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The Use of Tobacco Extract as an Environmentally Friendly Corrosion Inhibitor in the Protection of Steel Pipes in the Soil

Zainab H. Ali[1], Muna K. Abbass[2*], Muthana M. Kassim[1], Mahmood M. Sadalden[1]
[1]Iraqi Corrosion Center, The Cooperation of Research and Industrial Development, Ministry of Industry and Minerals, Baghdad, Iraq.
[2]Dept. of Production Engineering and Metallurgy, University of Technology, Baghdad, Iraq.
*Corresponding Author E-mail: muna.k.abbass@uotechnology.edu.iq

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Abstract

The research aims to solve the problem of corrosion in oil pipes buried in the soil by studying the addition of tobacco extract on the rates of corrosion of low carbon steel in a solution that simulates the soil conditions. The corrosion solution used is an aqueous solution that simulates soil conditions and pH of the solution was pH = 6.8 at 30°C samples of low carbon steels were used, which are used in the petroleum industries. In this research, the Tafel polarization method was carried out in Tobacco extract solution using Potentiostat device was used to measure corrosion parameters: corrosion potential, corrosion current, Tafel slopes and corrosion rates of all samples for the purpose of knowing the inhibition efficiency and completing the corrosion cell calculations. It was found that the samples coated with tobacco dust have lower corrosion currents than that of uncoated base (blank sample) at all month starting from June to November, but the coated samples have the lowest corrosion rate on June month (after 60 days' immersion in soil), the corrosion rate was 0.02237 mpy as comparison to as received blank 5.6168 mpy with inhibition efficiency 99.6%. But it becomes 3.2083 mpy on November month with inhibition efficiency 42.88% on November month because formation of a protective layer on the steel surface, it reduces the corrosion rate due to the absorption of water and the chloride ions.

Keywords: low carbon steel, Tafel polarization ,inhibition efficiency, Tobacco extract, corrosion rate.

أستخدام مستخلص التبغ كمثبط تآكل صديق للبيئة لحماية الانابيب الفولاذية في التربة

الخلاصة:

يهدف البحث الى حل مشكلة التآكل في الانابيب الفولاذية المدفونة في التربة من خلال استخدام مستخلص التبغ لعينات من الفولاذ منخفض الكاربون لغرض بيان تأثيره على معدل التآكل ومدى فعاليته بأستخدام محلول مائي يحاكي مواصفات التربة المستخدمة بمقاومة قريبة من مقاومة التربة ورقم هيدروجيني pH= 6.8 عند درجة حرارة 30°م واستخدام عينات من الفولاذ منخفض الكاربون والتي تستخدم في الصناعات البترولية والمتوفرة محليا. أستخدمت طريقة تافل بأستخدام

جهاز المجهاد الساكن Potentiostate لقياس معدلات التآكل: جهد التآكل، تيار التآكل، ومعدلات التآكل لغرض معرفة كفاءة التثبيط واستكمال حسابات خلية التآكل في درجة حرارة ثابتة 30°م. وكانت النتائج للعينات المغمورة بمستخلص التبغ تيارات التآكل اقل من العينات غير المغمورة في كل من شهر من حزيران الى تشرين الثاني وكانت العينات المغمورة اقل معدل تآكل في شهرحزيران (بعد 60 يوم من الغمر في التربة) وكان معدل التاكل 0.02237 mpy مقارنة بالعينة المستلمة 5.6168 mpy عند كفاءة التثبيط 99.6% في شهرحزيران. واصبح معدل التاكل 3.2083 mpy عند كفاءة تثبيط 42.88% في شهرتشرين الثاني وذلك بسبب تكون طبقة واقية على سطح الفولاذ تقلل من معدل التآكل بسبب امتصاص الماء وايونات الكلوريد الموجودة.

1. Introduction

Metals deteriorate due to corrosion, which may be caused by a chemical attack or chemical reaction with the surrounding environment. This issue never goes away and is notoriously tough to fix permanently. Complete elimination is unlikely ever to be achieved. Thus, focusing on prevention is preferable. Quickly following the disruption of the protective barrier, corrosion processes generate and are accompanied by a variety of reactions. These reactions alter the composition and properties of the metal surface and the surrounding environment, such as the forming of oxides, the diffusion of metal cations into the coating matrix, changes in local pH, and electrochemical potential. Corrosion of mild steel and iron has been the subject of much research because it is of great scientific and practical importance. Corrosion inhibitors are employed in acid solutions to prevent further corrosion of metals during processes such as industrial acid cleaning, acid pickling, acid descaling, and oil well acidizing [1]. Inhibitors are a valuable tool in the fight against the corrosion of metals. Numerous inhibitors are selected from compounds containing heteroatoms in their aromatic or long-chain carbon systems [2] or are produced from inexpensive starting materials. However, these inhibitors often come with a toxic to environment. This has sparked interest in finding environmentally green corrosion inhibitors. The corrosion inhibitors used in environmentally friendly practices are non-toxic and quickly degrade. Plant extracts and medications are examples of "green inhibitors" [3].

