Using of Nucleus Dates Waste with a Nanoscale Particles as a Green Inhibitor

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***Abstract*-- Effect of the weight additions of date seeds nanoparticles as a green inhibitor on the corrosion resistance of the rebar has been studied. Date seeds nanoparticles were added to the electrolyte solution (consists of water and sodium chloride in 3.5% conc.) in different weight fraction (1-5)wt.%. The results were shown that the sample without inhibitor that's submerged partially in only electrolyte solution have current corrosion high (I corr.=41.25 µA/cm^2) than samples with inhibitor, while the sample in (3.5% NaCl) with concentration of inhibitor (1-4) wt.%, the density of corrosion current will be decreased as inhibitor concentration was increased. But when inhibitor addition reached to 5wt.%, the density of corrosion current will increase compared with the other concentrations. The results obtained from tafel method proven that the better corrosion resistance was at a ratio 4 wt.% of the powder date seeds. And from the economic viewpoint, the powder date seeds are almost cheaper compared with synthesis inhibitors so it is considered the best.**

***Index Term*-- Green Inhibitor, rebar, date seeds, corrosion resistance.**

1. INTRODUCTION

In structures industry, concrete reinforced with rebar is considered the indispensable basic material for the building, because of its distinctive characteristics, and like almost metals, rebar suffers from corrosion when chloride ions attack the concrete due to the presence of salts and water. It is well known that the rebar is made from iron and corrosion in the iron undesirable because the corrosion layer doesn't protect the material as is the case with aluminum, so it begins crusted causing dislocation rebar from concrete and eventually cracking and failure of whole structures [1-2]. The best way to avoid rebar corrosion is by using inhibitors, where it can be reduced the corrosion rate of metals found in the corrosive environment. Inhibitors are a synthesis compound or natural (extracts from the plant) which have the ability to cut the corrosion cycle between the corrosive environment and metal causing reduce corrosion rate or completely stop it [3-5]. And based on the principle of sustainability and the search for environmentally friendly materials, a new type of corrosion inhibitor is extracted from the plant, which is called the green inhibitors began to be used with rebar to protect it from corrosion, where it can be added in liquid or nanoscale particles to concrete mixture. Green inhibitors have demonstrated effectiveness in corrosion protection, and another important point is maintaining the strength of concrete without decrease [6-7].

In the present study involved the study behavior of natural product (fenugreek seeds extract) as a safety and an environmentally friendly corroding inhibitor for rebar in aqueous media at various concentrations of the extract by using the electrochemical technique (Linear polarization).

2. EXPERIMENTAL WORK

2.1 Chemical Composition of the Rebar

The chemical composition of sample that used in this study shown in Table (1). The analysis has been done in AL ITTEFAQ STEEL PRODUCTS CO. , the product specification (ASTM A615 Gr 40).

Table I
Chemical composition of the rebar used in research

Chemical Analysis						
C %	**Si %**	**Mn %**	**P% Max**	**S% Max**	**N% Max**	**Fe %**
0.31 max.	0.13-0.15	0.7-1.1	0.045	0.045	0.012	Rem.

2.2. Materials Used

2.2.1. Green Inhibitor: date seeds were used as a green inhibitor in this paper. Grinding the date seeds to size about (5 nm), after that this powder added to electrolyte solution (3.5%NaCl) with different weight fraction (1- 5)wt.%. Mechanical mixer was used to move the solution in the room temperature.

2.2.2. Steel Reinforcement: The steel reinforcement that was used in this work were wires of (0.5 in) in diameter. These wires were cleaned with wetted grinding paper (rough then smooth) then immersed in cleaner liquid (flash liquid) to remove any rust or deposits on their surface. After that these wires were cut to the samples with thick disks (15mm) and diameter (10mm).

2.3. Sample Preparation: the sample was prepared in the form of thick disks (15mm) and diameter (10mm), by using electrical cutter, and then finishing it by polishing, grinding.

2.4. Analysis of the Powder Plant

Make detection of active compounds in powder plant of the powder date seeds using the test of Spectroscope (FTIR) appears in Fig. 1.

