Using Dry Olive Leaves for Oil Pipes Corrosion Inhibitor

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Abstract—At the present time the use of corrosion inhibitors is a good solution to maintain or reduce the corrosion problems in the equipment, so nowadays the production of inhibitors all non-toxic, natural and cheap is the most important demand. In this study dry olive leaves extraction used as inhibitor in a temperatures similar to the average temperature in Iraq, so as to bring the picture of reality as much as possible, at (25 °C and 45 °C) and solution was prepared in the following concentration to stimulate the field environment for oil extracting 19.2 % of sodium chloride (NaCl), 8% of calcium chloride (CaCl), 1.08 % of magnesium chloride (MgCl) and saturated with CO₂ gas, the corrosion rate of steel sample was measured by using a potentiostat device with reference of calomel electrode. The result was, the dry olive leaves extract is an effective inhibitor material. Dry olive leaves extraction inhibitor has a low corrosion rate at 25°C and 45°C and the corrosion rate decreases with increasing temperature for oil extraction solution. From the EDS test found that high percentage of carbon and oxygen caused to produce many compounds like the phenolic compound of the olive leaves is the responsible of inhabitation effect of the olive leaves.

Index Terms—Corrosion; Green Inhibitor; Mild Steel; Olive Leaves; Potentiostat.

I. INTRODUCTION

In most industries whose facilities are constituted by metallic structures, the phenomenon of corrosion is invariably present. This problem originates very important material and economic losses due to partial or total replacement of equipment and structures, and plant-repairing shutdowns [1].

Material losses and corrosion consequences are priced so high that in some countries like the U.S. and England these factors have been estimated from 3 to 4% of the GDP [2].

Corrosion not only has economical implications, but also social and these engage the safety and health of people either working in industries or living in nearby towns. The oil industry in Mexico is one of the most affected by corrosion because this phenomenon exerts its effects from the very moment of oil extraction on, causing a constant struggle against it [3].

The use of corrosion inhibitors (CIs) constitutes one of the most economical ways to mitigate the corrosion rate, protect metal surfaces against corrosion and preserve industrial facilities.

Inorganic CIs are those in which the active substance is an inorganic compound. This is one of the simplest ways to improve the passivity of a metal by adding electropositive metal salts to the medium. These metal ions must have a more positive redox potential more positive than the metal constituting the surface to be protected and also a more positive potential than that required for discharging a proton so that the electropositive metal to be reduced is deposited on the surface. The deposited metal promotes the cathodic depolarization by overvoltage reduction and formation of an adherent deposit. Among the metals used for this purpose are: mercury (Hg), palladium (Pd), iridium (Ir), platinum (Pt), rhodium (Rh) and rhenium (Re) [4], [5].

Moreover, there are inorganic anions providing passivation protection to metal surfaces through their incorporation into the oxide layer; the most widely used of these are: chromate (CrO₄²⁻), nitrate (NO₃⁻), molybdate (MoO₄²⁻), phosphate (H₂PO₄⁻) and silicates [6].

II. EXPERIMENTAL

Electrochemical Tafel test method, Electrochemical Impedance Spectroscopy, optical microscope examination m Fourier Transform Infrared-spectroscopy analysis and Energy Dispersive X-Ray Analysis (EDX) were used in order to detect the effect of dry olive leaves powder with different temperature on mild steel samples corroded in oil extraction solution.

A. Materials

1) The mild steel samples

A cylindrical mild steel sample which has a threaded hole in the center of it total surface area of the sample will be 5.3 cm² in order to be fitted in the holder of the working electrode of the potentiostat device to be immersed in the preparation solution. chemical composition is list in Table I.

<table>
<thead>
<tr>
<th>Element</th>
<th>C%</th>
<th>Si%</th>
<th>S%</th>
<th>P%</th>
<th>Mn%</th>
<th>Cr%</th>
<th>Ni%</th>
<th>Mo%</th>
<th>Cu%</th>
<th>Fe%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Result</td>
<td>0.21</td>
<td>0.12</td>
<td>0.02</td>
<td>0.03</td>
<td>0.6</td>
<td>0.07</td>
<td>0.07</td>
<td>0.1</td>
<td>0.03</td>
<td>Rem.</td>
</tr>
</tbody>
</table>

Cylindrical samples are used for electrochemical tests. Extraction of dry Powder of olive leaves is added to oil extraction solution at different temperatures.

2) Dry leaf extraction

The olive leaves are collected from the tree and washed from any dirt then Drying be sun when it's dry totally Grinding and sieving with sieve No. 300 micron Mixing 100 gm of olive leaves powder with 1000 ml of ethanol and made the fractional distillation for 1 hr. to get 450 ml the extraction and finally the solution is filtered.