Failures in onshore pipelines used to transport gas and hazardous liquids are often targeted by corrosion. Leaks or complete ruptures are two possible outcomes of corrosion failures. The most typical kind of failure is a leak. Due to the dispersion of the escaping gas into the atmosphere, leaks in gas pipelines often do not result in significant property damage. The soil, groundwater, or surface water might get contaminated if a liquid line leaks. However, gas pipeline ruptures are more likely to end in an explosion and fire, which in turn results in more fatalities and injuries. Onshore lines have accounted for almost all corrosion types in liquid pipelines. Since the likelihood of a human being in close proximity to an offshore failure is so low, it is not unexpected that the few injured offshore lines have not resulted in any fatalities or injuries [4]. There is significant potential for using tobacco plant extracts as environmentally friendly corrosion inhibitors. Using extracts from stems, twigs, and leaves significantly reduces corrosion when aluminum or steel is submerged in salt water or when steel is submerged in powerful pickling acids. The inhibition is supplied throughout a broad range of extract solution concentrations, and in some situations, it is more vital than that provided by chromates. Bright and shiny steel resulted after treating it in sulfuric acid with tobacco extract to eliminate mill scale and rust. Steel was blackened and pitted when treated with sulfuric acid alone. The tobacco extracts serve as corrosion inhibitors and come from a renewable resource with no ecological effect. Corrosion inhibitors may be obtained from waste plant material at a low cost.Tobacco products contain a high concentration of alkaloids, fatty acids, and N-containing compounds,14 many of which might be anticipated to exhibit electrochemical activity [4]. The tobacco plant's extracts have been shown to be potent corrosion inhibitors for a variety of metals. The USDA has identified over 4,000 chemicals in the tobacco plant, making it a veritable chemical factory. Antibiotics, industrial enzymes, sugars, and chemicals that fight cancer and AIDS are among the many things being tested out as production systems in tobacco right now. 59 Tobacco's components include chemicals with potent corrosion-blocking abilities. Extracts from tobacco plants are a promising new approach in the market for corrosion inhibition since they are inexpensive, highly effective, safe for the environment, non-toxic, and renewable [5]. investigate the solution that aqueous tobacco extract may prevent the corrosion of carbon steel when exposed to HCl [6]. Weight loss, electrochemical impedance spectroscopy (EIS), electrochemical frequency modulation (EFM), and potentiodynamic polarization were all employed to evaluate the effectiveness of the inhibition. Researchers discovered that adding the extract decreased the corrosion rate of carbon steel and improved the efficiency of the inhibition. The adsorption of the extract's components on the steel surface and their subsequent inhibitory impact were studied. The Langmuir adsorption isotherm describes the adsorption pattern of the extract components onto the C-steel surface. Higher temperatures result in more effective inhibition. Corrosion activation energy is reduced when the extract is present. Tobacco root extract (TRE) was studied by [7] to determine whether or not it might reduce the corrosion of Q235 in synthetic seawater. The experimental findings show that TRE is effective at inhibiting corrosion and that this efficacy increases with increasing TRE concentration. Corrosion inhibition was traced back to a chemisorbed coating on the steel, as shown by scanning electron microscopy (SEM) and X-ray photoelectron spectroscopy (XPS). Static tests for scale and X-ray diffraction (XRD) and scanning electron microscopy (SEM) analyses of scale deposits were used further to investigate the anti-scale property of TRE in artificial seawater. The presence of TRE altered the surface morphology and size of the scale deposit. The findings of the corrosion and scale inhibition experiments suggested that TRE might be used as a potential corrosion and scale inhibitor in artificial seawater. Tobacco extract was employed as a natural corrosion inhibitor by [8], and used it in underground steel pipes (Steel 355). The types of organic and clay soils were analyzed. The corrosion of steel pipes was tested after they were exposed to tobacco extract and then buried for five months. The findings confirmed that the tobacco extract is an excellent corrosion inhibitor, performing better than the control treatments in both soil counterparts. Organic soil showed 71.42 and 58.9 percent inhibition by tobacco extract and potassium chromate, respectively, after one month of testing. The tobacco extract's inhibitory impact was 38.55% and 34.99% in organic and clay soil during the fifth month. Recent studies have demonstrated that several different triazoles (especially those with a high nitrogen content) are effective in shielding against corrosion for the wide protection of alloys and metals (especially mild steel) [9]. Testing a wide variety of triazoles as corrosion inhibitors suggest that switching to triazole derivatives yields the best performances. [10-12]. Using mild steel in an H2SO4 environment, Zhang et al. looked into the corrosion protection offered by a newly synthesized triazole derivative. The study's results determined that the new chemical had more than 97.6% effectiveness at 298 K as a corrosion inhibitor for mild steel in an acid solution. [13]. Allium Jesdianum extract (AJE) was employed as a "green banner" for mild steel in a 1 M HCl solution by [14]. Electrochemical impedance spectroscopy allowed the highest possible inhibition effectiveness of around 96.18%. Potentiodynamic polarization verified the dramatic reductions in corrosion current density in both the cathodic and anodic branches and mixed-type inhibition. Measuring success with an eye toward weight loss suggests that AJE concentration is key to an effective inhibition's effectiveness. Banner adsorption on the metal surface fits the Langmuir adsorption isotherm. The mechanism of inhibition was shown using surface morphology and characterization techniques. An inhibitor was achieved using the triazole heterocyclic compound 3-(4-ethyl-5-mercapto-1, 2-triazol-3-yl)-1-phenylpropanone (EMTP) by authors in [15]. For example, they employed gravimetric methods to analyze mild steel's (MS) protection against corrosion in a 1 M HCl media. The findings demonstrate that the EMTP provided superior corrosion protection against MS in HCl solutions at both low and high concentrations. Additionally, the effects of temperature on inhibition efficiency were investigated, as was a comparison of EMTP's corrosion protection effectiveness to that of its parent triazole. At 303 K, EMTP shows promise as a corrosion inhibitor for mild steel in a 1.0 M hydrochloric acid solution. Research on the effectiveness of the corrosion inhibitors N-(2-nitrobenzylidene)-4-antipyrinamine (2-NAA) and N-(4-nitrobenzylidene)-4-antipyrinamine (4-NAA) was conducted experimentally and theoretically [16]. They were carried out using gravimetric analysis and quantum chemical evaluation using density functional theory (DFT). As corrosion inhibitors for mild steel, 2-NAA and 4-NAA in 1 M HCl solutions were examined using mass loss methods. For 2-NAA, the inhibitory efficiency was 95.03%, whereas, for 4-NAA, it was 91.88%. The creation of this protective layer causes the corrosion rate (CR) to drop and the inhibition efficiency (IE%) to rise when using the tested inhibitors. It replaced the water and chloride ions already adsorbing on the surface of the mild steel.

