(C) RESULTS

The curves of Fig (3) represent the anodic and cathodic polarization curves of C-steel in 0.1M HCl solution in the presence of different concentrations ranging from 200 to 800 ppm of inhibitor Lawasoni extract "L".

Figs (4 & 5) illustrate the anodic and cathodic polarization curves for C-steel in 3.5% NaCl and 0.1M NaOH solutions respectively in the presence of different concentrations ranging from 200 to 1000 ppm of inhibitor "L".

The curves of Fig (6) represent the anodic and cathodic polarization curves of C-steel in 0.1M HCl solution in the presence of different concentrations ranging from 200 to 1000ppm of inhibitor Ficus extract "F".

Figs (7 & 8) illustrate the anodic and cathodic polarization curves for C-steel in 3.5% NaCl and 0.1M NaOH solutions, respectively, in the presence of different concentrations ranging from 200 to 800 ppm of inhibitor "F".

The curves of Fig (9) represent the anodic and cathodic polarization curves of C-steel in 0.1M HCl solution in the presence of different concentrations ranging from 2 to 30% of volume / volume of inhibitor Opuntia extract "S". Fig (10) illustrates the anodic and cathodic polarization curves for C-steel in 3.5% NaCl solution in the presence of different concentrations ranging from 2 to 30% of volume of inhibitor "S".

Fig (11) represents the anodic and cathodic polarization curves of nickel electrode in 0.1M HCl solution in the presence of increasing concentrations ranging from 200 to 1000ppm of inhibitor "L". Moreover, the effect of inhibitor "L" on the anodic and cathodic Tafel lines for nickel electrode in 3.5% NaCl and 0.1M NaOH solutions in the presence of different concentrations ranging from 200 to 800ppm is shown in Figs (12 & 13) respectively.

Fig (14) represents the anodic and cathodic polarization curves of nickel electrode in 0.1M HCl solution in the presence of increasing concentrations ranging from 200 to 1000ppm of inhibitor "F". In addition, the effect of inhibitor "F" on the anodic and cathodic Tafel lines of nickel electrode in 3.5% NaCl and 0.1M NaOH solutions in the presence of different concentrations ranging from 200 to 800ppm is shown in Figs (15 & 16) respectively.

The curves of Fig (17) represent the anodic and cathodic polarization curves of nickel in 0.1M HCl solution in the presence of different concentrations ranging from 2 to 30% of volume / volume of inhibitor Opuntia extract "S". Fig (18) illustrates the anodic and cathodic polarization curves for nickel in 3.5% NaCl solution in the presence of different concentrations ranging from 2 to 30% of volume / volume of inhibitor "S".

The curves of Fig (19) show the anodic and cathodic polarization curves of zinc electrode in 0.1M HCl solutions in the presence of different concentrations, from 200 to 1000ppm of inhibitor "L". By the same zinc electrode the Figs (20 & 21) illustrate the anodic and cathodic polarization curves in 3.5% NaCl and 0.1M NaOH solutions respectively in the presence of different concentrations ranging from 200 to 800ppm of inhibitor "L".

The curves of Fig (22) show the anodic and cathodic polarization curves of zinc electrode in 0.1M HCl solutions in the presence of different concentrations, from 200 to 1000ppm of inhibitor "F". By the same zinc electrode the Figs (23 & 24) illustrate the anodic and cathodic polarization curves in 3.5% NaCl and 0.1M NaOH solutions respectively in the presence of different concentrations ranging from 200 to 800ppm of inhibitor "F".

The curves of Fig (25) represent the anodic and cathodic polarization curves of zinc in 0.1M HCl solution in the presence of different concentrations ranging from 2 to 30% of volume / volume of inhibitor Opuntia extract "S". Fig (26) illustrates the anodic and cathodic polarization curves for zinc in 3.5% NaCl solution in the presence of different concentrations ranging from 2 to 30% of volume / volume of inhibitor "S".

(D) DISCUSSION

Part I

Inhibition of C-steel corrosion in different aqueous media using naturally occurring substances

1.1. Lawsonia extract (L):

1.1.a. Acidic medium:

Fig (3) represents the anodic and cathodic polarization curves of C-steel in 0.1M HCl solutions devoid of and containing different concentrations of henna extract. The figure reveals that the potential is slightly changed from its equilibrium value upon application of the external current. This steeply change remains steady during the increased applied currents until a certain value at which the potential change becomes higher. The first region is known as the pre-Tafel region in which there is a competition between the anodic and cathodic reactions to occur. It is followed by a region where the potential is linearly increased with the increasing applied current, which is known as Tafel region. In the Tafel region, the reaction becomes pure anodic or cathodic depending on the sign of the applied current. The corrosion rate is considered to be the current corresponds to the point of intersection between the anodic and cathodic Tafel lines whereas the potential of this point is taken as the corrosion potential.

Fig (3) reveals also that the anodic curves of C-steel are shifted toward the noble direction whereas the cathodic ones shift toward the active direction upon addition of the henna extract. The magnitude of this shift increases with increasing the inhibitor concentration.

The values of the electrochemical parameters; corrosion potential ($E_{corr.}$), corrosion current ($I_{corr.}$), anodic Tafel slope (β_a), cathodic Tafel slope (β_c) and the inhibition efficiency (IE), were extracted from Fig (3) curves and given in Table (1). The data of Table (1) reveals that, as the concentration of henna extract is increased the corrosion potential shifts to more noble values. Moreover, the corrosion current decreases markedly in presence of henna extract. As the concentration of the extract is increased the corrosion current decreases. This behavior suggests the inhibitive effect of henna extract on the corrosion of C-steel in the acid solution. The calculated values of inhibition efficiencies of henna extract in Table (1), indicate a high performance of henna extract as corrosion inhibitor for C-steel corrosion in the acid solution.

In addition, Table (1) reveals that the values of anodic (β_a) and cathodic (β_c) Tafel constants are markedly changed in presence of henna extract. This result reflects the effect of henna extract on both the anodic and cathodic reactions and thus, it considered to be a mixed inhibitor.

1.1.b. Neutral medium:

Fig (4) shows the anodic and cathodic polarization curves of C-steel in 3.5% NaCl solutions devoid of and containing different concentrations of henna extract. The curves of Fig (4) reveal that, upon addition of henna extract the anodic curves are shifted toward more noble direction whereas the cathodic ones shift toward more active direction. The magnitude of shift increases with an increase of the additive concentration. Table (1) contains the electrochemical parameters of the corrosion of C-steel in these solutions. The data of Table (1) reveals that the corrosion potential is shifted toward less negative values as the concentration of the henna extract is increased. On the other hand, the