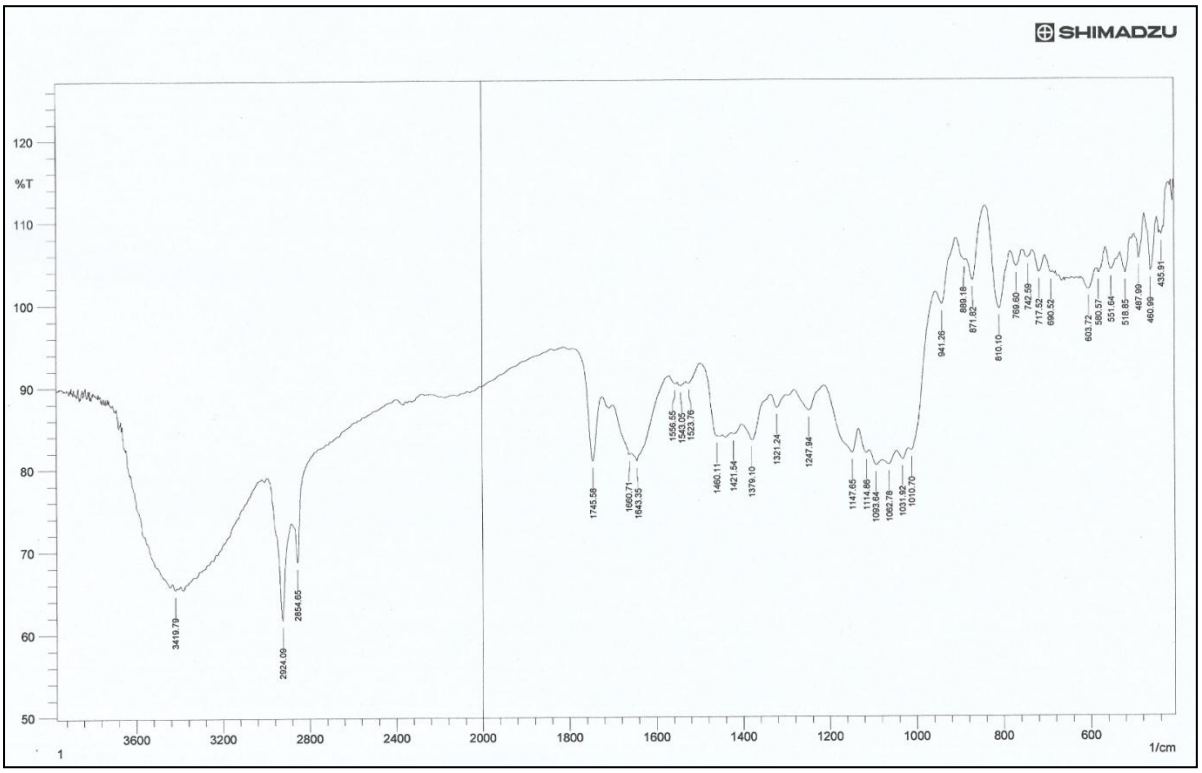

Fig. 1. Test of spectroscope (FTIR) for powder date seeds

2.5. Disclosure of Effective Groups in the Powder Plant

Analysis of chemical conducted on the powder plant of the inhibitor the new proved to fit on many of the groups active, which are often vehicles aldehydes, ketone, amines, polyamides, and alcohols or compounds of aromatic or phenolic. All of these compounds have properties of inhibition and this is consistent with the findings of other researchers. The presence of bounds double and ties triple and aromatic rings in inhibiting the new system will improve the act inhibitory to this inhibitor and Table II identifies the groups and numbers of wavelengths corresponding.

Table II
The active group and positive number

Positive Number	Active Group
(3419.79) cm^{-1}	-OH and Si -OH
(2924.09) cm^{-1}	C – H
(2854.65) cm^{-1}	CH
(1745.58- 1643.35) cm^{-1}	C = O
(1556.55-1523.76) cm^{-1}	C = C
(1460.11) cm^{-1}	CH_2
(1421.54-1321.24) cm^{-1}	C – O
(1247.94) cm^{-1}	CH-OH
(1147.65-1114.86) cm^{-1}	C – O
(1093.64-1010.70) cm^{-1}	Si-O-Si
(941.26) cm^{-1}	OH
(769.60-487.99) cm^{-1}	Si-H

2.6. Corrosion Test by Electrochemical Method (Linear Polarization)

This method to expose the samples to the electrolyte solutions [(1, 2, 3, 4 and 5 wt.% powder date seeds) + (3%NaCl)] on a regular basis and for periods of time equal to (20 min.) for each test. The Tafel tester type(**MLab 100, power 35 W**) to test electrochemical corrosion as shown in Fig.2.