3) The solution preparation

The medium used in testing is solution was prepared in the following concentration to stimulate the field environment for oil extracting: 19.2 % of sodium chloride (NaCl), 8% of calcium chloride (CaCl), 1.08 % of magnesium chloride (MgCl) and saturated with CO₂ gas, this
solution is the same as the solution used in the extraction process of oil, at temperature (25 °C and 45 °C). [7]

B. Electrochemical measurements

A Gamry Serise G300 Potentiostat built in a computer used for electrochemical corrosion measurement (Tafel test) and (EIS test). The test was of three electrodes connection (reference electrode, counter electrode and working electrode). Saturated Calomel reference electrode was the reference electrode and graphite rod was the auxiliary electrode. By using Gamry workframe software to record test data, the experiments were carried at room temperature. Saving data in Data Gamry folder and using Gamry Echem Analyst software [8]. The inhibitor efficiency percent (η%) has been calculated for each olive leave extraction at each test condition by using (1).

\[ \eta\% = \frac{W_{corr} - W_{H}}{W_{corr}} \times 100 \]  

where: η% = inhibitor efficiency percent, Wcorr = Corrosion rate in mils per year (mpy), and WH = Corrosion rate in (mpy) with inhibitor [9].

C. Microscopic test

Using optical microscope for examine the specimen surfaces. The images were taken for the specimen after test.

III. RESULT AND DISCUSSION

The results for each test have been recorded and then discuss to evaluate its effect. From the following test the result shows that the corrosion rate is decreasing with increasing temperature with dry olive leaf extraction inhibitor added, this is meaning that the inhibition of the dry extraction is became more active with increasing temperature.

A. Electrochemical polarization test

1) Electrochemical polarization test at 25 °C

This test is done at room temperature 25°C. Fig. 1 shows tafel test for steel specimen without inhibitor, with dry inhibitor.

2) Electrochemical polarization test at 45 °C

This test is done at 45 °C. Fig. 2 shows tafel test for steel specimen without inhibitor, with dry inhibitor.

3) Electrochemical polarization test without inhibitor at 25 and 45 °C

This test was carried out without inhibitor at 25 °C and 45 °C. Fig. 3 shows tafel test for steel specimen without inhibitor at 25 and 45 °C.

4) Electrochemical polarization test with adding dry inhibitor at 25 and 45 °C

This test was carried out with dry olive leaf extraction inhibitor at 25 °C and 45 °C. Fig. 4 shows tafel test for steel specimen with dry inhibitor at 25 and 45 °C.

B. Fourier Transform Infrared Spectroscopy Analysis (FT-IR test)

Fig. 5 shows the analyzing of the olive leaves extraction that Deposition on the surface of sample at 25 °C for dry leaves, FT-IR identifies chemical bonds in molecule by producing an infrared absorption spectrum. The spectra produce a profile of sample, a distinctive molecular fingerprint that can be used to screen and scan samples for many different components. These can be identified from the histogram. Each peak at a range gives a chemical compound. Table II shows the chemical compounds and their bonds of dry olive leaves powder [10],[11].
The inhibition process of olive leaves extract was also investigated by the EIS. The EIS was performed over the frequency range from 100 kHz to 0.02 Hz at different test temperatures (25–45 °C). Impedance measurements presented in the Nyquist format for mild steel immersed in oil drilling extraction liquid c with and without inhibitor. The impedance diagrams are semicircles and the presence of inhibitor does not change their profiles. This behavior indicates that the charge transfer process mainly controls the corrosion of the mild steel. The diameter of Nyquist plots increased with increasing the temperature for dry olive leaves inhibitor indicating strengthening of inhibitive film. The impedance parameters derived from the Nyquist plots and percentage inhibition efficiency are given in Table III and IV. The inhibition efficiency was calculated based on the charge transfer resistance by [13]:

\[ IE \% = \frac{R_{ct} - R'_{ct}}{R_{ct}} \times 100 \]

where \( R_{ct} \) and \( R'_{ct} \) are the charge transfer resistance values with and without olive leaves extract.

IV. CONCLUSION

i. Olive leaves could work as commercial inhibitor.

ii. Corrosion rate decrease with increasing temperature for oil extraction solution.

iii. Dry olive leaves not so effective at 25 °C but it's efficiency increase with increasing temperature.

iv. From the EIS tests the resistivity of the solution is maximum at 45 °C oil extraction solution with dry olive leaves extraction inhibitor, higher resistivity means lower corrosion rate.

v. From the EDS test found that the phenolic compound of the olive leaves is the responsible of inhabitation effect of the olive leaves [14].

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REFERENCES