Research into the solution of 2,2’-(1,4-phenylenebis(methanylylidene)) bis(N-(3-methoxyphenyl) hydrazinecarbothioamide) (PMBMH) as a corrosion inhibitor for mild steel in 1 M hydrochloric acid was conducted [17]. They used a variety of electrochemical methods, as well as assays for weight loss (potentiodynamic polarization and electrochemical impedance spectroscopy). As little as 0.0005 M of PMBMH was shown to provide 95% protection. The examined inhibitor decreased the corrosion rate and improved the inhibitory performance by forming a protective adsorption coating in place of the adsorbed H2O molecules and acidic chloride ions. Good agreement is found between experimental and theoretical results in this study. [18] conducted many experiments on protecting carbon steel from corrosion in a medium of crude oil with API 30.6 gravity using different concentrations ranging from 100 - 400 ppm of different green inhibitors such as corn oil, sunflower oil, flaxseed oil and castor oil at different spin speeds, which are 0, 500, 1250 and 2000 rpm. The results showed that the corrosion rate of carbon steel in crude oil decreases with the increase in the concentration of the inhibitors, while it corresponds to the increase in the rotational speed. It was also found that the maximum inhibition efficiency achieved for castor oil inhibitor in crude oil was using a concentration of 400 ppm, spin speed of 0 rpm and ambient temperature (25 °C) of 92.63%. The aim of this research is to study the effect of tobacco dust as natural inhibitor and environmentally friendly on corrosion rate and inhibition efficiency of tobacco extract for protection the steel oil pipes buried in soil and trying to solve the corrosion problems.

2. Experimental Work

2.1 Material

Low carbon steel or mild steel with the chemical composition analysis in wt (%): according to ASTM is shown in Table (1) was used in this study. Samples with a size of 1.5 x1.5 ×0.2 cm were used as working electrodes. Table (2) shows the chemical composition and detected elements (ppm) analysis of soil by using XRF instrument

Table (1): Chemical composition of low carbon steel according to AISI standard

Element Wt%	C	Si	Mn	P	S	Cu	Ni	Cr	Mo	Al	Fe
Measured value	0.1912	0.1503	0.6702	0.0271	0.0280	0.3414	0.0504	0.0802	0.0053	0.0241	Rem.
Standard value	0.12	0.10	0.096	0.035	0.03	-	-	0.027	0.003	-	Rem.