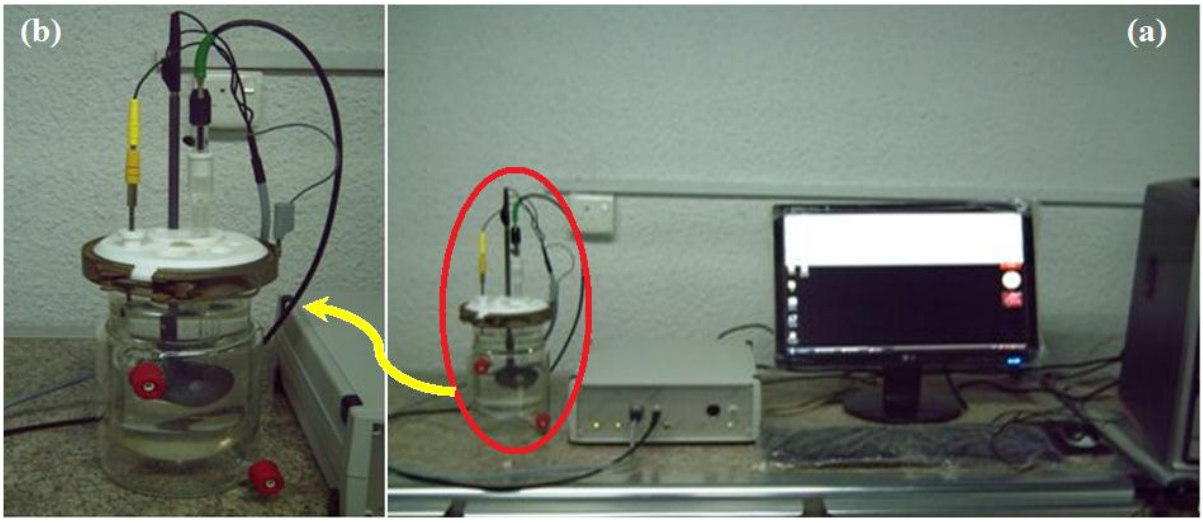

Fig. 2. Tafel tester (a), cell of electrochemical corrosion test (b)

3. Results and Discussion

Linear polarization was used to calculate corrosion potential(E corr.) and corrosion current density (I corr.)

