1,5M) i koncentracija soka lista papaje. Predviđanje je postignuto korišćenjem višestruke regresije (MR) i veštačkih neuronskih mreža (ANN). Pre toga, sveži listovi papaje su nabavljeni u okruženju Federalnog tehnološkog univerziteta, Overri, država Imo, Nigerija. Za mlevenje svežeg lišća korišćena je mašina za mlevenje sa

motorom sa unutrašnjim sagorevanjem, a za ceđenje soka korišćena je bela krpa. Filtriranje proizvedenog soka je obavljeno dva puta čistom belom krpom. Različite posude koje su sadržavale uzorke od mekog čelika (5,0 k 5,0 k 0,1 cm) i rastvore HCl (1,5 M) tretirane su ekstraktima listova Carica papaje u koncentracijama od 5 ml, 10 ml, 15 ml i 20 ml. Rezultati su pokazali da je najveća efikasnost inhibicije od 95,91% primećena nakon 120 sati kada je dodato 20 ml ekstrakta lista papaje. Nasuprot tome, najveća brzina korozije od 114,19 mpi je zabeležena nakon 24 sata izlaganja HCl (1,5M) sa 5 ml ekstrakta lista papaje. Generalno, dodavanje ekstrakta listova papaje u različitim koncentracijama koje se dodaju u 1,5M HCl rezultiralo je smanjenjem brzine blage korozije čelika tokom vremena. Primećeno je da predviđanje eksperimentalne brzine korozije veštačkom neuronskom mrežom nudi manju grešku u poređenju sa onom dobijenom višestrukom regresijom prema margini greške dobijenoj nakon predviđanja eksperimentalne brzine korozije.

Ključne reči: *Inhibitivni model, sok od lista papaje, korozija, meki čelik, veštačka neuronska mreža, višestruka regresija*

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