Table (2): The chemical composition analysis of soil by using XRF instrument

Element Detected	Ti	Cr	Mn	Fe	Ni	Cu	Zn	Zr	Ag
ppm	2816	440	344	1.83	120	74	35	140	83
Range value (±)	140	22	18	0.1	6	4	2	3	8

2.2 Plant chemical examination

Using the HPLC chromatographic technique (N) alkaloids, flavonoids, phytosterols, triterpenoids, and tannins) secondary The job title in its beginning is alkaloids, the most important of which is alkaloids Structural: $C_{10}H_{14}N_2$ Nicotine consists of two rings: pyrimidine and pyrrolidine. Nicotine is broken down by cell enzymes and turns into nicotinic acid (niacin).

2.3 Tobacco Extract Preparation

The tobacco extract was prepared by weighing 50 g of tobacco dust after drying it at a temperature of 100 °C for two hours in a drying oven and then immersed in 500 ml of 80% ethyl alcohol. Then filter it through filter paper and put it in the shaker device at a temperature of 40°C and a rotation of 125 revolutions per minute for 5 days. Then we filter it by a Buechner device. We take the filter and drip it with a rotary afaberter device. A quantity of 50 ml of the substance remains and the samples are immersed in the steel used in it. Figure (1) shows the prepared tobacco extract.

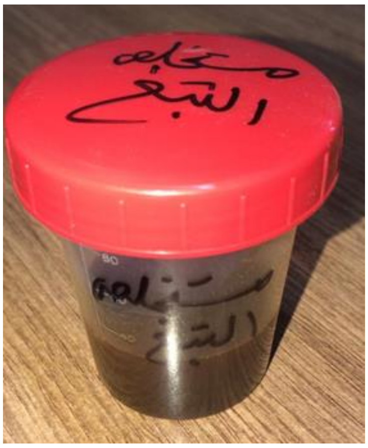

Fig. (1): shows the container of prepared tobacco extract

2.4 Samples preparation

To remove the layer of oxides and other unwanted materials, use various grades of SiC emery paper (100,200 and 400 were used to polish the specimen surface. Then the samples were washed with distilled water several times and then with pure acetone to remove the oily or greasy substances from the metal surface. Then the samples were placed in an oven at 100°C to dry and then kept in a desiccator. After the completion of each corrosion experiment, the sample is washed after being removed from the corrosion solution with distilled water and then dried for weighing.

2.5 Application of Tobacco Extract on samples and Immersing in Soil

The samples used are a square (1.5x1.5) mm and their surface area was fixed in the corrosion experiments close to 1 cm^2. Figure (2) shows the carbon steel samples after applied tobacco extract deposit or represent the coated samples with tobacco extract.

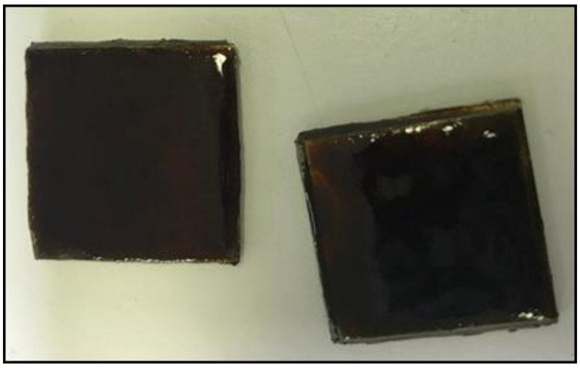

Fig. (2): Rrepresent the coated samples with tobacco extract

Figure (3) represents the method of immersing the coated samples in the soil, where the samples were taken and immersed in the tobacco extract for a period of time and left them to dry in air, then a pit was made in the soil to place the samples for specific periods of time for seven months starting from May month to November month. Then corrosion tests were carried out in a solution that simulates soil conditions with a pH of 6.8 at 30◦C.