3.1. Sample in (3.5%NaCl) Solution Without Inhibitor

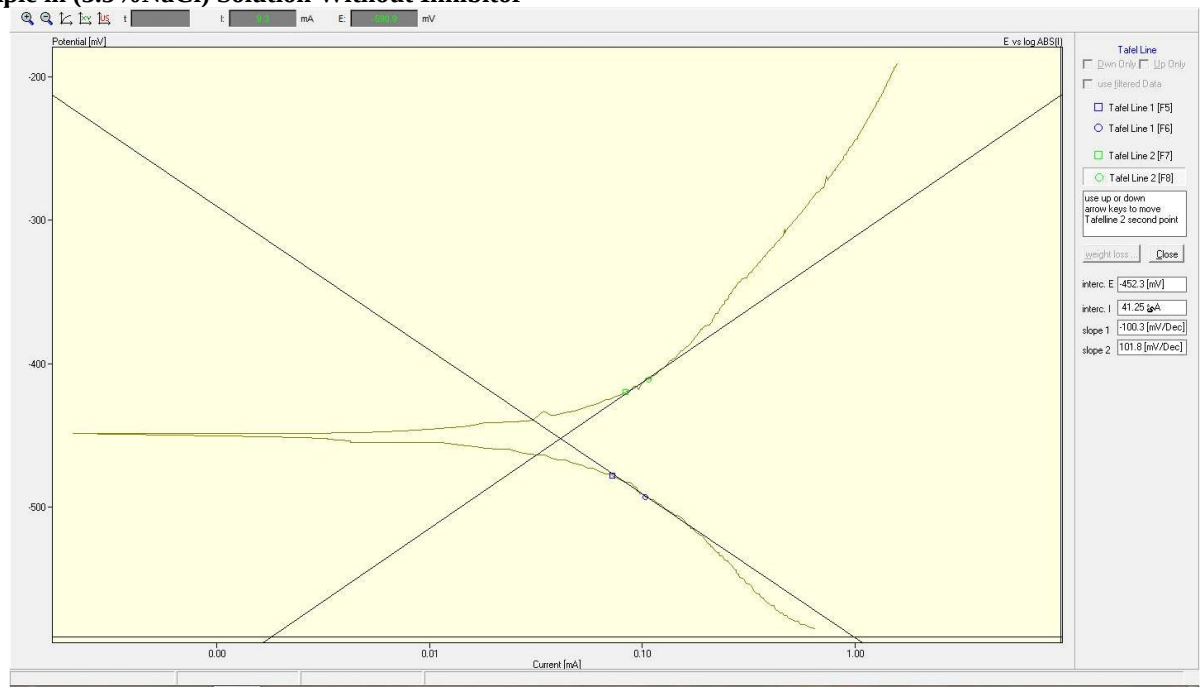

Fig. 3. Sample in (3.5%NaCl) solution without inhibitor

Fig.3 shows that sample without inhibitor has :I corr. = 41.25 µA/cm^2, E corr. = - 452.3 **mV**. The values of corrosion current density above indicate that the sample has low resistance to corrosion.

3.2. Sample in (3.5%NaCl) Solution With Inhibitor

Fig.4 shows that sample with 1% powder date seeds inhibitor has :I corr. = 25.89 µA/cm^2, and E corr. = - 623.3 **mV**. From Fig.4 the corrosion current density less compared with Fig.3 (sample without inhibitor) that mean the ability of the inhibitor to form a protective layer on rebar.

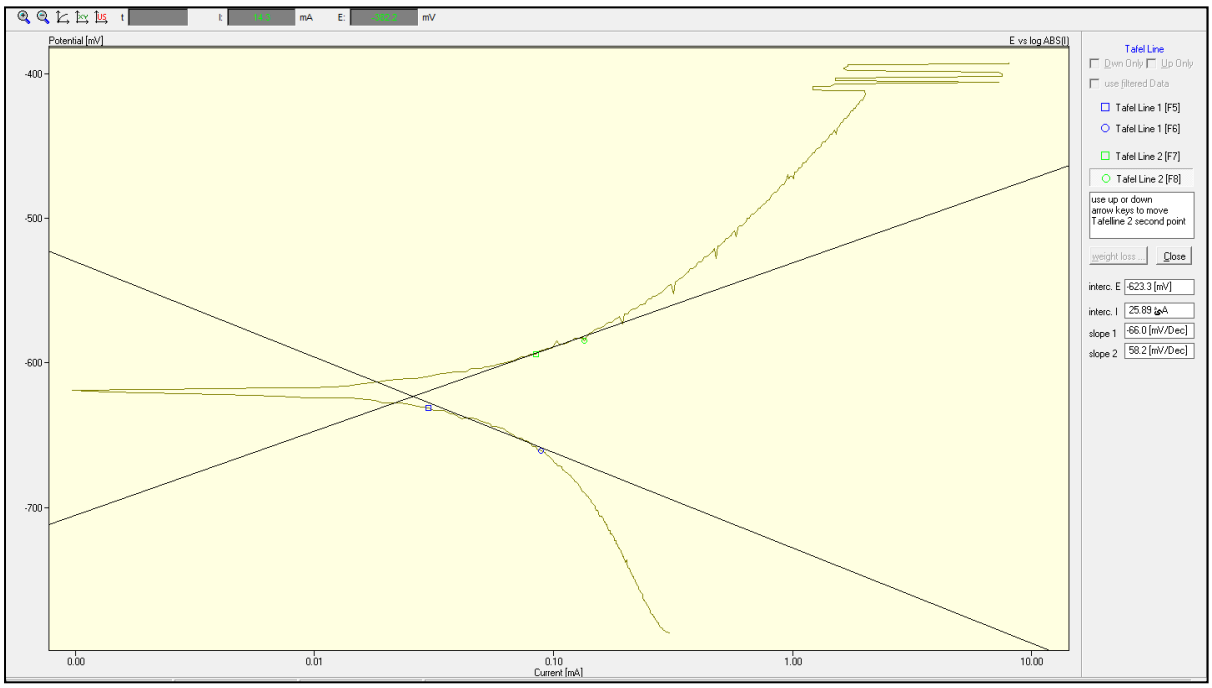

Fig. 4. Sample in (3.5%NaCl) solution with (1%)of powder date seeds inhibitor

Fig.5 shows that sample with 2% powder date seeds inhibitor has : I corr. = 25.62 µA/cm , and E corr. = - 533.4 **mV**.