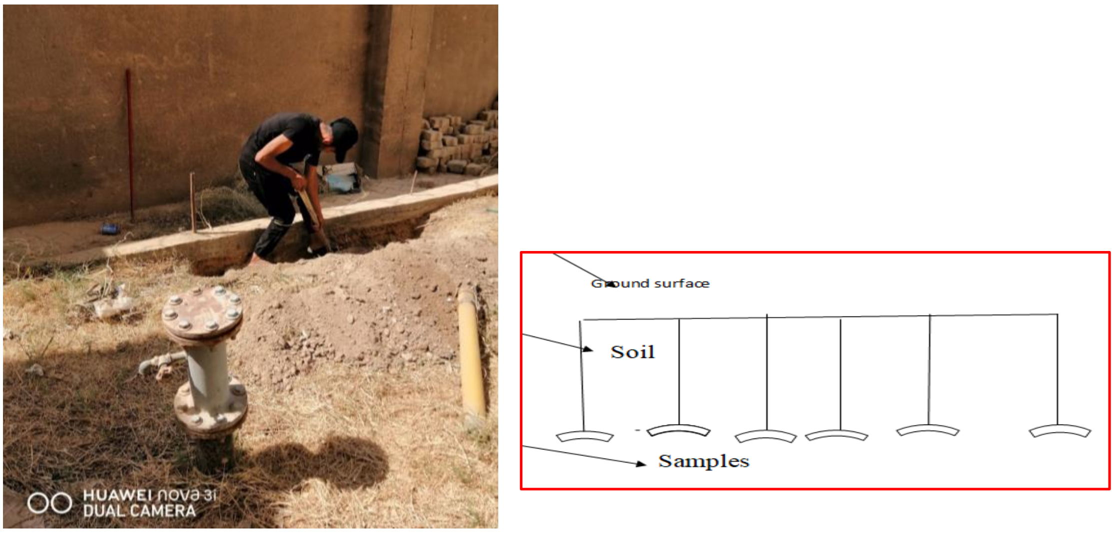

Fig. (3): (a) Indicates the immersing method of steel samples in pit, (b) Samples buried in the soil

2. Electrochemical Corrosion Test

The corrosion cell consists of a 1liter flask containing the corrosion solution, and three main electrodes which are the sample electrode, the platinum electrode as the counter electrode and the saturated Calomel electrode as the standard electrode.

Tafel polarization method was carried out in Tobacco extract solution using Mlab bichannel Potentiostat device (Model MLab200) to measure corrosion parameters. Corrosion parameters, voltage (Ecorr.), current (Icorr,), corrosion rate (CR) (mpy) were measured for the purpose of knowing the inhibition efficiency and completing the corrosion cell calculations. The temperature was held constant in all corrosion experiments at 30ºC, and the scanning voltage of the polarizer was 1mV/s within the range (+250 mV to -250 mV) using the open circuit voltage (OCP) method over a time period of 17 minutes.

Fig. (4): Potentiostat instrument and corrosion cell used in this study

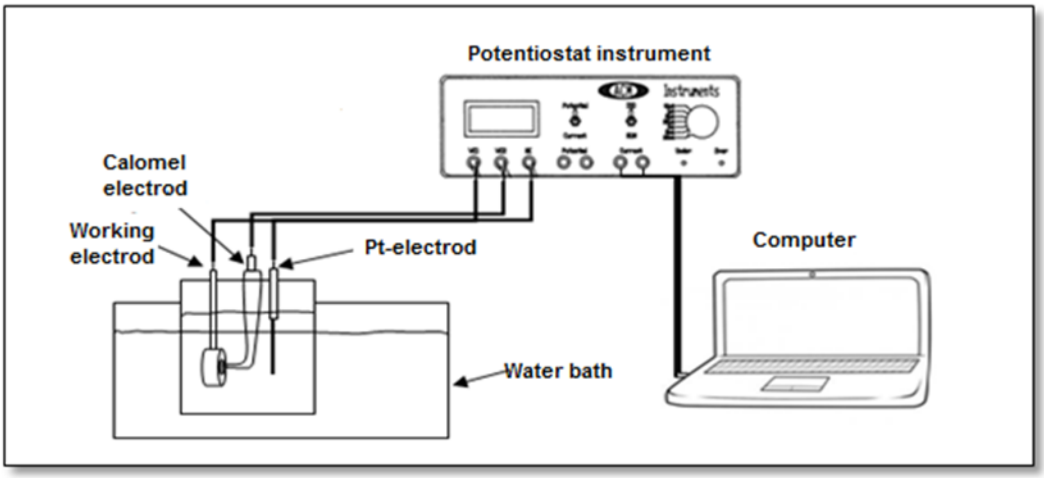

Fig. (5): Schematic diagram of Corrosion cell

3. Results and Discussion

3.1 Factors Affecting on External Corrosion of Buried Pipelines

Many characteristics of soil are correlated with its corrosivity. Since the flow of ions facilitates corrosion through the electrolyte (soil), factors that boost the soil’s electrical conductivity also boost its corrosivity. This way, corrosivity is boosted by high moisture levels, inadequate drainage, and a high salt concentration. Corrosivity tends to rise along with the concentration of oxygen. However, the rate of external corrosion on a pipeline is determined by several factors, corrosivity being just one of them and not even a key one. Factors in soil properties from one point along a pipeline to another and from top to bottom significantly contribute to the external corrosion rate. Variations in aeration, moisture content, and soil composition in these areas may create high corrosion pressures.

However, the passage of cathodic-protection currents to the pipe is slowed by low-conductivity soils, despite their comparatively low corrosivity. They may thus cause more pipeline corrosion than was previously anticipated. The coating's rate of deterioration might also be affected by the soil type. When the moisture level in the soil changes, heavy clay soils may pull the coating away from the pipe. Although rocky soils are often low in corrosivity, they may puncture a coating even if well-drained. In some instances, its high resistivity might prevent cathodic protection currents from entering the pipe [4].