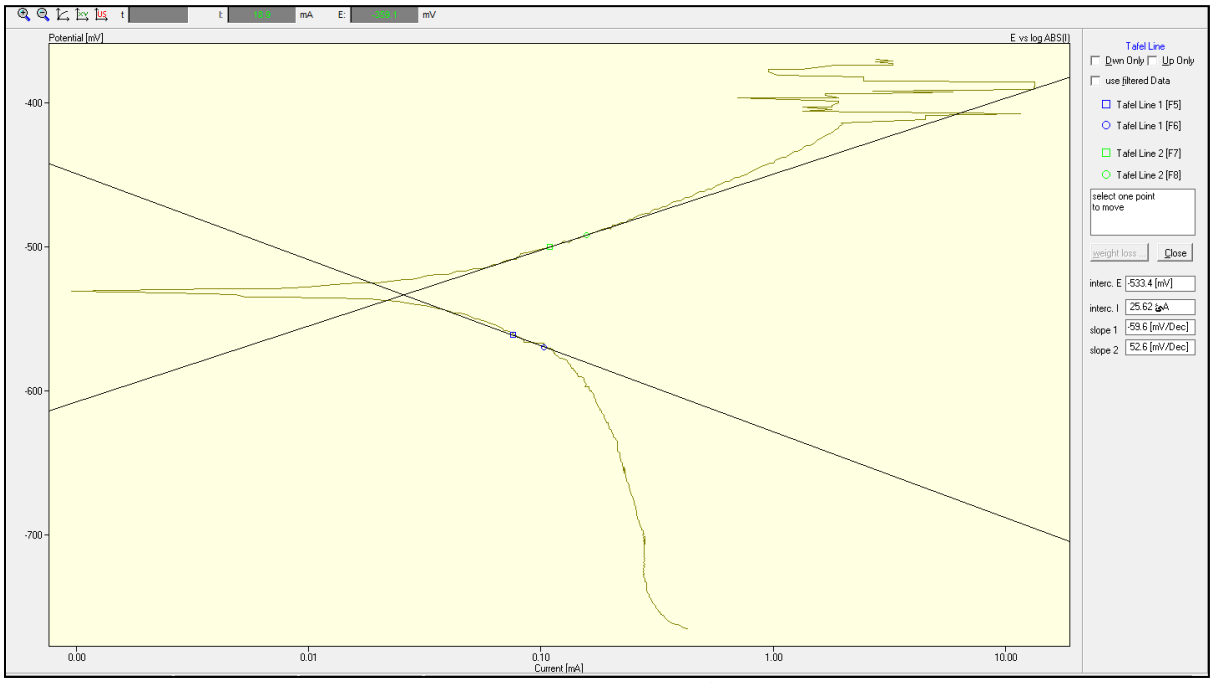

Fig. 5. Sample in (3.5%NaCl) solution with (2%) of powder date seeds inhibitor

Fig.6 shows that sample with 3% powder date seeds inhibitor has :
I corr. = 20.98 µA/cm^2
E corr. = - 582.4 **mV**