3.2 Corrosion Behavior in Pipelines

A chemical reaction with its surroundings causes metal deterioration. Corrosion in pipelines is prevented by a metal called line-pipe steel, mostly made of iron and has just 1% to 2% alloy for strength and toughness. In terms of corrosion, alloys are mostly unimportant. To prevent external corrosion, offshore pipelines are submerged in saltwater, whereas onshore pipelines are exposed to groundwater or damp soil. Water with hydrogen sulfide (H_2S), sodium chloride (salt), and/or carbon dioxide in the atmosphere is an environment conducive to internal corrosion (CO_2). Deterioration occurs when the iron dissolves into the environment, weakening the pipeline. Iron dissolves into positively charged ions when dissolved. The following diagram illustrates what is known as an anodic reaction [4]:

$$Fe \rightarrow Fe{+}{+} + 2e \qquad (1)$$

The process's electrons go down the metal pipe to a different place, where they are used in a different reaction to create hydroxyl ions. The precise reaction depends on the electrolyte's composition, although it commonly takes one of the following forms [4]:

$$O_2 + 2H_2O + 4e- \rightarrow 4OH \qquad (2)$$

$$2H_2O + 2e- \rightarrow H_2 + 2OH \qquad (3)$$

Cathodic reactions are those shown in the diagram above. The ions' movement completes the electrical circuit through the electrolyte. Rust or another iron oxide is often formed as a corrosion deposit when the iron ions react with water and/or oxygen. They may sometimes react to generate iron carbonate or iron sulfide when combined with carbon dioxide or hydrogen sulfide. The anode and cathode components of a corrosion cell can be next to be next to each other or separated by many feet [4]. Laboratory tests were conducted in the laboratories of the Chemical Analysis Department at the Oil Research and Development Center as shown in Table (3) and Table (4) shows the examination results of the ion concentration of Aljadriat soil with different depths (0.5, 1.0 and 1.5 m).

Table (3): Examination results of the coefficients of Aljadriat soil with different depths

Depth (m)	R (Q.m)	Moisture (%)	pH	T (°C)
0.5	262	8.3	6.0	**14**
1.0	72	13.6	6.0	**18**
1.5	27.1	30	6.0	**21.3**

Table (4): Examination results of the ion concentration of Aljadriat soil with different depth

Depth (m)	Chloride (ppm)	Sulfate (ppm)	TDS (ppm)
0.5	6592	18500	**30203.51**
1.0	9589	4378	**27400**
1.5	10885	18000	**33523.38**

Table (5) shows the soluble ions elements in the soil with different depth ((Na+, K+, Ca+, Mg+ with depth), as these coefficients increase their values with increasing depth and thus lead to an increase in the electrical conductivity of the soil, i.e. a decrease in its resistivity.

Table (5): The soluble elements in the soil with different depths

Depth(m)	Na$^+$ (ppm)	K$^+$ (ppm)	Ca$^+$(ppm)	Mg$^+$(ppm)
0.5	248.31	74.5	3407.33	**353.84**
1.0	169.24	48.35	3024.66	**685.2**
1.5	196.79	74.31	2939	**409.32**

The samples were immersed in the tobacco extract and buried in the soil at a depth of 0.5 m,1.0 m and 1.5 m and left for periods of 6 months in sequence (June, July, August, September, October, November). The corrosion rate was examined in the presence and absence of the inhibitor, and the results were as summarized in Table (6).

3.3 Evaluation of the Inhibition Efficiency of the Inhibitor

The inhibition of tobacco dust extract used in corrosion experiments was studied. The corrosion currents and potentials concentrations were measured in each of the experiments with and without the inhibitor. The degree of coverage of the corrosion-prone surface was calculated using the following equation:

$$\theta = \left[\frac{(I_o - I)}{I_o}\right] \qquad (4)$$

Where:

Io: represents the corrosion current in the absence of the inhibitor.

I: represents the corrosion current in the presence of the inhibitor.

The corrosion inhibition efficiency was calculated by the following equation:

$$\text{Inhibition Efficiency} = \left[\frac{(I_o - I)}{I_o}\right] \times 100 \qquad (5)$$

Corrosion inhibition of metal can be observed as a result of the use of tobacco dust extract on metal corrosion. It contains the corrosion currents and voltages extracted from the application of the Tafel equation on the curves in Figures (6) and (7). We note that the values of the corrosion current and the corrosion voltage also vary in value with a difference, and this in turn indicates the effect of the inhibitor on the anodic and cathodic corrosion curves, and the same conclusion can also be reached. Table (6) shows the corrosion variables obtained from the Tafel equations for carbonic iron metal in a solution of tobacco dust extract.

Corrosion products are formed when a metal gives up its electrons to an oxidant. This can be due to coating the surface of the metal, or another way to protect these metals from corrosion is by using corrosion inhibitors. The adsorption of a corrosion inhibitor mainly depends on the physicochemical properties of the molecule such as functional groups, molecular size, molecular weight, molecular structure, electron density of donor atoms and orbital character of donated electrons [19].