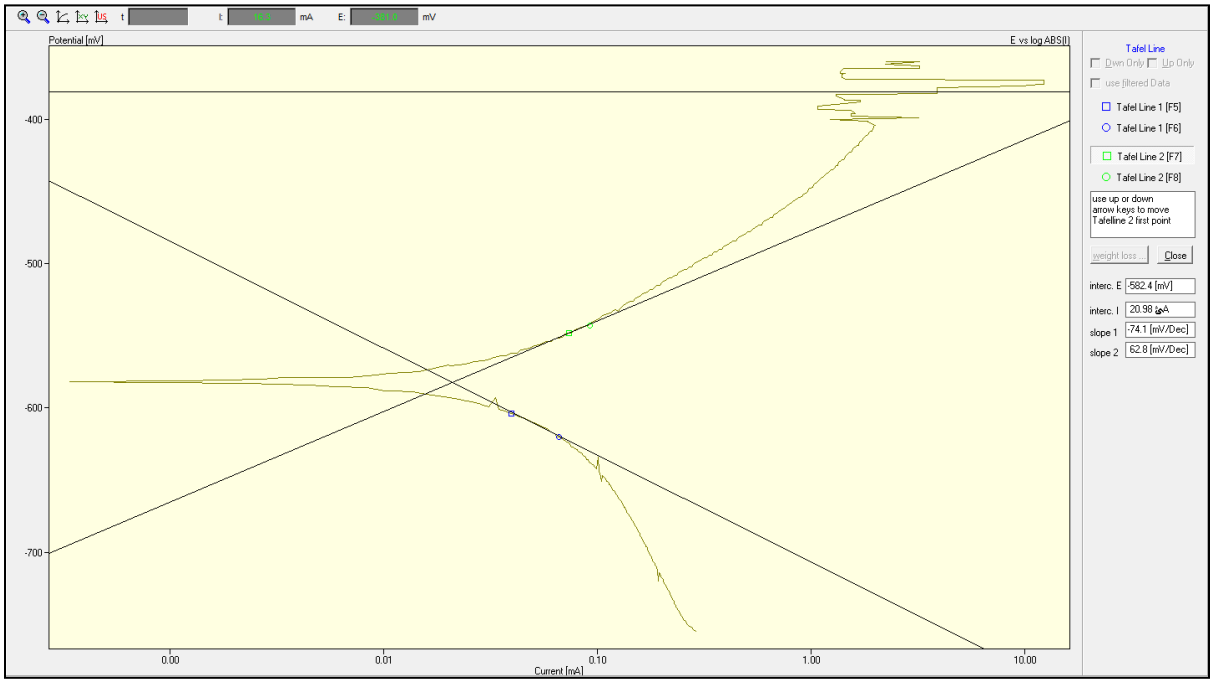

Fig. 6. Sample in (3.5%NaCl) solution with (3%) of powder date seeds inhibitor

Fig.7 shows that sample with 4% powder date seeds inhibitor has : I corr. = 4.32 µA/cm^2, and E corr. = - 288.9 **mV.**

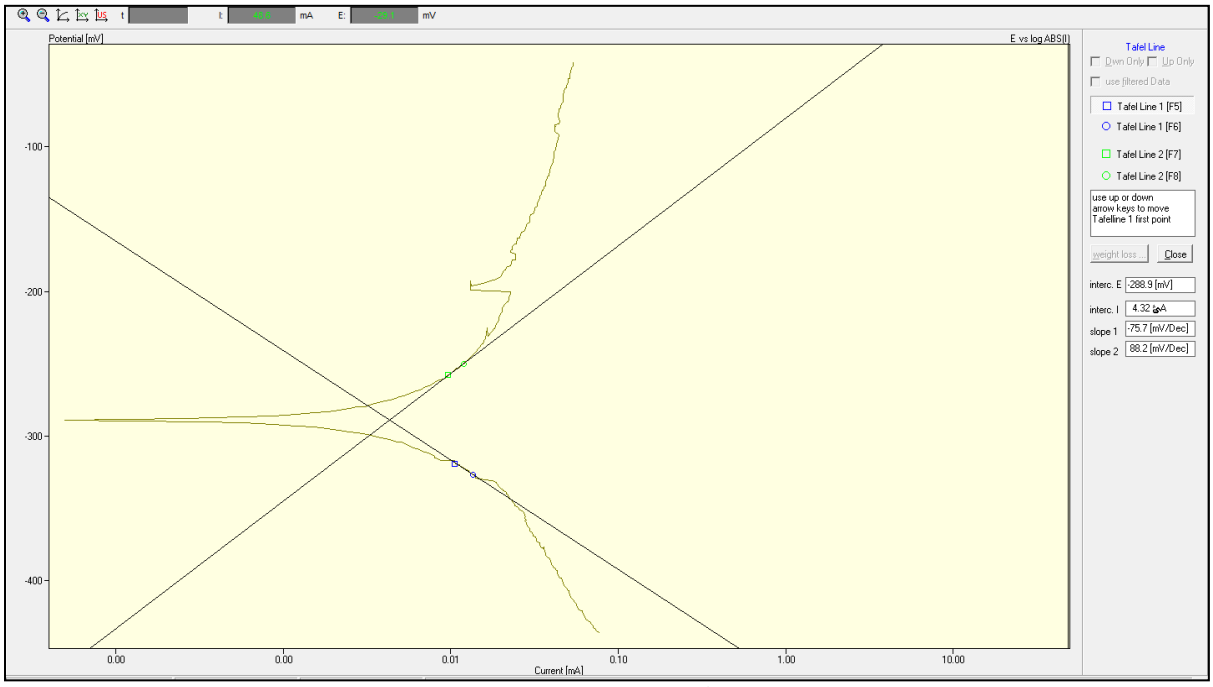

Fig. 7. Sample in (3.5%NaCl) solution with (4%) of powder date seeds inhibitor

Fig.8 shows that sample with 5% powder date seeds inhibitor has: I corr. = 6.61 µA/cm^2, and E corr. = - 573.8 **mV.**

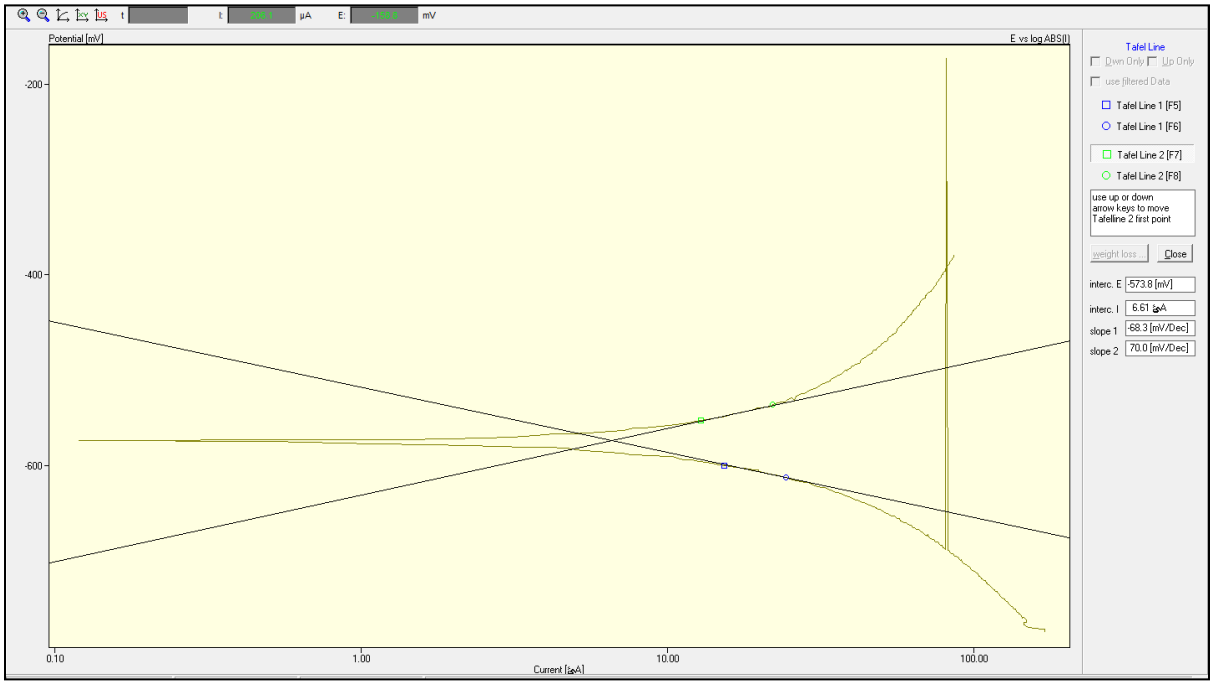

Fig. 8. Sample in (3.5%NaCl) solution with (5%) of powder date seeds inhibitor

From Fig. 5, 6, 7 and 8 we noted that when the sample in (3.5%NaCl) that contains the inhibitor with concentration of (1, 2, 3 and 4 %), the amount of the corrosion current density decrease with increasing concentration of inhibitor and this shows the ability of inhibitor to form a protective layer. But in Fig.8 the amount of the corrosion current density increasing that indicating crash protective layer and formation of the oxide layer on the surface of rebar.

4. CONCLUSION

According to results of present work, the following can be concluded :

The natural product of powder date seeds as a safety and an environmentally friendly corrosion inhibitor for rebar in aqueous media. The corrosion current density in (3.5%NaCl) decreases with the inhibitor concentration increases until 4% from inhibitor.

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