3.4 Corrosion Results

Figures (6) and (7) shows the polarization curves of samples of low carbon steel samples (samples A and B) which buried at 1 m in soil for one and two months respectively. These samples gave the lowest corrosion rate and the highest inhibition efficiency as compared to other samples. Figure (8) shows the effect of immersion time (in month) for all coated samples with tobacco dust extract (as inhibitor) after immersion at 1m in soil. It is noticed that the corrosion rate increases with increasing time until reaching to the highest value of C.R(mpy) =3.208 and more negative potential

E corr.= - 671.7mV and OCP = -609 mV on November month ,after seven month of immersion of coated samples in soil.

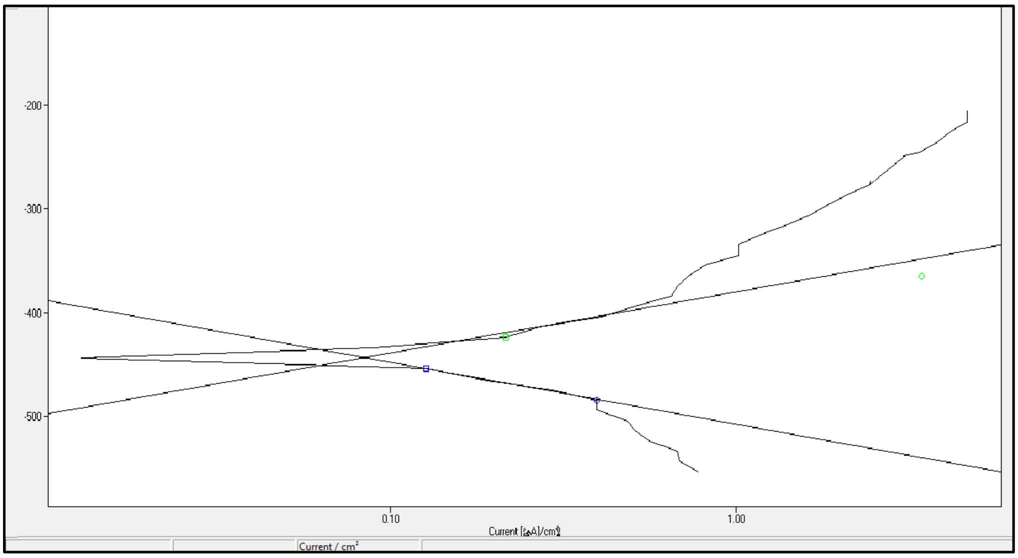

Fig. (6): Tafel polarization curves for sample A after immersing in soil for one month

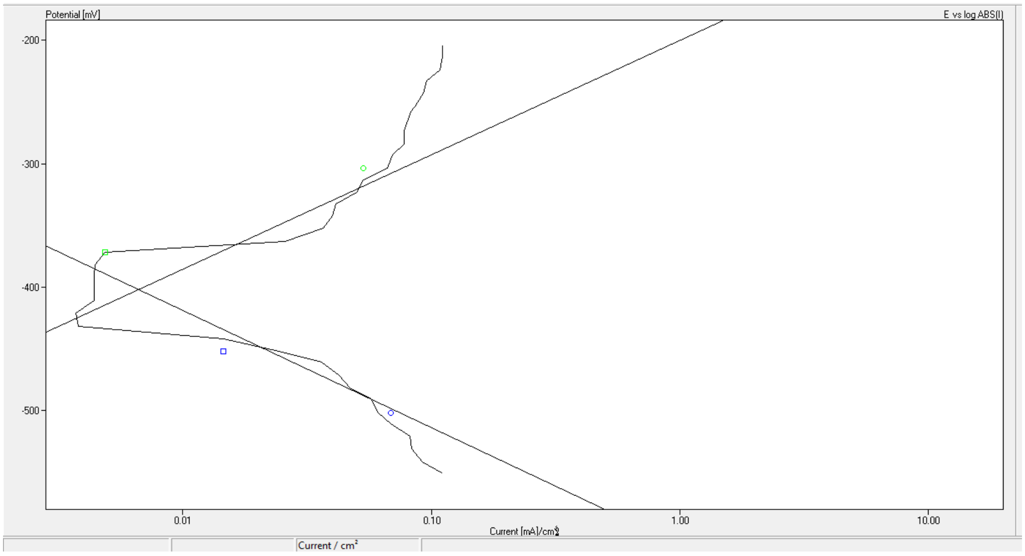

Fig. (7): Tafel polarization curves for sample B after immersing in soil for two month

Table (6) indicates the corrosion results of blank sample (as received) and coated samples with tobacco dust extract (as inhibitor) after immersion in soil for seven different months starting from May month into November. Figure (8) shows the effect of immersion time (in month) on the corrosion rate and Ecorr of coated samples with tobacco dust extract after immersion in soil for different period. Many researchers, Ramadanzadeh [20], Hamad [21] and Muna [22] noticed that the inhibition efficiency increases with the increase in the concentration of the inhibitor, and this is due to the fact that the thickness of the protective layer that protects carbon steel from corrosion, is directly proportional to the concentration of the inhibitor and the ability of the molecule adsorption on the surface of the metal. This leads to a decrease in the diffusion of dissolved oxygen (the main cause of corrosion) on the surface of the carbon steels, which leads to a decrease in the current density. In this study, the increase in inhibition efficiency is attributed to the larger number of inhibitor molecules attaching to the mild steel surface with longer exposure times, forming a protective layer.

Table (4): Corrosion results of blank sample and coated samples with tobacco dust extract (as inhibitor) after immersion in soil for seven months

Sample Symbol	Immersion time (month)	OCP (-mV)	Icorr (µA/cm^2)	Corrosion Rate (mpy)	Ecorr (-mV)	βc (mV/decade)	βa (mV/decade)	Inhibition efficiency%
blank	**As received**	**621**	**12.29**	**5.616861**	**586.7**	**-146.7**	**49.5**	
A	**May**	**387**	**0.06616**	**0.030236**	**443.2**	**-59.7**	**58.9**	99.461
B	**June**	**542**	**0.04896**	**0.022376**	**510.3**	**-66.4**	**35.4**	99.601
C	**July**	**588**	**1.07**	**0.48901**	**504.3**	**-177.6**	**101.7**	91.293
D	**August**	**547**	**3.31**	**1.512759**	**605**	**-48.3**	**114.6**	73.067
E	**September**	**385**	**5.21**	**2.381110**	**402.1**	**-95**	**92.8**	57.607
F	**October**	**467**	**6.81**	**3.112353**	**495.7**	**-100**	**100.6**	44.589
H	**November**	**609**	**7.02**	**3.208329**	**671.7**	**-107.7**	**36.3**	42.880

A= May, B= June, C= July, D= August, E= September, F= October, H=November

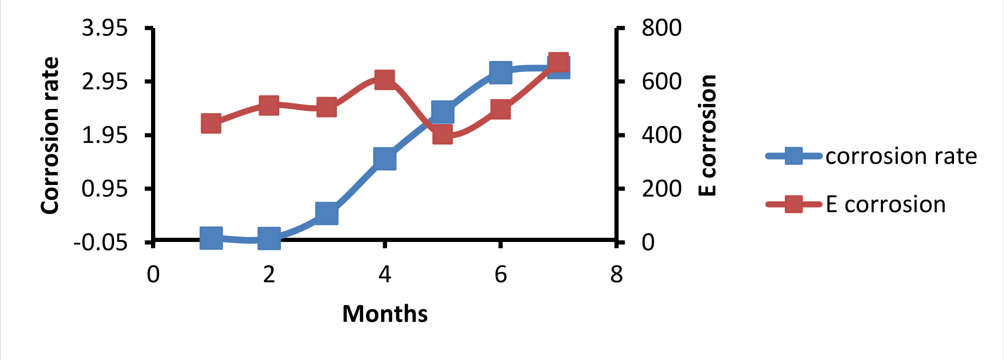

Fig. (8): Effect of immersion time (in month) on the corrosion rate and Ecorr. of coated samples with tobacco dust extract after immersion in soil for seven different months starting from May month into November

4. Conclusions

The inhibition efficiency of tobacco extract was recorded in organic soil for the first month (May) and seventh month (November) were 99.4% and 42.88% respectively, where the inhibition effect of the tobacco extract was maximum value (99.6%) for the second month (June) in soil at depth 1m. It was found that the lowest corrosion rate was after 60 day of immersion time in soil and then increases with increasing immersion time. The decrease in the corrosion rate (CR) and the increase in the inhibition efficiency (IE%) in the presence of the tobacco extract as inhibitor is due to the formation of a protective layer, which is adsorbed on the mild steel surface in place of the water and chloride ions which existed already. It was shown that the OCP value and E corr. for blank sample were - 621 mV and -586.7 mV respectively and shifts for less negative values (more noble) except last sample immersing in soil for longer time (7 months).

Recommendations and Suggestion Works:

1- Measurement of corrosion rate of tobacco extract coated samples of low carbon steel by using weight loss method and at various immersion depths in soil and different temperatures.
2- Measurement of corrosion rate of tobacco extract coated samples cyclic polarization corrosion test will carry out to study the pitting corrosion and the passivity of coated layer of tobacco extract deposited on low carbon steel samples.
3- Adsorption isotherms are suggested to study in order to define the possible mechanism of interaction between molecules inhibiting corrosion with the mild steel surface.
4- Surface analysis by using SEM are studied of the blank and tobacco extract coated samples of low carbon steel.
5- Study effect of nanocoatings (metals, ceramics and polymers) on corrosion behavior of low carbon steel pipes.

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